IMPLEMENTATION OF INTEGRATED ENVIRONMENTAL EDUCATION IN THE SECONDARY SCHOOL CURRICULUM FOR MANAGING ENVIRONMENTAL DEGRADATION IN MACHAKOS SUB-COUNTY, KENYA

BY:

TIMOTHY MANDILA CHIKATI
REG. PHD/ED/1017089

A THESIS SUBMITTED TO THE DEPARTMENT OF POST GRADUATE STUDIES IN EDUCATION IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF DOCTOR OF PHILOSOPHY DEGREE IN CURRICULUM STUDIES AND INSTRUCTION OF THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

NAIROBI-KENYA

OCTOBER, 2018
DECLARATION

I, the undersigned hereby declare that all the information in this dissertation is my original work and has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, the dissertation has not been presented for any purpose in any other institution of higher learning or university other than The Catholic University of Eastern Africa. I have fully acknowledged and referenced all materials and information that is not original to this work.

Signature: Timothy Mandila Chikati
Date: 8th October, 2018

Reg. PhD/Ed/1017089

This dissertation has been submitted for examination with our approval as university supervisors:

Signature: Dr Robert R. Kamau
Date: 8th October, 2018

Dr Robert R. Kamau
Senior Lecturer,
Coordinator, Post Graduate Studies,
Mount Kenya University, Nairobi, Kenya

Signature: Professor Joseph M. Malusu
Date: October 8, 2018

Professor Joseph M. Malusu
Associate Professor of Education,
Faculty of Education,
Mwenge Catholic University, Moshi, Tanzania
DEDICATION

I most profoundly dedicate this work to my wonderful wife, Annastasia Mwelu Mandila; my daughters, Fiona Mandila and Stella Mandila but not forgetting my granddaughters, Estelle, Melanie and Modi for their never-ending support, patience, help and love. This dissertation is also dedicated to my mother Priscilla Nekesa Chikati and my late father Mackenzie Lubisia Chikati for their unmistakable love and hard work that saw me through the whole course of my studies. Mom and dad, my efforts were possible because of yours. Almighty God, I intently thank you for giving me my parents.
ABSTRACT

This study investigated implementation of integrated environmental education (IEE) in the secondary school curriculum for managing environmental degradation in Machakos Sub-County. The study was guided by the following research questions: To what extent is environmental education (EE) integrated in the secondary school curriculum in Machakos Sub-County? What are the teachers’ and students’ perceptions of IEE in the secondary school curriculum? What are the levels of environmental literacy of secondary school teachers and students? What support do teachers require to implement IEE related topics in the secondary school curriculum? What instructional approaches do secondary school teachers use to teach IEE topics in the secondary school curriculum? What challenges are faced in implementation of IEE in the secondary school curriculum and what strategies are suggested to address these challenges? This study operated within Fullan’s change theory (2007) as a framework for examining the implementation of integrated environmental education in the school curriculum. The theory views curriculum implementation as a model of interactions between four change factors (need clarity, complexity, quality & practicality) as independent variables and teachers’ and students’ environmental literacy (awareness, knowledge, attitudes, skills, participation) as dependent variables. This study was guided by a conceptual framework that described the link between the stated variables. The study employed mixed methods approach. Both probability and non probability sampling designs were used in tandem with the mixed methods. The target population of the study consisted public secondary schools, public secondary school principals, teachers and form 4 students in Machakos Sub-County, in addition to Kenya Institute of Curriculum Development (KICD) officers from Nairobi County. Questionnaires; interview guides; document analysis schedules and observation guides were used as research instruments for data collection. Frequencies, percentages, means, standard deviations were used to analyse quantitative data while narrations were used to analyse qualitative data. Hypotheses were tested at a minimum of .05 level of significance using independent samples T-Test and one way ANOVA. Study findings demonstrated that EE topics in the secondary school curriculum were inadequate and inappropriately organized; both teachers’ and students’ perceptions of the integrated environmental education in the secondary school curriculum were generally weak; participants were not well prepared in environmental literacy; support to implement EE was inadequate; collegial cooperation among teachers was lacking; most teachers and students had not fully appreciated learner-centred approaches to EE and environment policy was lacking in schools. The study concluded that most teachers and students did not fully participate in reducing environmental degradation in Machakos Sub County; EE implementation faced specific challenges particularly heavy workload; lack of environmental policy; lack of time and high premium placed on national examinations. The study recommended that KICD should include at least 50% percent of EE topics in the curriculum; The Ministry of Education should prescribe and oversee implementation of environmental policies in schools. The study recommended for further studies on classroom teaching/learning practices to establish how EE pedagogies are employed in secondary schools in Machakos County.
ACKNOWLEDGEMENT

I would like to acknowledge and proffer my deepest gratitude to my supervisors, Professor Joseph M. Malusu and Doctor Robert R. Kamau for their priceless support throughout the pursuit of this dissertation. They have been resolutely guiding me and I really appreciate each of their observations and suggestions. They shaped and indeed stirred my dissertation in different ways.

Similarly, I would like to thank the Government of Kenya (The Ministry of Education, Science and Technology, and The National Commission for Science Technology and Innovation in Nairobi for approving the research application and providing the research permit for allowing me to collect the primary research data in Machakos Sub County. I am also deeply indebted to my family for their assistance, inspiration and unwavering support that made my academic journey worthwhile. I would specifically like to extend my appreciation to my brothers John Chikati, Joseph Chikati, Peter Chikati, George Chikati and Jacob Chikati who encouraged me throughout my doctoral program. Additionally, I recognize all my friends, for their exceptional backing during my studies and I will be forever grateful to them for their enduring collegiality.

I also want to express my appreciation to the respondents who participated in my study particularly the KICD officers in Nairobi and the Machakos County Education Officers, heads of schools, teachers and students in Machakos Sub County whose experiences and insights provided the stuff for this research. Finding participants for research is rarely easy and I was advantaged hugely from meeting and interacting with such helpful, dedicated, and qualified citizens.

I would also like to pass my profound gratitude to The Catholic University of Eastern Africa for providing me with the necessary conveniences which made this study a success. Foremost, I thank The Almighty God for giving me life, wisdom and the resilience to pursue this dissertation to its fruition. Thank you Father for your blessings which made me the person I am today.
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LIST OF ACRONYMS AND ABBREVIATIONS

AFEW  African Fund for Endangered Wildlife
AIDS  Acquired Immune Deficiency Syndrome
ASALs  Arid and Semi Arid Lands
ASESP  African Social and Environmental Studies Programme
ABC  News Internet Ventures
ANOVA  Analysis of Variance
ASCD  Association for Supervision and Curriculum Development
BOM  Board of Management
CD-ROMs  Compact Disk Read Only Memory
CEB  County Education Board
CEGN  The Canadian Environmental Grantmakers' Network
DHRO  Deputy Human Resource Officer
DIT  Diffusion of Innovation Theory
DQAS  Directorate of Quality Assurance and Standards
DVDs  Digitalized Video Discs
EE  Environmental Education
EETAP  Environmental Education and Training Partnership
ES  Environmental Studies
ESD  Education for Sustainable Development
ESP  Environmental Studies Program
GCP  Green Council Education Program
GDP  Gross Domestic Product
GOK  Government of Kenya
HIV  Human Immune-deficiency Virus
IBEA  Imperial British East Africa Company
ICARDA  International Center for Agricultural Research in the Dry Areas
ICT  Information and Communication Technologies
IEE  Integrated Environmental Education
IEEE  Institute for Electronics and Electrical Engineering
IGAD  Intergovernmental Authority on Development
IPCC  Intergovernmental Panel on Climate Change
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<tr>
<th>Acronym</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>KICD</td>
<td>Kenya Institute of Curriculum Development</td>
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<td>KIE</td>
<td>Kenya Institute of Education</td>
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<td>KNEC</td>
<td>Kenya National Examinations Council</td>
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<td>KOEE</td>
<td>Kenya Organization of Environmental Education</td>
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<tr>
<td>MCIDP</td>
<td>Machakos County Integrated Development Plan,</td>
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<tr>
<td>MDGs</td>
<td>Millennium Development Goals</td>
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<tr>
<td>MOE</td>
<td>Ministry of Education</td>
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<tr>
<td>MPs</td>
<td>Members of Parliament</td>
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<td>NAAEE</td>
<td>North American Association of Environmental Educators</td>
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<tr>
<td>NEETF</td>
<td>The National Environmental Education and Training Foundation</td>
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<tr>
<td>NEMA</td>
<td>National Environmental Management Authority</td>
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<td>NEPAD</td>
<td>New Partnership for Africa Development</td>
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<td>NES</td>
<td>National Environmental Secretariat</td>
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<td>NFE</td>
<td>Non Formal Education</td>
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<tr>
<td>NGOs</td>
<td>Non-Governmental Organizations</td>
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<tr>
<td>QASO’s</td>
<td>Quality Assurance and Standards Officers</td>
</tr>
<tr>
<td>SWOT</td>
<td>Strengths, Weaknesses, Opportunities and Threats</td>
</tr>
<tr>
<td>TSC</td>
<td>Teachers Service Commission</td>
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<tr>
<td>UNCED</td>
<td>United Nations Conference on Environment and Development</td>
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<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
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<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
</tr>
<tr>
<td>USSR</td>
<td>Union of Soviet Socialist Republic</td>
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<tr>
<td>WCK</td>
<td>Wildlife Clubs of Kenya</td>
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<tr>
<td>WMO</td>
<td>World Meteorological Organization</td>
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<td>WSSD</td>
<td>World Summit on Sustainable Development</td>
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<td>WWF</td>
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CHAPTER ONE

INTRODUCTION

1.1 Background to the Problem

Amidst severe and escalating environmental problems such as environmental degradation encountered by people and the other living species, posing serious threats to their well-being, triggered a proliferation of global, regional and local level calls to integrate environmental education (EE) in the schools curricula. The aim was to guide the new patterns of behaviour between mankind and the environment. According to Chowdhury (2015) educational institutions have been the grounds for spurring environmental change. A curriculum integrated with environmental education (EE) as stated by Alexandar and Poyyamoli (2014) is currently emerging as one of the most effective strategies to encourage students to conserve and protect the natural environment in their schools and in their neighbourhoods.

Research has shown that blending EE content with other subject topics in school curricula positively impacts students’ attitudes toward the environment (Ballantyne, Fien & Packer, 2001; NAAEE, 2011 as cited in Westmoreland-King, 2012). According to UNESCO–UNEP (1991), environmental education is crucial to prepare environmentally literate students who, as future citizens, would play an active role in protecting the environment through making informed decisions and taking environmental friendly actions. "Students will be living in a world different from the one they now occupy and schools should enable them to deal with that world" (Elliot & Eisner as cited in Ajayi, 2015).

Puglia (n.d) further argues that it is predicted individuals with higher education levels will both exhibit greater environmental concern and behave in a pro-environmental manner. This view accords with that put forward by Arny (2011) that environmental
education is needed as a tool for creating change and developing a population that is aware of environmental crisis and has the obligation to act on a personal and collective basis to solve environmental problems and prevent creation of future ones. According to Institute for Global Environmental Strategies [IGES] (2001), EE roles, among others, are changing people’s knowledge, attitudes and behavior; deepening people’s understanding and heightening their awareness; making people innovative, investigative and inquisitive and enhancing people’s resolve. In the same vein, Ünal (2008) points out that “Education is seen as the most effective way to cope with environmental problems because there is a need to find sustainable solutions not instantaneous ones.” p.101

The ultimate aim of environmental education is to motivate citizens to act individually and collectively in an environmentally conscious manner that balances the social, economic, and ecological needs of today without compromising those of the future (Hungerford, Peyton, Wilke, 1980; Yorek, Ugulu, Sahin, Dogan, 2010). Alix-Garcia (as cited in Howe, 2009) observes that on the whole environmental education has a beneficial effect. For example, one study estimated that between 4% and 21.5% less of the annual area of old forest growth was cut per household for each additional year of education that the household head received, depending on the society being studied (Godoy & Contreas, 2001). This view is consistent with Sukarjita, Ardi, Rachman, Supu, Dirawan and Sukarjita (2014) who argue that through formal, non-formal and informal education the government can prevent and save the environment by involving children from an early age in caring and loving the environment. Consequently Bartosh (2003) advises that environmental education should reach citizens of all ages and help them to understand how to play an effective role in solving environmental problems. Environmental education would therefore be an intervening mechanism of teaching man about the world events and the laws that govern man’s existence (Jekayinfa & Yusuf, 2008).
Given the demonstrated value of integrated environmental education, it is becoming an increasingly popular emerging issue in the school curriculum and has been a central theme in several international environmental education workshops and governmental conferences (the Belgrade Charter, UNESCO, 1976; the Tbilisi Declaration, 1977; the Brundtland Report, WCED, 1987; the Rio Earth Summit, UNCED, 1992 & the Johannesburg Summit, UN 2002). A common thread linking these global conferences is to call in education to implement a program of action to reform the world towards sustainability (Sauvé, Berryman, & Brunelle, 2000). The Earth Summit (UNCED) held in Rio de Janeiro with a focus on “Agenda 21, 1992” seems to be a climax call to integrate EE in curricula (Conde, & Sánchez, 2010).

The EE objectives (Figure 1) developed by the Tbilisi Conference (1977) turned out to be the foundation upon which IEE was implemented in the world.

![Figure 1: A model of environmental education based on Tbilisi objectives (1977)](image)

Source: Bartosch (2003 as cited in Sterling & Cooper, 1992)
The objectives were, to help social groups and individuals: to acquire an awareness and sensitivity to the total environment and its allied problems ( Awareness); to gain a variety of experience in basic understanding of the environment and its associated problems (Knowledge); to acquire a set of values and feelings of concern for the environment (Attitudes); to acquire the skills for identifying and solving environmental problems (Skills) and to be actively involved in working toward resolution of environmental problems (Participation/action).

Most nations globally were therefore mandated by the conference to chart approaches to EE inclusion in formal education. However, these charted approaches varied as individual countries had the freedom to develop their own educational programmes based on these objectives but reflecting their local, socio-economic and political situations. In more practical terms, effective implementation of IEE was therefore expected to crystallize in the attainment of the environmental education objectives of the United Nations.

At a regional level, the New Partnership for Africa Development (NEPAD) has developed strategies to implement global environmental conventions (NEMA, 2005). In view of this, EE has been integrated into school curricula for example in Nigeria (Adedayo & Olawepo, 1997); in Zimbabwe (Naome, Rajah, & Jerie, 2012); in South Africa (Rampedi, 2001); Uganda (Ofwono-Orecho, 1998) and in Tanzania (Kimaryo, 2011).

Nationally, the Government of Kenya has taken initiatives of preparing and implementing several pieces of legislation and policies on integration of environmental education (EE) into the school curriculum. In 2002 the Kenya Government revised the education curriculum laying emphasis on integrating into school curricula cross-cutting issues such as environmental education, disasters, integrity, moral values, and human
rights, child labour and abuse, gender responsiveness, HIV/AIDS pandemic, drug and substance abuse, information communication technology and industrial transformation. Subsequently, environmental education gradually permeated the mainstream secondary education curriculum through various integration programmes.

According to EETAP Resource Library (2004) implementation of integrated environmental content within the school curriculum, took various forms such as interdisciplinary approach by which EE content is slotted into the curriculum as a single subject (insertion/ imposition) as required by policy. Related content from diverse subjects is conscientiously reorganized and meaningfully built around an identified central environmental theme as a unifying framework (Figure 2). This way, Lake (1994) argues, multiple disciplines overlap and are examined from common skills, concepts and attitudes thus students see interconnectedness and interrelationships among the subjects and how they fit together.

Figure 2: Interdisciplinary (monolithic/single subject/imposition /insertion/transaction)

Source: Adapted from eNotes for education (2016)
Kelani (2015) however, warns that in reality; interdisciplinary approach is rarely used primarily because of the difficulties inherent in adding one more subject to an already crowded curriculum. The solution therefore has been to interweave environmental education (EE) topics, content, knowledge, skills, and values where they fit within the related content of the established carrier subjects (with deep seated, clear-cut EE content) across the curriculum so that students generally examine knowledge in those disciplines as related to various aspects of their environment. This approach in which environmental matters are presented to students through a wide range of disciplines is called multidisciplinary (infusion) approach (Figure 3)

Figure 3 Multidisciplinary (infusion) approach

Source: The Researcher’s Creation, 2016
According to Haris and Afdaliah (2016) multidisciplinary approach has been widely conducted by most secondary schools because environmental issues and problems require knowledge and skill from wide-ranging fields if such problems are to be understood properly and acted upon effectively. Therefore the implementation of IEE is, in effect, a combination of interdisciplinary and multidisciplinary approaches.

Both Multidisciplinary (infusion/blending) and interdisciplinary (insertion / imposition) models are approaches to integration (Lane as cited in Monroe & Cappaert, 1994). Therefore integration refers to the incorporation of EE content with the content of both non carrier and carrier subjects. Carrier subjects are those with clear cut environmental education content for example Geography, History, Agriculture, Biology and Chemistry. When opportunity arises, the teacher identifies related EE topics in the syllabus as entry points for integration. On the other hand the non carrier subjects are those with no clear cut environmental education content for example, Mathematics, Languages, Music and Art. The teacher uses own resourcefulness to connect EE content with the content of such subjects as Languages through asking students to read articles on topics like environmental pollution and write related poems about it. The current model of implementing EE in the Kenyan secondary school curriculum is therefore integrative in approach. Arguing for the integration, Bolstad (2005) notes that schools are likely to find space for environmental education if it can be associated with existing subjects in the curriculum rather than creating a new subject.

It was assumed that such integrated environmental education as argued by Garcia (2007) and Howe (2009) would have a beneficial effect on consequences of environmental degradation. Environmental degradation refers to the deterioration of the natural environment and includes climate change scenarios and land degradation. Chronicle (2014) defines land degradation as a general term for any change in the
condition of the land which reduces its productive potential. On the other hand climate change refers to long term alteration in the state of the average conditions of the atmosphere. Environmental degradation therefore provides a justification for integrated environmental education in the secondary school curriculum.

Over the past two decades, environmental degradation has continued to worsen (International Fund for Agricultural Development [IFAD], 1995-2014). Waswa (2012) asserts that land degradation remains a major threat to the world’s ability to meet the growing demand for food and other environmental services. Areas of the world vulnerable to land degradation cover about 33 per cent of the land surface (World Meteorological Organization [WMO], 2005). Nearly 2 billion of the 8.7 billion hectares of arable land, pastures and forests worldwide have been degraded over the past 50 years (Agyemang, 2013). This is a critical global concern because land is one of the resources where reducing supply threatens our capacity to feed a growing world population estimated to be over 9 billion by 2043 (United Nations, 2015).

The second notable aspect of worldwide environmental degradation that demands attention is climate change. According to Houghton (as cited in Sapiano, Stephenson, Grubb & Arkin, 2005), the Intergovernmental Panel on Climate Change (IPCC) confirmed that global average surface temperature increased by 0.6 ± 0.2 ⁰C over the 20th century and precipitation is highly irregular. Such climate change scenarios are already having varied impacts on various sectors of the world environment.

At a regional level, evidence in Africa showed warming of about 0.7°C on average during the twentieth century (Intergovernmental Panel on Climate Change [IPCC], 2007). An increase in heavy rainfall scenarios has also been observed (Usman & Reason, 2004), including evidence of rainfall variability. According to Chronicle (2014)
70% of Africa’s 500 million people who depend directly on environment for livelihood will be affected.

At the national level, 80% of Kenya’s landmass that lies within the eastern end of Africa’s Sudano-Sahelian belt is classified as ASAL (Kenya, UNDP & FAO, 2005) and it is already affected by drought and desertification. The Kenya Meteorological Department (KMD) also reports that the minimum and maximum temperatures in Kenya have been increasing since the 1960s (The Republic of Kenya, NEMA, 2013). The costs of climate change in Kenya could be equivalent to 2.6% of the country’s GDP each year by 2030 (The Republic of Kenya, NEMA, 2013). The IPCC report warns that climate change combined with poverty and economic shocks, could lead to war and drive people from their homes (The Guardian News (Media Limited, 2014).

At the local level, Machakos Sub-County which is a microcosm of Kenya’s ASAL areas is undergoing continuous land degradation through loss of vegetation cover, soil erosion and degraded river banks (Kryptone Consulting Limited, 2012). Rocheleau, Benjamin & Diang’a (1995) point out that the Sub-County is a "classic example" of land degradation in accounts dating back to the 1930s. Study findings by Baaru, Gachene, Onwonga, Mbuvi & Gathaara (2010) in Kathekakai Location of the Sub-County show that vast land has been heavily degraded and therefore this remains a major threat to the provision of environmental services and the ability to meet the growing demand for food for the residents. Similarly, Masila, 2016 (as cited in Ellenkamp, 2004) observes that Kakayuni, Kyangala and Kinoi sub-locations in Kalama Division suffer comparable fate of recurrent soil erosion, landslides, deforestation and increased water scarcity due to destroyed catchment zones, affecting agricultural land use negatively.

The main drivers of land degradation in the Sub-County include overgrazing, tilling the wet hill slopes and irresponsible and unsustainable sand harvesting along major
river banks (Appendix C) that are challenging the natural limits of the environment. Additionally the Sub-County experiences erratic and unpredictable rains of less than 500mm annually (Biscomm Consultants, 2014). According to Yeshalem (2013) education has been trusted as one of the potential human assets and mechanisms to tackle many of the social, economic and political problems we have seen so far. Yeshalem (2013) further asserts that education for the environment is one of the renewed brand mechanisms to confront the multifaceted consequences of climate change and various forms of environmental degradations seen today.

While there is an emerging consensus on the perceived value and potential of environmental education as a powerful tool in providing solutions to some of the environmental problems afflicting our natural settings, Kimaryo (2011) cautiously observes that “The implementation of environmental education is a complex process, hence a challenge to educators” p. 18. Evidence from literature shows that implementation of an innovation is not an easy task anywhere, but is much more problematic in developing countries (ASCD, 2015). Similarly, Adams (2013) argues that implementing change in schools is fraught with challenges. Anyolo, (2015) further points out that the implementation poses many challenges to teachers due to the complexity of sustainable development issues. In general, these arguments imply that the implementation of environmental education is still area of concern. Wang, (2006) asserts that a discrepancy often exists between what was intended and what is enacted. In this regard, as EE is implemented in teaching and learning, there needs to be ways to investigate the extent to which this is put into practice.
1.2 Statement of the Problem

The nexus of environmental degradation and human consumerist interactions with the environment justifies for the integration of environmental education into the secondary school curriculum in Kenya. Despite, the heightened effort to integrate environmental education (EE) into the secondary school curriculum in Kenya, little attention has been put on its implementation especially in Machakos Sub County.

In view of that, there have been persistent claims that EE is seemingly not keeping pace with environmental degradation (Nijhuis, 2011; Poddar, 2009). In the same vein Nijhuis (2011) fittingly asks a passionate question, what is wrong with environmental education? Arguing in support of these views, parallel studies (Toili, 2007; Odeke, 2009; Kimaryo, 2011) seem to suggest that the implementation of integrated environmental education in the secondary school curriculum in Machakos Sub County was ineffective because environmental degradation continues to defy the acclaimed educational solutions. In view of that, Carson and Johnson (2004) have broadly complained, it is clear that our response to the need for environmental education has belittled the problems we are facing.

This raises a fundamental question for this study to address; how did educators implement an integrated environmental education program in the secondary school curriculum in Machakos Sub County? More specifically: to what extent have the secondary school teachers and students been prepared to implement Integrated Environmental Education in the school curriculum? What are the teachers’ and students’ perceptions of the integrated environmental education in the secondary school curriculum? What support do teachers need to carry out the mandate of implementing integrated environmental education topics in the secondary school curriculum? What instructional approaches do teachers employ to teach integrated environmental education
topics in the secondary school curriculum? What challenges are faced in implementation of integrated environmental education in the secondary school curriculum? These questions beg for answers because there is no known empirical study that has addressed the implementation status of EE and the various factors at work in the context of Machakos Sub-County.

The Kenya Institute of Curriculum Development (KICD) is expected to reorient teachers on implementation of Integrated Environmental Education (IEE) in the school curriculum. However, the task of integrating EE in the school curriculum has been left, in most cases, to individual schools and individual teachers. Since IEE is not tested under any national mandate, it is up to the teachers to implement it the way they perceive it (Bengtson, 2013). This is problematic considering that implementation according to Durlak and Dupre (2008) is rarely investigated in education. As a result, possibilities of achieving objectives for IEE implementation are seemingly compromised.

If no immediate action is taken to resolve IEE implementation concerns, there may be serious implications for the integrated curriculum and efforts to avert environmental degradation in Machakos Sub County might be futile. This may well risk destroying the very fabric of lives for the vulnerable population projected at 234,044 people (MCIDP, as cited from the Kenya National Bureau of Statistics, 2013) and whose very means of survival is wholly dependent on the natural environment. Against this backdrop, the current study therefore aimed to investigate implementation of integrated environmental education in the secondary school curriculum as a way of managing environmental degradation in Machakos Sub-County.
1.3 Research Questions

Six research questions and two hypotheses were explored to guide this study. The questions and hypotheses were grounded within the framework of EE objectives as agreed at the Tbilisi Declaration (1977) and within the four factors (need, clarity, complexity, quality & practicality) of Fullan’s (2007) theory of education change. To that end, this study sought to answer the following questions:

i. To what extent is environmental education (EE) integrated in the secondary school curriculum in Machakos Sub-County?

ii. What are the teachers’ and students’ perceptions of the integrated environmental education in the secondary school curriculum in Machakos Sub-County?

iii. What are the levels of environmental literacy of secondary school teachers and students of Machakos Sub-County?

iv. What support do teachers require to implement integrated environmental education related topics in the secondary school curriculum in Machakos Sub-County?

v. What instructional approaches do secondary school teachers use to teach integrated environmental education topics in the secondary school curriculum in Machakos Sub-County?

vi. What challenges are faced in implementation of integrated environmental education in the secondary school curriculum in Machakos Sub-County and what strategies are suggested to address these challenges?

1.4 Hypotheses

According to Farrugia, Petrisor, Farrokhyar and Bhandari (2010), the research hypothesis should be stated at the beginning of the study to guide the objectives for
research and at the end of the study, the null hypothesis is then tested statistically. Therefore the following two research hypotheses were stated to guide the analysis of data in this study:

\( H_{a1} \): There is a statistically significant difference between the mean scores of teachers’ and students’ perception of the integrated environmental education in the secondary school curriculum in Machakos Sub-County

\( H_{a2} \): There is a statistically significant difference between single sex and mixed sex public secondary schools with respect to form four students’ mean scores of environmental awareness, knowledge, skills and attitudes in Machakos Sub-County.

1.5 **Significance of the Study**

Conducting research on implementation of IEE is important, first to understand the reasons for the failure or success of innovations Fullan (as cited in Dönmez, 2010). Second it is hoped the study will provide a deeper insight into understanding some of the reasons why so many educational changes fail to become established. Third, the study has identified some of the most problematic aspects of bringing about educational change in Machakos Sub-County. Fourth, lessons for improving and replication of implementation strategies for IEE may be derived from the study. This may significantly contribute to conservation of the environment particularly on the hill slopes of Machakos Sub-County and other Counties in the country.

The study presents takeaway lessons on challenges encountered and strategies suggested for implementation of IEE to policy makers (Ministry of Education, Curriculum Developers, Quality Assurance & Standards officers, & Examinations officers) for articulation of future policies to enhance the programme in the secondary school curriculum. Additionally the study might help the curriculum developers to envision how the decisions they make are reconstructed and practiced by the teachers in
the classroom. The findings are therefore intended to help inform policymakers on how to help classroom teachers in meeting their obligation for both integrating IEE in the subjects that they teach and generally participating in curricular reforms in environmental studies.

The study also presents the principals, teachers and students the opportunity to give their opinions regarding the implementation of IEE in the secondary school curriculum within Machakos Sub-County. In addition the study will empower teachers and students to contribute to curriculum development in terms of environmental integration through their critical and systematic reflections as they interact with the curriculum. The findings related to challenges encountered in curriculum implementation will also help teachers to improve their performance.

Besides, this study portrays the gap between what was intended and what is actually being done in practical terms as far as implementation of integrated environmental education is concerned. The study therefore highlights the complexity of implementation of curriculum reforms in the context of IEE. The study particularly throws light on some of the curriculum implementation questions that still remain unanswered as observed by Bhandari and Abe (2000) that curriculum implementation is not an event but a process which is dynamic and embedded in unique contexts.

This study is a significant platform for further research to improve school-based integrated environmental education programmes. The study findings will make significant contributions to the increased body of literature available on implementation of integrated environmental education in the secondary school curriculum. Helen (2011) posits that research in education builds knowledge to improve practice. Lessons learned may provide the foundation upon which other initiatives involving change can build (Shaukati, 2013). The findings from this study will serve as an important reference material and a basis for
further research by academicians and researchers. More significantly, findings of the study will be used by those scholars who might wish to replicate it in different settings. While the study was limited to secondary schools in Machakos Sub County, the results might have national and even international relevance and significance in the ongoing global discourse on implementation of IEE for managing environmental degradation.

1.6 Scope and Delimitations of the Study

This study investigated implementation of integrated environmental education in the secondary school curriculum as a response to environmental degradation in Machakos Sub-County. Specifically, the study aimed at finding out how educators implemented integrated environmental education in the secondary school curriculum and challenges faced to propose strategies for enhancing an education that will alleviate environmental degradation in Machakos Sub-County.

The study was therefore positioned in the field of education and was conducted within the boundaries of Machakos Sub-County (Appendix A). Data for the study was also collected from the Kenya Institute of Curriculum Development (KICD) situated at the junction of Murang’a/Desai road, Ngara area, Nairobi County. Respondents at this site were limited to KICD officers because they were the initiators of the IEE programme in the secondary school curriculum. It is important to find out from them their understanding of curriculum integration and its inherent challenges and strategies. The officers were also targeted because they were expected to offer rich information on IEE to inform the study.

In addition, this study was restricted within the confines of only those factors relating to the Education Change Theory (2007) and the EE objectives as agreed at the Tbilisi Declaration (1977). The factors identified by the Education Change Theory (2007) as influencing the implementation of IEE were characteristics of change: need, clarity,
complexity and practicality as they interacted with local and external factors to influence the implementation of IEE. The EE objectives relating to awareness, knowledge, attitudes, skills & participation that were agreed at the Tbilisi Declaration (1977) were perceived as influencing the implementation of IEE. The factors were therefore used as a framework for examining the challenges relating to IEE implementation in the secondary school curriculum.

Likewise, participants’ responses were confined to their personal experiences with the IEE content in chemistry, biology, history and geography. The study specifically focused on six research questions currently set in the preceding subsections of this dissertation.

1.7 Theoretical Framework

This study investigated implementation of integrated environmental education in the secondary school curriculum for managing environmental degradation in Machakos Sub-County. Specifically, the study aimed at finding out how educators implemented integrated environmental education in the secondary school curriculum and challenges faced to propose strategies for enhancing an education that would alleviate environmental degradation in Machakos Sub-County. The study used the theory of educational change (2007) by Fullan, as a framework for examining the implementation of Integrated Environmental Education in the secondary school curriculum.

Walker (1990) observes that “Powerful curriculum theories enable us to act effectively in a wide range of situations because we can deduce from them what are likely to be the consequences of acting in different ways” p. 139. Therefore the quest of theories is to improve practice. According to Phakisim (2008) curriculum-related theories could be used to develop models to explain why some initiatives were less or more successful than others.
1.7.1 **The Theory of Educational Change (2007).**

The theory of educational change by Fullan identifies four phases in the change process thus initiation, implementation, institutionalization and outcome. According to Fullan (2007), initiation is the launch of the change process. This phase commences with the idea of integrating IEE into the school curriculum. At this stage mobilisation of staff and resources around the idea is thus an important activity (Fullan, 1991) and may determine the success or failure of the innovation.

The second phase in the theory of education change is initial trial and error process of putting reforms (IEE) into practice (implementation). The implementation stage of a syllabus is the most vital stage in curriculum change (Fullan 2001). It is at this stage that the new ideas for the new programme for example IEE are put into action by stakeholders.

The third phase in the theory of education change is institutionalization by which diffusion of an innovation gains acceptance by members of a community (Couros, 2003). This implies that the IEE program becomes part of the core business of the school. The fourth phase in this theory of education change is outcome. Outcome entails several types of products which include ‘attitude change and students’ learning; teachers’ and other school personnel satisfaction; new skills; and improved problem-solving capacity of the school as an organization’ (Fullan, 2007).

According to Fullan (2007) therefore, success or failure of a programme such as IEE is determined by three categories of factors thus characteristics of change (need, clarity, complexity, quality & practicality) networking with relevant local factors (leadership of the County Education Board [CEB], school principals’ perceptions, creativity & collegial cooperation) and external factors (The role of the Ministry of
Education agencies /KICD as important sources for technical support, resources and monitoring policies) to determine failure or success of implementation (Table 1)

Table 1

Factors that Influence Educational Change

<table>
<thead>
<tr>
<th>Characteristics of Change</th>
<th>Local Factors</th>
<th>External Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need for change</td>
<td>County Education Board,</td>
<td>Ministry of Education &amp; its agencies /KICD</td>
</tr>
<tr>
<td>Clarity about goals and objectives</td>
<td>School Principals’ perceptions, creativity</td>
<td></td>
</tr>
<tr>
<td>Complexity of the programme</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality and practicality of the program</td>
<td>&amp; collegial cooperation</td>
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Source: Adapted from Fullan (2007)

Need involves whether the implementers of integrated environmental education (IEE) see the value in this advocated programme. For example, do the teachers as line implementers of IEE genuinely value the IEE programme? Do they get a sincere reward or tangible proof that the programme will be beneficial in terms of improved students’ knowledge, skills, values, attitudes, concern and participation in environmental sustainability? For that reason, successful implementation of IEE is dependent on whether the felt need of all the key players is enhanced enough to place IEE above all the other programmes. According to Fullan (as cited in Hammonds, 2002) “If people cannot find meaning in any reform it cannot have any impact” Therefore to gather support for IEE, teachers and administrators will need to be convinced that it is worth the time, money and effort (Westmoreland-King, 2012).

On the other hand, clarity is a condition of communicating goals and objectives of EE effectively for easy understanding by the intended programme implementers from the start. Fullan (2007) notes, “It should be clarified what the teachers should do differently” p.89. Short of this may cause anxiety and frustration among the teachers on how the programme translates into practice.
According to Fullan (2007) complexity is the “level of difficulty...” p.90 of an innovation such as IEE. Complexity therefore is the degree to which an innovation such as implementation of IEE is perceived as difficult to understand. In support of the theory of change, Rogers (2003) notes that excessive complexity of an innovation is an obstacle to programme adoption. This implies that processes involved in implementation of a new programme such as IEE should be simplified to such a degree that they are understood by all interested parties to enhance effective implementation.

The fourth characteristic of the theory of educational change relates to quality and practicality of the programme (Table 1). Quality of a new programme involves the degree of commitment directed at the initiative in terms of resources and time (Fullan, 2001). This implies that all stakeholders (local and external) need to direct a great deal of their attention to implementation of IEE in terms of the requisite resources and set timelines to accomplish each identified task. Without resources effective implementation of any new programme would be counterproductive. According to the Theory of Educational Change (2007), support in terms of the amount of resource (human and material) deserves clear-headed attention in programme implementation.

In the context of the theory of educational change practicality implies how realistic the implementation process of the new programme is and how well this fits in with the teachers’ current work conditions. For example, do the teachers have the time to learn and practice the change in a safe setting? If teachers are already overloaded, practicality of the IEE programme would be sacrificed especially when the teachers are expected to implement several other programmes simultaneously.

**Strengths of the Theory of Educational Change**

This theory is selected because it is leading in large scale reforms (Shaukat, 2013). Fulani’s appreciation of the complexity of organizations and the change process makes
his work stand out as he avoids oversimplification (Stranack, 2011). The theory is most appropriate because it places this study in its relevant context by considering curriculum issues such as relevance of content, teaching and learning methodologies used, leadership in the school, preparedness of the teachers and the students to accept and implement an educational innovation (Dove & Honigsfeld, 2014).

The Theory describes dynamics of interactions and interrelationships among variables of the change process which are becoming increasingly important in understanding success or failure of educational changes and innovations (Vundiniabola, 2011). Additionally, the Theory of Educational Change provides tested and valid ways of identifying challenges to implementation process of innovations in secondary schools and attempts to offer informed choices and strategies to mitigate the situation. Nancy (2011) observes that Fullan’s ideas in the theory keep the structure working from the top down to ensure that everyone more or less is following the processes that are in place. The choice of the Theory of Educational Change is therefore rooted in the fact that it has an outstanding contribution in educational reform programmes internationally. According to Boston College Libraries (2009), Fullan's assessments of each of the periods of education reform reveal that he has been more influential in the large-scale reform period than the other scholars. Sharing a similar view, Bennett (2011) observes that three decades after he burst on the scene, Fullan is not only still standing, but controlling the school change agenda.

**Weaknesses of the Theory of Educational Change**

In this theory Fullan remains indecisive. Bennett (2011) observes that Fullan is almost always half right and half wrong on matters of importance in education and usually he is right on the easy stuff that the whole progressive movement agrees on and wrong when it really starts to count. The theory also seems to rest on the assumption that
for it to work leadership must be right and its job is to convince others who are resisting the new reforms to share the same values and the same vision at each level in the hierarchy (Nancy, 2011). However, leadership and vision building alone do not count in successful implementation of any new programme. Deep and sustained reform depends on many of us, not just on the very few who are destined to be extraordinary” (Nancy, 2011).

Besides, Theory of Educational Change seems to appeal to the top down hierarchical structure in implementation of new programmes. One problem with this is that teachers see themselves as performers of someone else’s plans and will not find it easy to commit themselves to reforms (Phakisim, 2008). Top-down management can work only if it is supplemented by constant communication, continuous teacher development, persistent monitoring and feedback, and realistic timelines for implementation (Hall & Hord, 2006). It appears therefore that accomplishment of this approach requires the delicate skill of balancing top down and bottom up change processes. By the Theory of Educational Change, Fullan seems to be understood as ‘importing North American middle-class values that are being imposed on education systems worldwide’ (Nancy, 2011).

**Justification for using the Theory of Educational Change**

The Theory of Educational Change finds justification in this study because curriculum implementation is in itself a process of change. Fullan & Pomfret (as cited in Coffee, n.d,) argue that curriculum implementation should be considered as a process of educational change. Yusof, Sidin and Sihes (n.d) concur, stating that implementation can also be considered as a process of change. And curriculum change in terms of integration with Environmental education according to Kimaryo (2011) “can be considered a new innovation in education” p. 18. Rogers (2003) contends that innovation may mean a new
object, idea, practice or process … to be adopted by an individual or organisation. In this regard, the process of implementing integrated environmental education is considered as the trying out of a new practice that has been introduced into the school curriculum.

Besides, the Theory of Educational Change has also been found relevant because it has been successfully applied in a variety of settings by several researchers. For example, Maddin (2002) used the Theory of Educational Change as a framework for examining the implementation of instructional technology in elementary schools in one district in Ohio. The study questions focused on four factors of implementation — Need, Clarity, Complexity, Quality and Practicality. This study demonstrated the utility of the Theory for examining implementation progress in technology integration and produced astounding findings.

Additionally, the Theory of Educational Change was also applied in a case study on educational reform in Czech Republic by Polzyoi & Cerna (Kirova, 2004). According to Kirova (2004) the study employed three sets of implementation factors (nature of the reform; local characteristics; & external factors) as a framework for analysis. The researchers appreciated the value of The Theory of Educational Change framework for understanding the Czech Republic’s implementation of change.

Okwara, Shiundu, and Indoshi (2009) conducted a study on the integrated English language curriculum for secondary schools in Kenya, Busia District and the Kenya Institute of Education in Nairobi. The purpose of the study was to evaluate the implementation of the integrated approach to the teaching of English in secondary schools in Kenya. The researchers found The Theory of Educational Change appropriate because it conforms to curriculum development approach in Kenya which is based on the top-down paradigm. Kelwon (1991) conducted a case study on curriculum implementation in Biological Sciences under the 8.4.4 system of education in secondary schools in Baringo
District of Kenya and observes that indeed the Theory of Educational Change resonates with implementation processes and its phases help to bring some order in the discussion of the educational change process.

However, Fullan (2006) advises “Having a ‘theory in use’ is not good enough, of itself. The people involved must also push to the next level, to make their theory of action explicit”p3 While appreciating the Theory of Educational Change in guiding this study; the researcher was cautious of its shortcomings just like for most other theories which could at times be contradictory and therefore requires critical but judicious application to maximise the benefits. Therefore while this study was guided by the Theory of Educational Change, it was informed by the realities on the ground. This means that for the Theory of Educational Change to remain effective, it has to be customized to local conditions.
1.8 Conceptual Framework

The Conceptual framework for this study is articulated in figure 4.

![Diagram](image)

**Figure 4: Dynamics of interactions among variables that influence the implementation of an IEE program**

**Source:** Adapted from Fullan (2007)

Conceptual Framework according to Nalzaro (2012) refers to visual presentation of variables that work together as perceived by the researcher to guide the development of a study. The independent variables (need, clarity, complexity, quality & Practicality)
network with the intervening variables thus local factors (County Education Board, School Principals’ perceptions, creativity & collegial cooperation) and external factors (The role of the Ministry of Education agencies /KICD) represented by the two smaller circles on edge of the super circle (Figure 4) to alter the dependent variables namely teachers’ and students’ (literacy) or environmental awareness, knowledge, skills, attitudes and participation represented by the circle at the centre of the super circle (Figure 4). In this implementation arrangement, the independent and dependent variables interact through the mediation of intervening variables for technical support, resources and monitoring policies to influence the outcome of IEE implementation process.

The three thin arrows illustrated in figure 4 imply that the interaction process among the variables is nonlinear with events at one step feeding back to alter decisions made at previous stages. On the other hand the three stocky arrows radiating from the edge of the super circle demonstrate the influence which the independent and intervening variables have on the dependent variables for effective implementation of IEE in the secondary school curriculum.

1.9 Operational Definition of Terms

Challenges: refer to the difficulties, bottlenecks, hitches or obstacles that teachers and students perceive make implementation of integrated Environmental Education in the secondary school curriculum either difficult or impossible. This was measured through narratives and descriptive statistics of responses to open ended questions, closed ended questions, document analysis and observation guides.

Clarity: refers to understanding of objectives and content of IEE effectively by the intended implementers from the onset (Can teachers facilitate specific IEE activities using suggested resources?) This was measured through teachers’ and students’ responses on the criteria of having used or having not used certain instructional approaches. The
responses were then calculated in terms of frequencies, percentages (%) and means and analyzed.

**Climate change:** refers to long term alteration in the state of the average conditions of the atmosphere.

**Complexity:** refers to the degree to which curriculum implementation is perceived as difficult to understand (How prepared are teachers to undertake the complex integration of EE in the curriculum using new approaches). Complexity was measured through teachers’ and students’ levels of environmental literacy (environmental awareness, knowledge; attitudes; skills and participation) which were based on EE objectives. Multiple choice questions on each aspect of environmental literacy were asked. Frequencies, percentages (%), means and standard deviations for teachers’ and students’ responses were calculated and analyzed

**Curriculum:** refers to learning experiences which are planned, organized and provided to learners directly (formal) and indirectly (non formal, informal, emergent events & priorities from conversations among children; between children and teachers; and other partners) under the patronage of the school to attain educational goals.

**Environmental Degradation:** refers to deterioration of the natural environment and includes land degradation and climate change.

**Environmental literacy:** For purposes of this study, literacy variables were identified as awareness, knowledge, attitude, skills and participation and were measured through Environmental Literacy Test and the Likert scale in five subsections; knowledge (11 items), awareness (5 items), attitude (10 items), environmental skills (8 items) and participation (4 items).

**Environmental services:** refer to those fundamental life-supporting benefits that we take for granted like purification of air, purification of water, provision of fertile soil, plant
pollination, dispersal of seeds, climate stabilization, flood protection, erosion prevention, decomposition, maintenance of biodiversity, control of agricultural pests, and carbon sequestration

**Implementation of Integrated Environmental Education (IEE):** refers to putting into practice integrated environmental education by students, teachers, the community, the government and by other education stakeholders. Implementation of IEE was investigated through interview guides, questionnaires, and observation guides on the basis of characteristics of change (need, clarity, complexity, quality and practicality) of IEE as a new practice.

**Integrated Environmental Education (IEE):** is used interchangeably with Environmental Education (EE) and Education for Sustainable Development (ESD) to mean multidisciplinary approach to teaching and learning in which environmental topics are organised and incorporated across different curriculum subjects and dimensions thus formal, non formal, informal, hidden and emergent curricula.

**Integration of environmental issues:** integration in this study refers to incorporation of EE content with the content of both the carrier subjects e.g. Geography, History, Agriculture, Biology, Chemistry, Religious Education, Life skills( infusion/) and non carrier subjects e.g. Mathematics, Languages, Music and Art (insertion/). This study will therefore generally use the term, ‘integration’ in a wider sense to cover both infusion and insertion of environmental education across different curriculum dimensions thus formal (various subject areas), non formal (clubs, youth organizations, workshops & games), informal (implicit learning), hidden (unofficial & unintended learning) and emergent (accidental learning) to be dealt with through document analysis schedule, questionnaires and interview guides.
Land degradation: is a general term for unfavourable processes acting upon the biological and physical systems of the environment caused usually by inappropriate use reducing the productive potential of the land to support its major uses.

Need: refers to finding value or meaning in any change hence agreeing with it. Need for IEE was measured by looking at teachers’ and students’ perceptions of the integrated environmental education in the secondary school curriculum.

Need/value for integration of environmental education in the secondary school curriculum was also measured by looking at the extent to which environmental education (EE) was integrated in the secondary school curriculum. 6 Likert-type items were constructed. Frequencies, percentage (%) responses, means and standard deviations for teachers’ and students’ were computed and analyzed.

Participation: refers to a process that entails having a voice and choice of varying degrees of involvement from enrolment, attendance; and engagement in learning. This was measured through overall mean score of responses on closed ended questions and through narratives of responses on open ended questions and observations.

Quality and Practicality: refer to what conditions, resources, and support teachers need in order to integrate EE routinely in the learning opportunities they create for students. This was measured through teachers’ and students’ responses on support to implement integrated environmental education topics in the secondary school. The responses on Likert-type items were calculated in terms of frequencies, percentages (%), means, and standard deviations and analyzed.

Secondary school: in the Kenyan context, secondary school refers to the formal category of school level that offers education to forms one to four in public schools and forms one to six in some private schools.
**Strategy:** refers to plan of action presenting good options that could enable successful implementation of integrated environmental education within the secondary school curriculum. This was measured through narratives of responses on open ended questions on questionnaires and interview guides.

**Syllabus:** refers to the official document of prescribed topical content of subjects listed for a particular course to be studied in a school. Generally a syllabus includes course policies, rules and regulations, titles of required texts and a schedule of assignments.
CHAPTER TWO
REVIEW OF RELATED LITERATURE

2.1 Introduction
A review of related literature for this study is organized thematically into three
sub-sections namely review of related theories; review of related empirical studies and
summary of the reviewed literature. The chapter shows what other researchers found out
about implementation of IEE in the secondary school curriculum. The studies helped the
researcher to identify the knowledge gap to justify the need to carry out this study in
Machakos Sub County.

2.2 Review of Related Theories
A theory is a well-established principle that has been developed to explain some
aspect of the natural world (University of Southern California, 2012). According to
Walker (1990 p.139) “Powerful curriculum theories enable us to act effectively in a wide
range of situations because we can deduce from them what are likely to be the
consequences of acting in different ways”. Seen in the light of the preceding definition,
this study will restrict itself to the following theories as practical guides because they are
either popular or widely practiced.

2.2.1 Rogers Diffusion of Innovations Theory (DOI), 2003
Rogers, who is considered the founding father of diffusion of innovations theory,
developed this concept. Rogers (2003) defined innovation as any object, idea, technology,
practice, methodology or pedagogical technique that is new. He further defined diffusion
as “the process in which an innovation is communicated thorough certain channels over
time among the members of a social system” (Sahin, 2006).

Diffusion of Innovations Theory (DOI), explains how, why, and at what rate a
new idea, product, practice, philosophy and technology spreads through cultures (Sohail
& Sahin 2010). Thus the theory recognizes that the rate of adoption of an innovation on which participants have received information or training is a function of antecedent factors (factors preceding the process of disseminating the innovation) such as perceived attributes of that innovation which are observability, triability, complexity, compatibility and relative advantage (Figure 5)

Figure 5: Diffusion of Innovation Framework
Source: Adapted from Rogers (2003).

Rogers (2003) observes that innovativeness is determined by relative advantage which speaks to an individual’s perception of how effective and cost efficient an innovation is over other alternatives. For instance, if the implementation of integrated
environmental education (IEE) is perceived to be convenient, gainful, socially prestigious and therefore better than its alternatives, it is adopted.

Compatibility is the fit of the innovation to established ways of accomplishing the same goal (Dearing, 2009). The more the potential adopters perceive the innovation as consistent with their past experiences, needs, values and the “normal” ways of doing things the more readily they adopt it and the vice versa is also true. For example, is the integration of IEE in the secondary school curriculum perceived as relevant with the core functions and realities of heads of schools, teachers and students? Does IEE in the school curriculum fit together well with the available time, financial position, values and practices of the implementers? For instance, is the change compatible with teachers’ own preferences of working with students in the classroom?

The degree of complexity is also a critical quality in adoption of an innovation. Complexity speaks to how simple the innovation is from the perspective of the potential adopter. For example if IEE was perceived as simple to understand, it would have been adopted more readily than when it is complicated.

In the context of trialability, if a user is able to experiment an innovation on a smaller, less intensive scale, the individual would be more likely to adopt it. Rogers (1995) asserts that “an innovation that is trialable represents less uncertainty to an individual who is considering it for adoption” p.16. Therefore the implementation of IEE in the secondary school curriculum requires trialing it to boost its rate of adoption by minimizing adopter doubts.

Observability relates to the degree to which the potential adopter obtains the opportunity to see the results of the implemented practice by others. For instance, are outcomes of integrating IEE in the school curriculum visible? Visible results lower suspicion and therefore individuals who see the results of an innovation, are more likely
to be adopted by individuals more quickly. According to Rogers, the five qualities outlined here determine between 49 and 87 percent of the potential adoption of new practices (Robinson, 2009).

In terms of implementation of IEE, these innovation attributes of observability, triability, complexity, compatibility and relative advantage (Figure 5) have significant impact on teachers’ and students’ attitude towards integration of environmental education content in the school curriculum and are also significant drivers of the decisions of the policy makers on how EE programs should be conducted within the formal education sector.

Other relevant factors that have influenced decisions on adoption or rejection of innovations such as IEE include the social system. According to Rogers (2003 p. 23), a social system is “a set of interrelated units engaged in joint problem solving to accomplish a common goal” The structure of the system may constitute a sole teacher as the potential adopter or local opinion leaders at village level who may constitute social pressure to adopt the innovation such as IEE. The teacher or opinion leaders may be involved in social networks of conversations with innovation champions (visionary and imaginative innovators) at the local level; with education officers for instance QASO’s at Sub- County level and with KICD officers at the nationally level to influence adoption and spread of the innovation.

Communication channel is another significant antecedent factor that influences the flow of new ideas and practices. An innovation can be communicated through peers, family members, co-workers and mass media such as radios, videos, DVDs and television commercials. While many individuals may at first hear about an innovation through mass communication channels, it is the interpersonal communication that is likely to influence adoption decisions (Chigona & Licker, 2008). According to Rogers (2003),
recommendation of an innovation through interpersonal channels of peers who share similar attributes (homophily) is more readily acceptable and encourages pursuance of a technology rather than recommendation from peers of dissimilar attributes (heterophily).

Each adopter’s degree of innovativeness (earliness relative to others) is another component of diffusion theory. The concept of adopter categories states that, for any given innovation, a certain percentage of the population will readily adopt the innovation, while others will be less likely to adopt (Surry & Ely, n.d). According to Rogers (1995) these categories of adopters are assumed to fall into a bell-shaped diffusion pattern, in which innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggards (16%) are predictable with generally fixed size and once the innovation enters maturity, adoption rate starts declining (Figure 6)

![Figure 6: Hypothesized distribution of adopter categories within a typical population](image)

**Source:** Reproduced from Penaz (as cited in Le Hoang, 2011)

From figure 6, innovators are the earliest individuals to adopt an innovation because they have great financial status and they also interact with original innovators. The second category is that of early adopters who hold leadership roles in the social system; are well informed; more socially respected and are therefore trend setters. The
third category is the early majority who only act with tangible proof of benefits of an innovation. They want to hear about “user-friendly” innovations, “no sweat” (Robinson, 2009). On the other hand the late majorities avoid taking risks and are therefore uncomfortable with a new idea for fear of failing to fit in it. Similarly the laggards tend to be doubtful and uneasy about the innovation because it challenges their established routines and are therefore against it altogether.

However, it should be noted that the influence of the preceding antecedent factors on the adoption of an innovation is based on the individual’s adopter variables illustrated in a stage-ordered model of knowledge and awareness, persuasion, decision, implementation, and confirmation (Figure 7).

![Figure 7: Five stages of Roger’s (2003) Innovation-Decision Process Model](image)

**Figure 7: Five stages of Roger’s (2003) Innovation-Decision Process Model**

Figure 7 illustrates that the individual needs prior knowledge and awareness about the practice. This generally persuades one to forming attitude and making decision about that innovation. This would then lead one to weighing costs and benefits of integrating the innovation into regular use. If adopted the innovation would then be employed (implemented) on a limited basis before the final decision (confirmation) to use it to its fullest potential. But, the individual might sometimes reverse the original decision, a situation that Rogers (1995, p.20) describes as delayed rejection or discontinuance of the practice after evaluation of the potential in terms of costs.

**Strengths of the Diffusion of Innovations Theory (DOI)**

According to William & Lorilee (2007), Roger’s Diffusion of Innovation Theory (DIT) provides insight into why participants in an educational program adopt or reject a
practice on which they have received information. The diffusion model may therefore provide valuable insights into why some practices change and others do not.

Additionally, the theory leads to a better understanding of issues surrounding adoption of a practice by incorporating end user obstacles. Diffusion concepts can also be operationalised in projects to influence the rate of adoption of innovations by slowing the spread or by accelerating it. Rogers’s model readily generalizes and has wide applicability. Because of its scope and scholarly reputation, Rogers’s model is amongst the most reliable in the social sciences and important for consideration in the study (Robinson, 2009). The theory will therefore provide a basis for the communication strategies to be utilized in the implementation of IEE in secondary school programmes.

**Weaknesses of the Diffusion of Innovations Theory (DOI)**

One of the cons of the diffusion of innovation approach is that the communication process involved is a one-way flow of information. The sender of the message persuades the receiver, and there is little or no dialogue. Therefore the initiator of the change controls the direction and outcome of the campaign. In some cases, this is the best approach, but in other cases a more participatory approach is required.

Although the theory is excellent in explaining how an innovation is diffused among individuals in terms of time and adopter categories, the theory might not fully explain all phenomena throughout diffusion process in the present fast-growing technology society (Le Hoang, 2011).

### 2.2.2 The Chaos Theory

The Chaos theory emerged during the second half of the 20th century when scientists from different fields of research, championed by Henri Poincare, observed similarities in the behavior of natural systems like weather, chemical reactions, movement of water molecules in a container being gradually heated (Butz, 1997; Brno, 2014). The
movement of water molecules in boiling water might seem chaotic and random, although there are patterns of movements that change over time and tend to form similar structure (Brno, 2014)

Chaos theory therefore posits that nonlinear systems sometimes appear chaotic, unpredictable or disorderly but small inputs into the life of the system can produce massive consequences that trigger a new order navigating the system out of the chaos to solve traditional problems. Therefore according to Bussolari and Goodell (2009) Chaos theory is presented as a model that regards disorder, unpredictability and lack of control as normal manifestations of transition processes in the implementation of a program. The name “Chaos” comes from the fact that nonlinear systems seem to behave chaotically or randomly (Brno 2014) but over time they finally generate an order of their own to further meet their requirements.

Brno (2014) argues that in real dynamic systems “Everything relates to everything” 1p7. However the interactions are hardly in a linear manner. Instead interactions among team members are unrestricted and therefore set up nonlinear networks where elements appear disorganized but mutually affecting each other with dynamics of the team. Over time, the interactions reconstruct their own new order. Houry (2011) describes this as the process of chaos and organizational emergence. This is the essence of the Chaos theory.

Although the chaos theory originated in the hard sciences, its applications to humanities and social sciences (Friedrich, 1988; Smith & Higgins, 2003) are becoming more common. For example, in the management and social sciences literature, chaos theory has been used primarily as a metaphor/imagery to explain organizational behavior (Friedrich, 1988; Smith & Higgins, 2003). For example, those small inputs into the system could generate immense outputs hence the metaphor of the butterfly effect. When
a butterfly flaps its wings in one part of the world, it can initiate a series of air currents that influence weather events that can eventually cause a hurricane in another part of the world (Friedrich, 1988; Smith & Higgins, 2003). This “Shows how your everyday actions can make a difference for generations to come” (Étienne, 2012).

Aspects of the chaos theory have also been applied to management (Wheatley, 1992) and to teaching (Iannone, 1995). Similarly, McBride (2005) points out that, concepts from the chaos theory have recently been applied as a model for interpreting organizational change and understanding organizational behaviour. According to Brno (2014) the theory can be applied to various subjects of study for example to project management in which all activities can be perceived as a network and in a chaotic project environment, but injection of new ideas into the system can make a difference in accomplishing specific project tasks or goals.

In the case of implementation of Integrated Environmental Education (IEE) in the secondary school curriculum in Machakos Sub County, the Chaos theory in my view may provide a sound theoretical framework. Under the current arrangement, the Kenya Institute of Curriculum Development (KICD) is expected to reorient teachers on the implementation process of IEE. In spite of this, the institute has not done enough in that direction hence the task of implementing IEE has been left mostly to individual schools and individual teachers. Consequently, the implementation process is now open to all manner of approaches. Bengtson (2013) correctly observes that since IEE is not tested under any national mandate, it is up to the teachers to implement it the way they perceive it. This position generates a state of confusion and chaos lending the analysis of the IEE implementation process through lenses of the Chaos theory.

Chaos theory is grounded in mathematical principles (Crandall, Crandall, Parnell, 2013). Mathematical models could therefore help identify the edge of chaos in
implementation of a programme such as IEE. Chaos could then attract the attention of programme initiators for example KICD. An intervention for instance from successful cases or verified innovations in terms of technical and soft skills could be injected into the programme at the edge of chaos or point of crisis. This could then guide programme managers (Principals) in directing IEE implementation process out of chaos on an infinitesimal incremental basis (the butterfly effect). Slight changes in initial conditions can lead to a vastly different outcome in the life of the system (Crandall, Crandall, Parnell, 2013). Systems have the ability to adapt and change in relation to the feedback they receive from the environment (Moffat, 2003). According to Alberto (2013) thorough understanding of these dynamics is one of the critical factors of the success of a programme outcome.

2.2.3 Advanced Change Theory (ACT)

Quinn, Spreitzer, & Brown (as cited in Donmez, 2010) observe that at the core of the Advanced Change Theory (ACT) is the principle that “changing others requires changing ourselves first”. According to Donmez (2010), implementing change or a new programme such as IEE requires making painful adjustments to one’s behavior and taking risks that put the common good above the self as modelled on the lives of Jesus, Gandhi, and Martin Luther King, Jr.

The ACT theory basically places personal responsibility and commitment on steadfast individual school principals, classroom teachers and students, to make changes within themselves as much as practically necessary to accomplish an innovation such as IEE. Fullan (2001, p. 3) describes this sacrifice as moral purpose of leadership that involves acting “with the intent of making a positive difference in the lives of employees, customers, and society as a whole”
Although it is possible to practise self-sacrifice, it seems that the ACT theory is unrealistic and has limited application because very few individuals operate at advanced developmental stages as those quoted here. Therefore using the examples of Jesus Christ, Gandhi, and Martin Luther King, Jr as a model is apparently curious because they are far removed from reality and seemingly too demanding to try to emulate.

2.3 Review of Empirical Studies on implementation of integrated environmental education in secondary school curriculum

The empirical review for this study was organized thematically into six themes based on the six research questions set out in chapter one. The themes are, Integration of environmental education into the secondary school curriculum; teachers’ and students’ perceptions of integrated environmental education in the secondary school curriculum; levels of environmental literacy of secondary school teachers and students; support that teachers require to implement integrated environmental education topics in the secondary school curriculum; instructional approaches that secondary school teachers use to teach integrated environmental education; challenges that face the implementation of integrated environmental education in the secondary school curriculum and strategies that are suggested to address these challenges.

The review subsumes international studies in Washington (USA); South West Florida (USA); Canada; Poland (Europe); and Asia-Pacific region, Philippines, Hong Kong, Malaysia and India. The review also covers regional studies especially in Africa such as Nigeria and Tanzania and local studies particularly in Kenya.

2.3.1 Integration of Environmental Education into the Secondary School Curriculum

With regard to integration of environmental education into schools’ curriculum, Joaquin (2008) conducted a study on implementation of environmental education in
selected schools in the Philippines. The overarching objective of the study was to assess the level of incorporation of environmental education (EE) in the vision/mission statements of the respective schools. The study employed qualitative method using case studies and quantitative method using survey design. The target population of the study was all elementary schools and all high schools, all the teachers, all students and all administrators in Luzon, Visayas and Mindanao Islands of the Philippines. Sample selection was based on willingness of the administrators, accessibility of the place and safety of the one conducting the study. The study sample consisted of six schools. The research instruments consisted of survey questionnaires and perception scale checklist. Class observation and interview guides were also used. Data was then collected through administration of questionnaires, pre- and post-test evaluation measures, class observation and interview guides.

Joaquin’s study findings indicated that teacher-respondents integrated EE core messages in the subjects they taught; environmental protection is a part of the school’s general policy and the implementation of the policy depends to a large extent on the degree to which the school administrator is convinced of its importance, which in turn depends on his/her knowledge of EE; teachers who have attended EE training have substantial knowledge of content, skills and pedagogical competencies for effective EE integration in their subjects; Strategies employed by the teachers in integrating the EE core messages are hands-on activities (most commonly used strategy); group activities; in-door games & outdoor activities; interactive class discussions; graph analyses and project-making, film showing, constructing concept maps and role-playing.

The findings of Joaquin’s study were however in conflict with Otieno’s (as cited in Mulà, & Tilbury, Eds, 2011) that integration of ESD in the curriculum, was generally weak in all learning environments except at tertiary levels under the MESA
programme. Joaquin’s study findings were also not in tandem with Odeke’s (2009) findings in Kisumu County that teachers did not integrate EE in the subjects they taught; rather they taught what was only offered by the syllabus. Kimaryo (2011) further argues that “teachers do not know what to include because they are not used to include things which are not explicitly mentioned in the syllabus” p. 39.

Joaquin’s (2008) study is further criticised for its inadequacy in data collection techniques such as convenience sampling. Whereas convenience sampling technique is fast, inexpensive, easy and subjects are readily available, the most obvious criticism about convenience sampling is bias (Castillo, 2009). This sampling technique may result to a higher error margin leading to less representative outcomes. Castillo (2009) further observes that since the sample is not representative of the population, the results of the study cannot speak for the entire population and therefore limited in generalization of the findings.

In light of the foregoing findings, this study intended to establish the coverage of EE content in the secondary school curriculum in Machakos Sub County because this influenced what teachers taught and what students learnt as prescribed by the official school curriculum. Besides the assessment of the EE content under the integration approach was dependent on how much of such content was integrated in the curriculum. Therefore the existing curriculum documents, especially the syllabuses were analysed for the relevant concepts and themes that were linked to EE. The study also intended to establish what strategies KICD and the school principals use to clarify the vision for integrating IEE in the secondary school curriculum. Additionally, the study attempted to avoid sampling weaknesses such as those cited here by adopting both probability and non probability sampling techniques to be in tandem with the proposed mixed research paradigm.
2.3.2 Teachers’ and Students’ Perceptions of Integrated Environmental Education in the Secondary School Curriculum

The effectiveness of an innovation, in a school organization, is dependent on the extent to which the people concerned perceive the problem and hence appreciate the existence of a need for change. Fullan (1991) notes that “many innovations are attempted without a careful examination of whether or not they address what are perceived to be priority needs.” p.69 Chi-Chung Ko & Chi-kin Lee’s (2003) study further points out that teachers tended to teach more environmental education if they held more favourable attitudes towards it and had more skills of teaching environmental education in the face of fewer constraints.

With regard to teachers’ perceptions of integrated environmental education in the secondary school curriculum, Ko and Chi-kin (2003) conducted exploratory study of Hong Kong secondary school Integrated Science teachers' perceptions of environmental education. The study employed both quantitative and qualitative methods. Both questionnaire survey and interview schedule were used to collect data. Findings of the study showed that teachers’ perceptions and attitudes toward environmental education influenced them to teach more environmental education in Integrated Science than in the other subjects.

While Ko and Chi-kin’s (2003) study findings attempted to answer the study question on teachers’ perceptions of the integrated environmental education in the secondary school curriculum, Ko and Chi-kin’s (2003) study tended to narrow down to science subjects yet integration of EE cuts across science as well as arts based subjects. Although the study by Ko and Chi-kin (2003) employed mixed methods paradigm, the researchers did not explicitly spell out the study designs they employed. Besides, purposive sampling was the main selection technique for the respondents yet the study
had employed both quantitative and qualitative methods. What sampling technique did they use in the case of the quantitative approach? The researchers also designed a questionnaire and interview schedule as instruments for collecting data which appear to address the quantitative approach. Then, what instruments did they use to collect qualitative data? This therefore leaves the status of their study findings questionable.

Kearney (1999) carried out another study to determine teachers’ perception of environmental education and school improvement in Washington. The target population was all non-EE teachers (those who do not include environmental education in their instruction), all EE teachers of grades 4-8 with varying levels of experience and all experts in the field of EE. The study sample consisted of 9 experts selected through snowball sampling approach and 12 Washington teachers of grades 4-8 selected through purposive, stratified, cluster and random sampling techniques to participate in the study. The study sample consisted of nine hundred and ninety eight (998) respondents.

Data were collected through in-depth interviews administered to each participant. Data were also collected through mailed questionnaires along with a cover letter and a tea bag, which was included as incentive to participate. As an additional incentive, participants who returned the questionnaire could receive a set of 4 posters (depicting scenes of Washington’s ecosystems) if they so requested. The total response rate was 35%. Open-ended questions were subjected to content analysis. Pro-environment attitudes were analysed by averaging each participant’s responses on all the items. The findings of the study established that the depth of participants’ conceptualizations of EE increased with increasing experience.

However, Kearney‘s (1999) study was criticised for not establishing the participants’ perceptions of IEE in the Secondary School Curriculum. This would confirm whether they perceived IEE as priority need worthy pursuance in implementing
the curriculum. Kearney's (1999) study was criticised for offering incentives which were included in the mailed questionnaires for the respondents to participate. Although Rybarova (2006) argues that the deception must be justified in terms of some benefit that outweighs the risk to the participants, Kearney’s (1999) incentives were out of step with research ethics and would if anything influence participation and encourage less genuine responses. Rybarova (2006) observes that participants may adjust their own levels of performance in an attempt to satisfy the experimenter. Consequently, less genuine responses would be encouraged. Besides, Kearney's (1999) response rate of 35% on the questionnaire also appears questionable as it was seemingly less representative to generate dependable results. The current study therefore attempted to resolve inadequacies in data collection procedures by taking into account all ethical issues at each step in the research process especially by steering clear of inappropriate motivations of any sort for respondents’ participation. It was also important that the study inquired into teachers’ perceptions toward IEE with a view to understanding their willingness and ability in developing suitable pedagogies and materials for effective implementation of the IEE programme.

Regarding students’ perceptions of the integrated environmental education in the secondary school curriculum, Thang and Kumarasamy (2006) investigated Malaysian secondary school students’ perceptions of the environmental contents in their English language classes. Objectives of the study were to investigate students’ perception of environment topics in the English language syllabus; to find out if students felt that these topics helped them in the improvement of their language skills; to find out whether students’ gender and proficiency levels had any effects on their perceptions of environmental topics. The study adopted a qualitative research design, targeting all secondary schools and all form five students from Malaysian secondary schools. The
study sample comprised 100 form five students from a Malaysian secondary school. Data were collected through questionnaire and a structured interview guide. Data were analysed through quantitative methods using SPSS Version 11.0. Statistical measures that were used in the analysis of the data were mean score ranking and analysis of variance (ANOVA).

The findings of Thang and Kumarasamy’s study established that through use of environment content in the English class, students developed a more positive attitude towards the environment. Both male and female students shared similar perceptions of the environment and therefore gender seems to have a limited bearing on students’ perceptions of the environment. However, Thang and Kumarasamy’s study seemed to appeal to qualitative research design and yet the corresponding data analysis was through quantitative methods. It was expected that since Thang and Kumarasamy’s (2006) research design was qualitative, data should have been analyzed qualitatively by building a narrative. Besides, Thang’s and Kumarasamy’s (2006) study adopted the qualitative research design which was singular in orientation hence lacking the advantage of complementarity that the mixed methodology offers. This study therefore resolved this dilemma by employing mixed research approach as the third research paradigm which according to Ivankova (2002) is in combination to complement each other and allow for more complete analysis.

2.3.3 Levels of Environmental Literacy of Secondary School Teachers and Students

Environmental literacy is defined as a set of understandings, skills, attitudes and habits of mind that empower individuals to relate to their environment in a positive way (Roth, n.d). Literacy of secondary school teachers and students is very important for effective implementation of integrated environmental education. The success or otherwise
of any curriculum depends largely on the important role of the teachers (Jekayinifa & Yusuf as cited in Awoyemi, 1986). There is no educational system that can rise above the quality of its teachers (Gimba as cited in FGN, 2004).

Regarding levels of environmental literacy of secondary school teachers, Lasso De Lavega (2004) conducted a study in South West Florida Counties on environmental awareness, knowledge and attitude (AKA) of environmental specialists, high school instructors, students and parents. The study employed the causal comparative research design with volunteers involving 27 environmental specialists, 15 high school instructors, 224 high school students and 222 parents. Study findings indicated that there were no significant differences between high school instructors and high school students regarding AKA. In relation to gender, there was no significant difference between teachers’ sexes in terms of environmental literacy.

Lasso De Lavega’s (2004) study findings also revealed that students’ levels of awareness and pro-environmental attitudes were higher than their parents’. Study findings further illustrated that students tended to generally have higher levels of awareness than their knowledge levels as a result of easy access to information through the electronic media. The study also indicated that there were no significant differences between high school students and high school instructors regarding their knowledge levels.

Additionally Lasso De Lavega’s (2004) study findings indicated that there were no significant differences between high school students and high school instructors regarding pro-environmental attitudes. As regards gender, there was no significant difference in attitudes between sexes across the groups. This seemed contradictory with Rickinson’s (2002) assertion that girls were more pro-environmental than boys in their attitudes and behaviours. Although Lasso De Lavega (2004) study attempted to address environmental awareness, knowledge and attitude (AKA) of high school instructors,
students and parents, the findings concentrated more on comparisons rather than the actual levels of Environmental Literacy for each category of respondents. The study did not therefore portray a clear picture of secondary school teachers’ levels of environmental literacy.

Lasso De Lavega’s (2004) study was also criticized for its inherently biased data collection methods. The researcher’s confidence in the reliability and competency of volunteer respondents makes it difficult to establish whether the findings from the sample population reflected the attributes of the population.

Another study was conducted by Poddar (2009) on environmental education awareness and attitudes of teachers and students of North-East Chhattisgarh region of India. The objectives were to study: the correlation between environmental awareness and environmental attitude of teachers; the effect of environmental awareness and environmental attitude on the environmental achievement of their students; the effect of gender on the environmental awareness of teachers; the effect of location on the environmental awareness of teachers; to study the effect of gender on the environmental attitude of teachers; the effect of location on the environmental attitude of teachers; the effect of gender on the environmental achievement of students; the effect of location on the environmental achievement of students. The study adopted the quasi-experimental design targeting all schools; all teachers and all the students. The study sampled 117 schools; 500 teachers, and 1000 students through quota sampling and random sampling techniques, respectively. Schools, teachers and students of Sarguja, Jashpur, Raigarh, Korba and Janzgeer Districts of North-East Chhattisgarh constituted the Population for the study. Data were collected through environmental awareness ability measures, environmental attitude measures and environmental achievement measures.
Data were analysed using means, medians, modes, dispersion, t-value, F-value and correlation.

Study findings indicated that school teachers possessed the knowledge necessary for implementing integrated environmental education. Study findings also demonstrated that environmental awareness of urban school teachers was significantly higher than that of rural school teachers. The study further indicated that school teachers possessed attitudes necessary for implementing the integrated environmental education. While Poddar’s (2009) study findings attempted to answer the study question on the levels of environmental literacy of secondary school teachers, Poddar is criticised for using the quasi-experimental design which lacks randomization in selection of respondents. Without proper randomization, personal bias would skew results making it difficult to replicate (Colorado State University, 1993-2012). Similarly Poddar’s (2009) study findings were apparently in conflict with other parallel studies (Kimaryo 2011; Odeke 2009; Ajipoye, & Silo, 2008; Jian 2004; Bhandari & Abe, 2000).

Ko and Chi-kin, (2003) conducted exploratory study of Hong Kong secondary school Integrated Science teachers' perceptions of environmental education. Both questionnaire survey and interview schedule were used to collect data. Findings of the study showed that Hong Kong secondary school Integrated Science teachers tended to teach more environmental education if they held more favourable attitudes toward environmental education. However Ko and Chi-kin’s (2003) study findings did not attempt to answer the study question on levels of environmental literacy of secondary school teachers. Instead their study tended to show the effect of favourable attitudes towards teaching of integrated environmental education. The purpose of this study was therefore to seek for further answers to disparities cited in the preceding study findings.
Rickinson’s (2002) reviews of recent research on students and their learning in school-based environmental education also found out that young people in several countries were generally of low levels of factual knowledge on environmental issues. Rickinson’s (2002) findings also indicated that young people in several countries reported generally positive environmental attitudes and had some involvement in environmental practices influenced by such factors as gender, age, socio-economic grouping, geographical location and schooling. Rickinson (2002) further observes that in terms of gender, girls are more pro-environmental than boys in their attitudes and behaviours.

Another remarkable study conducted by Kobierska, Tarabuła-Fiertak and Grodzinska-Jurczak (2007) on students’ environmental knowledge, behaviour and actions for the benefit of the environment in Poland showed that students had interest and active attitudes to nature and take part in pro-environmental actions. Findings further revealed that contact with nature and the resultant sensitivity (emotions) played a major role in shaping students’ pro-environmental attitudes. As reflected in the foregoing empirical studies (Rickinson, 2002; Chi-chung Ko & Chi-kin Lee, 2003; Lasso De Lavega, 2004; Kobierska, Tarabuła-Fiertak & Grodzinska-Jurczak, 2007; Poddar, 2009), environmental literacy is one of the basic goals of Environmental education. Its key target is to empower individuals to reconcile their needs and actions with environmental issues in order to relate to their environment in a positive manner.

Implementation of an innovation such as IEE in the secondary school curriculum therefore requires that teachers and students achieve high levels of environmental literacy. For that reason this study sought to establish whether secondary school teachers and students in Machakos Sub-County had been sufficiently capacity-built in terms of environmental awareness, knowledge, skills, attitudes and active participation in environmental issues or not. Some of the items to be evaluated for teachers’ and students’ environmental literacy
were based on the ten concepts which according to Swanepoel, Loubser and Chcko (2002) are: the biosphere, ecological perspective, interrelationships in the ecosystem, environmental changes, basic human needs, resources, maintaining environmental quality, the ability to make choices, decision-making on environmental issues and environmental ethics.

2.3.4 Support that teachers required to implement integrated environmental education topics in the secondary school curriculum in Machakos Sub-County

Fullan’s Theory of Educational Change (1991) identifies support of programme implementation as critical in terms of quality and practicality of a change initiative. According to the theory support in terms of the amount of resource (human and material); reasonableness of the timelines for implementation and work conditions deserved clear-headed attention in programme implementation. Hammonds (2002) asserts that “People must work together to figure out what is needed to achieve what is worthwhile” Therefore, tri-level engagement, thus school and community; district; and state is essential for system reform (Fullan, 2006).

Teachers must have the right work conditions in place in order to effectively teach related topics of environmental education. Maddin’s (2002) observes that the practicality of a change initiative is determined by how well it fits teachers’ current work conditions. Berry, Smylie and Fuller (2008) outline the following working conditions that could enhance or challenge teachers on what and how they can teach: a well-rounded curriculum; time; suitability of the physical environment such as buildings and equipment; facilities and resources; organizational structures that influence workload such as class size; autonomy and shared governance; school leadership styles; teacher
empowerment; professional development; parent/community involvement; external support and teams or working parties.

With regard to this theme, Akinnuoye and Nor (2011) carried out a case study on implementation of EE in Malaysian and Nigerian Secondary Schools. The overarching objective of the study was to compare availability of materials, facilities and resource persons in schools implementing environmental education. Twenty (20) schools were selected from both countries using simple random sampling. Twenty (20) students were sampled from Forms 3 to 5 in each school; ten teachers were selected from each school in each country. Data were collected from Government secondary schools in Klang valley, Selangor State in Malaysia and Lagos State in Nigeria using questionnaires and direct interviews. Six hundred (600) questionnaires were distributed but only 420 (70%) were retrieved. Data were analyzed using data editor of SPSS version 16 software.

Findings indicated that the Malaysian schools with 100% facilities had better implementation status compared to Nigerian schools with a paltry 12% of the facilities. For example 54% of the schools researched in Malaysia had EE display rooms compared to only 28% in Nigeria. More schools in Malaysia provided EE newspapers and magazines and 70% of the schools studied in Nigeria did not have EE newspapers and magazines. More than 50% of the teachers from the schools of study in Malaysia had attended E.E. in–service training while in Nigeria only 40 % had attended the training. More teachers in Nigeria agreed that the concept of E.E. was difficult to teach due to lack of or inadequate facilities and conducive environment. As a result Akinnuoye and Nor (2011) observe that more than 75 % of students in Malaysian schools had better environmental education awareness as against their counterparts in Nigerian.

Akinnuoye and Nor’s (2011) study findings in Nigerian and Malaysian schools agreed with Koskey’s (2013) Kenyan study on implementation of Early Childhood
Development (ECD) curriculum in Uasin Gishu County which showed that ECD curriculum by NACECE was not adequately implemented as it was initially designed and conceptualized because of lack of and poor usage of necessary facilities and materials among other reasons. Fullan and Miles (1992) caution that change is resource-hungry and therefore reformers must be prepared to the growing costs of the change process.

Koskey’s (2013) study on stakeholder attitudes, provision of materials and support for implementation of Early Childhood Development (ECD) curriculum (NACECE) in Uasin Gishu County of Kenya indicated similar findings that the curriculum was not adequately implemented due to lack of and poor usage of facilities and materials. However, Koskey’s study was, faulted on the premise that it took the qualitative orientation yet the researcher collected data through questionnaires, observation schedules, interview schedules and document analysis which meaningfully lay in the domain for the quantitative approach.

The current study therefore avoided this weakness by employing data collection instruments that were in tandem with the mixed research approach. The study also established the resources and conditions on the ground under which teachers in secondary schools worked to further establish whether the said conditions enhanced or impeded the implementation of integrated environmental education particularly in Machakos Sub-County.

### 2.3.5 Instructional Approaches that Secondary School Teachers use to teach Integrated Environmental Education

Instructional approaches are ways by which information is presented to students. According to Vudiniabola (2011) quality of a change such as a new curriculum also refers to the nature of the implementation including methods of teaching and the content of what is taught.
With regard to instructional approaches, two categories stand out. They are teacher-centered approaches and student-centered approaches (O’Bannon, 2002). However, literature confirms that most instructional approaches worldwide tend to pursue behavioural learning theories which assume that learning takes place through simple processes of ‘knowledge transfer’ and through rewarding appropriate behaviour modifications (Ward & Denny 2006, p.26). The implication is that learning is mostly teacher-centered. Judy & Wood (1993) report that in classrooms around the world, teachers lecture, students take notes, and then students are tested on what they have learned. In sharing this view, Freire (as cited in Grandy, 1987), observes that “Education is suffering from narration sickness. Narration turns the students into containers to be filled by the teacher; the more completely he fills the receptacles, the better the teacher he is. The more meekly the receptacles permit themselves to be filled, the better the students they are”. However, Judy and Wood (1993) contend that “The mind is not a vessel to be filled, but a fire to be ignited.” Gimba (2012) argues that curricular changes demand for related changes in approaches and methods of teaching and student assessment.

While literature confirms that most instructional approaches worldwide tend to pursue behavioural learning theories which assume that learning takes place through simple processes of ‘knowledge transfer’ and through rewarding appropriate behaviour modifications (Ward & Denny 2006, p.26), Lee & Williams (2001) & O ‘Donoghue (as cited in Roselimo, 2010) claim that the focus of environmental education has since shifted focus from such approaches that support education about the environment (knowledge) to the most-promoted constructivist and critical theory pedagogies that support experiential or action oriented methods involving teacher guided but learner centred approaches such as cooperative learning and students voice in terms of values, attitudes and positive actions for the environment.
The cone of experience (Figure 8) emphasizes experiential learning.

Figure 8 illustrates that abstract learning by only hearing contributes 10% of information learned and remembered. Reading and seeing contribute 15% of information learned and remembered while hearing and seeing contribute 20% of information learned and remembered. Talking with others contributes 40% of information learned and remembered whereas practice through field trips which involves all senses contributes 80% of information learned and remembered. Peer teaching contributes 90% of information learned and remembered.

Study findings demonstrated that experiential learning outdoors, was easier and more effective for most students than the traditional classroom setting. Experiential learning supports active learner centred activities in the environment with the teacher as a facilitator and organizer of those experiences. Experiential learning creates fun for the children and this enhances a passion for what they are involved with resulting in developing curiosity, competency, and creativity. Through experiential learning students are able to apply classroom skills for solving real environmental problems. However, EE methodology is a balancing act (Figure 9).

Figure 9: Education about, in and for the environment

Source: Adapted from Tilbury (as cited in Ma Kwan Ki, 2013)

Kimaryo’s (2011) study advises that a balance among the three approaches to EE thus education about the environment; education in the environment and education for the environment (Figure 9) must be reached within some kind of organizational framework if they have to be successful. To make implementation of EE more meaningful it is
therefore important not to take these methods as alternatives, but rather as mutually supportive of each other since most of them tend to overlap in theory and practice.

Some goals are better suited to teacher-centred approaches while others clearly need student-centred approaches (O’Bannon, 2002). Teachers could guide and support children through a broad range of strategies, so each child could have more than one pathway. This is why Osakinle, Onijigin and Falana (2010) argue in favour of the eclectic method by which a combination of all that is good in all the other methods of teaching is incorporated. This view is consistent with the findings of Ko and Chi-kin (2003) exploratory study of Hong Kong secondary school Integrated Science teachers’ perceptions of environmental education. The findings showed that teachers’ variations in the teaching of environmental education were reflected by teachers' emphasis on teaching environmental education, and their use of a variety of teaching methods. This is due to the fact that students have different leaning styles and therefore they require differentiated instruction to meet their learning needs. According to Tulbure (2012), diagnosing students’ individual learning styles to match the differentiated instruction therefore represents an expected challenge.

2.3.6 Challenges that were faced in implementation of integrated environmental education in the secondary school curriculum

Challenges are bottlenecks, hitches or obstacles that teachers and students perceive make implementation of integrated Environmental Education in the secondary school curriculum either difficult or impossible. Lee and Williams (2001, p.230) observe that “Although there is a general perception that schools should be instrumental in realising the goals of environmental education, past studies have shown that there are many barriers in schools which impede progress in environmental education. Lee and Williams (2001) further point out that” Such barriers are much more acute in schools in
rural areas or in developing countries where there is lack of material resources and teacher expertise.

With reference to challenges, Bhandari and Abe (2000) conducted a study on the general trends, patterns and problems of environmental education (EE) based on the analysis of reports from some countries in the Asia-Pacific region. Purposive and snowball sampling designs were used to select the 4 study regions, 36 study countries, 2 agencies and 2 collaborators from each country respectively.

Study findings indicated that constraints impeding effective implementation of EE in the region included: lack of national environmental policy; lack of coordination and collective action amongst NGOs and other agencies in the region resulting in duplication of activities and competition among different organizations; inflexible curricula; elitist education system hence classroom instruction geared towards examinations; inadequately trained manpower particularly of environmental educators and facilitators.

In spite of the findings, Bhandari and Abe’s (2000) study was criticized on the premise that it employed biased sampling designs thus purposive and snowball. These sampling designs reduced the likelihood that the sample would represent a good cross section of the population (Trochim, 2006) and therefore diminished chances of making inferences and generalisation about that population. Besides, Bhandari and Abe’s (2000) study did not show how data was analysed but merely mentioned that a framework for analysis of data was employed to review and analyze the status reports. Additionally, seemed to be contradictions in the researchers’ study findings that EE had obtained momentum leap in the region yet environmental degeneration did not seem to be diminishing. Therefore this study intended to fill the gap left by Bhandari and Abe’s study by carrying out further investigation on this theme in order to provide a proposal for
factors that would facilitate effective implementation of IEE in the secondary school curriculum in Machakos Sub-County.

2.3.7 Strategies that were suggested to address the challenges of implementing integrated environmental education

In the context of this study, strategies are plans of action presenting good options that could enable successful implementation of environmental education within the secondary school curriculum. In connection with strategies, Kobierska, Tarabula-Fiertak and Grodzinska-Jurczak’s (2007) conducted a study on learners’ environmental knowledge, behaviour and actions for the benefit of the environment in Poland. The study was quantitative in nature. It involved 421 pupils from 20 gymnasiums, 613 pupils from 22 general lyceums selected using the stratified random method. The study established that strategies for implementation of EE were nested in experiential learning through media services. In support of this view Novacek (2008) points out that media in the form of news and EE programmes such as Planet Earth and other programmes teach both the beauty of nature and pass messages that encouraged stewardship of nature which was totally compatible with the agenda for biodiversity conservation. Therefore through media essential EE messages would be delivered to students.

But, even as these studies seemed to share similar viewpoints in regard to mass media, Filho (1996) and Conell (as cited in Rickinson, 2001) argue that mass media was not considered a reliable source of information about the environment as it often distorted knowledge and promoted attitudes to environment on the basis of consumption. Onder (2006) further argues that print media is out of favour with the youth unless it is something really interesting. However, Lee and Williams (2001, p.218) advise that “we do not underestimate the substantial contributions made to environmental education by a number of other formal and informal agencies” According to McKeown (2002), for
effective implementation of IEE, the formal, non-formal, and informal educational sectors have to work in concert to reach a broader spectrum of people and prevent redundant efforts in attempting to achieve local environmental goals.

From the foregoing studies, it is reasonable to argue, as noted by Weladji, Moe, & Vedeld (2003) that informal curriculum, hidden curriculum and non-formal curriculum are necessary strategies and supplements to the formal curriculum for integration of environmental education (EE) content. Formal curriculum constitutes the intentionally expressed and organized dimension of a curriculum. It reflects academic disciplines and learning activities that students and teachers participate in within school settings. Such formal curriculum emerges as a worthwhile option to integrate EE in classroom lessons because the curriculum is recognized and guided by government and attracts officially recognized certificates as motivating factors.

In a similar way, non-formal curriculum offers another strategy that would enhance implementation of IEE in the secondary school curriculum. Non-formal curriculum addresses teaching and learning activities that are generally organised outside the formal school system (The Canadian Environmental Grantmakers' Network [CEGN], 2006). Non-formal curriculum is loosely organized and may not necessarily lead to any certificate. However within the framework of non-formal curriculum, environmental education would be highly enriching as it builds on students’ skills and capacities in less official settings such as environmental education camps, zoos, museums and nature centres in the surrounding communities. Here, participation is driven by the learner’s interest. Jian (2004 p.2) observes that “a school is an integral part of the community and it is not only a site to practice sustainable development education, but also a model for the community to practice sustainable development education” thus linking school environmental education agenda to programmes in the communities.
Further strategies for effective implementation of IEE in the secondary school curriculum could be pursued through informal curriculum. This implies that underlying messages in the informal curriculum are delivered through ad-hoc activities that occurred outside regular school hours, during break time, after school and sometimes on weekends. In this context the teacher is anyone with some experience such as a parent, a friend or mass media. For example a father teaching his child how to construct terraces on a farm or teaching a child how to use domestic water efficiently is an example of informal environmental education. While informal curriculum does not lead to any certificate it often contributes to learning of EE by experience.

Reviewed literature (Novacek, 2008; Weladji, Moe, & Vedeld, 2003) also points to the hidden curriculum as a relevant intervention to IEE practices in schools. The hidden curriculum constitutes the unwritten, unofficial, unintended and unspoken academic activities and social messages and values that are communicated to students while they are in or out of school. The hidden curriculum is generally not an outcome of conscious intention because learning of EE is through incidental events which according to Conde and Sánchez, (2010) include code of conduct, the eco-vigilante rules of being careful with the hedges, use of bins, respect for the plants and willingness to participate in environmental issues.

In spite of the foregoing suggestions, Fullan (1999) notes in his eight new lessons about guiding change, that there is no single solution to change, but individuals need to craft own theories and actions as critical consumers. This study therefore aimed to substantiate the suitability of the strategies considered here and the contradictions raised in the reviewed literature (Filho, 1996; Conell [as cited in Rickinson, 2001]; Onder, 2006) to contribute to effective implementation of integrated environmental education in the Secondary School Curriculum in Machakos Sub-County.
2.3.8 Summary of the Reviewed Literature and Knowledge Gap

Based on the literature reviewed (Thang & Kumasamy’s, 2006; Kimaryo, 2011; Odege, 2009; Poddar, 2009; & Joaquin, 2008), it emerged that some of the current related studies cited here were exemplary, but many of them appeared to be based on methodologies that were either lacking in rigor or too poorly articulated. Weak methodologies raise serious questions relating to reliability and validity of study findings.

Similarly, while there was rapidly growing literature on integrated environmental education (Baaru, et al. 2010; Rocheleau et. al., 1995), no study had actually been done to investigate how integrated environmental education had been implemented over time and the outcome of such implementation in Machakos Sub-County. Despite the fact that EE is both a product and a process (Gough, Annette, & Gough, Noel in Kridel, Craig [Ed.] (nd), studies dealing with its implementation have also tended to be heavily influenced by its objectives (product) rather than by the course of action (process) intended to achieve the result. Information produced along these lines may not necessarily provide insight into the process of teachers’ and students’ engagement in environmental action in the Sub-County.

Besides, an analysis of environmental education studies conducted in the African schools indicated that 51.11% of the studies placed more emphasis on primary school programmes while only 48.89% focused on secondary school programmes (Ogunseitan, 2008). This trend witnesses an ever-widening gap of environmental education studies pursued by researchers between primary and secondary schools. Yet, secondary school students are at a different age bracket and they interact with specific EE content under different contexts and therefore require equal emphasis. This study therefore investigated the implementation of integrated environmental education in the secondary school.
curriculum for managing environmental degradation in Machakos Sub-County. Specifically, the study aimed at finding out how educators implemented integrated environmental education in the secondary school curriculum and challenges faced to propose strategies for enhancing an education that will alleviate environmental degradation in Machakos Sub-County.
CHAPTER THREE
DESIGN AND METHODOLOGY

3.1 Introduction
This chapter focuses on the methodology used in this research. The chapter covers location of the study; research designs; target population; sample and sampling procedures; data collection instruments; data collection procedures and data analysis procedures to address the research problem stated in Chapter One.

3.2 Locale of Study
This study investigated implementation of integrated environmental education (IEE) in the secondary school curriculum for managing environmental degradation. The study was conducted in Machakos Sub-County. The Sub-County is located 64 kms South East of Nairobi city (Appendix A). The Sub-County is surrounded by a horse-shoe shaped ridge of hills namely, Iveti, Mua, Kyamwilu, Kiima Kimwe and Kyamutheke all flanking Machakos town (Appendix B). The wet rural hill slopes are predominantly inhabited by the Akamba community who derive their livelihood from environmental consumer services; disposal services and productive/economic services. As a result resources have been exploited indiscriminately. In view of the fragility of the ecosystems, environmental degradation is now rampant in the Sub-County.

Out of the eight sub-counties of Machakos County (Masinga, Yatta, Kangundo, Kathiani, Mavoko, Mwala, Matungulu and Machakos) Machakos Sub-County was thus selected for this study because it has diverse landscape, varied climate and wide-ranging environmental problems including great gullies (Appendix D) attesting to the bad state of the environment that attracted immediate concern. The study also drew inspiration from landmark events such as those illustrated in appendices E and F in which Moi the
then president of Kenya was shouldering enormous boulders, placing them in the gabions in effort to conserve soil at Mwanyani area of Machakos Sub-County. The Sub-County therefore is a rational location for the study because land use change triggered by socio economic and environmental factors merits urgent attention.

Additionally, the study coincided with the devolution of the Kenyan administration from the national level down to the sub-county level. Therefore it would be important to establish how the new political dispensation at the sub-county level coped with the implementation of integrated environmental education in secondary schools to alleviate environmental degradation. Similarly, the Sub-County was selected for study because of its easily accessible critical mass of secondary schools, secondary school teachers and form 4 students. These sources would provide rich data for the study.

3.3 Research Design

This study operated within a mixed research tradition as the third research paradigm in educational research (Johnson & Onwuegbuzie, 2004). Mixed methods research employs a combination of quantitative and qualitative approaches thus mixing the characteristics of both methods.

Within the overall mixed methods research paradigm, the study employed “equal-status concurrent triangulation strategy” symbolized as “QUAL + QUAN” (Creswell, 2012; Johnson & Christensen, 2004). “QUAN” and “QUAL” stand for quantitative and qualitative approaches respectively. Quantitative and qualitative approaches were engaged simultaneously in such a way that one data set (qualitative) clarified and built on the other data set (quantitative). Data from the two strands were analysed and harmonized at the level of comparison of results for the overall study thus adding richness to study
findings (Figure 10). Thus, the researcher reported the results for quantitative and qualitative data together in the discussion section of the study.

**Figure 10:** The “equal-status concurrent triangulation” strategy symbolized as “QUAN + QUAL”

1. “QUAN” and “QUAL” stand for quantitative and qualitative approaches respectively.
2. A plus sign ‘+’ indicate concurrent collection of data.

**Source:** Adapted from Wang (2006)

The rationale for mixing the methods was that when used in combination, quantitative and qualitative approaches complement each other and allow for more complete analysis (Ivankova, 2002). By combining different methods in one study, it is possible to understand the same event from various perspectives (Koo, 2009). Johnson and Onwuegbuzie (2004) further note that mixed methods can provide stronger evidence for conclusion through convergence and corroboration of findings and can cross-validate findings such that weaknesses of one kind of data are offset by strengths of the other kind.

The qualitative approach employed phenomenological design and the quantitative approach used the cross-sectional survey design. The cross-sectional survey design was preferred for this study because according to Cohen, Manion and Morrison (2007) it gathers data at a particular point in time on a one-shot basis, hence economical and efficient. Researchers choose to use surveys because the surveys rely on large scale data especially from questionnaires and therefore according to Alreck and Settle (as cited in
Wang, 2006) surveys are effective ways to obtain the required information from a large number of individuals.

Similarly phenomenological design was found ideal for this study because it described the situation under study deeply and accurately from the perspectives of those involved. The aim of phenomenology is to determine what an experience means for those who had the experience and are able to provide a comprehensive description of it to reveal how EE is implemented in schools (Kimaryo, 2011). According to Elder-Hurst (2012) the phenomenon of interest could be emotion, a relationship, organization, or culture. In this study, therefore, the phenomenon of interest was the relationship of school principals to implementation of the new crosscutting issue, EE in an already crowded curriculum.

School principals were therefore encouraged to share their lived experiences as they perceived them in their own voices and this was used to understand how they implemented the integrated curriculum in secondary schools. The reason for phenomenological design was purely pragmatic as the respondents who directly participated and therefore experienced the actual implementation of the IEE programme could vividly relate their lived practice.

3.4 Target Population

This study targeted all the sixty four (64) public secondary schools; all the sixty four (64) public secondary school principals; all the seven hundred twenty four (724) public secondary school teachers (358 male & 426 female) and all the four thousand and thirty (4030) form 4 students in the Sub-County (Courtesy of the Deputy DQASO, Machakos Sub-County). Data was also collected from four (4) KICD officers in Nairobi County. Additionally, the study targeted Chemistry, Biology, Geography and History subjects.
Form 4 students studying Chemistry, Biology, Geography and History were targeted because they had already made their subject choices and had stabilized on them and hence were more versed with challenges faced in implementation of IEE than the other students. Besides, form 4 students could also be used to verify the information given by teachers. The study settled for the four (4) subjects, Chemistry, Biology, Geography and History because they carried IEE topics that were under investigation. These subjects were also used demonstrate how environmental education had been integrated into the secondary school curriculum.

Teachers handling Chemistry, Biology, Geography and History at form 4 levels were targeted because of their role in implementing IEE in the mentioned carrier subjects. Similarly, the study targeted teachers because their pedagogies in environmental education might have had some influence on their perceptions and their attitudes toward integration of EE in the school curriculum. Secondary school principals were targeted because as Fullan (2007, p. 74) notes, they have always been the “gatekeepers” of change, often determining the fate of innovations. Secondary schools were targeted because they represented big human concentration points and would guarantee readily available respondents who were directly and immediately involved in the implementation of IEE in the school curriculum. The KICD officers were targeted because they were expected to be rich in IEE related information and as initiators of the integrated environmental education (IEE) programme, their understanding of IEE and the challenges and strategies for implementing it in secondary schools was critical.

3.5 Sample Design

To select the respondents, both probability and non probability sampling designs were used in tandem with the mixed methods paradigm that underpinned the study.
Probability sampling designs thus stratified and simple random sampling were employed in sampling of secondary schools, teachers and students.

On the other hand non probability sampling designs, specifically purposive sampling, proportionate sampling, snowball sampling and criterion case sampling techniques were used to sample school principals and KICD officers.

3.6 Description of Sample and Sampling Procedures

A sample is a subset of a larger population. Sample size refers to the number of respondents who complete a survey (IEEE, 2012). Sampling procedure therefore is a process of specifying the size of a sample on the basis of specified rules. Conroy (n.d) cautions that sample size is an important issue in research because unrepresentative sample would result in biased conclusions.

Scholars do not seem to agree on a common sample size that can be drawn from the target population. Israel (2012) argues that if descriptive statistics are to be used, nearly any sample size will suffice. Cohen, Manion & Morrison (2007) argue that “a sample size of thirty (30) is held by many to be the minimum number of cases if researchers plan to use some form of statistical analysis in their data” p.101 According to Krathwohl (1998 p.161) “If the units are identical, a sample of one tells the nature of the population.” Therefore the most important consideration in determining the sample is not so much dependent on its size but on its representativeness.

3.6.1 Sampling of Secondary Schools

Based on the guideline (Cohen, et al, 2007), the researcher sampled 30 schools from a target of 64 public secondary schools. Out of the sample size of 30 public secondary schools, all the six (6) public boys and all the six (6) public girls’ secondary schools were picked for the study because they were few. Mugenda and Mugenda (2003) state that if the target population is so small that selecting a sample is meaningless, the
researcher can take the whole population. The remaining 18 were therefore mixed secondary schools (Table 2). One (1) public secondary school was purposively selected for pilot testing of the research instruments and the pilot data were not included in the results of the actual study. According to Wang (2006), one needs to select a sample from which one can learn the most about central issues with respect to the purpose of the inquiry.

3.6.2 Sampling of Secondary School Principals

According to Creswell (2007) and Mertens & McLaughlin (2004), the appropriate number of participants for phenomenological research is 6 to 10 participants. For this study, secondary school participants were used for phenomenological study and therefore a sample size of 12 principals was appropriate (Table 2). Cohen, Manion & Morrison (2007) assert that “The larger the sample, the greater is its chance of being representative” p.103 The 12 secondary school principals from the 30 secondary schools were selected proportionately in the ratio of 6: 6: 18 thus 1:1:3 which translated to approximately 3 principals from public boys’ secondary schools; 3 principals from public girls’ secondary schools and 6 principals from public mixed secondary schools.

One principal was then purposively selected at the research site on the criterion of having experienced the inception and sustained implementation of IEE in the secondary school curriculum. Snowball sampling (i.e., chain sampling) was then used for selection of other principals for inclusion in this study. However, their inclusion was based on the criterion (criterion sampling) that they had been school principals at high school during the inception (2002) and sustained implementation of IEE in the secondary school curriculum. According to Creswell (2007), criterion sampling was used to identify participants based on whether or not they met the specific criteria for the study. In spite of this, Lincoln and Guba (1986) advise that the researcher reserves the right to add persons
based on their potential to add insight or expand a theory. Both male and female principals were used for this study.

3.6.3 Sampling of Secondary School Teachers

According to The Research Advisors’ (2006) table (Appendix M) a sample size of 250 teachers out of 724 teachers was reached at 95% confidence level and 5% margin of error (precision level). The 250 secondary school teachers from (6 public boys, 6 public girls and 18 public mixed) secondary schools, were selected proportionately in the ratio of 6: 6: 18 thus 1:1:3 which translated to 50 teachers from the 6 public boys’ secondary schools; 50 teachers from the 6 public girls’ secondary schools and 150 teachers from the 18 public mixed secondary schools.

Eight (8) teachers from each secondary school divided by the four (4) carrier subjects (chemistry, biology, geography and history) yielded 2 teachers per subject per school. Stratified and simple random sampling techniques were then used to select the two (2) teachers per subject for study. Stratification was based on gender and the subject taught by the teachers. Names of the teachers from each identified subject were written on pieces of paper and folded not to expose them. The papers were thereafter folded and put into a container and shuffled thoroughly to ensure equal chances of being picked. Once a maximum of 2 names, one male and one female were blindly picked, they represented a sample size of 2 teachers per identified subject. The total number of teachers from public secondary schools who were to fill the questionnaire were therefore (2 teachers x 4 subjects x 30 secondary schools) translating to 240 teachers (Table 2).

3.6.4 Sampling of Form Four Students

To sample the students, The Research Advisors (2006) table (Appendix M) was used. According to the table, out of 4030 form four students, a sample size of 357 (approximately 360) was reached at 95% confidence and 5% margin of error (precision
The 360 form four students were selected proportionately in the ratio of 6: 6: 18 thus 1:1:3 which translated to 72 students from the 6 public boys’ secondary schools; 72 students from 6 public girls’ secondary schools and 216 students from the 18 public mixed secondary schools. Twelve (12) students from each school divided by the four (4) carrier subjects (chemistry, biology, geography & history) yielded three (3) students per subject.

For public boys and public girls schools stratified random sampling technique was used to select the students. The stratification criterion was the four subjects that the students studied. In each public secondary school, class lists for each form four stream were obtained. Names of all form four students studying each of the subjects, chemistry, biology, geography and history were written on pieces of paper and folded not to expose them. The folded pieces of paper were placed into separate containers according to respective subjects and thoroughly shuffled to ensure equal chances of being picked. Once a maximum of 3 names of form four students per identified subject were blindly picked the sample size was established.

For public mixed secondary schools, proportionate stratified random sampling technique was used to select the students. The stratification criteria were sex and the four subjects that the students studied. To arrive at 3 students per subject each stratum of form four girls and form four boys provided a proportionate number of students relative to each entire sex in the class. From each sex stratum random selection was then carried out until the sample size of 3 students per subject was achieved.

The total number of students from public secondary schools who were to fill the questionnaire therefore translated to (3 students x 4 subjects x 30 secondary schools = 360 students) (Table 2).
3.6.5 Sampling of Kenya Institute of Curriculum Development (KICD) Officers

Purposive sampling technique was used to select the four (4) KICD officers (Table 2). Officers in charge of the potential subjects that carried IEE topics thus chemistry, biology, history and geography were purposively picked on the basis of the subject that each officer was in charge of at the work station. Each officer was purposively picked because the researcher was assured of the officer’s knowledge and experience with curriculum development and curriculum implementation in the respective subjects. Bryman (2012) argues that purposive sampling targeted accessing informed people who had in-depth information about a particular issue by virtue of their experience or expertise.

Table 2
Sampling Matrix

<table>
<thead>
<tr>
<th>Category</th>
<th>Population</th>
<th>Sample Size</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schools</td>
<td>64</td>
<td>30</td>
<td>47</td>
</tr>
<tr>
<td>Boys’ secondary schools</td>
<td>6</td>
<td>9.4</td>
<td></td>
</tr>
<tr>
<td>Girls’ secondary schools</td>
<td>6</td>
<td>9.4</td>
<td></td>
</tr>
<tr>
<td>Mixed secondary schools</td>
<td>18</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Principals</td>
<td>64</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>Teachers</td>
<td>784</td>
<td>240</td>
<td>31</td>
</tr>
<tr>
<td>Form 4 students</td>
<td>4030</td>
<td>360</td>
<td>9</td>
</tr>
<tr>
<td>KICD officers</td>
<td>4</td>
<td>4</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Field Data, Courtesy of the Deputy DQASO, Machakos Sub-County, 2016
3.7 **Description of Research Instruments**

The descriptive function of research is heavily dependent on instrumentation for measurement and observation (The Association for Educational Communications & Technology, 2001). According to Best & Kahn (as cited in Koo, 2009, p.82) data for research could be gathered by “observation, interviews, questionnaires and recorded data”. This study employed questionnaires, interview guides, document analysis schedule and observation guide to address the six research questions set down in chapter one. The questionnaire and interview guide had related questions. The instruments were explained in details as follows:

3.7.1 **Questionnaire**

The questionnaire was used for collection of data from secondary school students and teachers in Machakos Sub-County. The questionnaires were used because they could be administered to many people with reasonable ease and cost. With questionnaires the respondents would not disclose their names and therefore they were likely to offer honest responses since confidentiality and anonymity were to be guaranteed. The questionnaire was widely used and it was found a useful instrument for collecting survey information, providing structured, often numerical data and being able to be administered without the presence of the researcher (Cohen, 2008). Additionally, Kombo and Tromp (2006), observe that a questionnaire is an instrument that gathers data over a large sample. Empirical studies in general education have utilized the questionnaire technique to examine implementation issues as well as factors contributing to teachers’ resistance to curriculum implementation (Wang, 2006).

Actual data collection on questionnaires employed concurrent mixed method strategies by which each research topic had a specific set of structured questions which were followed by semi-structured questions at later stages.
3.7.1.1 Questionnaire for Teachers

The teacher’s questionnaire (Appendix G) was structured into 9 sections. These comprised Section I: informed consent for the research participant; Section II: background information; Section III: the extent to which the curriculum for secondary schools integrated environmental education (EE) and the strategies that teachers used to clarify the vision for integrating EE in the curriculum (clarity); Section IV: teacher’s perceptions of the integrated environmental education in the secondary schools curriculum (need/relevance); Section V: levels of environmental literacy of secondary school teachers (complexity); Section VI: support that teachers required to implement integrated environmental education related topics in the secondary school curriculum (quality & practicality); Section VII: instructional approaches that secondary school teachers used to teach integrated environmental education topics; Section VIII: Challenges faced in implementation of integrated environmental education in the secondary school curriculum in Machakos Sub-County; IX: Strategies that were suggested to address the challenges.

3.7.1.2 Questionnaire for Students

The student’s questionnaire (Appendix H) was structured into 9 sections. These comprised Section I: informed consent for the research participant; Section II: background information; Section III: the extent to which secondary school curriculum integrated environmental education (EE) and the strategies that students used to clarify the vision for integrating EE in the curriculum (clarity); Section IV: student’s perceptions of the integrated environmental education in the secondary schools curriculum (need/relevance); Section V: levels of environmental literacy of secondary school students (complexity); Section VI: support that students required to implement integrated environmental education related topics in the secondary school curriculum (quality &
practicality); Section VII: instructional approaches that secondary school teachers used to teach integrated environmental education related topics; Section VIII: Challenges that faced implementation of integrated environmental education in the secondary school curriculum; and Section IX: Strategies that were suggested to address these challenges.

3.7.2 Interview Guides for KICD Officers and Secondary School Principals

This study employed semi-structured interview guides (Appendices I and J). According to Cohen, Manion and Morrison, 2007(as cited in Patton 1980) an interview guide approach is one in which topics and issues to be covered are specified in advance, in outline form. Interviews could be the best way of collecting high quality data and as Marshall (2016) observes the interviewer could probe for explanations of responses. Kerstin Becker & UBA-Team (2011) further observe that ... interviews are convenient for the respondents, especially in their residences or work places.

The interviews involved four (4) KICD officers in Nairobi and 12 principals in Machakos Sub-county. The interview guides covered 6 themes based on research questions set out in chapter one. Each interview commenced with starters on respondents’ past experiences with EE; extent to which environmental education (EE) was integrated in the secondary school curriculum; teachers’ perception of integration of environmental education in the secondary school curriculum; levels of environmental literacy of secondary school teachers; support that teachers required to implement integrated environmental education related topics in the secondary school curriculum; teachers’ instructional approaches to IEE; challenges that faced implementation of integrated environmental education in the secondary school curriculum and strategies that were suggested to address the challenges.

Semi-structured interview guides were used in this study because they enabled the researcher to bring to light the details to understand the respondents’ perspectives related
to the implementation process (Patton, 1987). The interviews were transcribed and stored in a retrievable form for subsequent analysis and report writing. After the interviews, the participants were thanked and requested for follow-up if it was necessary.

### 3.7.3 Documents Analysis Schedule

Document content analysis is a systematic procedure involving a thorough examination, interpretation and evaluation of evidence in the written text (Bowen, 2009). Document analysis was an instrument of choice because it could give a quick review and impression of a programme without interruptions. Besides, it was an important component of triangulation to ensure research validity and reliability. For purposes of this study, subject syllabi were analysed because they expressed the expectations of teachers’ and students’ efforts to succeed in completing the course. Besides, subject syllabi defined how the teacher would teach a course and what types of materials were necessary for study. Additionally, syllabuses outlined the learning outcomes for students and served as a permanent record of official policy documents and therefore teachers would not be expected to deviate from them without a very good reason.

The present status of Environmental Education (EE) in the subject syllabi had its genesis in the National Policy of Education in which 'Protection of the Environment' was stated as a common issue around which the National Curriculum Framework (NCF) was woven. Efforts were made by the Kenya Institute of Curriculum Development, Ministry of Education to suitably integrate EE concepts into various subject syllabi intended for secondary school students.

According to this study the extent to which EE was integrated in the syllabuses was viewed as influencing teachers’ and students’ perceptions towards EE. Therefore measures need to be developed to determine the adequacy of infusion and quality of teaching and learning (Menon, n.d.)
This study therefore examined the official syllabuses of Chemistry, biology, geography and History to establish to what extent the identified EE aspects had been included. To do this, document analysis checklists were developed in which the major environmental topics were listed against each subject topic. Tallies were made each time an environmental topic was identified within the subject topic (Appendix K). The information obtained was then triangulated to provide confirmatory evidence of the information obtained from observation schedule, interview guide and from the questionnaires.

3.7.4 Observation Guide for Evidence of Environmental Improvement

Observation as a method of data collection entails planning and developing a structured observation schedule (Appendix L). The choice of observation schedule as a tool for collecting data aims at collecting live information from naturally occurring settings. By this, the researcher intended to seek evidence on students’ conservation of resources, promotion of environment aesthetics, executing environmental health practices and checking for visible pollution. The structured observation schedule was completed by the researcher at each study unit.

3.8 Pilot Testing of the Research Instruments

The research instruments were piloted in one public secondary school which was within the study population. Mugenda and Mugenda (2003) point out that 1% of the target population is representative enough for the pilot study. The purpose for piloting was to check for construct validity to ensure that the items in the instruments were appropriate and clearly stated to the respondents. The aim was to adjust inconsistencies arising from the questions, which would ensure that the instruments measured what they were intended to measure.
The pilot run involved 1 principal, 8 sampled teachers and 12 students selected from form 4. The pilot instruments were administered to the sampled respondents and data collected was analysed and interpreted. However the pilot findings were not included in the results of the actual study. Based on the critically examined feedback, the researcher identified and carefully reviewed illegible, inconsistent, ambiguous, confusing and sensitive items to improve clarity and format of the instruments but without compromising the intended content. The clarity of instruments’ content to the respondents was necessary so as to enhance validity.

3.9 Validity of the Research Instruments

Validity refers to the extent to which a measure adequately represents the underlying construct that it is supposed to measure (Bhattacherjee, 2012). An instrument measures what it is supposed to measure and performs as it is designed to perform (Biddix, 2009). In evaluating the validity of a research study, internal and external validity are relevant (McLeod, 2013). External validity refers to the extent to which the results of a study can be generalized to other settings (McLeod, 2013). On the other hand, internal validity to some degree concerns accuracy (Cohen, Manion & Morrison, 2007).

3.9.1 Internal validity of instruments

In this study, internal validity or credibility of instruments was ensured through content validity and face validity. Quantitative Methods in the Social Sciences (QMSS) e-Lessons (2012) assert that a valid measure should satisfy four criteria thus content validity (the extent to which a measure adequately represents all relevant elements of the desired “content domain”); construct validity (accuracy of measurement of intended intangible concepts); criterion validity (accuracy of a measure compared with another measure which has been demonstrated to be valid) and face validity (assessment of
whether a measure appears, on the face of it, to measure the concept it is intended to measure;

Face validity of instruments was therefore ensured by the researcher going over the items in the instruments and deciding for himself according to own subjective evaluation if the instruments adequately covered all content raised in the research questions and whether the questions were seen to measure what they were supposed to measure.

Similarly content validity of instruments were ensured by asking the opinions of curriculum practitioners. According to Chong (2012) content validity is usually established by content experts. Three lecturers in the Faculty of Education were signed up as experts to scrutinise the instruments for readability of the items, accuracy of language and for lack of ambiguities to enhance accurate interpretation. The experts thus refined the items to ensure that they accurately mirrored research questions and adhered closely to the intended focus. Feedback was later on used to revise the content of the instruments until all the items were ready for the main study.

Credibility for instruments collecting qualitative data was ensured through triangulation of instruments for data collection thus questionnaires, interview guide, document analysis guide and observation guide that were complementary with each other and helped to validate and enrich the results for the purpose of wider interpretation. According to Cohen, Manion and Morrison (2007) if, the outcomes of a questionnaire survey correspond to those of an observational study of the same phenomena, the more the researcher will be confident about the findings.

3.9.2 External validity or generalisability

External validity or generalisability is the extent to which the findings can be generalized to other settings. Establishing external validity for an instrument follows
directly from the degree to which a sample represents the population (Biddix, 2009). This school of thought conceptualizes validity as unbiasedness (Chong, 2012). External validity of the instruments for collecting quantitative data was therefore ensured by randomizing samples.

Conversely external validity or generalizability in naturalistic research is interpreted as comparability and transferability (Lincoln and Guba 1985). Comparability and transferability of instruments for collecting qualitative data particularly interviews were ensured through careful formulation of items so that the meaning was crystal clear. The researcher also asked unbiased probing questions and at the same time avoided asking leading questions. Besides, the researcher bracketed himself consciously not to allow own meanings and interpretations to interfere with the interviewees’ ideas.

Validity of observation schedules was ensured through the observer’s entry of data into the appropriate categories accurately. Besides, validity of document analysis schedules was ensured through the researcher’s keenness, capability and accuracy of collecting data in the field. According to Patton (1990), in qualitative research the researcher is the instrument thus the validity of the qualitative items depended on the skill, competence and effort of the researcher. Research is only as good as the investigator (Morse, Barrett, Mayan, Olson, & Spiers, 2002).

3.10 Reliability of the Research Instruments

Reliability is the degree to which the measure of a construct is consistent or dependable (Bhattacherjee, 2012). Does the instrument measure and perform reliably each time? (Walden University, 2016)
3.10.1 Internal reliability

Internal reliability is also referred to as internal consistency of a research instrument. According to Reynaldo & Santos (1999), internal consistency is the average correlation of items within a survey instrument itself. The most popular method of testing for internal consistency in the behavioural sciences is Cronbach’s coefficient alpha (Drost, 2011). The alpha or reliability index is expressed as a digit between 0 and 1. According to Stack Exchange Inc (2016) values of Cronbach's alpha are commonly described as follows:

- $\alpha \geq 0.9$ Excellent
- $0.7 \leq \alpha < 0.9$ Good
- $0.6 \leq \alpha < 0.7$ Acceptable
- $0.5 \leq \alpha < 0.6$ Poor
- $\alpha < 0.5$ Unacceptable

Similarly George & Mallery (2003, p. 231) described Cronbach's alpha by the rule of thumb as follows “$\geq .9$ – Excellent, $\geq .8$ – Good, $\geq .7$ – Acceptable, $\geq .6$ – Questionable, $\geq .5$ – Poor, and $< .5$ – Unacceptable”

The higher the alpha, the more the items probably measure the same underlying concept (Rector & Visitors of the University of Virginia, 2016). Therefore, to ensure internal reliability of questionnaires, Likert-type responses for teachers and students were subjected to reliability analysis using the SPSS software. The alpha provided an estimate of the internal consistency of the items under each construct as reported in tables 3 and 4.
Table 3
Cronbach Reliability Coefficients for Teachers’ Questionnaire

<table>
<thead>
<tr>
<th>Sections</th>
<th>Item</th>
<th>Sub-items</th>
<th>Reliability Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>III Curriculum Integration</td>
<td>6</td>
<td>i-vi</td>
<td>0.625</td>
</tr>
<tr>
<td>IV Teachers’ perceptions</td>
<td>7</td>
<td>i-vi</td>
<td>0.583</td>
</tr>
<tr>
<td>V Teachers’ Env. Attitudes</td>
<td>24</td>
<td>i-x</td>
<td>0.674</td>
</tr>
<tr>
<td>VI Support for Teachers</td>
<td>27</td>
<td>i-vii</td>
<td>0.799</td>
</tr>
<tr>
<td>VIII Challenges</td>
<td>30</td>
<td>i-xi</td>
<td>0.831</td>
</tr>
</tbody>
</table>

Table 4
Cronbach Reliability Coefficients for Students’ Questionnaire

<table>
<thead>
<tr>
<th>Sections</th>
<th>Item</th>
<th>Sub-items</th>
<th>Reliability Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV Students’ perceptions</td>
<td>9</td>
<td>i-vi</td>
<td>0.545</td>
</tr>
<tr>
<td>V Students’ Env Attitudes</td>
<td>24</td>
<td>i-x</td>
<td>0.646</td>
</tr>
<tr>
<td>VI Support for Teachers</td>
<td>27</td>
<td>i-vii</td>
<td>0.807</td>
</tr>
<tr>
<td>VIII Challenges</td>
<td>31</td>
<td>i-xi</td>
<td>0.810</td>
</tr>
</tbody>
</table>

Key: Env. - Environmental

While Motive Metrics (2016) points out that solid scientific instruments should have a Cronbach Alpha of at least 0.7 to obtain a satisfactory internal consistency; Zywno (2003) observes that lower thresholds are sometimes used in the literature. For instance according to Kerlinger (1998), the reliability of more than 0.5 is acceptable; 0.6-0.7 is good and 0.8-0.9 is excellent. Tuckman (1999) further asserts that alpha test reliability should be above 0.75 for achievement tests but only above 0.5 for attitude tests. It could be inferred from tables 3 and 4 that the computed reliability coefficients for teachers’ items were from 0.583 to 0.831 and for students’ items were from 0.545 to 0.810. According to Stack Exchange Inc (2016); George & Mallery (2003); and Kerlinger (1998) these coefficients were considered to be within the acceptable range of reliability.
and therefore the instrument can be used in the field of environmental education for data collection.

On the other hand dependability for instruments collecting qualitative data was ensured through triangulation of data. This multiple approach through using questionnaires, interview guide, document analysis schedule and observation guide enhanced the reliability of the results. Thus, teachers’ responses in the questionnaires were checked with students’ responses. Similarly data from questionnaires, interview guides, document analysis schedule and observation guides were cross checked for reliability.

3.10.2 External reliability

External reliability is concerned with the replication of the study (Zohrabi, 2013). A study is replicable when it is stable and therefore transferable. In this case consistence is not within an instrument itself but within a particular group of respondents. To ensure external reliability or replication, the researcher provided as much contextual details as possible by quoting the participants verbatim in association with their experiences with implementation of integrated environmental education in the secondary school curriculum. Therefore the instruments designed and tested in this study had been shown to be appropriate and accurate tools to obtain acceptable results.

3.11 Data Collection Procedures

The researcher gained access to the research site by obtaining an official introduction letter from the Faculty of Education, Department of Post Graduate Studies of the Catholic University of Eastern Africa to the National Commission for Science, Technology and Innovation. Once the research permit from the Commission was granted, it was passed on to the Director, KICD in Nairobi requesting him to allow the researcher
to collect data from the Institute. Likewise, the research permit was passed to the Machakos County Commissioner, who then recommended the researcher to the relevant line administrators requesting them to allow the study to be conducted in their respective units. Under their guidance, the researcher made arrangements with the respective sampled public secondary schools when to visit each of them in order to meet the relevant respondents to sign informed consent and then collect data. Meanwhile analysis of syllabuses of the four mentioned subjects for evidence of environmental topics had been done in advance (Appendix K).

3.12 Data Analysis Techniques

The study generated both qualitative and quantitative data. Before the data that was obtained from each instrument was analysed, it was edited to ascertain completeness and consistency of information. The Data was then organized according to respective research questions. Data was entered in the computer and coded. For each category of data, techniques for analysis were identified (Appendix N, Table of Research Method Matrix).

Quantitative data was analysed using simple descriptive statistics such as frequencies, percentages, means and standard deviations generated by the Statistical Package for Social Sciences (SPSS version 20). The findings were presented using visual devices such as graphs, charts, diagrams and tables. The SPSS version 20 was also used to test the hypotheses. Hypotheses were tested using independent samples T-Test and one way ANOVA. All hypotheses were tested at a minimum of .05 level of significance.

On the other hand, qualitative data was transcribed and analytical categories and themes from the statements of the respondents were established and analyzed using narratives (verbatim reports). The researcher’s observations were also directly interpreted and reported descriptively.
Data analysis process also included triangulation of information from related instruments to supplement quality of information. Based on key findings and further information from literature reviews, conclusions and recommendations were made for improvement.

3.13 Ethical Considerations in the Study

One may define ethics as a perspective for deciding how to act (David & Resnik, 2011). In this regard, to conduct oneself ethically is to take appropriate action in line with what is moral. According to Stefan (2010) ethical issues may arise throughout the research process and it is mandatory to address them properly during the planning stage.

Given that this study largely involved human subjects, it was guided by respect for truth, respect for persons and respect for democracy (Bassey, 1999). Consequently, no one was forced to take part in the study. In compliance with this consideration the researcher first gained access to research sites by obtaining an official introduction letter from the Faculty of Education, Department of Post Graduate Studies of the Catholic University of Eastern Africa. The permission request letter was then passed on to the National Council for Science and Technology, Ministry of Higher Education for the research permit. Once this was granted, the research permit was passed to the Director, Kenya Institute of Curriculum Development for permission to carry out interviews with the officers of the institute. To ensure confidentiality, the interviews were conducted in a place that the officers preferred.

Before the researcher conducted the study in the schools, permission was sought from the County Director of Education. The Sub-County officials were then served with the research permit and a permission letter from the County Director of Education to enter the schools and conduct the study. At each school, the Principal was furnished with
permission letters from Sub-County officials and an informed consent form for signing before the data collection commenced.

The researcher explained in detail the purpose of the study to the participants and that their role was voluntary and hence, they had the right to withdraw from the study at any time without any consequence to them. The participants were also requested to sign an informed consent to agree to take part in the study. A statement relating to informed consent was affixed to the relevant research instruments. Frankfort-Nachmias and Nachmias (1992) caution that informed consent is particularly important if participants are going to be exposed to any stress, pain, and invasion of privacy. Situations of tensions such as participants’ wishes to be taped or not to be taped were considered (Dönmmez, 2010).

Frankfort-Nachmias and Nachmias (1992) further underlined the need for confidentiality of participants’ identities. This study therefore employed strict measures to ensure that individuals’ names were not directly associated with the information obtained from them. The names of participants and those of the institutions to which they were attached were therefore disguised by labelling them pseudonyms. Questionnaires were also kept anonymous and confidential.

Besides, intellectual property was guaranteed through acknowledgement of scholarly works and own previous works. The researcher was also keen to recognize and abide by relevant institutional and governmental laws and policies while executing the study. The researcher therefore undertook special efforts to uphold these values as well as maintaining scientific integrity by avoiding misrepresentations of the collected data and steered clear of inducement of any nature to coerce participants to offer information related to the study.
CHAPTER FOUR
PRESENTATION AND DISCUSSIONS OF THE FINDINGS

4.1 Introduction

This chapter focuses on data presentation, discussion and interpretation of the findings on the implementation of integrated environmental education in the secondary school curriculum as a way of managing environmental degradation in Machakos Sub-County of Kenya. The chapter is divided into eight (8) sections. The first two (2) sections cover the response rate and demographic information of the respondents. The third to the eighth sections address the findings organized along six themes based on the six research questions. The themes are: integration of environmental education into the secondary school curriculum; teachers’ and students’ perceptions of integrated environmental education in the secondary school curriculum; levels of environmental literacy of secondary school teachers and students; support that teachers require to implement integrated environmental education topics in the secondary school curriculum; instructional approaches that secondary school teachers use to teach integrated environmental education; challenges that face the implementation of integrated environmental education in the secondary school curriculum and strategies that are suggested to address these challenges.

4.1.1 Response Rate

From a sample of 30 public secondary schools 24 (80%) of them participated in the study. From a sample of 360 student respondents, 229 (63.61%) responded, from a sample of 250 teachers 119 (47.60 %) responded; from a sample of 12 principals 10 (83%) responded and from 4 KICD officers 4(100 %) of them participated in the study giving an overall response rate of 74.84 %. Mugenda and Mugenda (2003) point out that 60 percent response rate is good and 70 percent is excellent. Therefore 74.84 % return
rate for this study was excellent for the researcher to carry out data analysis. The response percentage rates per type of school were summarized individually in figure 11:

![Figure 11](image_url)

**Figure 11: The percentage response rates per type of school**

As shown in figure 11, mixed schools registered the highest response at 60% while boys’ schools were at 13% excluding 7% who did not respond. The girls’ schools were the least represented at 7% while 13% did not respond. The researcher did not achieve 100% response rate for all categories of schools because some of them declined to participate in the study due to varied reasons. However this distribution of schools was not unexpected because the proportion of public boys 6 (20%) and girls 6 (20%) secondary schools was relatively lower than the proportion of public mixed 18 (60%) secondary schools. The proportion of public boys 2 (7%) and girls 4 (13%) secondary schools that did not participate in the study was relatively higher than that of public mixed 0 (0%) secondary schools that did not participate. This implied that comparatively, girls’ and boys’ schools were seemingly not as much of implementers of IEE as the mixed schools.
4.1.2 Questionnaire Return Rate

The study used a structured questionnaire to collect the primary data. Six hundred questionnaires were distributed to teachers and students in 24 public secondary schools. The researcher managed to collect data from 119 teachers and 229 students. The distribution of teachers and students who returned the questionnaires from each category of school is illustrated in figure 12 that follows:

![Figure 12: The percentage response rates per type of school](image)

From figure 12, teachers who returned the questionnaires from mixed secondary schools posted a higher percentage (68.10%) followed by teachers (20.20%) from boys’ secondary schools. Teacher respondents from girls’ secondary schools posted the lowest percentage (11.80%) of questionnaire return rate.

Similarly students who returned the questionnaires from mixed secondary schools (Figure 13) posted a higher (72.10%) percentage followed by student respondents (17.50%) from boys’ secondary schools. However, student respondents from girls’ secondary schools posted the lowest (10.50%) percentage. Students from mixed secondary schools registered a high questionnaire return rate because they enrolled more
students from the most popular urban and peri-urban catchments that constitute most of Machakos Sub-County.

Figure 13: Students who returned the questionnaires

4.2 Demographic Characteristics of Respondents

4.2.1 Gender of the Respondents

The study sought to establish the distribution of 119 teacher respondents and 229 student respondents by gender. Sex of the respondents was of particular importance to the researcher as it gave general information on who participated in the study. Gender was also considered important as it gave a clue on respondents’ environmental attitudes and whether these attitudes influenced the respondents’ implementation of integrated environmental education in the secondary school curriculum in Machakos Sub-County or not. To determine the respondents’ sex their bio data was collected by way of questionnaire and presented in figure14.
Figure 14: Percentage respondents by gender

As illustrated in figure 14, female teacher respondents were few (42%) compared to their male counterparts (58%). Although teachers’ gender response was varied, students’ gender was almost at the same level for males (49.30%) and females (50.70%). Overall, the findings indicated that there were apparently gender disparities among the respondents in the study and this could have affected their interpretation and implementation of integrated environmental education in the secondary school curriculum as it would be observed later on (ref environmental attitudes & participation p. 133 & 141)

4.2.2 Teachers’ Years of Professional Experience

Work experience was considered an important indicator of whether a teacher was well informed in his/her area of specialty or not. A study by Wang (2006) on implementation of English as a foreign language in China showed that teaching experience had a positive effect on teachers’ ability to implement the curriculum. This study therefore sought to investigate the teachers’ professional experience to establish if this affected their implementation of integrated environmental education in the secondary
school curriculum. Data on the 119 teachers’ years of professional experience was collected through questionnaire and summarized in percentage in figure 15.

**Figure 15 Teachers’ Years of Professional experience**

It could be inferred from figure 15 that most (48.70%) of the teacher respondents had been teaching for 1-3 years. Those with 4 –6 years constituted 11.80 % while those with 7 –10 years experience were represented by 9.20 %; 11-15 years by 2.50% and those between 16-19 years of experience made up 10.10% and the rest (17.60%) had been teaching for 20 years and above. These responses imply that the highest percentage 48.70% of secondary school teachers in Machakos Sub-County did not seem to have had enough experience for teaching integrated environmental education as they had a short stint (1-3 years) of professional experience and therefore not adequately informed on environment issues compared to only 17.60 % experienced teachers who had been teaching for 20 years and above.

The findings of this study parallel the observation by The Center for Public Education (2005) that research has also been consistent in finding positive correlations between years of teaching experience and higher student achievement. Martin (as cited in
Giallo, & Little, 2003) further argues that one possible explanation for the improvement in teacher self-efficacy is the notion that confidence developed through experience. Fullan (2006 p. 4) therefore advises that “If teachers are going to help students to develop the skills and competencies of knowledge-creation, teachers need experience themselves in building professional knowledge”

4.3 Teachers' Educational Levels

The researcher sought to determine how teachers’ levels of education affected their implementation of integrated environmental education. To determine teachers’ levels of education, they were asked to indicate against the options of the levels listed in the questionnaire. Figure 16 presents findings of the various educational levels of the 119 teachers who participated in the study.

![Figure 16: Teachers’ Educational level](image)

The highest percentage of teachers’ educational level was recorded by the Bachelors degree (69.70%) followed by the diploma level (17.60%). Masters degree level occupied only 10.10% while the doctorate degree level of education occupied a paltry 2.50%. However the diploma level at 17.60% was only covering for the shortage of teachers in science subjects. The low percentages (10.10%; 2.50%) of master and
doctorate degree levels respectively imply that teachers of IEE had not been keen on improving their professional skills and competence by pursuing higher level qualifications that could be crucial in implementation efforts of IEE.

The effectiveness of any curriculum implementation depends on the quality of teachers to translate the syllabus into practical instructional content in class. Ajayi (2015 p.191) asserts that “Teachers’ knowledge is central to any curriculum implementation effort” Fullan and Pomfret (1977 as cited in Wang, 2006 p. 250) found that teachers who received in-service training had a higher degree of implementation than those who did not. Research has shown that students of teachers who have greater academic ability perform better (The Center for Public Education, 2005).

4.4 Integration of environmental education into the secondary school curriculum

The intention of research question (i) was to establish the extent to which the content of environmental education (EE) was integrated in the secondary school curriculum in Machakos Sub-County. This was important because what was to be taught in terms of EE content and students’ consumption, comprehension, and retention depended on how much environmental education content was integrated in the curriculum. Kimaryo (2011, p. 167) asserts “If what is to be taught as environmental education is not prescribed in the syllabus, then it will not be taught” Additionally, the degree to which EE content was integrated into the official secondary school curriculum could demonstrate teachers’ and students’ priority or felt need for what they articulated, taught and learnt as EE. Fullan (1991, p. 69) notes that “many innovations are attempted without a careful examination of whether or not they address what are perceived to be priority needs.” Therefore measures need to be developed to determine the adequacy of infusion (Menon, 2016).
To determine the extent to which EE was integrated in the school curriculum, Likert-type items were constructed. The response options were on five-point scale in which the choices ranged from 1 to 5. Five (5) points were assigned to “strongly agree”, 4 points to “agree”, 3 to “undecided”, 2 to “disagree” and 1 to “strongly disagree”. Teachers and students therefore recorded their order of agreement and disagreement on various statements and their percentage (%) responses were entered in table 5. Means and standard deviations for teachers’ and students’ responses were also computed and recoded in table 6 that followed.
Table 5

Percentage of teachers’ and students’ responses on integration of environmental content in the secondary school curriculum (Teachers n=119; Students n= 229)

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>SA</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.  There are some environmental topics in the secondary school curriculum</td>
<td>43.70 1.70 49.60 1.30 1.70 2.20 2.50 33.20 .80 59.40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II. It easy to identify environmental education (EE) topics in some subjects you teach/learn</td>
<td>5.00 2.20 3.40 3.50 2.50 5.70 57.10 50.20 30.30 35.80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III. There is adequate coverage of EE in the subjects that you teach/learn</td>
<td>9.20 8.70 32.80 27.10 8.40 11.80 37.00 30.10 10.90 18.80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV. There is adequate coverage of EE in students’ activities outside the official class lessons</td>
<td>11.80 10.50 40.30 29.70 5.00 13.10 35.30 24.50 5.00 18.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V. Environmental Education is not suitable for integrating in some subjects</td>
<td>3.40 13.10 16.00 11.80 5.00 9.60 37.80 32.80 36.10 28.80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VI. Integrating environmental education in teaching and learning is stressful</td>
<td>2.50 4.40 8.40 9.20 8.40 7.90 38.70 34.10 40.30 40.60</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Key: T% = Teacher percentage S% = Student percentage

Source: Field data, 2017.
Table 6
Teachers’ and Students’ mean scores and standard deviations on integration of EE content

<table>
<thead>
<tr>
<th>Perception</th>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. There are some environmental topics in the secondary school curriculum</td>
<td>1.65 (.72)</td>
<td>1.50 (.77)</td>
</tr>
<tr>
<td>ii. It’s easy to identify environmental education topics in some subjects you teach</td>
<td>1.94 (.96)</td>
<td>1.83 (.86)</td>
</tr>
<tr>
<td>iii. There is adequate coverage of EE in the subjects that you teach</td>
<td>2.92 (1.24)</td>
<td>2.76 (1.29)</td>
</tr>
<tr>
<td>iv. There is adequate coverage of EE in students activities outside the official class lessons</td>
<td>3.19 (1.20)</td>
<td>2.89 (1.32)</td>
</tr>
<tr>
<td>v. Environmental Education is not suitable for integrating in some subjects</td>
<td>3.89 (1.17)</td>
<td>3.55 (1.39)</td>
</tr>
<tr>
<td>vi. Integration environmental education in teaching and learning is stressful</td>
<td>4.08 (1.04)</td>
<td>4.01 (1.14)</td>
</tr>
</tbody>
</table>

M= Mean; S=Standard deviation

Source: Field data, 2017.

From tables 5 and 6, the overall theme that ran through the findings was that there seemed to be some environmental topics in the secondary school curriculum but they were inadequately covered. For example as indicated in Table 5, when “strongly agree” and “agree” choices were evaluated together and disagree and strongly disagree were calculated collectively, the teachers’ responses on adequacy of IEE content coverage in the secondary school curriculum were consistently in agreement with the statements i, ii, iii, and iv in the order of 93.30 %; 8.40 %; 42% and 52.10 % respectively compared to students’ responses that were persistently low in the order of 3 %; 5.70 %, 35.80 % and 40.20 % respectively. Therefore teachers’ and students’ average responses (Teachers= 48.95%; Students=21.17%) indicated that integration of environmental content in the secondary school curriculum was generally below average (<50%) hence inadequate. The findings also suggested that it was difficult to identify EE topics in some subjects (teachers 87.40 %; M= 1.94 & students 86%; M=1.83) (Tables 5 and 6). However, when teachers were asked how they identified environmental education topics in the syllabus (Figure 17).
Figure 17: How to identify environmental Education topics from the syllabus

Twenty three point five per cent (23.50 %) of them indicated that they identified the topics because they were titled in the syllabus and 25.20% indicated that they used experience and applied knowledge to identify the topics. However, 3.40 % of the teachers indicated that environmental education topics were not there in the syllabus. Kimaryo (2011) points out that “Environmental education components which are to be taught in different topics are not shown clearly in the subject syllabi” p.39

The researcher further sought to establish whether teachers could detect environmental education topics stated as separate topics in their teaching subjects. Table 7 shows the findings.
As indicated in table 7, thirty three point six percent (33.60 %) of the teachers agreed with the statement that environmental education topics were stated as separate topics in the teaching subjects while majority (66.40 %) of the teachers disagreed. Kimaryo’s (2011) study conducted in Tanzania, indicated that “Although it is said that it is integrated into the content of all the subjects, the environmental education content is not stated clearly in most subjects, so it is left to the teacher to decide what to teach” (p.107)

Besides it was also established that EE coverage in out of class activities was inadequate (Teachers: M=3.19; SD=1.20 & Students: M=2.89; SD=1.33). This could have been as a result of students seemingly viewing those environmental activities as punitive. This observation concurs with Toili’s (2007) study on secondary school students’ participation in environmental action in Bungoma County. One of his major findings was that students participated in environmental action majorly because they were coerced into it particularly in their school environment. This is indicative of the limited integration of EE in the school curriculum.
Overall, while students’ responses towards integrated environmental education in the secondary school curriculum were lowest, most teachers’ responses were on the higher end. The explanation to this disparity in the findings was seemingly due to the teachers’ high experience on issues of curriculum interpretation hence capable to decipher EE content in the curriculum. However it would appear that students, who were not as experienced as teachers, were incompetent in making sense of EE content in the curriculum. This outcome concurs with Kearney’s (1999) study on teachers perceptions in Washington where the findings established that depth of participants’ conceptualizations of EE increased with increasing experience. The findings cast doubt on the popularity of integrating EE in the school curriculum. It seems this was a possible source of challenge to effective implementation of the IEE programme in the school curriculum.

However, these study findings accord with those put forward in the interviews with secondary school principals and KICD officers regarding the integration of EE in the subjects that were taught. One lady school principal remarked:

EE is integrated in the curriculum in subjects like Business studies and Home Science but it is not coming out easily.

Yet another male school principal commented:

For now nothing is clearly set out for integration of EE into the curriculum. Some teachers on their own integrate it and others don’t. Those who integrate do it only in the topics that may call for its mention.

Seemingly, these statements were a pointer to the fact that adequacy of EE coverage in the curriculum was lacking. In spite of this, teachers and students seemed to show interest in integrating EE in the curriculum by pointing out that integrating it in teaching and learning was suitable (Teachers 73.90 %; Students 61.60 %) and less stressful (Teachers 79%; Students 74.70 %).
Guided by the questionnaire item “Which EE topics would you like to see addressed in the secondary school curriculum” Teachers’ and students’ responses to the question were recorded in figures 18 and 19.

![Pie chart showing teachers' suggestions on EE topics]

**Figure 18: Teachers’ suggestions on which EE topics to be addressed in the secondary school curriculum**

From figure 18, 45.40% of teachers suggested environmental pollution and environmental degradation to be addressed in the curriculum while 43.70% recommended integration of environmental conservation. On the other hand only 7.60% of teachers suggested integration of climate change. A few (1.70%) of teachers recommended integration of HIV& AIDS and the remaining (1.70%) of teachers recommended further increase in EE content suggesting that the EE content was inadequate in the current curriculum. With reference to the literature reviewed (Baaru, Gachene, Onwonga, Mbuvi & Gathaara 2010; Biscomm Consultants, 2014; & United Nations, 2015), strong pressure exerted by land degradation and climate change on the environment in Machakos Sub-
County might have pushed teachers to suggest inclusion of environmental education topics in the school curriculum. Ünal (2008) observes that related literature showed that people mostly concern themselves about the environmental issues that affected their daily lives.

Students’ responses to the same item “Which EE topics would you like to see addressed in the secondary school curriculum” were recorded in figure 19.

![Figure 19: Students’ suggestions on which EE topics to be addressed in the secondary school curriculum](image)

From figure 19, 28.40% of the students suggested the integration of environmental conservation into the curriculum. Only 3.50% suggested the integration of growth and development and the remaining 2.20% recommended integration of HIV & AIDS into the secondary school curriculum. The underlying reason for a larger percentage (65%) of students’ who did not respond to the item “Which EE topics would you like to see addressed in the secondary school curriculum” was probably due to inadequacy of opportunities for them to discuss and familiarise themselves with local environmental issues in their curriculum. This is in accordance with the scholarly
argument advanced by Ünal (2008) that focusing on local environmental issues is an important dimension for effective EE applications.

Recognising that integration of EE in the formal school system is flexible with many existing innovative channels, teachers were asked to suggest other best ways of integrating EE in the school curriculum. Figure 20 illustrates the findings.

**Figure 20: Teachers’ suggestions on other best way for integrating EE in the school curriculum**

From figure 20, one can gather that integration of EE in subjects or syllabus had the highest (48.31%) percentage followed by introduction of EE as an independent subject (46.07%). Teaching EE during free lessons posted 2.25% and teaching EE during field excursions recorded the same percentage (2.25%). Training teachers as a way of integrating EE in the school curriculum registered an insignificant percentage of 1.12 %. In general, it has been shown that majority of teachers could at least suggest in what other ways EE could be integrated in the school curriculum. This finding is an indication that participating teachers were aware of and demonstrated support for the integration of EE in the secondary school curriculum. The findings are consistent with Jekayinfa, &Yusuf’s (2008) Nigerian study on teachers’ opinions on incorporation of environmental education
in the Nigerian primary school curriculum which demonstrated that teachers were aware of the incorporation of EE in the curriculum and they had been teaching it. However, it would seem that marginal percentages representing those teachers who suggested that EE be integrated in learning only during free lessons and during field excursions accorded EE a low status in curriculum probably because it was not being examined externally and therefore it did not have to be taught effectively. The analysis of the results ties in with Kimaryo’s (2011) Tanzanian study whose results revealed that teachers were of the opinion that effective teaching would depend on whether the subject was examined or not.

Teachers’ suggestion of being trained in integrating EE in the school curriculum was a promising step for integration of environmental issues into formal education. Sharing this view Michele (nd) citing Brenda Weiser, p.7 argues that “The really big bang for the buck will be when environmental education, like technology, is infused into every pre-service program and every special program area.” This would save the situation of retooling teachers while on the job.

Apart from teachers, the students were also asked ‘which was the best way of integrating EE into the school curriculum?’ Students’ responses to the questionnaire item were presented in figure 21.
Figure 21: Students' suggestions on the best way of integrating EE into the school curriculum

As shown in figure 21, introduction of EE in the school curriculum through the syllabus posted 47.37% followed by Guidance and counseling (28.95%), then group discussion (17.11%). Training of teachers recorded the lowest (6.58%). A critical observation of the result demonstrated that students were aware of the various ways of integrating EE into the school curriculum. Sharing a common view with the teachers, most of the students suggested that integration of EE would be through the syllabus or the subjects that the students learned. The implication of this was that EE content could be woven into every subject content that the teacher taught. Kimaryo (2011) contends that “if environmental education is included in these subjects, it will be easy to teach because
the teachers have the knowledge and making sure that it is taught, because teachers will not skip it” pp.115-116)

The second most suggested approach to integration of environmental education into the school curriculum was through guidance and counselling. Green positive guidance and life counseling are associated with connectedness to nature (Di Fabio & Bucci, 2016). The close association between connectedness to nature and empathy suggests that individuals sensitive toward other people could also be sensitive toward nature (Di Fabio & Bucci, 2016). This suggests that if students were positively counselled, they would be sympathetic with nature and therefore responsive to it. This would be an innovative approach to integration of EE into the school curriculum but it would require highly trained personnel to execute the mandate.

Students further recommended use of group discussions as the other strategy for integration of EE into the school curriculum. It is likely that the students who suggested group discussions were those who preferred group therapy as a style of learning. To such students learning EE would be best by using group activities or social events such as debates, music, drama, school publications, school clubs, contests, sports and peer tutoring to examine social environmental issues such as climate change and land degradation among others. Through such social events students help each other to understand environmental problems. Social activities would also be used to supplement the curriculum with experiences which could not be possible in regular classroom settings. For example according to Romano, Papa and Saulle (2016), while drama allows students to make sense of their ‘real’ life problems it is also fun. Fun is learning, and learning is fun (Romano, et al., 2016)

Students also seemed to be of the opinion that training teachers would be a worthwhile channel for integration of EE in the school curriculum. A study by Jekayinfa
and Yusuf (2008) on teachers’ opinions on incorporation of environmental education in the Nigerian school curriculum established that teachers were instruments through which EE could be taught for its objectives to be realized. In view of this, orienting teachers on EE concepts would reduce the challenges that teachers face when integrating EE in the school curriculum. This is in accordance with the scholarly argument attributed to Michele (nd) that the most workable approach to expanding environmental education for tomorrow’s teachers is to integrate it into existing pre-service education courses. This would cut down on costs of mounting refresher courses, seminars and workshops on new EE innovations such as integration procedures. Overall study findings demonstrate that teachers and students in Machakos Sub-County were aware and could identify alternative strategies for integrating EE in the school curriculum.

The study further sought to investigate the distribution of 119 teacher respondents and 229 student respondents on subjects taught and learned in secondary schools to establish those subjects that could present opportunities for integration of environment education. Figure 22 illustrates the percentage response of teachers and students on the issue under discussion.
It could be inferred from figure 22 that teachers presented Geography (32.80%) and Chemistry (29.90%) as the most popular subjects and mathematics as the least (2.50%) popular. On their part, students pointed out that Chemistry (24.90%) was the most popular subject while Mathematics (0%) was least mentioned. Generally the findings imply that Geography and Chemistry were more popular with the respondents and would seemingly be the best choices for hosting more integrated environmental education content compared to Mathematics.

The researcher also triangulated information on the extent to which environmental education (EE) was integrated in the secondary school curriculum by carrying out document analysis. According to Elder-Hurst (2012), document analysis is the systematic examination of documents in order to identify needs and challenges within the research phenomenon that is being studied. Therefore the EE content in the syllabi of four host subjects, thus Chemistry, Biology, Geography and History was analysed. The aim was to
ascertain the extent to which environmental education component had been integrated in the syllabi in compliance with the goals of environmental education as agreed at the Tbilisi Conference (1977). The study therefore concentrated on content analysis of the following aspects of EE in the syllabi: waste management, agro-forestry, water & sanitation, food security, and finiteness of resources, materials cycles, health, population, land degradation, pollution, climate change, gender, poverty, conflict resolution, violation of human rights and cooperation. Topical analysis of Environmental education in the Chemistry syllabus was illustrated in (Figure 23).

![Figure 23: Environmental topics in the Chemistry Syllabus](image-url)

It could be inferred from figure 23 that the most integrated EE topics in Chemistry were waste management (30%), materials cycles (18%) and pollution (15%). The least prevalent topics reported were climate change (4%), agro forestry (0.50 %), population (0.25%) and conflict resolution (0.25%). The syllabus showed four more EE topics that
were not specifically addressed. These topics were land degradation 0 (0%), gender 0 (0%), poverty (0%) and cooperation (0%). Generally, it has been shown that EE topics do not cut across all the Chemistry topics and that the percentage integration of the EE topics in the Chemistry syllabus was also generally low, ranging between 0% and 30%.

Analysis of the Biology syllabus (Figure 24) pointed out that the most frequent EE topics that were integrated in Biology included health (28%) and materials cycles (18%). The least prevalent of the topics reported was climate change (5%). The syllabus reported two more topics that were not specifically addressed in the Biology syllabus. These topics were land degradation (0%) and conflict resolution (0%). In general, it has been shown that EE topics do not cut across all the Biology topics and the percentage integration of EE topics in the Biology syllabus was generally low, ranging between 0% and 28%.

Figure 24: Environmental topics in the Biology Syllabus
Analysis of the Geography syllabus is illustrated in figure 25.

Figure 25: Environmental Education topics in the Geography Syllabus

The most prevalent EE topics in the Geography syllabus were climate change (8.80 %), violation of human rights (7.50 %), population (7.40 %), poverty (7.30 %), land degradation (7.20 %) pollution (7.10 %), cooperation (6.60 %) and health (6.40 %). The least prevalent topic reported was Gender (2.90 %). The analysis also revealed that EE topics generally cut across all the Geography topics although the percentage integration of the topics in the Geography syllabus was generally low ranging between 2.90 % and 8.80 %.

The most prevalent EE topics in the History syllabus (Figure 26) that follows, were, health 39 (8.70 %), materials cycles 38 (8.40 %), cooperation 38 (8.40 %), Population 34 (7.60 %), Land degradation 34 (7.60 %), Pollution 34 (7.60 %), Poverty 34 (7.60 %), and climate change 32 (7.10 %). The least prevalent topic reported was gender 12 (2.70 %).
In general, it has been shown that EE topics do not cut across all the History topics and that the percentage integration of the EE topics in the History Syllabus is also generally low, ranging between 2.70% and 8.70%.

Analysis of all the four syllabi showed that the coverage of EE topics was limited (< 50%) yet teachers would not be expected to deviate from what is in the official school syllabi without very good reasons. The analysis also showed that the coverage of EE topics in the Geography and History syllabi was not as scattered (range 3% to 9%) for example in Chemistry and Biology syllabi (range 0% to 30%). In all the four syllabi, the most prevalent EE topics integrated was materials cycles (18%) in the Chemistry syllabus, 18% in the Biology syllabus and 8% in the History Syllabus.

Among the least prevalent EE topics in all the four syllabi were climate change (4%) in the Chemistry syllabus and 5% in the Biology syllabus. Gender was reported at 3% in the Geography syllabus and 3% in the History syllabus.

**Figure 26: Environmental Topics in the History Syllabus**

In general, it has been shown that EE topics do not cut across all the History topics and that the percentage integration of the EE topics in the History Syllabus is also generally low, ranging between 2.70% and 8.70%.

Analysis of all the four syllabi showed that the coverage of EE topics was limited (< 50%) yet teachers would not be expected to deviate from what is in the official school syllabi without very good reasons. The analysis also showed that the coverage of EE topics in the Geography and History syllabi was not as scattered (range 3% to 9%) for example in Chemistry and Biology syllabi (range 0% to 30%). In all the four syllabi, the most prevalent EE topics integrated was materials cycles (18%) in the Chemistry syllabus, 18% in the Biology syllabus and 8% in the History Syllabus.

Among the least prevalent EE topics in all the four syllabi were climate change (4%) in the Chemistry syllabus and 5% in the Biology syllabus. Gender was reported at 3% in the Geography syllabus and 3% in the History syllabus.
Besides, analysis of the syllabi indicated that some EE topics were commonly omitted. The most frequently missing EE topic particularly in the Chemistry and Biology Syllabi was land degradation which posted 0%.

The least prevalent of EE topics and the most frequently missing in all the four syllabi were climate change and land degradation. This is problematic because environmental problems associated with these topics are the most common in Machakos Sub-County. A comprehensive portrayal of the percentage coverage of EE topics in the four subjects is demonstrated in figure 27.

**Figure 27: Integration of EE topics in the four subjects**

Figure 27 shows that EE topics were integrated in all the four carrier subjects offered. However the syllabi were found to vary on the extent of integration of the topics. Among the 4 syllabi (Chemistry, Biology, Geography & History), Geography posted the highest coverage 862 (46%) of IEE topics followed by History 448 (24%) and Chemistry 403 (21%). Biology was placed last with only 161(9%). The Social Studies subjects (Geography & History) combined contained more 1,310 (70 %) environmental education topics in the school curriculum than the science subjects (Chemistry & Biology) which
covered only 30%. This finding is aligned with Kimaryo’s (2011) assertion that environmental education is built in the school curriculum, although some subjects had more environmental content than others. The finding is also highly consistent with Verma and Kumar (n.d), and Bhawalkar’s (2003) analysis of school syllabi in context of environmental education in India found that environmental contents had the lowest value in the Hindi subject in comparison to science.

The way integrated environmental education topics are unevenly distributed in the curriculum raises misconceptions amongst teachers and students. The majority of them would think that environmental issues are more related to the social studies subjects (Geography & History) hence reducing its crosscutting nature to other fields especially the science subjects (Chemistry & Biology). This result seemingly dumped down the motivation for and effectiveness of implementation of integrated environmental education by both teachers and students.

The results reported here therefore provide clear empirical evidence that the research question “To what extent is environmental education (EE) integrated in the secondary school curriculum in Machakos Sub-County?” has been reasonably addressed.

4.5 Teachers’ and Students’ Perceptions of Integrated Environmental Education in the Secondary School Curriculum

The purpose of the research question (ii) was to establish if teachers’ and students’ views on integrated environmental education in the secondary school curriculum affected the way in which they viewed and rated their involvement in implementation of integrated environment education. Perception was of particular importance to the researcher as it gave an indication on whether IEE was or was not worthy pursuance in curriculum implementation. Park and Sung (2013) contend that perceptions negatively impact involvement in and commitment to implementing reform. Hart (2003) shares this
view when he further asserts that teaching and learning are strongly influenced by the individual’s perception and action.

To measure teachers’ and students’ perceptions, quantitative data from 6 Likert-type items were presented. The response options for each item were on a five-point scale in which the choices ranged from 1 to 5. Five (5) points were assigned to “strongly agree”, 4 “agree”, 3 “undecided”, 2 “disagree” and 1 “strongly disagree”. Teachers and students therefore recorded their order of agreement and disagreement on various statements and their percentage (%) responses were entered in table 8.

Table 8
Percentage of teachers’ and students’ perceptions of the integrated environmental education (IEE) in the secondary school curriculum (Teachers n=119; Students n=229)

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>SA %T</th>
<th>A %S</th>
<th>U %T</th>
<th>D %S</th>
<th>T %T</th>
<th>S %S</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) The integration of EE into the school curriculum is a priority need</td>
<td>47.9</td>
<td>5.7</td>
<td>42.0</td>
<td>9.8</td>
<td>1.7</td>
<td>4.2</td>
</tr>
<tr>
<td>(ii) I understand environmental education concepts in the secondary curriculum well enough to effectively teach /learn them</td>
<td>21.8</td>
<td>4.4</td>
<td>47.9</td>
<td>9.6</td>
<td>5.9</td>
<td>8.3</td>
</tr>
<tr>
<td>(iii) I can design enhanced learning activities in environmental education for my students</td>
<td>16.0</td>
<td>5.7</td>
<td>54.6</td>
<td>10.0</td>
<td>9.2</td>
<td>12.6</td>
</tr>
<tr>
<td>(iv) Teachers receive training for integration of environmental education in their teaching</td>
<td>8.4</td>
<td>9.6</td>
<td>32.8</td>
<td>14.0</td>
<td>5.9</td>
<td>22.7</td>
</tr>
<tr>
<td>(v) Teaching/learning is more complex since EE was introduced in the school curriculum</td>
<td>8.4</td>
<td>23.1</td>
<td>11.8</td>
<td>25.8</td>
<td>15.1</td>
<td>11.8</td>
</tr>
<tr>
<td>(vi) Integrated EE often relies on motivated teachers to succeed</td>
<td>30.3</td>
<td>7.0</td>
<td>42.9</td>
<td>13.1</td>
<td>1.7</td>
<td>8.7</td>
</tr>
</tbody>
</table>

Key: SA=strongly agree, A= Agree, U= Undecided, D=Disagree, SD= strongly disagree,
T% = Teacher percentage S%=Student percentage Source: Field data, 2017

It is evident from table 8 that when “strongly agree” and “agree” choices were evaluated together and disagree and strongly disagree were calculated jointly, the
responses for teachers’ perceptions of IEE in the secondary school curriculum were consistently in agreement with the statements i, ii, iii, and vi in the order of 89.90 %; 69.70 %; 70.60 % and 73.20 % respectively compared to students’ perceptions that were in agreement with the statements in the order of 14.70 %, 14%, 15.70 %, and 20.10 % respectively. Therefore teachers’ and students’ average perceptions (Teachers= 75.85%; Students=16.12%) towards IEE in the secondary school curriculum indicated that while students held very low perceptions, most teachers were of the opinion that integrated environmental education was important.

Likewise, less than 50% of both teachers and students (49.60 %; 44.50 % respectively) were of the opinion that “Teachers receive training for integration of environmental education in their teaching” but this is only to a small extent and therefore integration of environmental education in their teaching is to a lesser degree. The data further demonstrate that while teachers disagreed (62.20 %) with the statement “Teaching/learning is more complex since EE was introduced in the school curriculum”, the students agreed (30.5%) with the statement implying that teachers in spite of everything continued to support integration of environmental education in their teaching while the students expressed a negative perception.

To enhance these findings, the mean and standard deviation values for teachers’ and students’ perceptions of IEE in the secondary school curriculum were computed. The data is highlighted in table 9
Table 9

Presents mean scores and standard deviations of each item on teachers’ and students’ perceptions of IEE in the secondary school curriculum

<table>
<thead>
<tr>
<th>Item</th>
<th>Teachers M</th>
<th>SD</th>
<th>Students M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Integration of EE into the school curriculum is a priority need</td>
<td>1.68</td>
<td>.90</td>
<td>1.74</td>
<td>1.01</td>
</tr>
<tr>
<td>ii. I understand environmental education concepts in the secondary curriculum well enough to effectively teach them</td>
<td>2.30</td>
<td>1.10</td>
<td>2.17</td>
<td>1.09</td>
</tr>
<tr>
<td>iii. I can design enhanced learning activities in environmental education for my students</td>
<td>2.31</td>
<td>1.01</td>
<td>2.28</td>
<td>1.12</td>
</tr>
<tr>
<td>iv. Teachers receive training for integration of environmental education in their teaching</td>
<td>3.20</td>
<td>1.33</td>
<td>2.68</td>
<td>1.25</td>
</tr>
<tr>
<td>v. Teaching is more complex since EE was introduced in the school curriculum</td>
<td>3.59</td>
<td>1.22</td>
<td>2.68</td>
<td>1.39</td>
</tr>
<tr>
<td>vi. Integrated EE often relies on motivated teachers to succeed</td>
<td>2.27</td>
<td>1.29</td>
<td>2.32</td>
<td>1.25</td>
</tr>
</tbody>
</table>

M=Mean  SD=Standard Deviation

The findings illustrated in table 9 show that on average teachers’ perceptions of IEE in the secondary school curriculum on the six statements were more positive (M=2.56) compared to average students’ perceptions which were only (M=2.31). The overall implication of these findings was that most teachers appeared to support the integration of EE in the school curriculum and they seemingly perceived that they had self efficacy of implementing it while most of the students appeared to have had a contrary view probably due to their low learner knowledge on integrated EE. A study by Ledden and Kalafatis (2010) related to perceptions found that learner knowledge influenced their perceptions. Perhaps the students needed additional knowledge and experience with integrated EE before they were ready to make judgment on the value that integrated EE holds for them and for environmental sustainability.

In spite of this, the support for integrated EE in the school curriculum by both the teachers and the students was weak (< M=3) demonstrating that teachers and students unsatisfactorily perceived EE as priority need in the school curriculum hence its low
implementation status. This was further ascertained by interviews with secondary school principals and KICD officers who revealed that the respondents were aware of and valued the need for EE to improve the quality of human life. However the principals lamented that they did not have any policy on EE in their schools to support this. They expected the Ministry of Education to provide the policy. The following excerpt from one lady principal demonstrates this view:

    My school has no policy on environmental education. There is need to have a policy from the Ministry of Education.

    But where policy was available in form of school vision and mission, it was translated into a mere intention that was not implemented. For example in one mixed secondary school the mission statement read:

    To provide and maintain caring and stimulating environment where learners will recognize and achieve their full potential.

    In spite of the display of the mission statement in the open place, raw sewage was traversing the school compound without any action to correct the situation. On this, the school principal said that the municipal council was supposed to attend to that problem. This meant that officers charged with the responsibility of environmental management in institutions of learning do not seem to take environmental issues seriously and therefore they do not appear to perceive this as priority need. In support of these arguments, one KICD male officer observed:

    But EE is not taken seriously by teachers and students because it is not externally examined. Teachers are not even trained on how to assess EE internally because it targets behaviour which is difficult to evaluate.

    Despite that, this has been a persistent practice because monitoring is rarely carried out. The following quotation from one KICD male officer illustrated this view:
Monitoring has not been done since the inception of integrating EE in the school syllabus in 2002 except during occasional surveys but once reports are written there is no follow up.

One would therefore wonder how EE would be implemented in a school curriculum by the administrators who were less sensitive to monitoring its execution. This meant that school administrators’ perception of EE was seemingly superficial, indifferent and therefore a negative influence on its implementation in view of the fact that EE was partially perceived as a priority need. Thus, it is evident that implementation of environmental education was seemingly not done effectively.

In order to figure out whether there was a significant difference in the levels of perception for teachers and students about integrated environmental education in the school curriculum, the researcher conducted hypothesis testing as follows:

**Hypothesis testing principles that were used in this study were:**
Null hypotheses tested at .05 significance level.

**Decision rule**
If the p-value is less than or equal to 0.05 (p ≤ 0.05) the null hypothesis is rejected. This means that there is significant difference between the variables that are being tested. But if p-value is greater than 0.05 (p > 0.05) we fail to reject the null hypothesis (the null hypothesis is not rejected). This means that there is no significant difference between the variables that are being investigated.

**Null Hypothesis 1**
H01: There is no statistically significant difference between the mean scores of teachers’ and students’ perception of the integrated environmental education in the secondary school curriculum in Machakos Sub-County
The t-test statistic was used to test means between teachers’ and students’ levels of perception

**Independent samples T-Test**

**Assumptions:**

- Independent variable consists of two independent groups
- Dependent variable is either interval or ratio
- Dependent variable is approximately normally distributed
- Similar variances between the two groups (homogeneity of the variances)

Using the SPSS software, the independent samples T-Test output (Table 10) was generated to test the Null Hypothesis \((H_0)\)

**Table 10**

**Independent samples T- Test Output on the Difference between teachers’ and students’ perception of the integrated environmental education in the secondary school curriculum**

<table>
<thead>
<tr>
<th>percept</th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>12.827</td>
<td>.000</td>
<td>-4.989</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>-5.852</td>
<td>341.307</td>
<td>.000</td>
</tr>
</tbody>
</table>

The findings in table 10 illustrates a summary of independent T-Test: \(t (344) =341.307, p=0.000.\) The p- value 0.000 is less than 0.05 level of significance (p<0.05).
**Decision**

Null hypothesis was rejected.

**Conclusion**

This means that there is a significant difference between the mean scores of teachers’ and students’ perception of the integrated environmental education in the secondary school curriculum in Machakos Sub-County. This view is consistent with earlier researches by Ko and Chi-kin (2003) in Hong Kong and Kelani’s (2015) in Benin. Their findings showed that all teachers indicated a strong support for the importance of EE in the secondary science curriculum.

However, findings in terms of students’ perceptions indicated negative support for the importance of EE in the secondary science curriculum hence a significant difference between the mean scores of teachers’ and students’ perceptions. Students’ negative perception seemed contradictory to a study by Thang and Kumarasamy (2006) in Malaysian secondary schools which reported that students developed a more positive view towards the environment through use of environmental content in their class. Irwin (as cited in Odege, 2009) laments “Where then do we stand with this wide range of viewpoints? How do we both celebrate diversity and have a sense of direction for environmental education?” To reconcile the dilemma, Laughlin, Zastavker, and Ong (2007) argue strongly that students perceived greater subject matter integration when they learned this from their teachers. It is therefore reasonable to assume that students in Machakos Sub-County did not support integration of EE in the school curriculum because they had not been actively engaged by their teachers in the integration process hence they did not see it as necessary.

Fullan’s, Theory of Educational change makes it clear that integration of EE in the curriculum may be dependent on teachers’ and students’ felt need for EE, if it was
beneficial to them in terms of improved students’ knowledge, skills, values, attitudes, concern and participation in environmental sustainability. This implies that felt need seemed to drive teachers’ and students’ perception of EE in the school curriculum. In this particular scenario, it would seem that teachers and students were not convincingly explained the need for EE. Westmoreland-King (2012) contends that to gather support for EE, teachers will need to be convinced that it is worth the time, money and effort. And even if this was clear to them, often there are competing needs for teachers and students in many school setups. Fullan (1991, p. 69) observes “It is not only whether a given need is important, but also how important it is relative to other needs” which seem to vary from community to community. The researcher finds this development a possible challenge to implementation of integrated environmental education in the secondary school curriculum.

Therefore regarding the research question “What are the teachers’ and students’ perceptions of the integrated environmental education in the secondary school curriculum?” a critical observation of the research outcome shows that this question has been adequately addressed through the finding that both teachers’ and students’ perceptions of the integrated environmental education in the secondary school curriculum were weak (< 50%). A possible interpretation of this finding is that teachers and students did not perceive IEE as worthy pursuance in the curriculum and therefore it gives the impression that they did not adequately integrate it in the school curriculum. This finding has some major implications that implementation of environmental education in the school curriculum is seemingly not done effectively in Machakos Sub-County.

4.6 Levels of environmental literacy of secondary school teachers and students

Guided by research question (iii), the researcher sought to establish secondary school teachers’ and students’ levels of environmental literacy in Machakos Sub-County.
It was found necessary to examine literacy from the point of view that it informed the researcher on preparedness of teachers and students to undertake the complex nature of integration of EE in the school curriculum using new approaches. Since curriculum innovation contained a number of new complex ideas and expectations as regards materials and their usage, as well as new instructional approaches and beliefs, it was found reasonable that curriculum implementers developed high levels of literacy to effectively manage the innovation. The National Audubon Society (2013) further asserts that people with higher levels of environmental literacy also have an outlook that makes them more sensitive to the natural environment.

Levels of environmental literacy were premised on five literacy dimensions thus environmental knowledge; awareness, attitudes; skills and participation. These dimensions of environmental literacy were the basis for formulation of EE objectives at the Tbilisi Declaration (1977) and therefore they also helped establish teachers’ and students’ levels of understanding (clarity) of EE objectives as formulated at Tbilisi so that they could understand the effect of their choices, rather than continuing to damage the environment unnecessarily through their ignorance.

4.6.1 Knowledge Dimension

To establish the levels of environmental literacy (knowledge) of secondary school teachers and students and also ascertain whether teachers and students demonstrated mastery of the environmental content which they taught and learnt respectively, the researcher administered environmental literacy test addressing the knowledge component, with a set of Ten (10) questionnaire items (12 to 22). The items were based on the ten concepts which according to Swanepoel, Loubser and Chcko (2002) were; the biosphere, ecological perspective, interrelationships in the ecosystem, environmental changes, basic
human needs, resources, maintaining environmental quality, the ability to make choices, decision-making on environmental issues and environmental ethics (Table 11).

Although Zoos Victoria (n.d) asserts that knowledge increases are not necessarily a reliable predictor of a related change in behaviour, research suggests that teacher content knowledge does influence classroom instruction and is a prerequisite for appropriate conservation actions (Thapa, 2010; Kollmus & Agyeman, 2002; Kaiser, et al., 1999 as cited in McGuire, 2015; Kuhar, Bettinger, Lehnhardt, Tracy, & Cox, 2010). In the end we will conserve only what we love; we will love only what we understand; we will understand only what we are taught (Saylan & Blumstein as cited in Muranen, 2014)

Environmental knowledge was therefore of particular importance to the researcher as it gave a general view of the respondents’ involvement in integration of EE in the school curriculum and the resultant environmental engagement. Table 11 summarizes the data on secondary school teachers’ and students’ environmental knowledge.
The results in table 11 show that in the 12th item, 71.40 % of the teachers and 63.30 % of the students responded to the correct option (limited moisture availability). This showed that both teachers and students were knowledgeable on the topic of climate.

While more than one half (52.10 %) of teachers and slightly above one quarter (28.80 %) of students’ responded correctly to the questionnaire item 13 concerning the
definition of ecology (ecology is the discipline that is independent from natural selection and evolutionary history), only 26.80 % of teachers and 31% of students selected wrong options. Likewise, an overwhelming majority (95%) of teachers and 96.50 % of students selected the correct option (a food chain) on questionnaire item 14. Although teachers’ and students’ knowledge on ecology (items 13 & 14) was variable, generally over 70 % of teachers and about 60 % students selected correct options. This implies that teachers and students were convincingly knowledgeable on ecology.

Questionnaire item 15 sought to find out the respondents’ knowledge levels on green house effect. Majority (84.0 %) of teachers and just more than half (55.0 %) of students selected the correct option (ability of certain atmospheric gases to trap heat and keep the planet relatively warm). However, 14.20 % of teachers and 39.30 % of students gave the wrong answers. Only a few 1.70 % of the teachers and 5.70 % of the students preferred not to respond to the questionnaire item. These findings could be interpreted to imply that teachers were more knowledgeable on green house effect than their students. The findings concur with Fisher’s study (as cited in Varisli, 2009) which assessed Australian students’ explanations of the greenhouse effect and the ozone hole and found that the students confused the two terms.

Questionnaire item number 16 sought to determine respondents’ knowledge levels on basic physiological needs. An overwhelming 96.10 % of students and 73.90 % of teachers selected the correct option (Food). About one quarter (25.10 %) teachers and less than five percent (2.20 %) of students selected wrong options. Only 0.80 % of teachers and 1.70 % of students preferred to ignore responding to the questionnaire item. These results could suggest that teachers and students were both knowledgeable on basic human needs although a striking feature from the responses was that students had a surprisingly awesome outcome compared to their teachers. Students’ better performance on this item it
could be argued might be reflected on their own personal concern for EE, use of a variety of sources of environmental information and out-of-school EE related practices.

Questionnaire item 17 sought to establish respondents’ knowledge on unsustainable resource use. While only a few (28.60 %) teachers and some (30.0%) students selected the correct option (Use of few products based on natural resources), about 70 % of teachers and over 50% students identified wrong options. Only 2.50 % of teachers and 9.20 % of students preferred not to respond to the item. From the responses, it could be inferred that teachers and students performed dismally on causes of poor resource use. This suggested that teachers and students it would seem had limited understanding of resource use due to possibly lack of teacher guidelines, lack of curriculum materials and inadequate active engagement of both parties in environmental activities.

Questionnaire item number 18 sought to find out respondents’ knowledge on the definition of the word smog. Nearly equal percentage (70.60 %) of teachers and 68.60 % of students selected the correct definition of smog (a combination of smoke and fog). Similarly, just about an equal percentage (27.70 %) of the teachers and 26.70 % of the students selected wrong options. However a trivial (1.70 %) of teachers and 4.80 % of students preferred to ignore responding to the item. The study findings demonstrate that both students and teachers had reasonable knowledge on the definition of the word smog.

For the questionnaire item 19 concerning ‘the least appropriate choice of action about the most damaging environmental consumer behaviour’, only 24.40 % of teachers and 31.30 % of students selected the correct option (I will choose a fuel-efficient, low polluting car), while about three quarters (74.80 %) of teachers and more than half (63.80 %) of students selected the wrong choices. Only an insignificant 0.80 % of teachers and 4.40 % of students opted not to respond to the item. This can be interpreted to imply that
teachers and students performed dismally and therefore least knowledgeable on some damaging environmental consumer behaviour as nearly 70% of each group selected wrong options. This meant that they could not decide on the least appropriate choice of action to take in order to minimize environmental damage by driving cars and light trucks.

Questionnaire item 20 sought to establish respondents’ knowledge on wastage of our usable water. While only a few (28.60 %) teachers and slightly more than one third (40.20 %) of the students selected the correct option (Careless usage), nearly seventy percent (69.70 %) of the teachers and more than half (55.50 %) of the students selected the wrong alternative. However, only a few (1.70 %) teachers and 4.40 % students preferred not to respond to the questionnaire item. This finding could be interpreted to imply that teachers and students had low knowledge levels (< 50%) on wastage of our usable water.

The questionnaire item 21 aimed at finding out respondents’ levels of knowledge on the option that does not fit into correct feelings towards preservation of the environment. Nearly half (47.90 %) of teachers and slightly more than a quarter (27.90 %) of students identified the correct option (Nature is there to supply limitless need for humankind). Similarly approximately half (49.60 %) of teachers and more than half (65.50 %) of students selected the wrong alternative. Only a negligible percentage (2.50 %) of teachers and 6.60 % students preferred not to respond to the item. The study findings demonstrated that teachers and students performed below average (50%) making it evident that they were inadequate in terms of knowledge on preservation ethic towards the environment.

In questionnaire item 22, the researcher sought to establish respondents’ levels of knowledge on how the gap between the rich and poor countries contributed to the current
environmental crisis. While a majority (81.50 %) of teachers and more than half (65%) of the students had the incorrect options, only a few (16%) of teachers and (21.80 %) of students selected the correct option (Developed countries consume a unbalanced share of the resources). However, less than five percent (2.50 %) of teachers and more than ten percent (13.10 %) of students chose not to respond to the item. These findings demonstrated that slightly below one quarter of teachers and students identified the correct option therefore it could be argued that the respondents performed worse than in the earlier items.

The questionnaire item that posted the lowest outcome was number 22 (decision-making on environmental issues) which placed the correct option for teachers at 16 % and for students at 21.80 % and the item that posted the highest outcome was number 14 (ecology, food chain) which placed the correct option for teachers at 95% and students at 96.50 %.

Overall study findings demonstrated that secondary school teachers’ and students’ responses to the knowledge questionnaire items were variable in Machakos Sub-County. However, teachers and students in the Sub-County were knowledgeable on questionnaire items 12 (climate), 13 and 14 (ecology), 15 (green house effect) and 16 (basic physiological needs). This finding supports results for Poddar’s (2009) study in North-East Chhattisgarh region of India which demonstrated that teachers possessed the knowledge necessary for implementing integrated environmental education. Odeke (2009) observes that education is grossly incomplete without knowledge of the environment, human relationship with the environment and how to interact with earth’s resources in a sustainable manner. Elder-Hurst (2012, p.54) further asserts that “the implementation of an innovation or new program hinges on the appropriate level of teacher knowledge, willingness to change and professional development”
In spite of this, the findings showed that teachers and students had insufficient knowledge on questionnaire items 17 (unsustainable resource use); 19 (decision making on most damaging environmental consumer behaviour); 20 (waste of our usable water); 21 (preservation ethic towards the environment) and 22 (decision-making on environmental issues). These findings are supported by Rickinson’s (2002) reviews of recent research on students that young people in several countries are generally of low levels of factual knowledge on environmental issues. Blum (as cited in Bartosh 2003) shared a similar view that results of a survey of environmental knowledge and attitudes in the United States of America, England, Israel and Australia concluded that 9th and 10th grade students in all the four countries had low environmental knowledge.

Although some items showed that students’ percentages for correctly answered options were slightly higher than the teachers’, it could be inferred from the overall average percent that teachers were more knowledgeable (59.25%) about most environmental issues than students (56.81%). This is contrary to the findings posted by Lasso De Lavega’s (2004) study that there were no significant differences between high school students and high school instructors regarding their knowledge levels.

However, it should be noted that overall, teachers’ and students’ environmental knowledge levels were slightly more than just fair considering the issues investigated in the study. This implies that teachers and students somehow knew and understood contemporary and dynamic environmental issues but their contribution to curriculum integration and implementation it would seem had an insignificant effect.

Therefore information gathered from this section seemingly attempted to answer the research question: What are the levels of environmental literacy (knowledge) of secondary school teachers and students of Machakos Sub-County?
4.6.2 Awareness Dimension

In the awareness dimension of the study, the researcher sought to find out levels of environmental literacy (awareness) of secondary school teachers and students. Environmental awareness was considered important because according to (Harry-Moss, 2016), it instills in individuals sensitivity to certain human activities that are detrimental to the environment, which in turn elicits an emotional response. Harry-Moss (2016) further notes that environmental awareness essentially serves as an educational tool, helping people around the world understand the consequences of human activities on various lands and the importance of preserving resources. Therefore the researcher wanted to establish if teachers and students of Machakos Sub County were environmentally aware and therefore able to integrate EE in the school curriculum. Data on environmental awareness was therefore sought through administering a five item questionnaire based on yes and no responses. Table 12 presents details of the various responses regarding teachers’ and students’ environmental awareness.
Table 12
Teachers and Students’ Responses Regarding their Environmental Awareness
(Teachers n=119; Students n= 229)

<table>
<thead>
<tr>
<th>Items</th>
<th>Teacher</th>
<th></th>
<th></th>
<th></th>
<th>Student</th>
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</tr>
</thead>
<tbody>
<tr>
<td>i. Did you ever attend any awareness programmes conducted by your local Authority?</td>
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<td>F</td>
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<td>F</td>
<td>%</td>
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<td>%</td>
<td>F</td>
<td>%</td>
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<tr>
<td></td>
<td>34</td>
<td>28.60</td>
<td>83</td>
<td>69.7</td>
<td>2</td>
<td>1.7</td>
<td>61</td>
<td>26.6</td>
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<tr>
<td>ii. Do you think environmental problems are important to your school?</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>106</td>
<td>89.1</td>
<td>10</td>
<td>8.4</td>
<td>3</td>
<td>2.5</td>
<td>164</td>
<td>71.6</td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>56</td>
<td>24.5</td>
<td>9</td>
<td>3.9</td>
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<tr>
<td>iii. Is it important that everyone should be aware about environmental problems?</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>113</td>
<td>95.0</td>
<td>3</td>
<td>2.5</td>
<td>3</td>
<td>2.5</td>
<td>210</td>
<td>91.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9</td>
<td>3.9</td>
<td>10</td>
<td>4.4</td>
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<tr>
<td>iv. Do you understand the role you need to play in environmental protection?</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>100</td>
<td>84.0</td>
<td>16</td>
<td>13.4</td>
<td>3</td>
<td>2.5</td>
<td>179</td>
<td>78.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40</td>
<td>17.5</td>
<td>10</td>
<td>4.4</td>
</tr>
<tr>
<td>v. Are you aware of the outcome of improper management of the environment?</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>103</td>
<td>86.6</td>
<td>13</td>
<td>10.9</td>
<td>3</td>
<td>2.5</td>
<td>171</td>
<td>74.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>48</td>
<td>21.0</td>
<td>10</td>
<td>4.4</td>
</tr>
</tbody>
</table>

**Key:** F - Frequency    Miss – missing Percentage

**Source:** Field data, 2017.

As illustrated in table 12, it could be inferred that 69.70 % of teachers and 69% of the students did not attend any environmental awareness programmes organised by their local Authority although 38% of the students said that they were familiar with the concept of integrated environmental education from (teacher sources, 16.60 %; television, 10.50 %; newspapers and magazines, 9.20 % and individual studies, 4.40 %). This meant that media was the major source of environmental information for students. In support of this view, Novacek (2008) points out that media in the form of news and EE programmes such as Planet Earth and other programmes teach both the beauty of nature and pass
messages that encourage stewardship of nature. However, there appears to be a conflict between this view and those of Rickinson (2001) and Onder (2006) that mass media was not considered a reliable source of information about the environment and that print media was out of favour with the youth unless it was something really interesting. With such wide ranging viewpoints it is my considered opinion that integration of EE in the school curriculum be approached from wide ranging angles such as the media as well as teachers as sources of environmental information for students.

In spite of this, majority (62%) of the students had never heard about integrated environmental education. This result is in tandem with the preceding finding that majority (69%) of the students had never attended any environmental awareness programmes organized by their local Authority and therefore they were not aware of integrated environmental education. This category of students was further asked if they would be willing to know something about integrated environmental education and 67.70% of them showed willingness. By the looks of this outcome, there are indications that students had a conviction of knowing something about integrated environmental education but lacked the opportunity from their local Authority.

As illustrated in table 12, majority (89.10%) of teachers and (71.60%) of students saw the importance of studying environmental problems in their’ schools. This finding could be interpreted to imply that teachers and students were aware of and appreciated the importance of environmental problems in their schools and it would seem were eager to integrate EE in the school curriculum if they were support to do so.

The findings of this study also showed that majority (95%) of teachers and students (91.70%) were of the view that everyone should be aware about environmental problems. This response implies that the teachers and students knew what environmental problems were and therefore they were supposedly the prime candidates for integration of
EE in the school curriculum. About whether the respondents understood the role they needed to play in environmental protection, a great majority (84 %) of teachers and (78.20 %) of students indicated that they understood their role in environmental protection and were seemingly ready to help in promoting integration of EE in the school curriculum.

Similarly, (Table 12) shows that nearly an equal percentage of teachers (86.60 %) and students (74.70 %) indicated that they were aware of the outcome of improper management of the environment and it was seemingly their responsibility to promote integration of EE in the school curriculum. This finding is supported by the results of a similar research realized by Hausbeck, Milbrath & Enright (as cited in Lasso De Lavega, 2004) which demonstrated that students’ scores for awareness were higher than the scores for knowledge due to the relatively easy access to information by electronic media.

From these findings it could be argued that although teachers’ and students’ responses to awareness showed greater diversity, the overall results demonstrated that while average positive responses to the sub-items were seen in 76.66% of teachers and in 68.56% of students, average negative responses were seen in only 20.98% of teachers and 27.18% of students. These results suggest that teachers and students in Machakos Sub-County were ostensibly aware of environmental issues and therefore seemingly able to integrate EE in the school curriculum. Therefore information collected from this section evidently addressed the research question: What are the levels of environmental literacy (awareness) of secondary school teachers and students of Machakos Sub-County?

4.6.3 Environmental Attitudes

Under the attitude dimension of the study the researcher sought to find out levels of environmental literacy (attitudes) of secondary school teachers and students in Machakos Sub County. Environmental attitudes were considered important because
having an idea about environmental attitudes of people provides important clues for development of effective EE strategies (ÜNAL, 2008). According to McGuire (2015) there is evidence that under certain conditions, attitudes can be reasonably predictive of behaviour. Koskei (2013) further observes that positive attitudes do not only influence the willingness of people to implement but also the pupil’s willingness to learn. (Burchett, 2015) further asserts that media reports of deteriorating ecosystems and environmental disasters should trigger an emotional reaction among people. Therefore the respondents’ attitudes toward and beliefs about the value and potential contribution of EE to sustainable development would define how they integrate it into the formal school curriculum.

The researcher therefore wanted to establish if teachers and students of Machakos Sub County had what it takes in terms of environmental attitudes to integrate EE in the secondary school curriculum. Data on environmental attitudes were therefore sought through administering ten (10) Likert-type items (5 positive and 5 negative), to the respondents. The items were on a five-point scale in which the choices ranged from 1 to 5. Five (5) points were assigned to “strongly agree”, 4 to “agree”, 3 to “undecided”, 2 to “disagree” and 1 to “strongly disagree” Table 13 summarizes the data on teachers’ and students’ environmental attitudes.
Table 13

Teachers’ and Students’ percentage responses on Environmental Attitudes

(Teachers n=119; Students n= 229)

| STATEMENT                                                                 | SA   | A   | U   | D   | SD  | %T | %S | %T | %S | %T | %S | %T | %S |
|---------------------------------------------------------------------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| i. I feel that the benefits that I get from the environment have altered my attitude towards the environment and its conservation | 42.0 | 49.3 | 35.3 | 31.9 | 10.9 | 12.7 | 6.7 | 2.6 | 5.0 | 3.5 |
| ii. I teach/learn environmental education as well as I do most subjects   | 11.8 | 17.0 | 39.5 | 34.5 | 15.1 | 18.8 | 27.7 | 18.3 | 5.9 | 11.4 |
| iii. Environmental education can help students understand concepts in other subjects more easily | 23.5 | 33.2 | 47.9 | 38.4 | 15.1 | 22.3 | 11.8 | 4.4 | 1.7 | 1.7 |
| iv. Environmental topics are logically organized in the syllabus          | 5.0  | 16.6 | 26.9 | 27.9 | 16.0 | 20.5 | 35.3 | 21.0 | 16.8 | 14.0 |
| v. I am willing to volunteer my free time to help out in integrating environmental concepts and issues in the curriculum | 21.0 | 39.3 | 42.9 | 35.8 | 22.7 | 18.8 | 10.9 | 3.5 | 2.5 | 2.6 |
| vi. Environmental education is an overload in the school curriculum       | 7.6  | 10.9 | 12.6 | 7.4  | 11.8 | 16.6 | 42.9 | 29.3 | 25.2 | 35.8 |
| vii. It is demanding to prepare environmental education lessons           | 12.6 | 25.3 | 30.3 | 29.3 | 16.0 | 22.3 | 29.4 | 13.1 | 11.8 | 10.0 |
| viii. It is difficult to infuse EE and requires extensive teacher training | 16.0 | 17.5 | 25.2 | 19.2 | 12.6 | 15.7 | 36.1 | 25.3 | 10.1 | 22.3 |
| ix. Integrated EE is difficult to evaluate                                | 8.4  | 9.6  | 21.0 | 10.9 | 15.1 | 23.6 | 41.2 | 32.8 | 14.3 | 23.1 |
| x. Students might not “get integrated EE messages” as they are diluted to fit the objectives of the carrier subject | 18.5 | 14.0 | 31.1 | 28.8 | 8.4  | 14.0 | 30.3 | 21.4 | 11.8 | 21.8 |

Key: SA-strongly agree; A- Agree; U- Undecided; D-Disagree; SD- strongly disagree; %T-Percent teachers; %S- Percent students

Source: Field Data, 2017

As shown in table 13, “strongly agree” and “agree” choices were evaluated together. Similarly, disagree and strongly disagree were calculated together. The subitems on environmental attitudes which to some extent received comparatively significant results on the agreement scale for both teachers and students respectively were i (77.30
The responses were mostly well above 50% on the agreement scale implying that on average 65.90% of teachers and 69.80% of students had satisfactorily positive attitudes towards integration of EE in the curriculum. Some teachers and students also expressed positive attitudes towards integration of EE in the curriculum by disagreeing with the statements vi (Teachers=68.10%; Students=65.10%) and ix (Teachers=55.50%; Students=55.90%). However, a few teachers and students expressed variable but low attitudes (<50%) towards integration of EE in the school curriculum by weakly agreeing with the statements vii (Teachers=42.90%; Students=54.60%) and x (Teachers=49.60%; Students=42.80%) but unconvincingly disagreeing with the statement viii (Teachers=46.20%; Students=47.60%). Despite the fact that the percentage of teachers (8.40% to 22.70%) and students (14% to 23.60%) who were undecided was low, the findings show that students were more undecided than the teachers since the percentages for the students who were undecided were persistently above those for the teachers for all the items except sub item v.

It could be argued that the extent to which students were interested and involved in environmental activities might have influenced their variable environmental attitudes. This finding is supported by the results of a similar research by Le Hebel, Montpied and Fontanieu (2014) in France which demonstrated that 15-year-old students showed links between their environmental attitudes and level of interest in learning about specific environmental topics and practice of extra-curricular activities linked to nature.

Presented second were the mean scores and standard deviation values for teachers’ and students’ responses on Environmental Attitudes. The higher the score, the more favorable the attitude was towards the environment. Table 14 presents details of the outcome.
Table 14

Mean scores and standard deviations for each attitude item

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.  I feel that the benefits that I get from the environment have altered my attitude towards the environment and its conservation</td>
<td>1.94 1.126 1.69 .976</td>
<td></td>
</tr>
<tr>
<td>ii. I teach environmental education as well as I do most subjects</td>
<td>2.76 1.164 2.70 1.307</td>
<td></td>
</tr>
<tr>
<td>iii. Environmental education can help students understand concepts in other subjects more easily</td>
<td>2.19 .991 1.91 .932</td>
<td></td>
</tr>
<tr>
<td>iv.  Environmental topics are logically organized in the syllabus</td>
<td>3.33 1.205 2.87 1.344</td>
<td></td>
</tr>
<tr>
<td>v.   I am willing to volunteer my free time to help out in integrating environmental concepts and issues in the curriculum</td>
<td>2.29 1.013 1.86 .968</td>
<td></td>
</tr>
<tr>
<td>vi.  Environmental education is an overload in the school curriculum</td>
<td>3.67 1.214 3.78 1.358</td>
<td></td>
</tr>
<tr>
<td>vii. It is demanding to prepare environmental education lessons</td>
<td>2.97 1.280 2.49 1.322</td>
<td></td>
</tr>
<tr>
<td>viii. It is difficult to infuse EE and requires extensive teacher training</td>
<td>2.99 1.303 3.17 1.473</td>
<td></td>
</tr>
<tr>
<td>ix.  Integrated EE is difficult to evaluate</td>
<td>3.33 1.224 3.52 1.266</td>
<td></td>
</tr>
<tr>
<td>x.   Students might not &quot;get integrated EE messages‖ as they are diluted to fit the objectives of the carrier subject</td>
<td>2.85 1.360 3.09 1.446</td>
<td></td>
</tr>
</tbody>
</table>

**Key:** M = Mean Score; SD= Standard Deviation

**Source:** Field data, 2017

Table 14 shows that students and teachers had variable but positive attitudes towards integration of environmental education in the school curriculum. For instance, teachers’ and students’ mean score on attitude dimension were almost equal on items vi (teachers M= 3.67; students M=3.78), viii (teachers M=2.99; students, M=3.17), ix (teachers M=3.33; students, M=3.52) and x (teachers, M=2.85; students, M=3.09). These findings suggest that on average both teachers (M=3.21) and students (M=3.39) had
reasonable attitudes towards the environment on the items in reference. These findings support results for Sarkar’s (2011) study on secondary school students’ environmental attitudes in Bangladesh which established that overall, students expressed favourable environmental attitudes.

From the responses, it is clear that teachers had higher mean scores of attitude than the students on items ii (Teachers M=2.76; Students, M=2.70), iii (Teachers M=2.19; Students, M=1.91), v (Teachers M=3.33; Students, M=2.87), vi (Teachers M=2.29; Students, M=1.86) and vii (Teachers M=2.97; Students, M=2.49). On average teachers had moderate (M=2.71) but more positive attitudes towards the environment than the students (M=2.37) on the same items in reference. These findings concur with those in other scholarly studies carried out by Kumari, Gangwar, Singh, & Singh’s (2012) in India which demonstrated that teachers possessed positive albeit modest attitudes towards both environmental issues and environmental education.

The overall mean score (M 2.83 out of 5) of teachers’ attitudes over all the items and the pooled mean score (M 2.71 out of 5) of students’ attitudes over all the items could be described as fair attitudes and therefore the respondents seemed to have had a fair conviction of their own role towards integration of environmental education in the secondary school curriculum. Going by these findings therefore, the information collected from this section seemingly attempted to answer the research question: What are the levels of environmental literacy (attitude) of secondary school teachers and students of Machakos Sub-County?
4.6.4 Skills Dimension

Under the skills dimension of the study, the researcher sought to find out levels of environmental literacy (skills) of secondary school teachers and students in Machakos Sub County. Environmental skills of secondary school teachers and students were sought, since according to Burchett (2015) they were key to fostering appreciation of the environment and its resources rather than exploiting it for financial benefit. Environmental skills assisted in protection of biodiversity, increased energy efficiency and assisted in new technologies that facilitated the transition to low-carbon economy; supported adaptation to and mitigation of climate change; facilitated decision making processes and were also key to individual character formation (Soft skills). Soft skills are key personal attributes and interpersonal skills that define an individual’s interaction with other people (Bogzaran, 2018). It was therefore hoped that environmental skills would prepare teachers and students to undertake integration of EE in the school curriculum using new approaches.

To establish levels of environmental literacy (skills) of secondary school teachers and students, eight items based on EE skills were presented to them and their yes and no responses were highlighted in table 15.
Table 15
Skills promoted in students by learning Integrated Environmental Education. (Teachers n=119; Students n= 229)

<table>
<thead>
<tr>
<th>Skills</th>
<th>Teachers</th>
<th></th>
<th></th>
<th>Students</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Miss</td>
<td>Yes</td>
<td>No</td>
<td>Miss</td>
</tr>
<tr>
<td>F</td>
<td>%</td>
<td>F</td>
<td>%</td>
<td>F</td>
<td>%</td>
<td>F</td>
</tr>
<tr>
<td>i. Decision-making</td>
<td>106</td>
<td>89.1</td>
<td>13</td>
<td>10.9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ii. Problem-Solving</td>
<td>102</td>
<td>85.7</td>
<td>17</td>
<td>14.3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>iii. Creative Thinking</td>
<td>99</td>
<td>83.2</td>
<td>19</td>
<td>16.0</td>
<td>1</td>
<td>.8</td>
</tr>
<tr>
<td>iv. Communication (Oral and Written)</td>
<td>69</td>
<td>58.0</td>
<td>50</td>
<td>2.0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>v. Computation/calculation skills</td>
<td>60</td>
<td>50.4</td>
<td>59</td>
<td>49.6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>vi. Research skills</td>
<td>97</td>
<td>81.5</td>
<td>22</td>
<td>18.5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>vii. Teamwork</td>
<td>104</td>
<td>87.4</td>
<td>15</td>
<td>12.6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>viii. Conflict resolution</td>
<td>86</td>
<td>72.3</td>
<td>33</td>
<td>27.7</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Key: F=Frequency. % = Percentage

Source: Field data, 2017

It could be inferred from table 15 that findings seemed to suggest that learning through integrated environmental education boosted skills of decision-making (teachers 89.10%; students, 83%), problem-solving (teachers, 85.70%; students, 83%), research skills (teachers, 83.20%; students, 80.30%) and teamwork (teachers, 87.40%; students, 86.90%). Similarly, nearly an equal percentage (72.30%) of teachers and (65.50%) of students selected the sub-item viii (conflict resolution). From this outcome it would seem that students adequately developed the skill of conflict resolution by learning it through integrated environmental education.

Likewise slightly more than half (58%) of teachers and (58.50%) of students selected the sub item iv (oral and written communication skills). This finding is an indication that students reasonably developed the skill of oral and written communication by learning it through integrated environmental education. However, about half (50.40%)
of teachers and half (51.10 %) of students selected sub item v (computation/calculation skills). This response implied that students had a slight development of computation/calculation skills by learning it through integrated environmental education.

A critical observation of the overall findings showed that (teachers =75.95% & students =74.45%) observed that students developed the skills identified in this study by learning them through Integrated Environmental Education and that the students needed such skills to address future environmental concerns. This suggests that the respondents were prepared and had an overall willingness to integrate EE skills in the secondary school curriculum.

These results find support in Reilly, Petrillo, and Demchik’s (2008) three case studies from India, South Africa and the United States which demonstrated that students and teachers who were actively engaged in their local community gardens or village ecosystems as practical laboratories developed valuable life skills such as critical thinking and communication. These skills were also fundamental for continued learning once formal schooling was over.

Emanating from the analysis of data from this section there are indications that seem to suggest that the findings tried to answer the research question: What are the levels of environmental literacy (skills) of secondary school teachers and students of Machakos Sub-County

4.6.5 Participation Dimension

Under this aspect of the study, the researcher sought to find out levels of environmental literacy (participation) of secondary school teachers and students in Machakos Sub County. According to Short (2010) actions are important to goals of environmental protection. Herbert Spencer (as cited in Short, 2010) further observes that, “The great aim of education is not knowledge but action.” P.1 Kimaryo (2011) calls this,
action competence or competency-based skills for environmental sustainability. Through action or environmental participation it was envisioned teachers’ and students’ preparedness would be enhanced to integrate EE in the school curriculum as an intervention measure to environmental degradation in Machakos Sub County.

Therefore, self-reported data on secondary school teachers’ and students’ environmental participation in schools, in homes and within communities was sought to elicit information on common environmental activities the teachers and students were committed to in their respective environmental settings. Table16 illustrates findings in percentage.

**Table 16**

**Percentage of common environmental activities teachers and students were committed to in secondary schools, in homes and within communities. (Teachers, n=119; Students n=229)**

<table>
<thead>
<tr>
<th>I am committed to:</th>
<th>School</th>
<th>Home</th>
<th>Community</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%T</td>
<td>%S</td>
<td>%T</td>
</tr>
<tr>
<td>i. Controlling visible pollution: Removing cobwebs, clearing soot, dust and garbage.</td>
<td>47.1</td>
<td>23.1</td>
<td>69.7</td>
</tr>
<tr>
<td>ii. Taking environmental safety measures: Cleaning rooms, toilets, compound, and slashing grass.</td>
<td>51.3</td>
<td>38.9</td>
<td>70.6</td>
</tr>
<tr>
<td>iii. Promoting environmental beauty: Maintaining flower beds, trimming hedges.</td>
<td>56.3</td>
<td>29.7</td>
<td>65.5</td>
</tr>
<tr>
<td>iv. Conservation of resources: conserving electricity, water, soils, planting and caring for trees.</td>
<td>59.7</td>
<td>24.9</td>
<td>64.7</td>
</tr>
</tbody>
</table>

**Key:** T% = Percent teachers; S% = Percent students

**Source:** Field data, 2017

Referring to table 16, it could be quickly observed that the overall comparison of percentage distribution of teachers’ and students’ levels of commitment to participation in environmental activities in Machakos Sub-County was variable. The study findings demonstrate that on average, levels of commitment at home were moderate for both
groups (teachers = 67.62% & students = 47.05%), low at school (teachers = 53.60% & students = 29.15%) and insignificant within the community (teachers = 17.22% & students = 17.37%). Based on the findings of this study, most teachers and students infrequently ventured into the communities for practical environmental activities seemingly due to lack of self-motivated qualities in addition to lack of foundational competence or reasons why they would take such actions within the communities. These findings are consistent with the study report by Toili (2007) in Bungoma district that secondary school students were engaged in environmental activities mostly while they were at home and school than within the community surrounding the school. This was for the apparent reason that teachers and students tended to associate more closely with their homes and their schools than with the wider communities. Besides, emphasis by families and school authorities on keeping their homes and school surroundings tidy and therefore hygienic compelled the teachers and students to concentrate more on their activities while at home and school than within the communities.

Thirdly, it could also be observed that the environmental activity that received the highest attention from both the teachers and students was controlling visible pollution thus removing cobwebs, clearing soot, dust and garbage (Teachers = 69.70%; students = 54.60%) at home, followed by taking environmental safety measures; cleaning rooms, toilets, compound, and slashing grass (Teachers = 70.60%; students = 45.40%) at home and then promoting environmental beauty; maintaining flower beds, and trimming hedges also at home. Removal of visible pollution was the most popular activity due to the fact that it presented itself more obviously than the other forms of pollution hence easier to detect and deal with.

Last of all was conservation of resources; electricity, water, soils, planting and caring for trees (Teachers = 64.70%; students = 40.20%) at home. Students seemed to have
performed poorly not only on conservation of resources but for all the other activities across all the three different environmental settings. It is apparent that students were not encouraged to engage in such activities. This outcome conforms to the findings of Tesfaia, Nagothua, Šimek, Fučík (2016) who observe that studies have shown that students take an active role in environment related activities at schools, if given an opportunity. Additionally, students were least involved in outdoor environmental activities because of their overall deficiency of environmental knowledge, values and sensitivity to environmental conservation. The students seemed to imagine that life-supporting resources from the environment were unlimited. This finding supports the Inglehart hypothesis that “one places the greatest subjective value on those things that are in relatively short supply” p.24 (Ronald Inglehart as cited in Iizuka, 2000).

The results also show that teachers’ levels of commitment were persistently higher than those of the students. This indicates that on average, teachers demonstrated a fairly moderate position (at school 53.60%; at home 67.60% & within the community 17.22%) regarding pro-environmental values than the students (at school 29.15%; at home 47.05% & within the community 17.37%). Therefore teachers were fairly sensitive to the environment than the students. Overall, it is evident that through environmental participation both teachers and students were seemingly inadequately prepared to integrate EE in the school curriculum as an intervention measure to environmental degradation in Machakos Sub County.

To support this information the researcher triangulated sources of students’ data (Table 16) with the researcher’s self reported observation (Figures 28 to 31) for evidence of environmental improvement in each of the sampled public boys’ secondary schools, public girls’ secondary schools and public mixed secondary schools. O’Donoghue and Punch (2003) observe that triangulation is a “method of cross-checking data from
multiple sources to search for regularities in the research data." p. 78 Adey, with Hewitt, Hewitt, and Landau (2004) further point out that personal observation must be supported by other sources of data in order to verify and validate the subjective assessments made by the respondents.

From the self reported observation of the school compound (Figure 28) it was evident that the girls’ schools were outstanding for conservation of resources posting 75% for planting trees, conservation of water and electricity and (0%). for conservation of soils.

![Figure 28: Conservation of Resources on school compounds](image)

Second in rank were mixed secondary schools posting 65.27% for conservation of the same resources whilst conservation of soils recorded an insignificant 2.77%. Boys’ secondary schools were last with 50% for conservation of resources thus planting trees, conserving water and conserving electricity. However Boys’ schools conservation of soils posted 0%. While all the schools demonstrated effort in conservation of mainly trees, water and electricity, they performed dismally on conservation of soils.
A striking feature from the responses is that students’ self reported average percent commitment to conservation of resources on school compounds was consistently lower than the researcher’s observed average percent of the said commitment levels. This finding seems to me somewhat interesting. For example while the researcher’s observed average percent of students’ conservation of resources within schools was at 63.42% (Figures 28) the students’ own self reported commitment to conservation of resources on school compounds was averaged at 24.90% (Table 17). This finding could be interpreted to imply that the students demonstrated lack of self-efficacy of undertaking environmental activities without coercion. The findings might therefore suggest that student respondents seemingly lacked confidence and self motivation hence the low percentage of self reported commitment to conservation of resources. According to the social cognitive theory, self-efficacy beliefs provide the foundation for human motivation, well-being, and personal accomplishment (Pajares, 2009).

Referring to figure 29, it is also evident that the girls’ schools were again outstanding at promotion of environmental aesthetic (100%) as proof for planting flowers, pruning hedges, caring for flower beds and tending school lawns. Second in position were mixed secondary schools posting (33.32%) for environmental aesthetic. Boys’ secondary schools rolled up last with affirmation for environmental aesthetic at 18% and no indication (0%) for pruning hedges, caring for flower beds and tending school lawns. The researcher’s observed average percent of students’ promotion of environmental aesthetic on school compounds was 50.44% (Figure 29) compared with students’ self reported commitment to promotion of environmental aesthetic at 29.70% (Table 16).

This finding could be interpreted to imply that the students did not exercise a self driven enterprise in promotion of environmental aesthetic rather they executed the
activity as pointed out by Toili (2007) mainly through class work, punishment, and routine manual work, hence ownership of EE activities by students remained weak.

Figure 29: Researcher’s Observation on Students’ Promotion of Environmental Aesthetic on school compounds

As illustrated in figure 30 page 143, it is noticeable that the girls’ schools again demonstrated great effort at executing environmental health practices posting 87.50% as testimony for cleaning toilets, cleaning classrooms, slashing grass and repairing leaking roofs. Second place were boys’ secondary schools posting 75% for executing environmental health practices. Mixed secondary schools were positioned last with confirmation for executing environmental health practices at 73.60 %. All the school categories performed above average on executing environmental health practices.
In summary, the researchers observed average percent of students’ execution of environmental health practices on school compounds was 78.70 % (Figure 29) compared to 38.90 % (Table 16) of students’ self reported commitment for execution of environmental health practices within schools. This variation seemingly demonstrated that students seemed to lack self efficacy in carrying out environmental activities in outdoor school spaces and as supported by literature (Toili, 2007) the students could have been coerced to participate in these activities as part of routine manual work and punishment hence the low self reported commitment to execution of environmental health practices.
It could also be inferred from figure 31 that follows that girls’ schools again were outstanding for checking visible pollution (87.50 %) as evidence for cleaning out cobwebs; disposing garbage; removal of graffiti and clearing derelict. Boys’ schools were next at 75% and last were the mixed secondary schools (59.70%).

![Figure 31: Researcher’s Observation on Students’ Checking of visible pollution on school compounds](image)

The researcher’s observed percentage of students’ checking of visible pollution on school compounds was averaged to 74.07% (Figure 31) compared to only 23.10% (Table 16) of students’ self reported commitment for execution of environmental health practices.

The researcher’s observed average percent of students who painstakingly focused their efforts on controlling visible pollution and improving environmental health in their
school environments was high. This is associated with the possible pressure on students by the school authorities to keep the school grounds clean and safe. In spite of this, it was interesting to note that students’ self reported commitment for execution of environmental health practices within school premises was three times lower than the researcher’s observed average percent. It would seem that students lacked ownership and confidence for carrying out the EE activities in outdoor school spaces because according to Toili (2007) such activities were apparently associated with conceivable routine manual work and punishment.

It should also be mentioned here that among all the groups studied, girls’ secondary schools were better rated in EE activities within school spaces than the mixed and boys’ secondary schools. This result does not come as a surprise in view of the fact that research (Clarke, 1999) has demonstrated that in many contexts, women were more concerned than men about preserving natural resources for their children’s future. Toomey (2015) and Krause (2015) further observe that gender dynamics play a huge role for conservation as men and women use natural resources differently especially in developing countries.

While women might be responsible for collecting firewood; fetching of water for household needs and production of food for feeding of the family, men might be more involved in economic and material well being of the family for instance forestry and livestock management (Toomey, 2015 & Volunteers for Africa, 2009). Women’s traditional gender roles therefore bring them in daily contact with natural resources such as land, water, forest and wildlife and when these resources are exploited and ruined, women suffer most but if they are used sustainably women benefit most (Volunteers For Africa, 2009). In spite of that, disparities in participation for environmental improvement that may exist from one type of school to another could also be due to differences in
student population, availability of basic needs, infrastructures, experience and skills of the students.

Generally, teachers and students participation in outdoor environmental activities showed insignificant levels within the community (teachers = 17.22% & students = 17.37%); low levels at school (teachers = 53.60% & students = 29.15%) and moderate levels at home (teachers = 67.62% & students = 47.05%). Students’ performance particularly on conservation of resources; electricity, water, soils, planting and caring for trees was rather low as they seemed to infrequently engage in outdoor environmental activities. Toili (2007) in his study shares this views when he asserts that those students who participated in some of those activities did so seemingly through coercion as part of punishment, routine manual work, club work and as part of the learning process.

The study further revealed that students’ self reported percentage commitment to conservation of resources on school compounds was inconsistent with the researcher’s observed average percent of the said commitment levels. This meant that students did not belief in their own capability and effectiveness (self-efficacy) of undertaking conservation activities without coercion. The researcher found this development a matter of concern for implementation of integrated environmental education in the secondary school curriculum.

In order to figure out whether there was a significant difference between single sex and mixed sex public secondary schools with respect to form four students’ environmental literacy dimensions, the researcher conducted hypothesis testing as follows:

**Hypothesis 2**

$H_0^2$: There is no statistically significant difference between single sex and mixed sex public secondary schools with respect to form four students’ mean scores of
environmental awareness, knowledge, skills and attitudes in Machakos Sub-County. One-Way ANOVA was run to investigate the difference between single sex and mixed sex public secondary schools with respect to form four students’ environmental awareness, knowledge, skills and attitudes.

**One way ANOVA**

**Assumptions**

- Independent variable consists of two or more than two categorical independent groups
- Dependent variable is either interval or ratio
- Dependent variable is approximately normally distributed
- Similar variances between the groups (Homogeneity of variance)

The researcher used the SPSS software to calculate the descriptives of the different categories of schools with respect to the mentioned variables. Table17 summarizes the descriptive data.
Table 17

Group statistics on the difference between single sex and mixed sex public secondary schools form four students’ environmental awareness, knowledge, skills and attitudes (Literacy)

<table>
<thead>
<tr>
<th>MMEAN</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
<td>Upper Bound</td>
<td></td>
</tr>
<tr>
<td>Boy's Secondary School</td>
<td>40</td>
<td>3.440</td>
<td>1.0527</td>
<td>.1664</td>
<td>3.103</td>
<td>3.777</td>
<td>.0</td>
</tr>
<tr>
<td>Girls Secondary school</td>
<td>24</td>
<td>3.217</td>
<td>.8302</td>
<td>.1695</td>
<td>2.866</td>
<td>3.567</td>
<td>.9</td>
</tr>
<tr>
<td>Mixed secondary school</td>
<td>165</td>
<td>3.185</td>
<td>1.0469</td>
<td>.0815</td>
<td>3.025</td>
<td>3.346</td>
<td>.0</td>
</tr>
<tr>
<td>Total</td>
<td>229</td>
<td>3.233</td>
<td>1.0279</td>
<td>.0679</td>
<td>3.099</td>
<td>3.367</td>
<td>.0</td>
</tr>
</tbody>
</table>

The findings from table 17 show that the different categories of schools demonstrated nearly equal but above average scores (Boy's Secondary Schools, M=3.44; SD= 1.05; Girls Secondary schools, M=3.22; SD= 0.83; Mixed secondary schools, M=3.18; SD=1.05) on form four students’ environmental literacy, thus awareness, knowledge, skills and attitudes. This could be interpreted to imply that in Machakos Sub-County, all categories of schools had negligible variation between them with respect to students’ environmental literacy levels.

A back up analysis was carried out to establish whether this outcome was significant or it was by chance. The SPSS software was used to run one way ANOVA testing and the output was summarized in table 18.
Table 18
One way ANOVA Output on the difference between single sex and mixed sex public secondary schools form four students’ environmental awareness, knowledge, skills and attitudes (Literacy).

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>2.093</td>
<td>2</td>
<td>1.047</td>
<td>.991</td>
<td>.373</td>
</tr>
<tr>
<td>Within Groups</td>
<td>238.814</td>
<td>226</td>
<td>1.057</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>240.908</td>
<td>228</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From table 18 the output was, ANOVA (F (2, 226) =0.991, p=0.373). These findings show that the p-value is greater than 0.05 significance level (p > 0.05)

Decision

Fail to reject the null hypothesis (Accept the null hypothesis).

Conclusion

The results showed that there was no statistically significant difference between single sex and mixed sex public secondary schools with respect to form four students mean scores on environmental awareness, knowledge, skills and attitudes in Machakos Sub- County. This finding demonstrates that, the students were in the same way relatively imparted with necessary environmental literacy that would enable them to meet the goals of EE irrespective of the type of public secondary school they attended.

Further, it was evident from interviews with the secondary school principals and KICD officers that students and teachers had what it takes to implement EE if they were oriented and in-serviced on implementation of EE. One male secondary school principal noted:

“Teachers are capable to implement EE if they are sensitized and in-serviced. They need a lot of intervention because they do not have the skills”
One KICD lady officer maintained:

“The task of orienting teachers on integrated environmental education in the syllabus was shared between us and the Quality Assurance and Standards officers of the Ministry of Education in 2002. But not all the teachers were actually oriented hence this remains a rumour to them. The cascading approach was employed to orient the teachers but it was not a smart plan because not all teachers were reached. Even those who were trained to integrate the cross-cutting issues in the curriculum did not develop the needed skills because the course lasted in just a week. There were no manuals and no clear standards followed’’

Yet another KICD lady officer commented:

Teachers are not up to scratch because not all of them have been oriented on issues of integrated environmental education. Teachers capacity is therefore still in doubt as in-servicing them is not implemented the way it was envisaged. For example when we go out on teachers’ orientation exercise, we approach it on a primary level and secondary level basis instead of subject specific basis. Consequently we end up less focused and the whole exercise is flawed

Another KICD lady officer observed:

Teachers are not fully prepared because pre-service courses at universities and teachers’ colleges were not first targeted before introducing cross cutting issues such as environmental education in schools. In- servicing is also not regularly done. Besides it is difficult to refocus teachers who are already bend on making the grade for their students on national examinations

Still another KICD Lady Officer quipped:

Teachers are not even attempting to integrate EE in the syllabuses and when they do so they merely do it for knowledge transfer and not application.
Interviews with the secondary school principals and KICD officers give the impression that teachers were to a large extent not adequately prepared to make a difference in integration and implementation of environmental education in the secondary school curriculum.

In summary therefore, this study investigated the secondary school teachers’ and students’ levels of environmental literacy premised on five dimensions of EE objectives thus knowledge; awareness, attitudes; skills and participation. The primary findings have shown that overall, teachers’ and students’ environmental knowledge levels were slightly more than just fair considering the issues investigated in the study.

The study further demonstrated that although teachers’ and students’ responses to environmental awareness dimension showed greater diversity, the overall results established that teachers and students were ostensibly aware of environmental issues and therefore seemingly able to integrate EE in the school curriculum. Similarly the overall mean score (M 2.83 out of 5) of teachers’ environmental attitudes over all the items and the pooled mean score (M 2.71 out of 5) of students’ environmental attitudes over all the items could be described as fairly favourable.

Additionally, a critical observation of the overall findings showed that (teachers =75.95% & students =74.45%) agreed that students developed the skills identified in this study by learning them through Integrated Environmental Education and that the students needed such skills to address future environmental concerns.

Finally, teachers and students participation in outdoor environmental activities showed insignificant levels within the community (teachers =17.22% & students = 17.37%); low levels at school (teachers =53.60 % & students =29.15% and moderate levels at home (teachers =67.62% & students = 47.05%). Students’ performance particularly on conservation of resources was rather low as they seemed inadequately
engaged in outdoor environmental activities. Additionally students demonstrated lack of self-efficacy of undertaking environmental activities without coercion. Thus, it is evident that there was overall lack of values and sensitivity to environmental issues by the students. This indicates that implementation of environmental education was seemingly not done effectively.

A hypothesis was also advanced to establish whether there was significant relationship between pure sex and mixed sex public secondary schools with respect to form four students’ mean scores on environmental literacy (awareness, knowledge, skills & attitudes). One-Way ANOVA was conducted and the results showed that there was no statistically significant relationship between single sex and mixed sex public secondary schools with respect to form four students’ mean scores of environmental awareness, knowledge, skills and attitudes.

On the whole, these findings give the impression that both teachers and students were seemingly inadequately prepared to integrate EE in the school curriculum in Machakos Sub-County. The results reported here provide clear empirical evidence that teachers’ and students’ demonstrated fair levels of environmental literacy because they seemingly lacked proper orientation on EE implementation. Shobeiri, Omidvar and Prahallada (2006) share similar views when they caution that if teachers do not have adequate environmental knowledge, skills and commitment to environmentalize their curriculum, it is likely that an environmentally literate student will be produced. This is an indication that teachers’ and students’ in Machakos Sub-County were not sufficiently prepared to integrate EE in the secondary school curriculum and therefore they could not satisfactorily manage environmental degradation. For that reason, the third research question which asked: What are the levels of environmental literacy of secondary school
teachers and students of Machakos Sub-County has been adequately addressed by these findings.

4.7 **Support that teachers required to implement integrated environmental education topics in the secondary school curriculum in Machakos Sub-County**

The research question iv intended to find out the support that teachers required in terms of conditions, resources (Quality & practicality) in order to routinely implement integrated environmental education topics in the secondary school curriculum in Machakos Sub-County. Therefore data about the respondents’ views on the required support was sought. This was considered important because support sustains the innovation or the new programme being implemented. Strong support positively impacted reform implementation, and the lack thereof often negatively impacted implementation (Maddin, 2002).

The support dimension in questionnaire item 27 addressed 7 Likert-type subitems. Teachers’ and students’ responses on a five-point Likert scale had choices ranging from 1 to 5. Five (5) points were assigned to “strongly agree”, 4 to “agree”, 3 to “undecided”, 2 to “disagree” and 1 to “strongly disagree”. Teachers and students therefore recorded their order of agreement or disagreement on various statements and their percentage (%) responses were presented in table 19.
Table 19
Percentage of teachers’ and students’ responses regarding the support that teachers require to implement integrated environmental education topics in the secondary school curriculum (Teachers n=119; Students n=229)

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Teaching resources for environmental education are readily available in school</td>
<td>7.6</td>
<td>15.3</td>
<td>22.7</td>
<td>21.8</td>
<td>9.2</td>
</tr>
<tr>
<td>(ii) Support from the Ministry of Education to improve the incorporation of EE in the school curriculum is readily available</td>
<td>9.2</td>
<td>11.8</td>
<td>44.5</td>
<td>32.3</td>
<td>13.4</td>
</tr>
<tr>
<td>(iii) The school principal encourages teachers to incorporate environmental education in their lessons</td>
<td>12.6</td>
<td>13.1</td>
<td>54.6</td>
<td>25.8</td>
<td>12.6</td>
</tr>
<tr>
<td>(iv) Other teachers in your school encourage the rest of the teachers to incorporate environmental education in their teaching</td>
<td>10.1</td>
<td>8.3</td>
<td>45.4</td>
<td>27.1</td>
<td>13.4</td>
</tr>
<tr>
<td>(v) In departmental meetings, teachers discuss the subject of integration of environmental education in the school curriculum</td>
<td>4.2</td>
<td>10.9</td>
<td>27.7</td>
<td>22.3</td>
<td>20.2</td>
</tr>
<tr>
<td>(vi) Teachers use the rich school outdoor experiences to teach EE lessons</td>
<td>8.4</td>
<td>8.3</td>
<td>42.9</td>
<td>20.5</td>
<td>12.6</td>
</tr>
<tr>
<td>(vii) The school community encourages teachers to integrate environmental education in teaching</td>
<td>10.1</td>
<td>16.2</td>
<td>33.6</td>
<td>32.3</td>
<td>21.8</td>
</tr>
</tbody>
</table>

Key: SA=strongly agree, A=Agree, U=Undecided, D=Disagree, SD=strongly disagree, %T=Percent teachers %S=Percent Students

Source: Field data, 2017
As illustrated in table 19, strongly agree and agree were evaluated together. Similarly, disagree and strongly disagree were treated collectively. From the responses, it can be inferred that, about 50% of the teachers and slightly below 50% of the students agreed with statements in sub-items ii (Teachers 53.70 %; Students 44.10 %); iii (Teachers 67.20 %; Students 38.90 %) and vii (Teachers 43.70 %; Students 48.50 %) indicating that support from the Ministry of Education; encouragement from the school principal and encouragement from the community that were required to implement integrated environmental education topics in the secondary school curriculum were available. However, the support was inadequate (<50%). Looking further at the results it is apparent that more support to implement integrated environmental education in the school curriculum is needed.

Similarly, a striking revelation from table 19 was that teaching resources for environmental education were inadequate (teachers=67.20 %; students=38.90 %) in schools for purposes of implementing EE and collegial cooperation among the teachers was also unsatisfactory (teachers=55.50 %; students=33.20 %).

From the findings it is apparent that support in terms of resources for implementing integrated environmental education in the school curriculum was identified as crucial, but currently inadequate to pursue this objective signifying that there is need for additional support. This is a serious problem that needs to be dealt with quickly. However the extent of support would vary from institution to institution depending on the contextual requirements. It should also be well understood that the availability of support in terms of resources itself does not automatically impact positively on IEE implementation performance. It is the implementers’ ability to integrate IEE well in their teaching which influences the outcome.
From the responses, it could also be inferred that teachers seldom shared the subject of integration of environmental education in the school curriculum. Yet the atmosphere of talking with each other throughout was necessary because it would build teachers’ confidence in implementing EE. It was also revealed that students did not seem to have had exposure to learning environmental education outdoors (47.60%) hence together with their teachers they thought very little about exploiting school outdoor experiences to teach and learn IEE lessons.

This outcome is consistent with Kimaryo’s (2011) study on Integrating Environmental Education in Primary School Education in Tanzania which demonstrated that in most developing countries teachers did not exploit the rich outdoor experiences for teaching EE due to the fact that class sizes were large, learning materials were inadequate and external examinations were too demanding and thus teachers were boxed in the traditional way of teaching, which was “talk and chalk”. Odeke’s (2009) Kenyan study on contextualizing curriculum through issues based approaches demonstrated that outdoor lessons were only regarded as optional pastime activities when teachers were bored and tired of routine classroom teaching. This has in effect impacted negatively on sustainability of implementation of the new programme (IEE)

Despite the fact that the percentage of teachers (14.70%) and students (23.10%) who were undecided was low, the findings show that students were more undecided than the teachers regarding the support required. The percentages for the students who were undecided were persistently above those for the teachers for all the items except for the sub items i, ii and vii (Table 19) demonstrating a manifestation of students’ indecision.

To corroborate the foregoing outcome, mean scores and standard deviations for teachers’ and students’ responses were also computed and recoded in table 20.
Table 20
Mean scores and standard deviations representing teachers’ and students’ response on the support that teachers needed to implement integrated environmental education in the secondary school curriculum.

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Teaching resources for environmental education are readily available in school</td>
<td>3.41  1.245</td>
<td>2.86  1.397</td>
</tr>
<tr>
<td>ii. Support from the Ministry of Education to improve the incorporation of EE in the school curriculum is readily available</td>
<td>2.83  1.258</td>
<td>3.08  1.298</td>
</tr>
<tr>
<td>iii. The school principal encourages teachers to incorporate environmental education in their lessons</td>
<td>2.44  1.062</td>
<td>2.95  1.355</td>
</tr>
<tr>
<td>iv. Other teachers in your school encourage the rest of the teachers to incorporate environmental education in their teaching</td>
<td>2.72  1.169</td>
<td>2.86  1.269</td>
</tr>
<tr>
<td>v. In departmental meetings, teachers discuss the subject of integration of environmental education in the school curriculum</td>
<td>3.24  1.119</td>
<td>3.00  1.234</td>
</tr>
<tr>
<td>vi. Teachers use the rich school outdoor experiences to teach EE lessons</td>
<td>2.82  1.147</td>
<td>2.63  1.322</td>
</tr>
<tr>
<td>vii. The school community encourages teachers to integrate environmental education in teaching</td>
<td>2.92  1.222</td>
<td>3.20  1.372</td>
</tr>
</tbody>
</table>

**Key:** M = Mean Score; SD= Standard Deviation

**Source:** Field data, 2017

It could be inferred from table 20 that the overall mean score for teachers’ response (M=2.91 out of 5) and the pooled mean score (M=2.94 out of 5) for students’ response suggest that teachers and students accepted to some degree, that support to implement IEE was available but insufficient. This view is consistent with the findings from interviews with the secondary school principals and KICD officers who revealed that assistance towards implementation of IEE was available but minimal as it was provided in terms of only seedlings and guidance and counselling services; orientation of teachers on EE integration and provision of some relevant materials such as orientation manuals.
On this issue one male secondary school principal emphasized:

There is very little support if any apart from seedling donation from NEMA and from the County Government of Machakos during meetings for heads of schools and heads of subjects.

However a KICD male officer observed:

We go out though irregularly to discuss integration of emerging issues in the syllabus with the teachers. Quality Assurance Officers also supply some orientation manuals to schools and help teachers with the integration.

To triangulate data students were further asked the requirements they needed to effectively carry out integrated environmental education activities in their schools. Cook (2009) observes that using a triangulation approach increases the confidence and trustworthiness of the study. Percentage students’ responses regarding the support that they required were therefore recorded in table 21.

**Table 21**

Percentage students’ responses regarding the support that they required (Students n=229)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Frequency(f)</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding</td>
<td>32</td>
<td>14.0</td>
</tr>
<tr>
<td>Provision of teaching / learning resources</td>
<td>32</td>
<td>14.0</td>
</tr>
<tr>
<td>Guidance</td>
<td>6</td>
<td>2.6</td>
</tr>
<tr>
<td>Environment Conservation</td>
<td>2</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Total response</strong></td>
<td><strong>72</strong></td>
<td><strong>31.4</strong></td>
</tr>
<tr>
<td>No response</td>
<td><strong>157</strong></td>
<td><strong>68.6</strong></td>
</tr>
</tbody>
</table>

**Source:** Field data, 2007

It could be inferred from table 21 that students pointed out that funding (14%) and provision of teaching/learning resources (14%) were required for them to effectively carry out integrated environmental education activities in their schools. Guidance (2.6%) and environmental conservation (0.9%) as requirements recorded insignificant
percentages. Although only 31.4% of the students responded to this sub-item, they seemed to point out that funding and resources were requisite provisions for carrying out environmental activities in schools.

Students were further asked to suggest conditions that might make it easier for their teachers to incorporate environmental education in their teaching. Responses were recorded in table 22.

Table 22
Conditions suggested by students that might make it easier for teachers to incorporate environmental education into their teachings. (Students n=229)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Frequency (f)</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making it a compulsory subject</td>
<td>17</td>
<td>7.4</td>
</tr>
<tr>
<td>training teachers</td>
<td>6</td>
<td>2.6</td>
</tr>
<tr>
<td>teamwork</td>
<td>4</td>
<td>1.7</td>
</tr>
<tr>
<td>Government / Ministry Support</td>
<td>6</td>
<td>2.6</td>
</tr>
<tr>
<td>Student Knowledge</td>
<td>11</td>
<td>4.8</td>
</tr>
<tr>
<td>Provision of learning materials/ resources</td>
<td>6</td>
<td>2.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>50</strong></td>
<td><strong>21.8</strong></td>
</tr>
<tr>
<td><strong>No response</strong></td>
<td><strong>179</strong></td>
<td><strong>78.2</strong></td>
</tr>
</tbody>
</table>

Source: Field data, 2017

As table 22 shows, 7.40% of students’ suggested making IEE a compulsory subject would make it easier for teachers to incorporate it in their teaching. Other requirements scored as follows; enhancing students’ knowledge (4.80%); training teachers (2.60%); Government / Ministry Support (2.60%); and provision of learning materials/ resources (2.60%). The least suggested option was teamwork (1.70%).

Although only 21.80% of the students responded to this sub-item, the suggestions were valid as they were backed by empirical studies. For example research has shown that support in terms of resources affected implementation of new programmes. Akinnuoye and Nor’s (2011) study on implementation of EE in Malaysian and Nigerian
secondary schools demonstrated that the Malaysian schools with 100% facilities had better implementation status compared to Nigerian schools with a paltry 12% of the facilities.

Koskey’s (2013) Kenyan study on implementation of Early Childhood Development (ECD) curriculum in Uasin Gishu County showed that ECD curriculum by NACECE was not adequately implemented as it was initially designed and conceptualized because of lack of and poor usage of necessary facilities and materials among other reasons. Fullan and Miles (1992) caution that change is resource-hungry and therefore reformers must be prepared to the growing costs of the change process.

According to Fullan’s Theory of Educational Change (1991) support in terms of human and material resource; reasonableness of the timelines for implementation and work conditions deserved clear-headed attention in programme implementation. Hammonds (2002) asserts that “People must work together to figure out what is needed to achieve what is worthwhile” Therefore, tri-level engagement, thus school and community; district; and state is essential for system reform (Fullan, 2006).

To address the research question on the support that teachers required to implement integrated environmental education related topics in the secondary school curriculum in Machakos Sub-County, the following summary adequately dealt with the issue:

Support in terms of resources for implementing integrated environmental education in the school curriculum was identified as crucial, but currently inadequate in Machakos Sub County. Interviews with secondary school principals and KICD officers concurred with these findings that assistance towards implementation of IEE was available but minimal. Teachers on their part also lacked collegial cooperation which undermined their confidence in implementing IEE. If teachers choose not to participate in
collegial relationships, or decision making, school improvement initiatives will not enjoy sustained implementation (Southwest Educational Development Laboratory [SEDL], n.d).

According to Maddin, (2002) strong support positively impacted reform implementation, and the lack thereof often negatively impacted implementation. Since support also sustains the new programme being implemented, the findings evidenced from the data analyzed here imply that implementation of related integrated environmental education topics in the secondary school curriculum in Machakos Sub-County was inadequate and might not satisfactorily address the problem of environmental degradation.

The students therefore pointed out that funding; provision of teaching/learning resources; guidance and environmental conservation were required for implementation of EE to be carried out. Similarly, the students further suggested that for their teachers to effectively carry out EE activities the following conditions be met: EE be made a compulsory subject; teachers are trained; more support is provided by Government / Ministry of Education and learning materials / resources are provided. However the least suggested preference was teamwork.

4.8 Instructional approaches that secondary school teachers use to teach integrated environmental education

Instructional approaches are ways by which information is presented to students. The research question number (v) intended to find out what instructional approaches secondary school teachers used to teach integrated environmental education topics in the secondary school curriculum in Machakos Sub-County. Instructional approaches that the teachers used were important because they enhanced positive learning outcomes resulting in students’ achievement thus reaching their educational potential. “The difference that standards of effective pedagogy can make in a child’s life can be as great as the difference
between success and failure in school and in life” (Entz, 2006 p 22). According to Chowdhury (2015) pedagogical practices that were employed in a classroom were fundamental to implementation of environmental education. Vudiniabola (2011) further observes that methods of teaching and the content of what is taught represent the quality of change of a new curriculum.

Therefore to establish teachers’ instructional approaches for EE content, the teachers’ and students’ responses were assessed on the criteria of having used and having not used various instructional approaches categorised as learner-centered and teacher-centered. According to Kelani, (2015) approaches that apply to guided discovery, experiments, role-playing, value judgment, problem-solving and project development were oriented towards learner-centred methodologies. Learner-cantered methodologies pursue constructivist and critical theories (O’Bannon, 2002). Constructivist theories whose main proponents were Dewey (1859–1952), Piaget (1976) and Vygotsky (1986) view learning as the effect of learners’ construction of own knowledge based on interactions with their environment and with other people.

Similarly, teacher-cantered pedagogies according to Westbrook, Durrani, Brown, Orr, Pryor, Boddy and Salvi (2013) express approaches such as lecturing, demonstration, rote learning, memorization, choral repetition and imitation which could be broadly categorized as ‘behaviourist’ in orientation. Behaviourist theories of learning whose main proponents were Watson (1903), Skinner (1904-1990) and Pavlov (1849-1936) uphold the view that animals and people are biologically "wired" so that a certain stimulus will produce a specific response (Educational Theories, n.d). Through repetitive uses of punishments and rewards animals and people could be conditioned to act consistently over time (Petrina, n.d. p. 211). This implies that behaviorist theories do not appreciate that students come into classrooms with prior knowledge and pre-conceptions (UK
Essays, 2003 – 2013) and therefore through rewards and punishment the students are coerced to promote desirable behaviour (Educational Theories, n.d) for instance of nurturing eco-friendly habits and discouraging irrational conduct.

In order for the researcher to identify the various methods that teachers used or not having used in EE content presentation; the following data were collected from teachers and students and summarised as in table 23.

**Table 23**

**Teachers’ and students’ percentage responses on teaching methods (Teachers: n=119; students: n=229)**

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Have used</th>
<th>Have not used</th>
<th>No response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%T%S</td>
<td>%T%S</td>
<td>%T%S</td>
</tr>
<tr>
<td>i. Lectures</td>
<td>76.5 39.3</td>
<td>21 52.0</td>
<td>2.5 8.7</td>
</tr>
<tr>
<td>ii. Demonstration</td>
<td>63.9 56.8</td>
<td>29.4 35.4</td>
<td>6.7 7.9</td>
</tr>
<tr>
<td>iii. Gaming &amp; Simulation</td>
<td>24.4 34.1</td>
<td>68.9 55.9</td>
<td>6.7 10.0</td>
</tr>
<tr>
<td>iv. Workshop</td>
<td>21.0 30.1</td>
<td>73.1 62.9</td>
<td>5.9 7.0</td>
</tr>
<tr>
<td>v. Experiments</td>
<td>63.0 64.2</td>
<td>31.9 30.6</td>
<td>5.0 5.2</td>
</tr>
<tr>
<td>vi. Field trips</td>
<td>67.2 60.3</td>
<td>26.9 32.3</td>
<td>5.9 7.4</td>
</tr>
<tr>
<td>vii. Role playing</td>
<td>47.9 47.6</td>
<td>45.4 39.7</td>
<td>6.7 12.7</td>
</tr>
<tr>
<td>viii. Group Discussion</td>
<td>77.3 59.8</td>
<td>18.5 24.5</td>
<td>4.2 15.7</td>
</tr>
<tr>
<td>ix. Seminar</td>
<td>25.2 28.4</td>
<td>68.9 59.8</td>
<td>5.9 11.8</td>
</tr>
<tr>
<td>x. Case Study</td>
<td>39.5 32.8</td>
<td>55.5 54.6</td>
<td>5.0 12.7</td>
</tr>
<tr>
<td>xi. Projects</td>
<td>39.5 62.4</td>
<td>55.5 27.9</td>
<td>5.0 9.6</td>
</tr>
<tr>
<td>xii. Self Study</td>
<td>62.2 60.3</td>
<td>31.1 30.1</td>
<td>6.7 9.6</td>
</tr>
<tr>
<td>xiii. Action research</td>
<td>33.6 44.1</td>
<td>61.3 46.7</td>
<td>5.0 9.2</td>
</tr>
<tr>
<td>xiv. Problem solving (Creative Thinking, Generating new ideas)</td>
<td>60.5 58.1</td>
<td>31.1 32.8</td>
<td>8.4 9.2</td>
</tr>
<tr>
<td>xv. Critical Thinking (Analyzing issues, evaluating issues, synthesizing issues)</td>
<td>59.7 61.6</td>
<td>34.5 31.4</td>
<td>5.9 7.0</td>
</tr>
<tr>
<td>xvi. Computer assisted learning</td>
<td>23.5 30.6</td>
<td>71.4 60.7</td>
<td>5.0 8.7</td>
</tr>
</tbody>
</table>

**Key:** %T = Percent teachers %S= Percent students

Source: Field data, 2017

As table 23 shows, on average 49.06% of teachers and 48.16 % of students commonly used demonstration; experiments; field trips; role playing; group discussion;
self study; problem solving and critical thinking. The method that was highly rated as having been used by both teachers and students was discussion (Teachers=77.3% Students=59.8%), highly rated by teachers only (Group discussion, 77.3% & lectures, 76.5 %) and highly rated by students only (experiments, 64.2% & projects, 62.4%). This showed that in some instances teachers preferred blending specific elements of group discussion (learner-cantered) and lectures (teacher-cantered) to realize maximum effect of teaching integrated environmental education, but students preferred mostly experiments and projects because they could remember well the activities during their hands on experiences and seemed to develop a pro-environmental attitude.

Similarly on average, 66.52% of teachers and 56.77% of students disapproved having used workshops; computer assisted learning; seminars; gaming & simulation; action research; and case study in that order. These findings clearly confirm that learner centred approaches were unpopular with the respondents especially the teachers.

Despite being regarded as one of the most effective strategy in education, computer assisted learning according to this outcome was among the first three unpopular techniques employed by teachers and students in Machakos Sub-County. This is quite contrary to an earlier study by Kelani (2015) on integration of environmental education in science curricula in secondary schools in Benin in West Africa where 91.70% of the respondents were reported having used computer-assisted lessons to enhance teaching and learning of environmental education. Liu (2010) claims that ICT shifted teaching towards constructivism in China where the computer became tutor, tutee and tool rolled into one. Yet in Machakos Sub-County 71.40% of teacher respondents and 60.70% of student respondents claim not having used computer assisted learning. It would seem that teachers and students in Machakos Sub-County lacked enough exposure to ICT.
Findings based on teachers' own responses (Table 23) also showed that teachers preferred blending specific elements of group discussion (learner-cantered) and lectures (teacher-cantered) to realize maximum effect of teaching integrated environmental education (IEE). With teaching experiences of between 1 to 20 years, teachers were in a position to demonstrate an understanding that learners with different learning styles required a combination of approaches to reach most of them. The UK Essays (2003 – 2013) shared a similar view that classroom practice could consider using a range of different teaching approaches in alignment with the favourable learning theory of the students and therefore teachers should consider combining specific elements of all these learning frameworks when teaching.

The students preferred mostly experiments & projects most likely because these approaches could have been interesting and interactive sessions out of classroom learning. This argument ties in with findings of a review article on students' perception about integrated teaching by Uma, Rajani, and Usha (2015, p. 48) that perception of students regarding various teaching methods showed that only 51% of students preferred traditional teaching methods such as black board teaching and power point presentation while interactive sessions attracted 96%, group discussion (94%), workshop (90%), demonstrations (94%) and out of class room teaching (95%) of student respondents.

This view is consistent with Westbrook, et al. (2013) rigorous literature review commissioned by the Department for International Development (DFID), focusing on pedagogy, curriculum, teaching practices and teacher education in developing countries. The review demonstrated that overall, 15 studies found group work effective, mostly in large resource-constrained classrooms. Nannyonjo’s study (as cited in Westbrook, et al. 2013) also found that ‘Pupils who worked together in small groups (with or without assistance from a teacher) had higher scores than those who did not’
Alexandar’s and Poyyamoli’s (2014) Indian experimental case study on effectiveness of active teaching and learning of environmental education for sustainable development at high school level in Puducherry and Cuddalore regions demonstrated a significant statistical difference between the overall pre and post test impacts on the level of environmental knowledge, behaviour, attitudes, and skills of the students from both the groups. In the post test result, the experimental group students scored significantly higher knowledge, attitudes, skills and behaviour on air, water, biodiversity conservation and solid waste management than the students who were exposed to the traditional teaching methods. Uma, et. al.(2015) further aligns with these views when he asserts that students listed the positive aspects of active learning as improving the application of knowledge, developing logical thinking, creating interest in subjects, boosting the confidence and speaking skills, providing extra information, promoting interaction and participation by all.

As further support for these views, Mustam and Sarojini’s (2016) Malaysian longitudinal intervention study report on the integration of Environmental Education demonstrated that students preferred field trips because even after one full year the participating students could remember well the activities during their trip and seemed to have developed a pro-environmental attitude. Literature review (Russell & Burton 2000) shares similar thoughts that experiential learning outdoors, is easier and more effective for most students than the traditional classroom setting. Further observation by Russell & Burton (2000) posit that outdoor learning creates fun for the children and this enhances a passion for what they are involved with, resulting in developing curiosity, competency, creativity and application of classroom skills to solving real environmental problems. This could be interpreted to imply that students preferred being actively engaged in
learning for sustainable environmental practices compared to non participatory teacher-centred pedagogies such as lecturing.

Burchett (2015) advises that we should abandon the Moses model of education, the delivery by elders of tablets of stone to be memorized. Lee and Williams (2001) and O’Donoghue (as cited in Roselimo, 2010) further contend that environmental education has since shifted focus from such approaches that support education about the environment (knowledge transfer) to the most-promoted action oriented (constructivist) approaches. Constructivist strategies therefore appear to be the most favoured and trustworthy description of modern learning (UK Essays, 2003 - 2013). Consequently, Kelani (2015) advises that learner-centred strategies should be used during EE as essential strategies for teaching and learning. However, Westbrook, et. al. (2013 p.31) cautions that without realistic support and scaffolding for learning, teachers were likely to implement the curriculum only partially and slip back to traditional methods for much classroom activity.

The scenario described here might suggest that active teaching and learning approaches were more effective in facilitating environmental education among school children. Westbrook, et. al. (2013) shares these views when he asserts that reforms that promote more social constructivist approaches seemed, from the relative strength of the findings here, to be making some impact where classes were smaller in number and there were sufficient learning materials. But according to Lozzi, and Marcinkowski (1990) the practice of environmental education is diverse in approach and application. Dunn & colleagues (as cited in Tulbure, 2012) warn, “We can no longer afford to assume that all students will learn through whichever strategy the teacher prefers to use” p. 372. Chowdhury (2015) reiterated “I know there is no one-size-fits-all approach to the work of teaching environmental education. Bingimlas (2008) further observes that no component
in itself is sufficient to produce good teaching. This implied that no one approach in itself was adequate to meet all students’ learning needs. Students have different leaning styles and therefore they require differentiated instruction to meet their needs. According to Tulbure (2012), diagnosing students’ individual learning styles to match the differentiated instruction represents an expected challenge. Therefore the presence of all approaches increased the likelihood of excellent learning and teaching opportunities of IEE.

Ko and Chi-kin’s (2003) study on teachers’ perceptions of teaching environmental issues within the science curriculum demonstrated that although some teachers promoted environmental education in extracurricular activities, many teachers continued to use exposition (lecture) methods which facilitated the transmission of knowledge and the coverage of the syllabus. Asif and Imran’s (2013) study on prospective teachers’ beliefs about concepts of teaching and learning in Pakistan further demonstrated that a significant majority (72%) of prospective teachers were of the view that teaching means to transfer information and knowledge to learners. Kimaryo (2011) asserts that the traditional approach to the teaching and learning of environmental education has been mainly based on the transmission of factual knowledge (lecturing). Lecturing is assumed, when people get more knowledge they become more aware of the environment, hence more motivated to act towards the environment more responsibly (Hungerford & Volk, 1990).

Lectures for knowledge transfer could also bring about changes in the attitudes of citizens to do something concrete toward resolving current environmental problems and in preventing new ones (Kelani, 2015). Behaviorist related methods of teaching such as lectures seem to guarantee specific learning outcomes which are easily measurable and applied (Tangent LLC, 2015). Such behaviourist methods according to Pritchard (2009) are also more advantageous for those students displaying anxious tendencies and low motivation. Behaviourist learning approaches could be beneficial especially in
establishing standards and classroom routines (UK Essays, 2003 - 2013) in regard to environmental ethic. Therefore there is a place for lecturing, memorization, rote learning of facts and skills in education and in every day contexts (Donnison & Penn-Edwards, 2012).

However behaviourist approaches for instance lectures tend to provide information rather than to facilitate student reflection and therefore some teachers tend to shape the students’ construction of a concept to align with teachers’ personal concept interpretation. Pritchard (2009) argues that learning concepts without understanding can fuel frustration, lead to misconceptions and generate a difficult learning environment. Besides behaviourist approaches are an extrapolation of animal behaviour to humans (Tangient, 2015). The assumption that humans behave in the same way as animals is open to discussion. New research has shown that pupils who are given rewards such as sweets, stickers, house points etc for good work and completing tasks will often lose interest in learning and may lose motivation altogether (UK Essays, 2003 - 2013).

In addition, the assumption that a single approach to learning fits-all students excludes those students with individual differences (Westbrook, et. al 2013). For instance while kinesthetic learners learn best when actively engaged, auditory learners prefer to collect and confirm information by way of listening say to lectures. In sharing this view Haris and Afdaliah (2016, p. 317) warn that “The reminder is to provide not the lecturing of concepts that create passive students as listeners but the learning environment that involves students actively in constructing knowledge, experience, and skills that can later be implemented in daily life and transferred to others” Therefore the traditional teacher-centred methods do not seem adequate on their own to meet the many students needs In this regard the researcher seemingly finds the behaviourist approach on its own,
problematic for implementation of integrated environmental education in the secondary school curriculum considering its inherent shortcomings.

O’Bannon (2002) further argues that there is not one "best" approach to instruction as some goals are better suited to teacher-centred approaches while others clearly need learner-centred approaches. Teachers in practice use a judicious combination of both learner-centred and teacher-centred pedagogical practices, integrating newer pedagogies with more traditional ones (Westbrook, et al. 2013, p.37).

O’Bannon (2002) and Westbrook et al. (2013, p.37) seem to suggest that the two learning theories and their respective strategies could be used concurrently to take full advantage of the competing students’ learning needs. In support of these arguments, Osakinle, Onijigin and Falana (2010) argue in favour of the eclectic method by which a combination of all that is good in all the other methods of teaching is incorporated. Kimaryo (2011) shares these views when she asserts that a balance among the approaches to EE thus education about the environment (knowledge transfer); education in the environment (experiential learning) and education for environment (ethics, values, attitudes, concern & positive actions for the environment) must be reached within some kind of organizational framework if they have to be successful.

Perhaps this was why in table 24, sub-items i (lectures) and xi (projects) received diverse outcomes as 76.50% of teachers approved having used lectures and 52% of students disapproved having used lectures. Conversely, 62.40% of students approved having used projects and 55.50% of teachers disapproved having used projects. This distribution is not surprising because participating teachers have had teaching experience of (1-20 years) and had opportunities of teaching EE topics using lectures and therefore seemed to have been in better position than their students to understand which teaching method was routinely employed.
This assertion also finds evidence from interviews with the secondary school principals and KICD officers that teachers used teacher-centred approaches in schools to cover the syllabus quickly. One male school principal elaborated:

Teachers mostly use lectures to cover the syllabus on time. Use of fieldwork studies and posters from some organizations are few. Students also learn EE through keeping the compound clean. The sanitation department of the students’ council and the patron of environmental club monitor the program.

KICD officers echoed the principals’ sentiments that indeed teachers were lecture specific in class content delivery. This was demonstrated in the words of one KICD lady officer who gave reasons for this view:

Lecture method is mostly used because of the large class sizes. Lectures are also popular with teachers because they can cover the syllabuses fast so that they may prepare their students for external examinations. Teachers are interested in making a good mean score. Learner-centred approaches are perceived by teachers as a waste of time.

However when teachers and students were further asked to suggest other methods that they would have liked the teachers to use in teaching EE, teacher respondents mentioned fieldwork and excursions (19.75%); seminars (18.52%); use of resources and models (16.05%) (Figure 32). On the other hand, student respondents pointed out fieldwork and excursions (24.04%); open forum (18.52%); guidance and counselling (7.41%); workshops (5.56%); observations (5.56%) (Figure 33)
Figure 32: Other methods that teachers would have liked to use in teaching IEE

Figure 33: Other methods that students would have liked used in teaching EE
From figures 32 and 33 it emerged that field work, field excursions and open forum seemed to be popular methods that teachers and students would have liked used for teaching EE. Fieldwork, excursions and open forum or group discussion were viewed as ‘child-friendly’ and progressive in essence because they had positive learning outcomes. Indicators used for effectiveness of the methods’ according to Westbrook, Durrani, Brown, Orr, Pryor, Boddy and Salvi (2013) were that students were happier, confident and participated in the learning. Even with this outcome, the overall findings on the methods that the respondents could have liked teachers to employ were well below 30 % (Figures 32&33).

Despite active teaching and learning approaches being more effective in facilitating environmental education among school children than the traditional classroom setting (Alexandar & Poyyamoli, 2014; Uma, Rajani, & Usha, 2015; Mustam & Sarojini, 2016; Westbrook, Durrani, Brown, Orr, Pryor, Boddy & Salvi, 2013; Russell & Burton 2000) on average >50% (66.52%) of teachers and >50% (56.77% ) of students disapproved having used workshops; computer assisted learning; seminars; gaming & simulation; action research; and case study in that order. Similarly <50% (49.06%) of teachers and <50% (48.16 %) of students responded having used demonstration; experiments; field trips; role playing; group discussion; self study; problem solving and critical thinking.

Overall findings could be interpreted to imply that most teachers and most students had not fully appreciated learner-centred approaches for EE and therefore they perceived learning strategies more in terms of teacher managed than learner centred. In effect these findings have some major implications for the current implementation of integrated environmental education in the school curriculum in Machakos Sub-County as
they impacted negatively on overall implementation of environmental education in classrooms

From the analysis of data in this section, there are indications that seem to suggest that the study findings endeavoured to address the research question: “What instructional approaches do secondary school teachers use to teach integrated environmental education topics in the secondary school curriculum in Machakos Sub-County?”

Despite that, it could be observed that the preceding findings were subject to various limitations. First, there was no classroom observation to authenticate the self-reported actual practices of the sample teachers. It is possible for some teachers to speak of using a particular teaching strategy but in practice they used teaching methods that they were comfortable with depending on contextual circumstances. Karavas-Doukas’s study (as cited in Wang 2006) found that although most teachers held favourable attitudes towards innovations proposed by policymakers, the same teachers still conducted classroom teaching in the teacher-fronted manner, an apparent discrepancy between policymakers’ intentions and teachers’ execution. Secondly, due to time and resource constraints, there was lack of follow up to check whether the inclusion of non-respondents would have changed the results.

4.9 Challenges that faced the implementation of integrated environmental education in the secondary school curriculum and strategies that were suggested to address these challenges

Guided by the sixth research question, the researcher sought to establish challenges encountered while implementing integrated environmental education in the secondary school curriculum and strategies that were suggested to address the challenges in Machakos Sub-County.
4.9.1 Challenges that faced the implementation of integrated environmental education in the secondary school curriculum

Challenges are obstacles that teachers and students perceived made the implementation of integrated Environmental Education in the secondary school curriculum either difficult or impossible. Challenges to implementation of integrated environmental education were sought because they were key according to Shenoy (2014) to offering ideal chances to learn how to get along with difficult implementation situations. This is consistent with Blair’s (2014) assertion that one will never know the full measure of one’s potential until tested. Fullan (1993) shares these views when he asserts that successful change requires the ability to work with polar opposites: problems versus creative resolution. McGuire’s (2015) further confirms that these new challenges create the opportunity for new solutions. By this, Fullan and McGuire implied that unpacking challenges opened up possible exploitable circumstances presenting good opportunities for solutions to improve implementation of Integrated Environmental Education.

Therefore to determine the challenges encountered during implementation of integrated environmental education, teachers’ and students’ views were sought using 11 Likert-type items on a five-point scale. Five (5) points were assigned to “strongly agree”, 4 to “agree”, 3 to “undecided”, 2 to “disagree” and 1 to “strongly disagree”. Teachers and students therefore recorded their order of agreement and disagreement on various statements. Mean scores and standard deviations for teachers’ and students’ responses were then computed, ranked and summarized in table 24. The higher the score, the more favourable the proposition of the statement was and vice versa.
Table 24
Means and standard deviations for teachers’ and students’ responses on the challenges encountered during implementation of integrated environmental education

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>Rank</th>
<th>Teachers</th>
<th></th>
<th>Students</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>i. There is the lack of environment policy in your school</td>
<td>2</td>
<td>2.78</td>
<td>1.35</td>
<td>3.00</td>
<td>1.47</td>
</tr>
<tr>
<td>ii. Poor coordination of environmental education EE programmes results to repetition and overloading of EE topics in the curriculum</td>
<td>8</td>
<td>2.19</td>
<td>0.97</td>
<td>2.61</td>
<td>1.30</td>
</tr>
<tr>
<td>iii. Overcrowded curriculum does not allow for integration of EE content into the curriculum</td>
<td>5</td>
<td>2.24</td>
<td>1.21</td>
<td>2.80</td>
<td>1.36</td>
</tr>
<tr>
<td>iv. There is no enough time to implement EE in the school curriculum</td>
<td>3</td>
<td>2.52</td>
<td>1.33</td>
<td>2.98</td>
<td>1.41</td>
</tr>
<tr>
<td>v. There is heavy workload for teacher since EE was introduced in the school curriculum</td>
<td>1</td>
<td>2.81</td>
<td>1.37</td>
<td>3.31</td>
<td>1.39</td>
</tr>
<tr>
<td>vi. High emphasis placed on national examinations reduces attention to EE</td>
<td>6</td>
<td>2.15</td>
<td>1.26</td>
<td>2.80</td>
<td>1.39</td>
</tr>
<tr>
<td>vii. Limited cooperation and exchange of ideas among schools and among students defeat efforts of implementing EE in the school curriculum</td>
<td>4</td>
<td>2.23</td>
<td>1.13</td>
<td>2.83</td>
<td>1.40</td>
</tr>
<tr>
<td>viii. Outdates and inadequate facilities in schools frustrate efforts to implement EE in the school curriculum</td>
<td>9</td>
<td>2.06</td>
<td>1.02</td>
<td>2.43</td>
<td>1.29</td>
</tr>
<tr>
<td>ix. Lack of instructional materials in schools affects efforts of implementing EE in the school curriculum</td>
<td>10</td>
<td>2.10</td>
<td>1.105</td>
<td>2.30</td>
<td>1.26</td>
</tr>
<tr>
<td>x. Lack of funding hinders implementation efforts of EE in the school curriculum</td>
<td>11</td>
<td>2.06</td>
<td>1.07</td>
<td>2.29</td>
<td>1.29</td>
</tr>
<tr>
<td>xi. Lack of qualified teachers in environmental issues hinders implementation of EE in the school curriculum</td>
<td>7</td>
<td>2.60</td>
<td>1.44</td>
<td>2.45</td>
<td>1.38</td>
</tr>
</tbody>
</table>

Key: M = Mean Score  SD= Standard Deviation

Source: Field data, 2017.

When the sub-items expressing the challenges encountered throughout the implementation of integrated environmental education in the secondary school curriculum
were ranked in terms of teachers’ and students’ mean scores (Table 24), the sub-item v “There is heavy workload for teachers since EE was introduced in the school curriculum” was ranked 1st (Teachers $M = 2.81$; Students $M = 3.31$). The implication of these mean scores was that teachers and students outstandingly supported the idea that heavy workload for teachers reduced their vigour for implementation of IEE.

This finding is consistent with the findings of a study with Ontario teachers by Byrne (as cited in Leithwood 2006) which reported that “Teachers’ organizational commitment was reduced by struggles over competing priorities such as multiple role expectations for example, teacher coach, mentor & advisor” pp.31, 35. Maddin (2002) further observes that the practicality of a change initiative is determined by how well it fits teachers’ current work conditions. For example, does the change fit the way teachers normally facilitate classroom activities? Fullan’s theory of education change (1991, revised 2006, 2007) identifies and clarifies the importance of practicality of work conditions during the implementation process of a new programme. Fullan argues that if teachers were already overloaded, practicality of such a programme would be sacrificed especially when the teachers were expected to implement several programmes simultaneously. It should be noted that teachers must have the right work conditions in place in order to effectively implement environmental education otherwise they would become anxious, stressed, and ultimately burnout of vigour.

Table 24, further demonstrates that sub-item i “There is the lack of environment policy in your school” was ranked 2nd (Teachers $M = 2.78$ & Students $M = 3.00$). These mean scores suggest that teachers and students indicated positive support for the statement that schools do not have environment policy. This result finds evidence in the Hon Kong study by Cueng (1994) which demonstrated that only 28 (7%) of the respondents reported that there was a school policy for environmental education while
290 (68%) of them said that there was none. Odeke (2009) further observed that while policies were reflected in school visions and missions, poor support for their implementation drastically changed their purpose and effectiveness. Freefind (n.d) cautions that the omission of policy proved to be the downfall of the 1970s global effort to infuse environmental education into the elementary and secondary curriculums. This implied that the implementation of IEE in the school curriculum would face a similar outcome if little articulation of environmental education policy devalues the force that propels environmental practice.

It could also be inferred from table 24 that sub-item iv “There is no enough time to implement EE in the school curriculum” was ranked 3rd (Teachers M = 2.52; Students M = 2.98). This could be interpreted to imply that participating teachers and students had a mean response in the moderate range for the support of the statement. Seemingly inadequate time was a challenge to implementation of IEE in the school curriculum. This finding corroborated an earlier research by Lumadi (2014) whose South African study in the North West and Limpopo Provinces revealed that 60% of the participants identified time factor as a frustrating challenge to both teachers and curriculum developers. Fear of "not covering the syllabus" was the major concern of many teachers (Chi-chung Ko1 & Chi-kin Lee, 2003). According to Symons (2008), time and money were quoted as the biggest impediments to implementation of IEE. From the aforementioned studies it would seem that teachers and students tended to display negative attitudes towards the implementation of IEE in the school curriculum due to inadequate time. This confirms Fullan’s theory that “effective change takes time” p. 109 (2001) and therefore the investment requires patience of different parties.

Table 24 also demonstrates that sub-item vii that read “Limited cooperation and exchange of ideas among schools and among students defeat efforts of implementing EE
in the school curriculum” was ranked 4th (Teachers’ views = 2.23; Students’ views M= 2.83). This suggests that teachers and students demonstrated a moderate position regarding the statement implying that limited cooperation and exchange of ideas among schools and among students was a challenge to implementation of EE. This outcome finds support in Krajnc, - Milena Valenčič Zuljan’s (2008) Slovenian empirical article that demonstrated 79.60% of pre-school teachers who found teamwork a very important factor of their professional development, 63.10% of them found feedback from critical friends very important, while 49.50% thought that educational conferences were very important forms of cooperation.

Additionally Scott (2013) argues that collaboration increases operational efficiency as tapping into the distributed intelligence of a group increases chances of solving problems more efficiently. Elder-Hurst (2012) further asserts that the community atmosphere of talking with each other throughout the year helped teachers build their confidence.

Fullan (2003) emphasizes the call for contacts, that looking at the connectedness of the work, there was a need to increase the amount of purposeful interactions between and among individuals within and across the levels, and indeed within and across systems. On the basis of this premise, Fullan (2006) further advised that tri-level engagement thus ‘school and community; district; and state is essential for system reform’ If various IEE implementation teams fail to collaborate to create a shared vision and definition of roles, there would be inadequate flow of information to inform interested parties about the relevant implementation issues.

Similarly, sub-item iii, that read “Overcrowded curriculum does not allow for integration of EE content into the curriculum,” was ranked 5th (Teachers’ views M = 2.24; Students’ views M= 2.80). The results demonstrated that, teachers’ and students’ mean
scores indicated a slightly favorable support for the statement implying that overcrowded curriculum is a challenge to implementation of IEE. Medlen (2010) shares these views when the scholar lamented that it seems nowadays that every interest group and government department is calling for their course to be included in what has become an increasingly crowded school curriculum. Yet, there are only so many hours in a day to teach. It should be noted that under such circumstances IEE would seemingly be outcompeted especially in a curriculum which is geared towards examinations. This statement finds support in Symons’ (2008) declaration that “Research found that ‘ESD appears to have a low priority in the curriculum and in schools. Schools concentrate their efforts on aspects of school life that are statutory and seen to be priorities such as literacy, numeracy and exam grades’ and ‘ESD cannot flourish in an overprescribed and over-full curriculum” p.22.

Likewise, sub-item vi “High emphasis placed on national examinations reduces attention to EE” was positioned 6th (Teachers’ views = 2.15; Students’ views M= 2.80); Teachers’ and students’ mean scores indicated that the respondents’ views were favourable as regards the statement. The result suggests that a high premium placed on examinations suppressed the implementation of IEE in the school curriculum. This statement finds evidence in Boit, Njoki and Koskey’s (2012) Kenyan study which established that examinations had a backwash effect on the curriculum such that selection of content and methods of instruction were examination oriented ignoring integration of life skills. Sharing this view, Jian (2004) observes that “A pyramid of school examinations seems to justify the exam-oriented education. It is a major obstacle in the implementation of quality education and knowledge innovation, as well as in the creation of “green schools.” p.72 As teachers prepare learners for the final examinations, they pattern their assessment approaches on the Kenya National Examinations Council
(KNEC) grid and learners spend too much time on preparing for tests at the expense of actual learning (UNESCO, International Bureau of Education, and VII Ed. 2010/11). There was little time for thinking, reflecting, problem-solving or exploration, contrary to environmental education goals which are expected to be achieved in the school curriculum.

It can further be inferred from table 24 that sub-item xi “Lack of qualified teachers in environmental issues hinders implementation of EE in the school curriculum” was ranked 7th (Teachers’ views M= 2.60; Students’ views M= 2.45). This finding could be interpreted to imply that students and teachers were reasonably positive about the statement. It was therefore presumed that lack of qualified teachers in environmental issues affected implementation of IEE in the school curriculum.

This finding is supported by Bhandari and Abe’s (2000) article, analysing status reports from 36 countries in the Asia-Pacific region which established that there was a notable shortage of trained manpower, especially of environmental educators and facilitators. Atiti (as cited in Odeke 2009) asserts that the major impediments to effective environmental education practice in Kenya have been identified to include; lack of appropriately trained professionals. At the current time, teachers engaged in basic education are relatively weak in concept, awareness, knowledge, and skill set in Environmental Education (Jian, 2004).

These arguments find evidence in Lumadi’s (2014) exploration of factors faced by teachers in curriculum implementation in the North West and Limpopo Provinces of the Republic of South Africa. The study reported that 53% of the teachers complained that they did not receive enough in-service training especially those teachers in rural areas who received training for only three to five days. Lumadi further laments that this period
of training did not suffice at all. Fullan (2003, p. 31) states that “no matter how promising a new idea may be, it cannot impact students learning if it is superficially implemented”

It should be noted that curriculum implementation and adjustment of teachers to it is a continuous process and not a one-time act. It does not happen all at once or proceed smoothly (Elder-Hurst, 2012). Therefore orientation programmes addressed in a hit or miss fashion, it would seem focused on small parts of the bigger problem and could have missed out on critical implementation details for IEE. The training simply reduced teacher preparation, as pointed out by Ravindranath (2007) and Marcinkowski (2010) to advocacy or awareness creation which was academic; theoretical and environmentally displaced.

Sub-item ii “Poor coordination of environmental education programmes results to repetition and overloading of EE topics in the curriculum” was ranked 8th (Teachers’ views M = 2.19; Students’ views M= 2.61). Although teachers’ and students’ mean scores weakly supported the statement, the views were positive and valid implying that flawed coordination of environmental education programmes resulted to overlaps and overloads of EE topics in the curriculum. The finding of this study reiterated that of Bhandari and Abe (2000) in the Asia-Pacific region which demonstrated that lack of coordination and synergy amongst NGOs and other agencies in the region resulted in duplication of activities in school curriculum. Duplication of certain initiatives and activities could result in overlaps and overloads of EE topics competing for space with topics of the carrier subjects in the curriculum. It would seem such a situation could significantly affect the implementation of EE in the school curriculum especially where classroom instruction is inclined towards externally examined contents of the carrier subjects rather than developing actual skills and competencies in EE.
Sub-item viii “Outdated and inadequate facilities in schools frustrate efforts to implement EE in the school curriculum” was ranked 9th (Teachers’ views M= 2.06; Students’ views M= 2.43). From the given mean scores, it could be advanced that teachers and students modestly supported the statement. This finding was similar with the results of Akinnuoye and Nor’s (2011) case study in Malaysian and Nigerian Secondary Schools which demonstrated that the Malaysian schools with 100% facilities had better implementation status compared to Nigerian schools with a paltry 12% of the facilities. As a result Akinnuoye and Nor (2011) observe that more than 75 % of students in Malaysian schools had better environmental education awareness as against their counterparts in Nigerian schools. More teachers in Nigeria agreed that the concept of EE was difficult to teach due to lack of or inadequate facilities and conducive environment (Akinnuoye & Nor, 2011). Koskey’s (2013) Kenyan study on implementation of Early Childhood Development (ECD) curriculum in Uasin Gishu County restated that ECD curriculum by NACECE was not adequately implemented as it was initially designed and conceptualized because of lack of and poor usage of necessary facilities and materials among other reasons. Inadequate facilities would also imply that teachers had been concentrating on imparting theoretical skills at the expense of the desired practical environmental skills, attitudes and values.

The sub-item ix “Lack of instructional materials in schools affects efforts of implementing IEE in the school curriculum” was positioned 10th (Teachers’ views M 2.10; Students’ views M 2.30 out of 5). This finding could be interpreted to imply that teachers and students fairly supported the statement since their mean scores definitely captured the idea that deficiency in instructional materials in schools affected implementation of IEE in the school curriculum.
Supporting this study findings, Westbrook, Durrani, Brown, Orr, Pryor, Boddy and Salvi (2013) in their painstaking literature review commissioned by the Department for International Development (DfID) in developing countries, contend that eighteen studies across sub-Saharan Africa, India, Bangladesh, Burma and Cambodia reported on the limited or severe lack of textbooks and teaching and learning materials and their poor quality as overriding impediments to student learning. Odeke (2009) further asserts that inadequate teaching and learning resource materials for environmental education was a major problem negatively influencing environmental education practice in Kenyan schools. These views corroborate Kimaryo’s Tanzanian study (2011, p.138) which demonstrated that many teachers emphasized lack of teaching and learning materials as one of the constraints facing them in the teaching of environmental education. Kimaryo further argues that the materials which were mostly referred to were text books and teaching guides although environmental education knowledge could be obtained from different sources like newspapers, radios, and the environment itself. These results might suggest that teachers were not innovative enough to find other sources of information on IEE, but were instead dependent on text books and teaching guides provided by the Ministry of Education. Fullan and Miles (1992) wisely caution that change is resource-hungry and therefore reformers must be prepared to the growing costs of the change process.

With reference to table 24, the sub-item x, “Lack of funding hinders implementation efforts of EE in the school curriculum” was ranked 11th (Teachers’ views M= 2.06; Students’ views M=2.29 out of 5). As demonstrated by the mean scores the sub-item received the lowest positive support. Although this finding displayed the least support it could still be interpreted to imply that insufficient funding to finance curriculum development, administration and accompanying materials, as well as teacher
orientation to the new curriculum hampered efforts to implement EE in the school curriculum. In support of these findings Kelani’s (2015) Benin study of teachers’ perceptions and challenges in schools demonstrated that overall funding (M 4.97; SD 1.94) was a barrier to implementation of EE. Freefind (n.d.) further asserts that one of the reasons why many experts perceive that little progress had been made regarding ESD since the Earth Summit in 1992 is that few financial resources had been dedicated to reorienting education to address sustainability. According to Jian (2004) almost every school had to deal with funding shortfalls and outdated facilities.

Overall, the surveyed secondary school teachers’ and students’ mean perceptions (Teachers M= 2.06 - 2.81 & Students M= 2.29 - 3.31) on challenges encountered could generally be interpreted as moderate. This finding implied that the respondents positively and sensibly supported the statements on the alleged implementation challenges ranked in table 25.
Table 25

The main extrinsic and intrinsic challenges identified by rank from the questionnaires as impediments to implementation of environmental education in schools

<table>
<thead>
<tr>
<th>Extrinsic challenges</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of environment policy</td>
<td>2</td>
</tr>
<tr>
<td>No enough time</td>
<td>3</td>
</tr>
<tr>
<td>Overcrowded curriculum</td>
<td>5</td>
</tr>
<tr>
<td>Emphasis placed on national examinations</td>
<td>6</td>
</tr>
<tr>
<td>Lack of qualified teachers in environmental issues</td>
<td>7</td>
</tr>
<tr>
<td>Poor coordination of environmental education programmes</td>
<td>8</td>
</tr>
<tr>
<td>Poor coordination of environmental education programmes</td>
<td>9</td>
</tr>
<tr>
<td>Outdated and inadequate facilities</td>
<td>10</td>
</tr>
<tr>
<td>Lack of funding</td>
<td>11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intrinsic challenges</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy workload</td>
<td>1</td>
</tr>
<tr>
<td>Limited cooperation and exchange of ideas</td>
<td>4</td>
</tr>
</tbody>
</table>

Source: Field data, 2017.

Khalid (2009) classifies such implementation challenges (Table 25) into extrinsic or first order and intrinsic or second order challenges. Extrinsic challenges pertain to organizations for instance time, support, scarcity of facilities and resources; training and high premium placed on national examinations; irregular revision of syllabuses; lack of feedback on orientations; lack of supervision. Intrinsic challenges are those pertaining to individuals for example teachers’, administrators’ and individuals’ attitudes, beliefs, practices such as poor syllabus interpretation and resistance. From table 25 it is clear that heavy workload; lack of environmental policy and lack of time as implementation
challenges were fairly consistent with those from interviews with the secondary school principals and KICD officers.

The greatest of these challenges that were described on interviews with the secondary school principals and KICD officers included lack of policy; limited time; inadequate exposure of teachers; poor syllabus interpretation; scarcity of facilities and resources especially funds; lack of supervision and high premium placed on national examinations; inadequate orientation of teachers; lack of feedback on orientations and irregular revision of syllabuses.

Speaking to secondary school principals on interview it became clear that lack of time for EE was a critical barrier to its implementation because EE was not allocated time in the time table. This was demonstrated in the words of one male school principal who admitted that:

Covering the syllabus is so demanding that there is hardly time and space for EE to fit in the time table other than a mere mention of it during morning school assembly, during the observation week and during life skills lessons. This way teachers and students take EE less seriously.

On lack of feedback after orientations, one KICD male officer commented:

There is usually no feedback given once in- service and orientation programmes are carried out. Revision of curriculum is also seldom done. As a result teachers concentrate on teaching for knowledge transfer which may not lead to environmental attitude and behaviour change.

A synopsis of EE implementation challenges as established by the findings from the interview guide and from the questionnaires were summarized in Table 26.
Table 26

The main challenges identified from the questionnaires and interviews as impediments to implementation of environmental education in secondary schools

<table>
<thead>
<tr>
<th>Lack of environment policy;</th>
</tr>
</thead>
<tbody>
<tr>
<td>limited time;</td>
</tr>
<tr>
<td>Inadequate exposure of teachers in environmental issues</td>
</tr>
<tr>
<td>Poor syllabus interpretation;</td>
</tr>
<tr>
<td>Inadequate and outdated facilities</td>
</tr>
<tr>
<td>Inadequate resources especially funds;</td>
</tr>
<tr>
<td>Lack of supervision and</td>
</tr>
<tr>
<td>Poor coordination of environmental education programmes</td>
</tr>
<tr>
<td>High premium placed on national examinations;</td>
</tr>
<tr>
<td>Inadequate orientation of teachers;</td>
</tr>
<tr>
<td>Lack of feedback on orientations and</td>
</tr>
<tr>
<td>Irregular revision of syllabuses.</td>
</tr>
<tr>
<td>Heavy workload</td>
</tr>
<tr>
<td>Overcrowded curriculum</td>
</tr>
<tr>
<td>Limited cooperation and exchange of ideas</td>
</tr>
</tbody>
</table>

These challenges (table 26) were the main reason for failure in implementation of IEE in the school curriculum. This is why Fullan (2001a, p. 88) argues that “if one or more factors are working against implementation, the process will be less effective” Therefore intervention measures needed to address these challenges as a precondition to successful implementation of IEE to alleviate environmental degradation Machakos Sub County.

The primary results reported here therefore provide clear empirical evidence that the research question vi a. “What challenges are faced in implementation of integrated environmental education in the secondary school curriculum in Machakos Sub-County” has been duly addressed.
4.9.2 Strategies that were suggested to address the challenges of implementing integrated environmental education

Strategies are plans of action presenting good options that could enable successful implementation of environmental education within the secondary school curriculum. Strategies suggested to address the challenges are a factor which affects implementation of integrated environmental education given that strategies according to Mintzberg (2001) are needed to at least help one to manoeuvre through threatening environments. Strategies are needed to reduce uncertainty and provide consistency, promote order, efficiency and stability by concentrating resources towards what’s most important (Blair, 2014 & Mintzberg, 2001).

To determine the strategies for addressing these challenges (Table 27), secondary school principals and KICD officers were interviewed. The following were some of the excerpts from the respondents to support the submissions. For example, on lack of time for EE, one male school principal put it:

There should be strict audit of environmental topics in the syllabus in order to determine whether environmental education can be included in the syllabus as a standalone subject. This will ensure that time for it is created in the time table.

On inadequate exposure of teachers to environmental issues one KICD lady officer made a suggestive remark:

Teachers need to be in-serviced on the importance of EE in the curriculum and how to integrate it in their teaching. Our learners are even better than their teachers. Role models to our teachers are lacking in society.

On inadequate resources especially funds, one male secondary school principal suggested:
Funding for EE can be met by making it priority in County and National budgetary allocations. Among the possible strategies that the respondents suggested which were also fairly consistent with the literature (Bhandari & Abe 2000; Westmoreland-King, 2012) are summarised in table 27.

### Table 27
**Possible strategies suggested for the challenges identified**

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Implementation Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lack of environment policy;</strong></td>
<td>Develop EE policy to be fixed in all National Education Policies</td>
</tr>
<tr>
<td><strong>Limited time;</strong></td>
<td>Ensure strict auditing of EE topics in the syllabus to determine whether EE could stand alone as a subject for time to be created for it in the time table</td>
</tr>
<tr>
<td><strong>Inadequate exposure of teachers in environmental issues</strong></td>
<td>Capacity building of staff through workshops; seminars and in-service training programmes for teachers</td>
</tr>
<tr>
<td><strong>Poor syllabus interpretation</strong></td>
<td>Environmental education orientation and sensitization workshops for teachers to improve understanding and increase confidence in syllabus interpretation</td>
</tr>
<tr>
<td><strong>Inadequate and outdated facilities</strong></td>
<td>Mobilize external assistance for enhancing environmental education facilities</td>
</tr>
<tr>
<td><strong>Inadequate resources especially funds</strong></td>
<td>Ministry of Education and the County Government should budget for EE</td>
</tr>
<tr>
<td><strong>Lack of supervision</strong></td>
<td>Need for Government support in supervision of EE programmes</td>
</tr>
<tr>
<td><strong>Poor coordination of environmental education programmes</strong></td>
<td>Seeking synergies, networking and coordination among EE clubs; NGO’s and other stake holders</td>
</tr>
<tr>
<td><strong>High premium placed on national examinations;</strong></td>
<td>Introducing EE as a separate subject which is externally examined</td>
</tr>
<tr>
<td><strong>Inadequate orientation of teachers</strong></td>
<td>Use multimedia elements to cover all teachers during orientation</td>
</tr>
<tr>
<td><strong>Lack of feedback on orientations</strong></td>
<td>Introduce subject specific monitoring of EE implementation; and sharing of monitoring reports between KICD officers, QASO officers and the teachers.</td>
</tr>
<tr>
<td><strong>Irregular revision of syllabuses.</strong></td>
<td>There is need to carry out environmental education curriculum audit, review and improve curriculum periodically</td>
</tr>
<tr>
<td><strong>Heavy workload</strong></td>
<td>Train more teachers to handle Environmental Education</td>
</tr>
<tr>
<td><strong>Overcrowded curriculum</strong></td>
<td>Environmental education be done after school-in clubs and weekend community activities; revise the timetable and allocate more time</td>
</tr>
<tr>
<td><strong>Limited cooperation and exchange of ideas</strong></td>
<td>Establishment of an inventory of stakeholders and initiate smart partnerships by bringing stakeholders together to share knowledge, experiences and skills for implementation of IEE</td>
</tr>
</tbody>
</table>

**Source:** Field Data, 2017

A quick impression of most of the suggestions made (Table 27) clearly demonstrates that addressing these challenges required introducing strategies that were
the reverse of the referred to challenges. For example for lack of funding it was suggested that the Ministry of Education and the County Government should budget for EE. In support of this argument, Khalid (2009) observes that strategies suggested to address the challenges outlined in table 28 were seemingly easy because the reasons for their occurrence could be reduced by turning the flip-side of the factors.

Such strategies were more issue specific and therefore key pointers to definite but rapid, short-term responses to the challenges. Such strategies might therefore not hold promise for effective implementation of EE because they are too narrow and too weak interventions addressed in a hit or miss fashion. Strategies are never simply a matter of executing prescriptions and procedures. Marcinkowski (2010) shares these views when he argues that reduction and prevention of such concerns was not enough on its own in providing a permanent solution to the problem. Marcinkowski seems to suggest that reduction of the reasons for the occurrence of the challenges was not a promising proposal for permanent solutions to environmental degradation in Machakos Sub-County. Real problems cannot be merely solved by the level of thinking that is inherent in what contributed to those problems but require a different kind of thinking (Haris & Afdaliah, 2016 & Marcinkowski, 2010).

As a step towards effectively addressing the aforesaid challenges, attempts at curriculum reorganization hold potential for a deeper, long-term strategy. Burchett (2015) shares this view when he asserts that education reform is the most straightforward strategy. Hence, repackaging the curriculum into a framework of formal, non-formal, and informal knowledge sources, according to Short (2010) and Lee, Nelson, Christopher, Cushion and Potrac (2006) would empower teachers and students to improve the overall level of IEE implementation because they optimize learning through creating synergies. Formal, non-formal, and informal knowledge sources serve a wider public engagement
(Institute for Global Environmental Strategies [IGES] 2001). The learners especially during the non-formal and informal processes maximize participation levels and enhance chances of interventions of environmental degradation ([IGES] 2001). It is further argued ([IGES] 2001) that during the processes, learners participate in IEE implementation by choice and this according to Ngaka, Openjuru, Mazur (2012) is a cost-effective educational service delivery.

In this regard teachers and students were asked to circle either very often, often, occasionally or never, listed against the likely environmental activities that they had undertaken under each of the formal, non formal and informal curriculum dimensions. The responses were summarised in table 28.
Table 28
Strategies suggested for addressing some challenges of implementing IEE

**Key:**  T %= Teacher Percentage; S %= Student Percentage

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>Very Often</th>
<th>Often</th>
<th>Occasionally</th>
<th>Never</th>
<th>Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FORMAL CURRICULUM DIMENSION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) Carrying out field work / instruction in the local environment</td>
<td>30.3</td>
<td>16.6</td>
<td>36.1</td>
<td>26.2</td>
<td>24.5</td>
</tr>
<tr>
<td>(ii) Encouraging students’ participation in class lesson environmental activities</td>
<td>42.0</td>
<td>22.7</td>
<td>37.8</td>
<td>29.3</td>
<td>15.1</td>
</tr>
<tr>
<td>(iii) Encouraging students to participate in environmental debates</td>
<td>32.8</td>
<td>27.1</td>
<td>30.3</td>
<td>21.4</td>
<td>31.1</td>
</tr>
<tr>
<td>(iv) Encouraging environmental essay writing competitions</td>
<td>26.9</td>
<td>18.3</td>
<td>21.8</td>
<td>18.3</td>
<td>37.8</td>
</tr>
<tr>
<td><strong>NON FORMAL CURRICULUM DIMENSION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(v) Involving students in community environmental clean-up projects</td>
<td>26.1</td>
<td>22.7</td>
<td>35.3</td>
<td>22.7</td>
<td>31.1</td>
</tr>
<tr>
<td><strong>INFORMAL CURRICULUM DIMENSION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(vi) Encouraging special events such as awareness week</td>
<td>21.0</td>
<td>19.7</td>
<td>34.5</td>
<td>21.4</td>
<td>32.8</td>
</tr>
<tr>
<td>(vii) Encouraging students regular going out to watch wildlife</td>
<td>19.3</td>
<td>21.4</td>
<td>21.8</td>
<td>23.1</td>
<td>51.3</td>
</tr>
<tr>
<td>(viii) Encouraging students to read newspaper articles concerning the environment</td>
<td>35.3</td>
<td>29.3</td>
<td>34.5</td>
<td>24.9</td>
<td>25.2</td>
</tr>
<tr>
<td>(ix) Encouraging students to read environmental magazines</td>
<td>31.9</td>
<td>24.0</td>
<td>43.7</td>
<td>24.5</td>
<td>19.3</td>
</tr>
<tr>
<td>(x) Encouraging students to regularly listen to environmental programmes on television and radio</td>
<td>26.1</td>
<td>23.6</td>
<td>37.8</td>
<td>23.6</td>
<td>27.7</td>
</tr>
<tr>
<td>(xi) encouraging environmental clubs and youth groups in schools</td>
<td>45.4</td>
<td>36.2</td>
<td>33.6</td>
<td>24.5</td>
<td>12.6</td>
</tr>
</tbody>
</table>

Source: Field data, 2017

As presented in table 28, formal dimension of the curriculum according to Eaton (2012) is an organized dimension advancing environmental education within the mainstream education system inside school settings. Curriculum interactions are therefore fixed within institutionalised spaces. The formal curriculum dimension also entails
conscious and intentional expression of learning activities that are written, supported, taught, and tested leading to an officially recognized credential often guided and recognized by government. The formal dimension of the curriculum is therefore a more structured style of learning leading to convergent thinking, a concept that all facts will lead to a single, indisputable answer (Burchett, 2015).

From Table 28 the data analyzed under the formal curriculum dimension (sub items i to iv), evidently demonstrate that the overall response for very often and often put together was (teachers 63.75% and students 44.97%). This result established that teachers’ responses were higher than the students’ on the same sub items. This would give the impression that the teachers supported and saw the need for integration of EE activities within the traditional formal curriculum dimension as illustrated in table 28. However, teachers’ responses seemed contradictory because they did not seem to have had adequate time for such EE activities. This conforms to Mustam and Sarojini’s (2016) assertion that teachers often said that preparing students for examinations superseded all else. A possible interpretation of this finding is that the desired teacher performance of the mentioned environmental activities within the formal curriculum dimension was seemingly higher than the actual performance because teachers might simply have perceived (self-efficacy) that they could perform the mentioned activities just to portray a positive picture of themselves. McGuire (2015) observes that teachers only sought to portray environmental activities that were fitting in with their self-identity as a form of ego-protection.

When percentage responses were computed for teachers and students on occasional use of environmental activities in the formal curriculum dimension (sub items i to iv) a similar trend emerged whereby average responses for teachers were 27.72% and
for students were 21.85%, while ‘never’ registered on average 3.98% and 19.45% for teachers’ and students’ respectively.

Overall, it was shown that while students posted weak results, teachers seemed to indicate a moderate support for the importance of teaching/learning EE lessons’ through the formal curriculum dimension for similar reasons advanced earlier. This finding does not come as a surprise since integration of EE in classroom lessons seemed to be a worthwhile agenda because formal curriculum is accepted and guided by government and attracts officially recognized certificates as appealing factors. However according to Ngaka, Openjuru and Mazur (2012), formal educational system alone is unlikely to achieve the projected impact of environmental education and therefore they suggested non-formal education as reinforcement.

Non-formal dimension of the curriculum addresses teaching and learning activities that are generally planned but loosely organised outside the established formal school system (The Canadian Environmental Grantmakers' Network [CEGN], 2006), but responding to education needs for persons of all ages. According to Latchem (2014) part-time second chance education’ for out-of-school youths and school dropouts; adult and continuing education; and personal development programmes such as cultural; professional and vocational programmes for the unemployed constitute non-formal learning. Learning takes place through students with similar interests coming together and exchanging views, e.g. in clubs, youth organizations or workshops; or even in various games; girl guides and boy scouts organizations. The purpose of Non-formal education is to provide alternative learning opportunities for those who do not have access to formal schooling or need specific life skills and knowledge to overcome different obstacles (UNESCO, 2006).
In this regard, teachers and students were asked to circle either very often or often against environmental activities they undertook within the non formal curriculum dimension. This was to establish whether the respondents were involved in non formal community environmental protection activities or not (Table 28 sub item v).

The overall result for very often and often put together was (teachers 61.40%; students 45.40%) while occasionally posted (teachers 31.10%; students 16.20%). However, “never” registered (teachers 4.20%; students 16.20%) and missing (teachers 4.20%; students 11.80%). This result confirmed a similar trend whereby teachers seemed to demonstrate more support than the students for the importance of teaching/learning EE lessons’ through the non formal curriculum dimension even though the support was modest ($\approx 60\%$). This indicates satisfactory knowledge and understanding of non formal dimension of curriculum and overall willingness by teachers to make a difference in helping to integrate EE through this curriculum dimension but that it was seemingly challenging in the face of exam oriented curriculum.

On the other hand, the students weakly (<50%) supported the inclusion of environmental education into the non-formal curriculum dimension because of simple overall lack of knowledge and having difficulties in conceptualizing non formal curriculum dimension. Therefore it was highly doubtful that they would implement EE if they were less supportive of its integration across the curriculum. Yet there is broad agreement in the literature (Latchem, 2014) that non-formal education improved self-confidence, knowledge and skills needed to make more sustainable use of natural resources. This view is consistent with Goldman and Assaraf’s (2011) Israel study which established that the non formal Green Council program (GCP) sharpened pupils’ sensitivity to human impact on the environment and their value for nature improved from an anthropocentric angle to a more egocentric view.
Despite that, Latchem (2014) laments the provision of non-formal education in developing nations which is limited and therefore of particular concern. According to Wallace Foundation (2016), non-formal education helps students to build bridges between their experiences inside and outside the classroom. Digby’s (2013) study on influences of non-formal and informal learning demonstrated that environmental behaviour prediction was most improved by adding these two dimensions. Czerkawski (2016) further argues that blending formal, non-formal and informal learning networks creates synergistic learning. That is to say the three networks synergise efforts to optimize effective integration of EE and learning opportunities of the EE content for the students. 

Informal or implied dimension of the curriculum includes those environmental activities that happen without an organized institutional structure but occurring through three forms thus incidental learning; reactive learning and deliberate learning (Erault as cited in Latchem, 2014)

Deliberate informal learning involves obvious intentions to acquire new environmental knowledge and skills through television and radio drama, music, discussions. According to Mustam and Sarojini (2016) deliberate informal learning occurs through co-curricular activities after school for example camping, environmental campaigns, field trips, out of class activities, school grounds activities such as planting trees and doing competitions.

Reactive informal environmental education is usually through role models such as the Kenyan Wangari Mathai’s environmental activities. Role examples could also be provided through street theatre, music, dance, puppetry and poetry which present alternative ways of learning EE to enhance commitment to environmental improvement.

Conversely, incidental informal learning which is often referred to as the hidden dimension of the curriculum is unwritten, unofficial and often unintended lessons that
students learn inside or outside the school. Incidental informal learning consists of indirect environmental messages received by learners without any conscious attempts and is usually unspoken, unacknowledged and unexamined. In this context the teacher is anyone with some experience such as a parent, grandparent or a friend (Eaton, 2012). The objective is to facilitate indirect incorporation and internalization of desirable environmental behaviour, religious values and attitudes from the school and the community. Informal education typically results in divergent thinking. Divergent thinking invokes deeper (critical) thought processes that encourage an individual to make connections in order to arrive at both, unique and varied answers (Burchett, 2015). Although no credits are earned, incidental environmental activities of the hidden curriculum are supposed to inspire decorum and life etiquette among students and teachers.

In connection to informal curriculum dimension, teachers and students were asked to select either very often or often against the environmental activities they carried out that were allied to this curriculum dimension (Table 28, sub-items vi-xi). The overall result for very often and often put together was (teachers 64.15%; students 49.37%) while occasionally posted (teachers 28.15%; students 17.4%). However, “never” registered (teachers 7.02%; students 19.07%) and missing (teachers 4.20%; students 14.17%). From the responses, it could be inferred that despite most teachers being more positive than the students about implementing EE through the informal curriculum dimension, it could generally be advanced that both teachers and students supported this strategy but only moderately. Yet, informal environmental education is strongly supported by several empirical studies (Smaller, Clark, Hart, Livingstone, & Noormohammed, 2000; Quarter, & Midha, 2001; & Westmoreland-King, 2012, Hanneman 2013) that it had a noticeable impact on students’ acquisition of environmental awareness, environmental knowledge
and development of enthusiasm and engagement. These views are in line with the recent Mustam and Sarojini (2016) WWF-Malaysian longitudinal study which revealed that informal infusion of environmental education at home and in school were the methods of implementing environmental education through experience.

Therefore there is cross-border collaboration among formal, non-formal and informal learning environments and it is possible to transit from a formal curriculum dimension to non-formal dimension by simply adjusting the “centre of gravity” from the school system to the student (Claudio, 1987). A case in point is when elements of non-formal curriculum such as environmental sport events and leisure activities such as feasts are either included in the formal curriculum or they are offered after school time and sometimes in Saturday schools to help pupils fill up knowledge gaps (Manuela du Bois-Reymond, 2009). Similarly shifting from formal to an informal curriculum dimension is by allowing students to determine the speed of learning and free movement in search for the best sites for learning, even outside the school premises to make use of available means to dictate the subjects that catch students’ interest” (Claudio, 1987).

This means that schools should draw budgets to finance additional staff and offer attractive environmental activities to keep students busy in their free hours to dissuade them from hanging around and being a nuisance to other people in the neighbourhood (Manuela du Bois-Reymond, 2009). Another innovative approach to integration of environmental education into formal and non formal curricula is illustrated by the Kenya Organisation of Environmental Education ECO school micro-projects in Kenya which according to Odeke, (2009) served to facilitate contextualised curriculum processes, problem solving and school-community cooperation.

Given the argument presented here, it could be suggested that formal, non formal and informal curriculum learning pathways for environmental education are like three
trunks of the same tree because they are mutually interdependent and so according to Weladji, Moe and Vedeld (2003) they are necessary strategies for integration of environmental education in secondary schools curricula. In essence, the best learning situation is one in which there is a balance of the three curriculum dimensions (Burchett, 2015) because they will be strengthening each other and making integration of environmental education in the school curriculum more efficient.

An outline of the findings in table 27, illustrate strategies suggested to meet challenges of implementing EE in the secondary school curriculum in Machakos Sub County. The strategies were however found seemingly cheap because the reasons for their occurrence could be lessened by turning the opposite side of the same factors. As a result, curriculum reorganization into formal, non-formal and informal dimensions, it was hoped would hold potential for a deeper, long-term strategy for implementation of EE.

Although teachers have been identified as a significant factor for integration of EE in the formal, non formal and informal curriculum dimensions, study findings indicate that the teachers only portrayed a modest support (~60%) for the three curriculum dimensions as alternative strategies. Teacher respondents also seemed to merely portray self efficacy but in the actual sense their implementation of the forenamed strategies was constrained by inadequate time that could not be spent on EE activities which were least externally examined.

On the other hand students’ overall lack of knowledge and limited conceptualizing of formal, non formal and informal curriculum dimensions rendered them incapable of supporting (<50%) the dimensions to exploit the available opportunities for implementing EE in the school curriculum.

In due course the implementation of environmental education in the secondary school curriculum was ineffectively carried out hence the problem of environmental
degradation was not adequately addressed in Machakos Sub County. Therefore the research question stated here (vi): b. What strategies are suggested to address these challenges? has been accordingly dealt with.
CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the study, the conclusions drawn and recommendations made together with suggestions for further research. The chapter is divided into three sections. Section 5.1 is an outline of chapters 1-3 along with a summary of the findings; Section 5.2 presents the conclusions and implications of the findings; and Section 5.3 outlines the recommendations for improving the current practice of implementing EE in the secondary school curriculum and offers suggestions for potential further research.

5.2 Summary

This study investigated the implementation of integrated environmental education in the secondary school curriculum for managing environmental degradation in Machakos Sub-County. Specifically, the study aimed at finding out how educators implemented integrated environmental education in the secondary school curriculum and challenges faced to propose strategies for enhancing an education that would alleviate environmental degradation in Machakos Sub-County.

The following six research questions and two hypotheses guided this study: to what extent is environmental education (EE) integrated in the secondary school curriculum in Machakos Sub-County? What are the teachers’ and students’ perceptions of the integrated environmental education in the secondary school curriculum in Machakos Sub-County? What are the levels of environmental literacy of secondary school teachers and students of Machakos Sub-County? What support do teachers require to implement integrated environmental education related topics in the secondary school curriculum in
Machakos Sub-County? What instructional approaches do secondary school teachers use to teach integrated environmental education topics in the secondary school curriculum in Machakos Sub-County? What challenges are faced in implementation of integrated environmental education in the secondary school curriculum in Machakos Sub-County and what strategies are suggested to address these challenges?

The hypotheses were; There is no statistically significant difference between the mean scores of teachers’ and students’ perception of the integrated environmental education in the secondary school curriculum in Machakos Sub-County; There is no statistically significant difference between single sex and mixed sex public secondary schools with respect to form four students’ mean scores of environmental awareness, knowledge, skills and attitudes in Machakos Sub-County.

This study was informed by Fullan’s theory of educational change which explains implementation processes of educational innovations such as integrated environmental education (IEE) in the school curriculum. The study was thus anchored on a conceptual framework that described links between characteristics of education change as independent variables and environmental literacy of teachers and students as dependent variables. Intervening variables in this respect were local factors and external factors.

Similarly, the study was grounded in literature covering international researches in Washington (USA); South West Florida (USA); Canada; Poland (Europe); and Asia-Pacific region, Philippines, Hong Kong, Malaysia and India. The review also covered regional studies especially in Africa such as Nigeria and Tanzania and local studies in Kenya.

The study operated within a mixed research approach. Cross-sectional survey design was employed under the quantitative approach and phenomenological design under the qualitative approach. The study targeted public secondary schools; principals of
public secondary schools; secondary school teachers; and form 4 students in Machakos Sub-County in addition to KICD officers in Nairobi County. Probability and non-probability sampling designs were used in line with the mixed methods approaches. Stratified and simple random sampling techniques were employed in sampling secondary schools, teachers and students. Purposive sampling, proportionate sampling and snowball sampling techniques were used to sample school principals and KICD officers.

Data collection instruments of the study included questionnaires for teachers and students; interview guides for secondary school principals and KICD officers; document analysis checklists and observation guides. Qualitative data from the interviews were transcribed and analytical categories from the statements of the respondents were established. Some responses from curriculum developers and school principals were reported verbatim (narratives). Quantitative data were coded and analyzed using simple descriptive statistics. All hypotheses were tested at a minimum of .05 level of significance using independent samples t-test statistic and analysis of variance (ANOVA). Ultimately, chapter four offers an analysis of the collected data. A summary of the findings was structured in terms of each research question as follows:

i. **Integration of environmental education into the secondary school curriculum**

In the context of integration of environmental education, the overall finding was that there were some environmental topics in the secondary school curriculum albeit inadequately covered (<50%) and not stated as separate topics in the teaching subjects. It was further revealed that the said EE topics were not logically organized in the syllabus. Furthermore, the topics were difficult to identify in the syllabi as pointed out by 87.4% of teachers and 86% of the students. Kimaryo (2011) asserts that “Environmental education
components which are to be taught in different topics are not shown clearly in the subject syllabi” p.39.

Another very important finding that was revealed through data analysis was the apparent marginalization of climate change topics in Chemistry and Biology syllabi respectively and land degradation topics in the Chemistry and Biology syllabi yet the topics happen to border on the most critical environmental issues in Machakos Sub-County. The researcher found this development a matter of concern for implementation of integrated environmental education in the secondary school curriculum in Machakos Sub-County.

Further analysis of syllabus documents showed that Social Studies subjects (Geography & History) combined covered more (70%) environmental education topics in the school curriculum than the science subjects (Chemistry & Biology) combined (30%). In support of these findings Kimaryo (2011) observes that environmental education is built in the school curriculum, although some subjects have more environmental content than others.

The way integrated environmental education topics are unevenly distributed in the curriculum raises misconceptions amongst teachers and students. The majority of them would think that environmental issues are more related to the social studies subjects (Geography & History) hence reducing its crosscutting nature to other fields especially the science subjects (Chemistry & Biology). This outcome dampened down teachers’ and students’ felt need for effective implementation of EE in the school curriculum. According to Fullan (as cited in Hammonds, 2002) “If people cannot find meaning in any reform it cannot have any impact”
ii. Teachers’ and students’ perceptions of integrated environmental education in the secondary school curriculum

By interpreting and summarising the respondents’ perspectives it emerged that overall, both teachers and students supported integration of EE in the school curriculum, although the support of both respondents was weak (<50%). in view of the fact that EE was not perceived as a priority need in the school curriculum. As a result implementation of EE in the school curriculum was seemingly not done effectively in Machakos Sub-County.

It was further confirmed by interviews with secondary school principals and KICD officers that the respondents were aware of and valued the need for integrated EE to improve the quality of the environment and hence human life. However, the respondents lamented that there was no policy on EE in schools; no monitoring of EE implementation in the school syllabus since 2002 except during occasional surveys but without follow up reports and hence EE was taken less seriously by teachers and students.

iii. Levels of environmental literacy of secondary school teachers and students

With regard to the levels of environmental literacy of secondary school teachers and students of Machakos Sub-County, five dimensions of environmental literacy thus knowledge; awareness; attitudes; skills and participation were measured. The findings have shown that overall, teachers’ and students’ environmental knowledge levels were slightly more than just fair. Besides, teachers and students were seemingly aware of environmental issues and therefore apparently able to integrate EE in the school curriculum. Similarly the overall environmental attitudes of teachers and students could be described as fairly favourable.

Additionally, observation of the overall findings showed that teachers and students agreed that students developed the skills identified in this study by learning them through
integrated environmental education and that the students needed such skills to address future environmental concerns.

Finally, teachers’ and students’ participation in outdoor environmental activities showed insignificant levels within the community; low levels at school and moderate levels at home. Students’ performance particularly on conservation of resources was rather low as they seemed inadequately engaged in outdoor environmental activities. Additionally students demonstrated lack of self-efficacy of undertaking environmental activities without coercion. Thus, it is evident that there was overall lack of values and sensitivity to environmental issues by the students. This indicates that implementation of environmental education was seemingly not done effectively.

A hypothesis was advanced to establish whether there was significant relationship between single sex and mixed sex public secondary schools with respect to form four students’ mean scores on environmental literacy (awareness, knowledge, skills & attitudes). The results showed that there was no statistically significant relationship between single sex and mixed sex public secondary schools with respect to form four students’ mean scores of environmental awareness, knowledge, skills and attitudes.

On the whole, these findings give the impression that both teachers and students were seemingly inadequately prepared to integrate EE in the school curriculum in Machakos Sub-County and therefore they could not satisfactorily manage environmental degradation.
iv. Support that teachers required to implement integrated environmental education topics in the secondary school curriculum in Machakos Sub-County

According to the findings in this section it was revealed that support in terms of funds and other resources was currently inadequate (<50%). Interviews with secondary school principals and KICD officers concurred with these findings that assistance towards implementation of IEE was limited to only seedlings and guidance and counseling services; orientation of teachers on EE integration and provision of some relevant materials such as orientation manuals.

The students suggested that for their teachers to effectively carry out EE activities the following conditions be met: EE be made a compulsory subject; teachers are trained; more support is provided by Government / Ministry of Education and learning materials / resources be provided. However the least suggested preference was teamwork. The findings also revealed that collegial cooperation among teachers was lacking, hence they lacked confidence and seldom discussed the subject of integration of environmental education in the school curriculum.

These findings imply that implementation of related IEE topics in the secondary school curriculum in Machakos Sub-County was inadequate because of the deficiency in support systems and therefore this might have interfered with how the problem of environmental degradation was being addressed.

v. Instructional approaches that secondary school teachers use to teach integrated environmental education

With regard to instructional approaches, teachers’ and students’ responses were assessed on the criteria of having used and not having used various teaching and learning
strategies. The study findings established that on average less than fifty present of teachers and students disapproved having used workshops; computer assisted learning; seminars; gaming & simulation; action research; and case study in that order. Similarly less than fifty present of teachers and students responded that they had used demonstration; experiments; field trips; role playing; group discussion; self-study; problem solving and critical thinking. This is despite the assertion in literature (Alexandar & Poyyamoli, 2014; Uma, Rajani, & Usha, 2015; Mustam & Sarojini, 2016; Westbrook, Durrani, Brown, Orr, Pryor, Boddy & Salvi, 2013; Russell & Burton 2000) that active teaching and learning approaches were more effective in facilitating environmental education among school children than the traditional classroom setting

When teachers and students were further asked to suggest other methods that they would have liked the teachers to employ, teacher respondents mentioned fieldwork and excursions; seminars; and use of resources and models. However, student respondents suggested fieldwork and excursions; open forum; guidance and counselling; workshops; and observations. Overall findings show that below 30% of the respondents could have liked teachers to employ learner centred methods in teaching EE which is a manifestation of the general indifference to learner centred approaches

Even though teachers preferred blending group discussion (learner-cantered) and lectures (teacher-cantered) to realize maximum effect of teaching integrated environmental education (IEE) a majority of them acknowledged that teacher centred pedagogies were fashionable. This was consistent with interview findings with the secondary school principals and KICD officers who asserted that teachers used teacher-centred approaches in schools to cover the syllabus quickly. However students claimed that they preferred mostly experiments & projects presumably because these approaches could have been interesting and interactive sessions out of classroom learning.
Overall findings could therefore be interpreted to imply that most teachers and most students had not fully appreciated learner-centred approaches for EE and hence perceived learning strategies more in terms of teacher managed than learner centred. However according to Anyolo (2015) participatory approaches are the best tools if teachers have to teach according to EE approaches. According to the scholar, a revised teachers’ approach in presenting the existing content in a changed context is what is needed for the successful implementation of the EE programme.

The study further established that a negligible percentage of teachers were experienced compared to a larger proportion of teachers who had been teaching EE for only 1-3 years. This implies that a significant proportion of the teachers had less experience and low professional development. A study by North Carolina State University (2012) demonstrated that teachers with Masters Degrees had students who showed higher levels of overall environmental literacy, suggesting that investments in teacher training were important to building environmental literacy.

In effect these findings have some major implications for the current implementation of integrated environmental education in the school curriculum in Machakos Sub-County as this situation seems to have negatively impacted on the overall implementation of environmental education in classrooms.

In spite of this, it could be observed that the preceding findings were subject to various limitations. First, there was no classroom observation to authenticate the self-reported actual practices of the sample teachers. It is possible for some teachers to speak of using a particular teaching strategy but in practice they used teaching methods that they were comfortable with depending on contextual circumstances. Karavas-Doukas’s study (as cited in Wang 2006) found that although most teachers held favourable attitudes towards innovations proposed by policymakers, the same teachers still conducted
classroom teaching in the teacher-fronted manner, an apparent discrepancy between policymakers’ intentions and teachers’ execution. Secondly, due to time and resource constraints, there was lack of follow up to check whether the inclusion of non respondents would have changed the results.

vi.a Challenges that faced the implementation of integrated environmental education in the secondary school curriculum

The study found out that the implementation of integrated environmental education in the secondary school curriculum faced many challenges among them were: heavy workload for teachers; lack of environment policy in schools; inadequate time to implement EE; limited cooperation and exchange of ideas among schools and among students. The challenges reduced the vigour for and seemingly impeded efforts of implementing EE in the school curriculum. Similarly, study findings showed that overcrowding the curriculum; high emphasis placed on national examinations reduced the attention paid to EE.

Study findings further indicated that lack of qualified teachers in environmental issues hindered implementation of EE in the school curriculum. Fullan (2003, p. 31) stated that “no matter how promising a new idea may be, it cannot impact students learning if it is superficially implemented” Among the other findings in this study was that poor coordination of environmental education programmes resulted to repetition of EE topics in the curriculum. This statement, was supported by literature (Bhandari & Abe’s, 2000 study in Asia) that lack of coordination and synergy amongst NGOs and other agencies in the region resulted in overlaps and overloads of EE topics in the curriculum. Such a situation it would seem could significantly affect the implementation of EE in the school curriculum
Similarly findings further highlighted that facilities in schools were outdated and inadequate) and therefore frustrated efforts to implement EE in the school curriculum. It also emerged from the study findings that lack of instructional materials in schools; lack of funding hindered implementation efforts of EE in the school curriculum.

Overall, the surveyed secondary school teachers’ and students’ perceptions on challenges encountered were generally moderate. This finding implied that the respondents positively and sensibly supported the statements listed on challenges of EE implementation. When the alleged challenges were ranked it became clear that they were fairly consistent with those from interviews with the secondary school principals and KICD officers. Additional challenges that the school principals and KICD officers pointed out during the interviews were poor syllabus interpretation; lack of supervision and adequate orientation of teachers; lack of feedback on orientations and irregular revision of syllabuses.

A synopsis of the challenges faced by EE implementation as established by this study, are the main reason for failure in implementation of EE in the school curriculum. Intervention measures will need to address these challenges as a precondition to successful implementation of IEE in order to alleviate environmental degradation in Machakos Sub County.

vi.b **Strategies that were suggested to address the challenges of implementing integrated environmental education**

Strategies are needed to reduce uncertainty and provide consistency, efficiency and stability by concentrating resources towards what’s most important (Blair, 2014 & Mintzberg, 2001). According to the findings from interviews with secondary school principals and KICD officers, it was revealed that the strategies that the respondents recommended to address the challenges of implementing EE included: budgeting for EE;
capacity building of staff through workshops; enhancing seminars and in-service training programmes for teachers; use of multimedia elements to cover all teachers during orientation; strengthening EE clubs, NGO’s and Government support in supervision of EE programmes; introducing EE as a separate subject which is externally examined; subject specific monitoring of EE implementation; and sharing monitoring reports between KICD officers, QASO officers and teachers.

But such strategies applied only to specific environmental issues and therefore they were not comprehensive enough to check environmental damage in Machakos Sub County. The message is very clear that there was need for a paradigm shift in implementation of integrated environmental education if it was going to mitigate the increasing environmental degradation in the Sub County. Curriculum reorganization was therefore sought as a hidden opportunity to raise the overall level of EE implementation in the school programme of study. Thus restructuring the curriculum into a framework of formal, non-formal, and informal knowledge sources, according to Short (2010) and Lee, Nelson, Christopher, Cushion and Potrac (2006) was sought to engage the teachers and students to improve the overall level of implementing IEE.

Therefore when teachers and students were asked to indicate which activities they had undertaken under each of the formal, non formal and informal curriculum dimensions, the overall result demonstrated that while teachers reasonably supported the importance of teaching/ learning EE lessons’ through the formal curriculum dimension, students were less supportive. A similar trend was observed in regard to the non formal and the informal dimension.

Overall, the formal curriculum dimension was most supported for integration of EE with teachers leading the pack because formal curriculum was perceived as more organized, planned, accepted and guided by government. McGuire (2015) observes that
teachers only sought to portray a positive picture of themselves as a form of ego-protection because according to Mustam and Sarojini (2016) teachers often said that preparing students for examinations superseded all else including environmental education.

The informal curriculum dimension posted the second preference and the non-formal curriculum dimension posted the lowest support from the teachers and students. It is evident from the findings that although teachers had been identified as a significant factor, for integration of EE in the formal, non-formal and informal curriculum dimensions, study findings indicate that the teachers only portrayed a modest support (≈60%) for the three curriculum dimensions as alternative strategies for implementation of EE.

On the other hand students overall lack of knowledge and limited conceptualizing of formal, non-formal and informal curriculum dimensions rendered them incapable of supporting (<50%) the three curriculum dimensions to exploit the available opportunities for implementing EE in the school curriculum.

Thus, it is evident that strategies suggested for implementation of environmental education seemingly cast doubt on the popularity of EE in the secondary school curriculum and ultimately implementation of environmental education was apparently not done effectively.

5.2 Conclusions

This study set out to investigate the implementation of integrated environmental education in the secondary school curriculum as a way of managing environmental degradation in Machakos Sub-County. Based on the findings of the study there is sufficient evidence to draw the following conclusions:
First, this study conclusively confirmed that some elements of environmental education were integrated in the subjects that were taught in the secondary school curriculum albeit inadequately and unevenly distributed, apparently marginalizing particularly climate change and land degradation hence reducing the crosscutting nature of EE. It is therefore evidently clear that teachers and students did not have stronger intentions (felt need) for effective implementation of EE within the school curriculum and therefore mitigation of environmental degradation in Machakos Sub-County through education as an intervention strategy was compromised. According to Fullan (as cited in Hammonds, 2002) “If people cannot find meaning in any reform it cannot have any impact”

Second, both teachers’ and students’ perceptions of the integrated environmental education in the secondary school curriculum were generally weak (< 50%) hence little attention was paid to adequate integration of EE in the school curriculum. According to Dangerfield (as cited in Lozzi, 2017) “EE just doesn’t get any respect” thus relegated to after-school activity status. This negatively impacted teachers’ and students’ involvement in and commitment to implementation of EE in the school curriculum hence the persistence of environmental degradation in Machakos Sub County.

Third, the study has further concluded that overall both teachers and students had low environmental literacy levels hence inadequately prepared to fully comprehend (clarity) and appreciate the complex nature of environmental education objectives, resulting to ineffective management of EE programs. Literacy of secondary school teachers and students is very important because it serves as an indicator of the effectiveness in managing of EE programs (Lasso de la Vega, 2004). Therefore the unyielding environmental degradation in Machakos Sub-County is notably attributed to low environmental literacy levels especially of the students who should have been
adequately equipped with the necessary environmental knowledge, skills and attitudes to demonstrate sustainable utilization of the environment at an early stage.

Fourth, the study concluded that support (quality) for implementation of integrated environmental education in the school curriculum in Machakos Sub-County was crucial but it was inadequate (<50%) According to Fullan’s Theory of Educational Change (1991) support in terms of the amount of resource (human and material); reasonableness of the timelines for implementation and work conditions deserved clear-headed attention in programme implementation.

The study further concluded that collegial cooperation among teachers was lacking which undermined their self-efficacy in implementation of IEE. Hammonds (2002) asserts that “People must work together to figure out what is needed to achieve what is worthwhile” The overall level of implementation of IEE topics in the secondary school curriculum in Machakos Sub-County is therefore low due to insignificant support and hence the problem of environmental degradation persists.

Fifth, in terms of instructional practices, the study concluded that most teachers and most students were still tending to teacher-based behaviourist approaches and therefore perceived learning strategies more in terms of teacher managed than learner centred. Teachers and students therefore did not use to a great extent workshops; computer assisted learning; seminars; gaming & simulation; action research; and case study. Yet according to literature the most effective teaching strategies in EE secondary programs were learner-centred.

Literature further argues in favour of the eclectic method by which a combination of all that is good in all the other methods of teaching is incorporated. Some goals are better suited to teacher-centred approaches while others clearly need learner-centred approaches. In effect Kimaryo (2011) asserts that a balance among the approaches to EE
thus education about the environment (knowledge transfer); education in the environment (experiential learning) and education for environment (ethics, values, attitudes, concern & positive actions for the environment) must be reached within some kind of organizational framework if they have to be successful. This study takes a similar stand because students with individual learning styles require differentiated instruction to meet their needs. In terms of experience and professional development evidence exists to support the argument that individual teacher qualities contributed to teachers’ ability to integrate environmental education into the public secondary school curriculum.

In this context, experience, professional development and pedagogical dilemma have impacted negatively on the overall implementation of environmental education in classrooms because a significant proportion of teachers had less experience and low professional development.

Sixth, this study concludes that implementation of IEE in the secondary school curriculum in Machakos Sub County is facing many challenges which include but are not limited to lack of environment policy; limited time; inadequate exposure of teachers in environmental issues; poor syllabus interpretation; inadequate and outdated facilities; inadequate resources especially funds; lack of supervision; poor coordination of environmental education programmes; high premium placed on national examinations; lack of feedback on orientations and irregular revision of syllabuses; heavy workload; overcrowded curriculum and limited cooperation and exchange of ideas. In the opinion of this study, the presence of these challenges is the main reason for failure in implementation of IEE in the school curriculum. Intervention measures will need to address these challenges as a precondition to successful implementation of IEE to alleviate environmental degradation in Machakos Sub County.
It was further concluded that the strategies suggested by the study respondents to address the aforementioned challenges were ineffective because they were tactless quick-fix interventions which were simply the flip side of the challenges. The study also concluded that both teachers and students did not fully exploit the available opportunities for implementing EE through non formal and informal curriculum dimensions as alternative modes of learning. Ultimately the implementation of environmental education in the secondary school curriculum in Machakos Sub County was ineffectively carried out hence the problem of environmental degradation was not adequately addressed.

5.3 Recommendations

Based on the findings of this study and conclusions presented, the challenges enumerated in the preceding section of this dissertation are the basis for failures in implementation of IEE in Kenyan secondary school curriculum in Machakos Sub-County. This study therefore makes practical recommendations that should address these challenges as a prerequisite to successful implementation of IEE to alleviate environmental degradation in the Sub-County.

Research Question i: To what extent is environmental education (EE) integrated in the secondary school curriculum in Machakos Sub-County?

With regard to the challenge of inadequate EE themes/topics in the syllabi, the study recommended that:

- The KICD should make a purposeful move to include a given percentage of EE topics, stated separately for easy identification and distributed throughout all the relevant subject areas of the curriculum, thus providing a multidisciplinary approach making it possible for each teacher to know what the others are teaching at each grade level.
Teacher training institutions should include environmental education themes in all course content and methodology to ensure that the pre-service teachers are trained on the use of environmental concepts in teaching the traditional subjects.

Authors of books in the various subjects taught in schools should integrate environmental issues in their text books particularly climate change and land degradation demonstrating how each topic or lesson could be used to promote knowledge, skills and awareness of the environment, to reinforce implementing EE in the curriculum. This move would be a direct manifestation of the felt need for integration of EE in the school curriculum.

Research Question ii: What are the teachers’ and students’ perceptions of the integrated environmental education in the secondary school curriculum in Machakos Sub-County?

Regarding teachers’ and students’ weak appreciation of and diminutive attention to integrated environmental education in the secondary school curriculum as a result of lack of EE policy, lack of monitoring of EE implementation and inadequate follow up reports, the study recommended that:

- The Ministry of Education should leverage on the appropriate and operational national environmental policies and clearly define them to put teachers and students on the right path to improve their perceptions for successful implementation of EE in the school curriculum.

- The KICD, DQAS and school principals should monitor teachers and students in order to leave up to their EE implementation expectations.
Research Question (iii): What are the levels of environmental literacy of secondary school teachers and students of Machakos Sub-County?

Regarding the low levels of environmental literacy, this study recommended that:

- The Ministry of Education and other relevant bodies like KICD, DQAS, KNEC and NGOs should work jointly with school managements to create an action plan to elevate teachers’ and students’ environmental literacy levels through organizing comprehensive pre-service courses and in-service training (for teachers) as well as workshops and seminars (for teachers and students) on contemporary environmental issues and how teaching subjects could be used to implement integrated environmental education.

- Through news and other special communications, print and electronic media should aim at raising environmental literacy levels for all audiences especially for the teachers and students to pursue and frequently participate actively in environmental activities at school; at home and within their greater communities beyond schools in order to assist in mitigating environmental degradation menace affecting the people of Machakos Sub-County.

Research Question iv: What support do teachers require to implement integrated environmental education topics in the secondary school curriculum in Machakos Sub-County?

The study has shown that implementation of integrated environmental education topics in the secondary school curriculum was frustrated by minimal support in terms of resources; work conditions and lack of collegial cooperation among curriculum implementers. This study therefore recommended that:

- The stakeholders especially the Ministry of Education, County Education Office; school principals, school communities, donor agencies and other
successful EE partners should establish an effective platform where they could usefully engage each other in planning in a bid to ensure adequate and continued support systems for accelerated implementation of integrated environmental education in the secondary school curriculum.

- The Machakos County Education Office should create a collaborative environment for interaction of all curriculum implementers through symposia, conferences and collaborative research to build synergies to ensure effective implementation of EE.

**Research Question (v): What instructional approaches do secondary school teachers use to teach integrated environmental education topics in the secondary school curriculum in Machakos Sub-County?**

The study has shown that most teachers and most students were still tending to teacher-based behaviourist approaches to teach integrated environmental education and therefore perceive learning strategies more in terms of teacher managed than learner centred. This study therefore recommended that:

- The Machakos County Education Office should take measures to identify curriculum implementation coaches who could act as supports to mentor teachers through regular demonstration seminars to showcase participatory teaching/learning approaches and their pedagogical value.

- The Ministry of Education and other relevant bodies like KICD, DQAS and KNEC should work together with school managements in organizing frequent and continuous in-service training workshops for teachers to accept and use blended (eclectic) teaching approaches and piloting with few schools as a starting point before full scale implementation is mounted.
Research Question (vi): What challenges are faced in implementation of integrated environmental education in the secondary school curriculum in Machakos Sub-County and what strategies are suggested to address these challenges?

Based on the conclusions regarding challenges and the strategies suggested to respond to the challenges of IEE implementation, this study recommended that:

- School principals should encourage environmental education initiatives that engage both schools and the surrounding communities which are likely to impact wider audiences.

- The Ministry of Education and the KICD should systemically pursue future curricular innovations aiming at restructuring the curriculum and the methods of assessment to capture a healthy balance among formal, non-formal and informal curriculum dimensions which according to (Menon, 2016 & the Canadian Environmental Grantmakers’ Network, 2006) could engage both the school and the surrounding community in translating the EE content into the EE experience, using project work, observations, and going out in nature, thus allowing learning beyond the confines of text books.

- The Ministry of Education and the KICD should pilot this innovation to see its effects and its validity before being applied throughout Machakos County, as a solution to environmental degradation.

5.4 Suggestions for further research

Considering the limitations of this study as outlined in 5.2 and the contradictory issues which arose throughout the research, this study made several recommendations as possible ways to improve the research. Specifically this report recommended further studies on:
• Integration of environmental issues and concepts in the secondary education curriculum in Machakos County
• A similar topic to be replicated in different counties in Kenya and even other countries to increase comparability and generalization of the findings.
• Investigation of further challenges to implementation of integrated environmental education in the secondary school curriculum
• Further Investigation of classroom practices of teachers and students to establish pedagogies employed to teach EE in secondary in Machakos County
• Assessment practices in EE and their relationships to pedagogy and student learning in secondary and tertiary institutions in Machakos County.
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APPENDICES

Appendix A: Map of Kenya showing Machakos County & Machakos Sub-County

Location of the Study Site: Machakos Sub-County

Source: Ngile (2015)
Appendix B Part of Machakos town with Iveti hills in the background


The Iveti hill slopes in the background of this photograph are richly settled and are more vulnerable to land degradation through soil erosion.
Appendix C: Harvesting sand in Thwake River, Machakos


According to Poverty Eradication Network (2010), uncontrolled sand harvesting has led to severe environment degradation resulting to devastated scenery and loss of retention capacities of some of the seasonal rivers. Such environmental degradation is best witnessed along Thwake River in Machakos area.
Appendix D: A photograph illustrating a worsening gulley.


Land degradation sting is a commonly observed problem in Machakos Sub-County. In the absence of the seasonal vegetation, the impact of precipitation on channel soil erosion especially at the start to an erratic rainy season with heavy rain drops has a greater impact of dislodgement and removal of soil leading to widening of channels into gulleys. Integrated environmental education in the school curriculum should aim at equipping students with knowledge, skills, attitudes and participation in planting trees and other types of vegetation in the upper slopes to stabilize the soil with root structure to control gullying.
Appendix E: President Moi bears huge boulders filling into a worsening gulley

Source: Daily Nation, 1984 October 20 p.16

Filling gulleys with stones is only a makeshift measure to controlling of worsening gulleys. A longer solution to gullying is to equip students and the general populace with knowledge, skills, attitudes and participation in constructing terraces and planting trees and cover crops in the upper slopes to stabilize the soil against erosion by rain water.
Appendix F: President Moi filling stones into the gabions to build a wall that would check soil erosion


Constructing gabions across gullies is only a provisional measure to managing worsening gulleys. A longer solution to gullying is to equip students and the general public with knowledge, skills, attitudes and participation in constructing terraces and planting of indigenous trees and cover crops in water catchment sites to stabilize the soil against erosion by rain water.
Appendix G: Questionnaire for Teachers (QT’s) on Effective Implementation of Integrated Environmental Education in the Secondary School Curriculum

SECTION I:
Informed Consent for Research

Introduction
My name is Timothy Mandila. I am currently enrolled for the doctoral programme at the Catholic University of Eastern Africa. I am conducting a research on Implementation of Integrated Environmental Education in Secondary Schools Curriculum as a Measure to Alleviate Environmental Degradation in Machakos Sub-County. This study is entirely for academic purposes and therefore I kindly request you to be part of this exercise by filling out the questionnaire which seeks your views on this issue. Completion of this questionnaire is entirely voluntary and all responses will be recorded anonymous and will be confidential to all persons except the researcher. Thank you in advance for your time and willingness to share your perspective in this study.

Sincerely,
Timothy Mandila.

Consent Statement
I, the undersigned participant, have been fully informed of this study and have understood its purpose and what is required of me, and give my consent to voluntarily participate in it.

Signature of Participant                     Date
..................................................                     ..................................................

Signature of Researcher                    Date
..................................................                     ..................................................
SECTION II: Background Information

You are kindly requested to answer the questions below as sincerely as possible. Please respond by filling in the spaces provided or ticking your choice of response where required. There is no correct or wrong answer. You are free to give any additional information where necessary. The information you give will be treated confidentially. Do not write your name anywhere on this questionnaire. Please answer all questions. We are aiming to get consensus on all topics.

Please Tick in the appropriate box.

1. What type is your school?
   A. Boys’ secondary school  
   B. Girls’ secondary school  
   C. Mixed secondary school  

2. What is your gender?
   A. Male  
   B. Female  

3. Which one of the following subjects do you teach in this school?
   A. Chemistry  
   B. Biology  
   C. Geography  
   D. History  

4. How many years of professional experience do you have in the field of teaching?
   A. 1-3  
   B. 4-6  
   C. 7-10  
   D. 11-15  
   E. 16-19  
   F. 20 years and more  

5. What is your highest level of education?
   A. Diploma  
   B. Bachelors  
   C. Masters  
   D. Doctorate  

6. In each of the questions or statements i-vi, use the key provided to tick only one choice that best describes your situation

Key
SA=strongly agree, A= Agree, U= Undecided, D=Disagree, SD= strongly disagree

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<tr>
<th>STATEMENT</th>
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<tbody>
<tr>
<td>i. There are some environmental topics in the secondary school curriculum</td>
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<td>ii. It easy to identify environmental education (EE) topics in some subjects you teach</td>
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<td>iii. There is adequate coverage of EE in the subjects that you teach</td>
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<td>iv. There is adequate coverage of EE in students’ activities outside the official class lessons</td>
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<td>v. Environmental Education is not suitable for integrating in some subjects</td>
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<td>vi. Integrating environmental education in teaching and learning is stressful</td>
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7. In each of the questions or statements i-vi, use the key provided to tick only one choice that best describes your situation

**Key**
SA=strongly agree, A= Agree, U= Undecided, D=Disagree, SD= strongly disagree

**SECTION IV: Teachers’ perceptions of integrated environmental education in the school curriculum**

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<tr>
<td>i. The integration of EE into the school curriculum is a priority need</td>
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<td>ii. I understand environmental education concepts in the secondary curriculum well enough to effectively teach them</td>
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<td>iii. I can design enhanced learning activities in environmental education for my students</td>
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<td>iv. Teachers receive training for integration of environmental education in their teaching</td>
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<td>v. Teaching is more complex since EE was introduced in the school curriculum</td>
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<td>vi. Integrated EE often relies on motivated teachers to succeed</td>
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8. Are environmental education topics stated as separate topics in your subjects?
   A. Yes [ ] B. No [ ]

9. If not, how do you identify them from the syllabus?
   __________________________________________
   __________________________________________
   __________________________________________

10. Which environmental education (EE) topics would you like to see addressed in the secondary school curriculum?
    __________________________________________
    __________________________________________
    __________________________________________

11. What do you perceive as the ideal way of including EE into the school curriculum?
    __________________________________________
    __________________________________________
SECTION V: Levels of environmental literacy among secondary school teachers

Part One: Knowledge: This sub-section of the questionnaire is designed to determine knowledge about 10 basic environmental concepts which according to Swanepoel, Loubser & Chcko (2002) are biosphere, ecology, ecosystem, environmental change, basic human needs, resources, environmental quality, ability to make choices, decision making on environmental issues and environmental ethics. In each of the questions 12-22, please circle only one choice that best describes your situation. If you don’t know the answer to any of these questions, guess.

12. What climatic conditions are xerophytes specifically adapted to?
   A. Extreme PH levels
   B. Limited moisture availability
   C. Saline conditions
   D. Cold temperatures

13. All of the following statements about ecology are correct except:
   A. Ecology is the study of the interactions between biotic and abiotic aspects of the environment
   B. Ecology is a discipline that is independent from natural selection and evolutionary history
   C. Ecologists may study populations and communities of organisms
   D. Ecological studies may involve the use of models and computers

14. Grass is eaten by a cow; The cow is eaten by a hyena; This is an example of
   A. An abiotic element.
   B. An omnivore.
   C. A herbivore.
   D. A food chain.

15. Greenhouse effect refers to
   A. Ability of atmosphere to retain water vapour
   B. Ability of certain atmospheric gases to trap heat and keep the planet relatively warm
   C. Ability of cloud to scatter electromagnetic radiation
   D. None of the above
16. Which of the following needs is a basic physiological need?
   A. Privacy
   B. Security
   C. Order
   D. Food

17. Underlying root causes of unsustainable resource use include all of the following except
   A. Poverty
   B. Overpopulation
   C. Over reliance on renewable energy resources
   D. Use of few products based on natural resources

18. Smog is
   A. A natural phenomenon
   B. A combination of smoke and fog
   C. Is colorless
   D. All of the above

19. Personal use of cars and light trucks is the most damaging consumer behaviour”
    Which one of the following is the least appropriate choice of action?
    A. I will think twice before buying a car
    B. Whenever practical, I will walk, cycle, or take public transportation
    C. I will choose a place to live that reduces the need to drive
    D. I will choose a fuel-efficient, low-polluting car

20. Which one of the following options results is the most serious waste of our usable water?
   A. Contamination by bacteria
   B. Uncontrollable drainage
   C. Careless usage
   D. Improper storage
21. Which one of the following options does not fit into the preservation ethic attitude towards the environment?
   A. Nature has inbuilt value
   B. A reverence for life and respect for the rights of all creatures
   C. Human species depend on, and learn from nature
   D. Nature is there to supply limitless needs for humankind

22. How does the gap between rich and poor countries contribute to the current environmental crisis?
   A. Developed countries consume a disproportionate share of the resources
   B. Rapid industrialization in developing countries poisons cities
   C. Increased agricultural production in developing countries often destroys soils and forests
   D. All of the above

**Part Two: Environmental awareness**

23. For each of the following questions (i-v) tick only one choice that best describes your situation.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>Did you ever attend any awareness programmes conducted by your local Authority?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii.</td>
<td>Do you think environmental problems are important to your school?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii.</td>
<td>Is it important that everyone should be aware about environmental problems?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iv.</td>
<td>Do you understand the role you need to play in environmental protection?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>v.</td>
<td>Are you aware of the outcome of improper management of the environment?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Part Three: Environmental Attitudes

24. There is no right or wrong answer, only differences of opinion. In the table that follows, use the key provided to respond by circling the appropriate number against each statement (i-x) that most represents your feeling:

**KEY**

<table>
<thead>
<tr>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree (SA)</td>
</tr>
<tr>
<td>Agree (A)</td>
</tr>
<tr>
<td>Undecided (U)</td>
</tr>
<tr>
<td>Disagree (D)</td>
</tr>
<tr>
<td>Strongly Disagree (SD)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. I feel that the benefits that I get from the environment have altered my attitude towards the environment and its conservation</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>ii. I teach environmental education as well as I do most subjects</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>iii. Environmental education can help students understand concepts in other subjects more easily</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>iv. Environmental topics are logically organized in the syllabus</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>v. I am willing to volunteer my free time to help out in integrating environmental concepts and issues in the curriculum</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>vi. Environmental education is an overload in the school curriculum</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>vii. It is demanding to prepare environmental education lessons</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>viii. It is difficult to infuse EE and requires extensive teacher training</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>ix. Integrated EE is difficult to evaluate</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>x. Students might not &quot;get integrated EE messages&quot; as they are diluted to fit the objectives of the carrier subject</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
Part Four: Environmental Skills

In the table that follows, tick against the appropriate option for each statement (i-viii)

<table>
<thead>
<tr>
<th>Question</th>
<th>Skills</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>25. Does the learning of Integrated Environmental Education promote the</td>
<td>i Decision-making</td>
<td></td>
<td></td>
</tr>
<tr>
<td>following skills in students?</td>
<td>ii Problem-Solving</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>iii Creative Thinking</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>iv Communication (Oral and Written)</td>
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<td></td>
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<tr>
<td></td>
<td>v Computation/calculation skills</td>
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<td></td>
<td>vi Research skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>vii Teamwork</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>viii Conflict resolution</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Part Five: Participation

The following are common environmental activities in secondary schools, within communities and at homes. In the blank spaces provided, tick against the common ones that you participate in, within your school, your community and your home.

<table>
<thead>
<tr>
<th>27 I am committed to:</th>
<th>In my</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>School</td>
</tr>
<tr>
<td>v.  Controlling visible pollution:</td>
<td></td>
</tr>
<tr>
<td>Removing cobwebs, clearing soot, dust</td>
<td></td>
</tr>
<tr>
<td>and garbage.</td>
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<tr>
<td>vi. Taking environmental safety measures:</td>
<td></td>
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<tr>
<td>Cleaning rooms, toilets, compound, and</td>
<td></td>
</tr>
<tr>
<td>slashing grass.</td>
<td></td>
</tr>
<tr>
<td>vii. Promoting environmental beauty:</td>
<td></td>
</tr>
<tr>
<td>Maintaining flower beds, trimming</td>
<td></td>
</tr>
<tr>
<td>hedges.</td>
<td></td>
</tr>
<tr>
<td>viii. Conservation of resources:</td>
<td></td>
</tr>
<tr>
<td>conserving electricity, water, soils,</td>
<td></td>
</tr>
<tr>
<td>planting and caring for trees.</td>
<td></td>
</tr>
</tbody>
</table>

Source: Adapted from Toili, 2007
SECTION VI: Support for teachers to implement integrated environmental education topics in the secondary school curriculum

27. In each of the questions or statements (i-vii), use the key provided to tick only one choice that best describes your situation

**Key**
SA=strongly agree, A= Agree, U= Undecided, D=Disagree, SD= strongly disagree

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Teaching resources for environmental education are readily available</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>ii. Support from the Ministry of Education enhances EE in the school curriculum</td>
<td></td>
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<tr>
<td>iii. The school principal in my school supports the integration of environmental education in the school curriculum</td>
<td></td>
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<tr>
<td>iv. Teachers in my school support each other in teaching Integrated Environmental Education</td>
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<tr>
<td>v. In departmental meetings, teachers discuss integration of environmental education in the school curriculum</td>
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<tr>
<td>vi. Teachers use the rich school outdoor experiences to teach EE lessons</td>
<td></td>
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<tr>
<td>vii. The school community encourages you to integrate environmental education in learning of EE</td>
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</tbody>
</table>
SECTION VII

28 Instructional approaches that secondary school teachers use to teach integrated environmental education topics

Please put a tick by each of the following methods you have used or have not used to teach environmental education.

<table>
<thead>
<tr>
<th>Have used</th>
<th>Have not used</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Lectures</td>
<td></td>
</tr>
<tr>
<td>ii. Demonstration</td>
<td></td>
</tr>
<tr>
<td>iii. Gaming &amp; Simulation</td>
<td></td>
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<tr>
<td>iv. Workshop</td>
<td></td>
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<tr>
<td>v. Experiments</td>
<td></td>
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<tr>
<td>vi. Field trips</td>
<td></td>
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<tr>
<td>vii. Role playing</td>
<td></td>
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<tr>
<td>viii. Group Discussion</td>
<td></td>
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<tr>
<td>ix. Seminar</td>
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<tr>
<td>x. Case Study</td>
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<tr>
<td>xi. Project</td>
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<tr>
<td>xii. Self Study</td>
<td></td>
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<tr>
<td>xiii. Action research Problem solving (Creative Thinking, Generating new ideas)</td>
<td></td>
</tr>
<tr>
<td>xiv. Critical Thinking (Analyzing issues, Evaluating issues, synthesizing issues)</td>
<td></td>
</tr>
<tr>
<td>xvi. Computer assisted learning</td>
<td></td>
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</tbody>
</table>

29. How else do you think the teaching of EE in secondary schools can be improved?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
**SECTION VIII**

Challenges that face implementation of integrated environmental education in the secondary school curriculum

30. In each of the questions or statements (i-xi), use the key provided to tick against only one choice that best describes your situation

**Key**
SA=strongly agree, A= Agree, U= Undecided, D=Disagree, SD= strongly disagree

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. There is lack of environmental policy in your school</td>
<td></td>
<td></td>
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<tr>
<td>ii. Poor coordination of EE programmes results to overlaps and overloads of EE topics in the curriculum</td>
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<tr>
<td>iii. Overcrowded curriculum does not allow for integration of EE content into the curriculum</td>
<td></td>
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<tr>
<td>iv. There is no enough time to implement EE in the school curriculum</td>
<td></td>
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<tr>
<td>v. There is heavy workload for teachers since EE was introduced in the school curriculum</td>
<td></td>
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<tr>
<td>vi. High premium placed on national examinations reduces attention to EE</td>
<td></td>
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<tr>
<td>vii. Limited cooperation and networking among schools and among teachers on environmental issues defeat efforts of implementing EE in the school curriculum</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>viii. Outdated and inadequate facilities in schools upset efforts to implement EE in the school curriculum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ix. Lack of instructional materials in schools affects efforts of implementing EE in the school curriculum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>x. Lack of funding hinder implementation efforts of EE in the school curriculum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xi. Lack of qualified teachers in environmental issues hinders implementation of EE in the school curriculum</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
31. Besides the factors already mentioned, what other challenges do you face in implementing EE in your subject?

________________________________________________________________________

________________________________________________________________________

SECTION IX

Strategies that are suggested to improve implementation of integrated environmental education in the secondary school curriculum in Machakos Sub-County

32. For each of the statements (i-xi), please circle only one choice that best describes opportunities that could be exploited in schools to improve implementation of integrated environmental education

<table>
<thead>
<tr>
<th>Opportunity</th>
<th>Very often</th>
<th>Often</th>
<th>Occasionally</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Formal curriculum dimension</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. Field work/instruction in the local environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii. Encouraging students’ participation in class lesson environmental activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii. Encouraging students to participate in environmental debates</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>iv. Encouraging environmental essay writing competitions</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Non formal curriculum dimension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>v. Involving students in community environmental clean-up projects</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>vi. Encouraging special events such as awareness week</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>vii. Encouraging students’ regular going out to watch wildlife</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>viii. Encouraging students to read newspaper articles concerning the environment</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>ix. Encouraging students to read environmental magazines</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>x. Encouraging students to regularly watch/listen to environmental programmes on television and radio</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>xi. Encouraging environmental clubs &amp; youth groups in school</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Thank you for completing this questionnaire.
Appendix H: Questionnaire for Students (QS) on Implementation of Integrated Environmental Education in the Secondary School Curriculum

SECTION I:
Informed Consent for Research

Introduction

My name is Timothy Mandila. I am currently enrolled for the doctoral programme at the Catholic University of Eastern Africa. I am conducting a research on Implementation of Integrated Environmental Education in Secondary Schools Curriculum as a Measure to Alleviate Environmental Degradation in Machakos Sub-County. This study is entirely for academic purposes and therefore I kindly request you to be part of this exercise by filling out the questionnaire which seeks your views on this issue. Completion of this questionnaire is entirely voluntary and all responses will be recorded anonymous and will be confidential to all persons except the researcher. Thank you in advance for your time and willingness to share your perspective in this study.

Sincerely,
Timothy Mandila.

Consent Statement

I, the undersigned participant, have been fully informed of this study and have understood its purpose and what is required of me, and give my consent to voluntarily participate in it.

Signature of Participant Date
…………………………... .............................................

Signature of Researcher Date
…………………………... .............................................
SECTION II
Background Information
You are kindly requested to answer the questions below as sincerely as possible. Please answer all questions by filling in the spaces provided or ticking your choice of response where required. There is no correct or wrong answer. You are free to give any additional information where necessary. The information you give will be treated confidentially. Do not write your name anywhere on this questionnaire.

Please Tick in the appropriate box.

1. What type is your school?
   A. Boys’ secondary school 
   B. Girls’ secondary school 
   C. Mixed secondary school 

2. What is your gender?
   A. Male 
   B. Female 

3. Which one of the following subjects do you learn in this school?
   A. Chemistry 
   B. Biology 
   C. Geography 
   D. History 

For each of the statements or questions 4-6, please tick only one choice that best describes your situation

4. Have you ever heard about Integrated Environmental Education?
   A. Yes 
   B. No 

5. If your answer in 4 is yes, from which source?
   A. Individual studies 
   B. Television 
   C. Teachers 
   D. Newspapers and magazines 

6. If your answer in 4 is no, would you like to know something about Integrated Environmental education?
   A. Yes 
   B. No
7. What requirements do you need in order to effectively carry out integrated environmental education activities in your school?

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

8. In each of the questions or statements (i-iv), use the key provided to tick only one choice that best describes your situation

Key
SA=strongly agree, A= Agree, U= Undecided, D=Disagree, SD= strongly disagree

SECTION III: The extent to which the curriculum for secondary schools integrates environmental education in the Curriculum

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. There are some environmental topics in some subjects that you learn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii. It easy to identify environmental education (EE) topics in some subjects that you learn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii. There is adequate coverage of EE in the subjects that you learn</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>iv. There is adequate coverage of EE in students’ activities outside the official class lessons</td>
<td></td>
<td></td>
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<tr>
<td>v. Environmental Education is not suitable for inclusion in some subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>vi. Including environmental education in teaching and learning is difficult</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9. In each of the questions or statements (i-vi), use the key provided to tick only one choice that best describes your situation

SECTION IV: Students’ perceptions of the integrated environmental education in the Curriculum

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>Inclusion of Environmental Education (EE) into the school curriculum is necessary</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>ii.</td>
<td>Teachers understand environmental education concepts in the secondary curriculum well enough to effectively teach them</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>iii.</td>
<td>Our teachers develop interesting learning activities in environmental education for us</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iv.</td>
<td>Our teachers receive training for inclusion of environmental education in their teaching</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>v.</td>
<td>Learning is more complex since EE was introduced in the school curriculum</td>
<td></td>
<td></td>
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<tr>
<td>vi.</td>
<td>Integrated IEE often relies on motivated teachers and students to succeed</td>
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</tbody>
</table>

10. Which environmental education (EE) topics would you like to see addressed in the secondary school curriculum?

________________________________________________________________________

________________________________________________________________________

11. Which is the best way of including EE into the school curriculum?

________________________________________________________________________

________________________________________________________________________
SECTION V: Levels of environmental literacy among secondary school students in Machakos Sub-County

Part One: Knowledge: This sub-section of the questionnaire is designed to determine knowledge about 10 basic environmental concepts which according to Swanepoel, Loubser & Chcko (2002) are biosphere, ecology, ecosystem, environmental change, basic human needs, resources, environmental quality, ability to make choices, decision making on environmental issues and environmental ethics. In each of the questions 12-22 please circle only one choice that best describes your situation. If you don’t know the answer to any of these questions, guess.

12. What climatic conditions are xerophytes adapted to?
   A. Extreme PH levels
   B. Limited moisture availability
   C. Saline conditions
   D. Cold temperatures

13. All of the following statements about ecology are correct except:
   A. Ecology is the study of the interactions between biotic and abiotic aspects of the environment
   B. Ecology is a discipline that is independent from natural selection and evolutionary history
   C. Ecologists may study populations and communities of organisms
   D. Ecological studies may involve the use of models and computers

14. Grass is eaten by a cow; The cow is eaten by a hyena; This is an example of
   A. An abiotic element.
   B. An omnivore.
   C. A herbivore.
   D. A food chain.

15. Greenhouse effect refers to
   A. Ability of atmosphere to retain water vapour
   B. Ability of certain atmospheric gases to trap heat and keep the planet relatively warm
C. Ability of cloud to scatter electromagnetic radiation
D. None of the above

16. Which of the following needs is a basic need for the human body?
   A. Privacy
   B. Security
   C. Order
   D. Food

17. Underlying root causes of poor resource use include all of the following except
   A. Poverty
   B. Overpopulation
   C. Over reliance on renewable energy resources
   D. Use of few products based on natural resources

18. Smog is
   A. A natural phenomenon
   B. A combination of smoke and fog
   C. Is colorless
   D. Dew

19. “Personal use of cars and light trucks is the most damaging consumer behaviour”
    Which one of the following is the least appropriate choice of action?
    A. I will think twice before buying a car
    B. Whenever practical, I will walk, cycle, or take public transportation
    C. I will choose a place to live that reduces the need to drive
    D. I will choose a fuel-efficient, low-polluting car

20. Which one of the following options results is the most serious waste of our usable water?
    A. Contamination by bacteria
    B. Uncontrollable drainage
    C. Careless usage
    D. Improper storage

21. Which one of the following options does not fit into correct feelings towards preservation of the environment?
    A. Nature has inbuilt value
    B. Respect for life and respect for the rights of all creatures is moral
C. Human species depend on, and learn from nature
D. Nature is there to supply limitless needs for humankind

22. How does the gap between rich and poor countries contribute to the current environmental crisis?
   A. Developed countries consume a unbalanced share of the resources
   B. Rapid industrialization in developing countries poisons cities
   C. Increased agricultural production in developing countries often destroys soils and forests
   D. All of the above

**Part Two: Students’ Environmental Awareness**

23. For each of the following questions (i-v) tick only one choice that best describes your situation.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>Did you ever attend any environmental awareness programmes conducted by your local authority?</td>
<td></td>
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</tr>
<tr>
<td>ii.</td>
<td>Do you know the importance of environmental problems in your school?</td>
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<tr>
<td>iii.</td>
<td>Is it important that everyone should be aware about environmental problems?</td>
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<tr>
<td>iv.</td>
<td>Do you understand the role you need to play in environmental protection?</td>
<td></td>
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<tr>
<td>v.</td>
<td>Are you aware of the effect of improper management of the environment?</td>
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</tbody>
</table>

**Part Three: Students’ Environmental Attitudes.**

24. In the table that follows, use the key provided to respond by circling the appropriate number against each of the statements (i-x) that most represents your feeling to it

<table>
<thead>
<tr>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Agree</td>
</tr>
<tr>
<td>Undecided</td>
</tr>
<tr>
<td>Disagree</td>
</tr>
<tr>
<td>Strongly Disagree</td>
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<tr>
<td>---</td>
</tr>
<tr>
<td>i.</td>
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<td>ii.</td>
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<tr>
<td>iii.</td>
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<tr>
<td>iv.</td>
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<tr>
<td>v.</td>
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<tr>
<td>vi.</td>
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<tr>
<td>vii.</td>
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<tr>
<td>viii.</td>
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<tr>
<td>ix.</td>
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<tr>
<td>x.</td>
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</tbody>
</table>
Part Four: Environmental Skills

In the table that follows, respond by ticking against the appropriate option (i-viii)

<table>
<thead>
<tr>
<th>Question</th>
<th>Skills</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>25. Does the learning of Environmental Education in the curriculum promote the following skills?</td>
<td>i. Decision-making</td>
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<tr>
<td></td>
<td>ii. Problem-Solving</td>
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<td></td>
<td>iii. Creative Thinking</td>
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<td></td>
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<td></td>
<td>iv. Communication</td>
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</tr>
<tr>
<td></td>
<td>(Oral and Written)</td>
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<td></td>
<td>v. Computation/calulation skills</td>
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<td></td>
<td>vi. Research skills</td>
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<td></td>
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<td></td>
<td>vii. Teamwork</td>
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<td></td>
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<td></td>
<td>viii. Conflict resolution</td>
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</tbody>
</table>
Part Five: Participation

The following are common environmental activities within secondary schools, in communities and at homes in which I participate. Please, tick against the appropriate spaces provided.

SECTION VI

Support for teachers to implement integrated environmental education topics in the secondary school curriculum

27. In each of the questions or statements (i-vii), use the key provided to tick only one choice that best describes your situation

Key

SA=strongly agree, A= Agree, U= Undecided, D=Disagree, SD= strongly disagree

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>SCORE</th>
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</thead>
<tbody>
<tr>
<td>i.  Teaching resources for environmental education are readily available in school</td>
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<tr>
<td>ii. Support from the Ministry of Education to improve the incorporation of EE in the school curriculum is readily available</td>
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<tr>
<td>iii. The school principal encourages teachers to incorporate environmental education in their lessons</td>
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<tr>
<td>iv. Other teachers in your school encourage the rest of the teachers to incorporate environmental education in their teaching</td>
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<td>v. In departmental meetings, teachers discuss the subject of integrating environmental education in the school curriculum</td>
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<td>vi. Teachers use the rich school outdoor experiences to teach EE lessons</td>
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<tr>
<td>vii. The school community encourages teachers to integrate environmental education in teaching</td>
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</tr>
</tbody>
</table>
28. What conditions would you suggest might make it easier for teachers to incorporate environmental education (EE) into their teaching?

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

SECTION VII

Instructional approaches that secondary school teachers use to teach integrated environmental education topics

29. Please put a tick against each of the following methods that your teachers have used or have not used to teach you environmental education topics.

<table>
<thead>
<tr>
<th>Method</th>
<th>Have used</th>
<th>Have not used</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Lectures</td>
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<td>ii. Demonstration</td>
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<td>iii. Gaming &amp; Simulation</td>
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<td>iv. Workshop</td>
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<td>v. Experiments</td>
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<td>vi. Field trips</td>
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<td>vii. Role playing</td>
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<td>viii. Group Discussion</td>
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<td>ix. Seminar</td>
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<tr>
<td>x. Case Study</td>
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<td>xi. Project</td>
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<tr>
<td>xii. Self Study</td>
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<tr>
<td>xiii. Action research</td>
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<td></td>
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<tr>
<td>xiv. Problem solving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Creative Thinking, Generating new ideas)</td>
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<td></td>
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<tr>
<td>xv. Critical Thinking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Analyzing issues, evaluating issues, synthesizing issues)</td>
<td></td>
<td></td>
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<tr>
<td>xvi. Computer assisted learning</td>
<td></td>
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</tbody>
</table>
30. Suggest other suitable methods that you would like your teachers to use in teaching you integrated environmental education.

SECTION VIII: Challenges that face the implementation of integrated environmental education in the secondary school curriculum.

31. In each of the questions or statements (i-xi), use the key provided to tick only one choice that best describes your situation

Key
SA=strongly agree, A= Agree, U= Undecided, D=Disagree, SD= strongly disagree

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. There is lack of environmental policy in your school</td>
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<tr>
<td>ii. Poor coordination of environmental education (EE) programmes results to repetition and overloading of EE topics in the curriculum</td>
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<tr>
<td>iii. Overcrowded curriculum does not allow for integration of EE content into the curriculum</td>
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<tr>
<td>iv. There is no enough time to implement EE in the school curriculum</td>
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<tr>
<td>v. There is heavy workload for teachers since EE was introduced in the school curriculum</td>
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<tr>
<td>vi. High emphasis placed on national examinations reduces attention to EE</td>
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<tr>
<td>vii. Limited cooperation and exchange of ideas among schools and among students defeat efforts of implementing EE in the school curriculum</td>
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<tr>
<td>viii. Outdated and inadequate facilities in schools frustrate efforts to implement EE in the school curriculum</td>
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<tr>
<td>ix. Lack of instructional materials in schools affects efforts of implementing EE in the school curriculum</td>
<td></td>
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<tr>
<td>x. Lack of funding hinders implementation efforts of EE in the school curriculum</td>
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<tr>
<td>xi. Lack of qualified teachers in environmental issues hinders implementation of EE in the school curriculum</td>
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</tr>
</tbody>
</table>
32. Besides the factors already mentioned, what other factors do you think would affect effective implementation of IEE?

________________________________________________________________________

________________________________________________________________________

 SECTION IX

Strategies that are suggested to address challenges facing implementation of integrated environmental education in the secondary school curriculum.

33. For each of the statements i-xi, please circle only one choice that best describes opportunities that have been exploited in schools to improve implementation of integrated environmental education

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Very often</th>
<th>Often</th>
<th>Occasionally</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formal curriculum dimension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. Carrying out field work/instruction in the Local environment</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>ii. Encouraging students’ participation in class lessons</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>environmental activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii. Encouraging students to participate in environmental debates</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>iv. Encouraging environmental essay writing competitions</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Non formal curriculum dimension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>v. Involving students in community environmental clean-up projects</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Informal curriculum dimension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vi. Encouraging special events such as awareness week</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>vii. Encouraging students’ regular going out to watch wildlife</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>viii. Encouraging students to read newspaper articles concerning the environment</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>ix. Encouraging students to read environmental magazines</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>x. Encouraging students to regularly listen to environmental programmes on television and radio</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>xi. Encouraging environmental clubs &amp; youth groups in schools</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Thank you for completing this questionnaire.

Introduction

My name is Timothy Mandila. I am currently enrolled for the doctoral programme at the Catholic University of Eastern Africa. I am conducting a research on Implementation of Integrated Environmental Education in Secondary Schools Curriculum as a Measure to Alleviate Environmental Degradation in Machakos Sub-County. This study is entirely for academic purposes and therefore I kindly request you to be part of the exercise by discussing out your views freely on this issue. Participation in this exercise is entirely voluntary and all responses will be recorded anonymous and will be confidential to all persons except the researcher. Thank you in advance for your time and willingness to share your perspectives in this study.

Sincerely,
Timothy Mandila.

Interview Questions for KICD Officers

1. What are contemporary issues in the current secondary school curriculum? (Probe for cross cutting issues in school curriculum)
2. Talk a little about your past experiences with integration of environmental education in the secondary school curriculum (Probe for the inception of IEE in the school curriculum: organization, duration it took, shortcomings, content & skills developed)
3. Why did KICD think of integrating EE in the secondary school curriculum?
4. How do you rate the capacity of teachers in secondary schools in implementing IEE in the school curriculum? (Probe for in-service training, seminars and orientations to IEE, financial capacity, materials / resources)
5. What support do you give teachers to implement integrated environmental education related topics in the secondary school curriculum? (Probe for collaboration in implementation of IEE in the school curriculum)
6. What instructional approaches do secondary school teachers mostly use to teach integrated environmental education topics in the secondary school curriculum? (Probe for learner centered & teacher centred methodologies)
7. How do you monitor implementation of IEE in the school curriculum?
8. What challenges face the implementation of integrated environmental education in the secondary school curriculum?
9. What strategies would you suggest to address these challenges?

Thank you for your time and contributions. It was an informative experience interviewing you.

Introduction

My name is Timothy Mandila. I am currently enrolled for the doctoral programme at the Catholic University of Eastern Africa. I am conducting a research on Implementation of Integrated Environmental Education in Secondary Schools Curriculum as a Measure to Alleviate Environmental Degradation in Machakos Sub-County. This study is entirely for academic purposes and therefore I kindly request you to be part of the exercise by discussing out your views freely on this issue. Participation in this exercise is entirely voluntary and all responses will be recorded anonymous and will be confidential to all persons except the researcher. Thank you in advance for your time and willingness to share your perspective in this study.

Sincerely,
Timothy Mandila.

Interview Questions for Secondary School Principals

1. Have you heard about emerging issues in the current secondary school curriculum? (Probe for cross cutting issues in school curriculum)

2. Talk a little about your past experiences with integrating environmental education in the secondary school curriculum? (Probe for first impressions of EE as introduced in the secondary school curriculum by KIE: organization, duration it took, shortcomings, content & skills developed)

3. Do you think it is important for IEE to be taught in your school? If yes, does your school have an IEE Policy? (Probe for the need for EE in the curriculum & interim measures /standards proposed by the school to address environmental problems).

4. Do teachers in your school integrate EE into the subjects that they teach? If yes how do they do that? (Probe for integration of EE into Formal, Non Formal, Informal, Hidden & Emergent curriculum dimensions)

5. How do you rate the capacity of teachers in your school to implement IEE in the school curriculum? (Probe for teacher qualifications, in-service training, workshops)
6 What support does your school receive to implement IEE topics in the secondary school curriculum? (Probe for collaboration in implementation of IEE in the school curriculum- Local & external support)

7 What instructional methods do teachers in your school mostly use to teach integrated environmental education topics in the school curriculum? (Probe for learner centered & teacher centered methodologies)

8 How is the implementation of IEE in the school curriculum monitored in your school?

9 What challenges face the implementation of integrated environmental education in the school curriculum?

10 What strategies would you suggest to address these challenges?

Thank you for your time and contributions. It was an informative experience interviewing you.
### Document Analysis Schedule for Environmental Topics in the Biology Syllabus

<table>
<thead>
<tr>
<th>Biology Topics</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction to Biology</td>
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<td>2. Classification</td>
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<td>3. The Cell</td>
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<td>4. Cell Physiology</td>
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<td>5. Nutrition in plants and animals</td>
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<td>6. Transport in plants and animals</td>
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<tr>
<td>7. Gaseous exchange</td>
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<td>12</td>
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<td>8. Respiration</td>
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<tr>
<td>9. Excretion and Homeostasis</td>
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<td>10. Classification</td>
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**Integrated Environmental Education (IEE) Topics**

1. Waste Management
2. Agro-Forestry
3. Water & Sanitation
4. Food Security
5. Finiteness of resources
6. Materials cycles
7. Health
8. Population
9. Land degradation
10. Pollution
11. Climate Change
12. Gender
13. Poverty
14. Conflict Resolution
15. Violation of Human Rights
16. Cooperation

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**Frequencies**

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Appendix L: Observation Schedule for evidence of environmental improvement in the local setting

1. Date: _________________________________
2. Time: _________________________________
3. Type of school:
   1. Boys’ secondary school [ ]  3. Mixed secondary school [ ]
   2. Girls’ secondary school [ ]

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Source: Adapted from Toili (2007)
Appendix M: Table for determining sample size from a given population

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## Appendix N: Research Methodology Matrix

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<tr>
<th>S/N</th>
<th>Demographic Information</th>
<th>Type of data</th>
<th>Source of data</th>
<th>Data collection instrument</th>
<th>Data analysis process</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type of school, Gender, teaching experience</td>
<td>Nominal &amp; Ordinal data</td>
<td>Principals, teachers &amp; students</td>
<td>Questionnaires &amp; Interviews</td>
<td>Descriptive analysis: Frequencies, std deviations, percentages</td>
</tr>
<tr>
<td>2</td>
<td>To what extent does the national curriculum for secondary schools infuse environmental education (EE)?</td>
<td>Quantitative and qualitative</td>
<td>Syllabuses for Geography, Agriculture, Biology &amp; Chemistry; students; Teachers; KICD Officers</td>
<td>Document analysis check questionnaires list; questionnaires (closed ended &amp; open items); interview guide</td>
<td>Frequencies, means, percentages and Narratives</td>
</tr>
<tr>
<td>3</td>
<td>What are the teachers’ and students’ perceptions of the integrated environmental education in the National Curriculum for secondary schools?</td>
<td>Quantitative and qualitative</td>
<td>Teachers’ and students</td>
<td>Questionnaires (closed ended &amp; open items)</td>
<td>Frequencies, means, percentages and cross tabulations.</td>
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<tr>
<td>4</td>
<td>What are the levels of environmental literacy of secondary school teachers and students of Machakos Sub-County?</td>
<td>Quantitative and qualitative</td>
<td>Teachers’ and students</td>
<td>Questionnaires (closed ended &amp; open items)</td>
<td>Frequencies, means, percentages, and simple regression analysis.</td>
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<td>5</td>
<td>What support do teachers require to effectively implement integrated environmental education related topics in the secondary school curriculum?</td>
<td>Quantitative and qualitative</td>
<td>KICD Officers, School principal &amp; Teachers</td>
<td>Interview Guide &amp; Questionnaires (closed ended &amp; open items)</td>
<td>Narratives/Descriptive analysis, Frequencies, means, percentages &amp; graphs</td>
</tr>
<tr>
<td>6</td>
<td>What instructional approaches do secondary school teachers use to teach integrated environmental education topics?</td>
<td>Quantitative and qualitative</td>
<td>Teachers and students</td>
<td>Classroom Observation Schedule &amp; Questionnaires (closed ended &amp; open items)</td>
<td>Frequencies, means, percentages, graphs &amp; Narratives</td>
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<tr>
<td>7</td>
<td>What challenges are faced in the implementation of integrated environmental education in the secondary school curriculum in Machakos Sub-County and what strategies are suggested to address these challenges?</td>
<td>Quantitative and qualitative</td>
<td>KICD Officers; School principals; Teachers’ and students; Syllabuses for Geography, Agriculture, Biology &amp; Chemistry</td>
<td>Document analysis check questionnaires list; questionnaires; Interview Guides; Classroom Observation Schedule</td>
<td>Frequencies, means percentages, cross tabulations, graphs &amp; Narratives</td>
</tr>
<tr>
<td>8</td>
<td>There is no statistically significant difference between the mean scores of teachers’ and students’ perception of the integrated environmental education in the secondary school curriculum in Machakos Sub-County</td>
<td>Quantitative</td>
<td>Teachers and students</td>
<td>Questionnaires</td>
<td>Independent samples t-test</td>
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<tr>
<td>9</td>
<td>There is no statistically significant difference between single sex and mixed sex public secondary schools with respect to form four students’ mean scores of environmental awareness, knowledge, skills and attitudes in Machakos Sub-County.</td>
<td>Quantitative</td>
<td>Teachers</td>
<td>Questionnaires</td>
<td>One-way ANOVA</td>
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</tbody>
</table>
Appendix P: Research clearance letters

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2113471, 2341349, 2319371, 22193620
Fax: +254-20-3195443, 318248
Email: sec1secretary@nacost.go.ke
Website: www.nacost.go.ke
When replying please quote:
Ref: No.

NACOSTI/P/15/4286/5924

Timothy Mandila Chikati
Catholic University of Eastern Africa
P.O. Box 62157-00200
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on “Implementation of Integrated Environmental Education in secondary schools curriculum as a measure to alleviate environmental degradation in Machakos Sub-County, Kenya” I am pleased to inform you that you have been authorized to undertake research in Machakos County for a period ending 30th June, 2016.

You are advised to report to the County Commissioner and the County Director of Education, Machakos County before embarking on the research project.

On completion of the research, you are required to submit two hard copies and one soft copy in pdf of the research report/thesis to our office.

Said Hussein
For: Director-General/CEO

Copy to:
The County Commissioner
Machakos County.
The County Director of Education
Machakos County.
CONDITIONS

1. You must report to the County Commissioner and the County Education Officer of the area before embarking on your research. Failure to do so may lead to the cancellation of your permit.
2. Government Officers will not be interviewed without prior appointment.
3. No questionnaire will be used unless it has been approved.
4. Excavation, sampling and collection of biological specimens are subject to further permission from the relevant Government Ministries.
5. You are required to submit at least two (2) hard copies and one (1) soft copy of your final report.
6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice.

CONDITIONS: see back page
THIS IS TO CERTIFY THAT:

MR. TIMOTHY MANDILA CHIKATI
of CATHOLIC UNIVERSITY OF EASTERN
AFRICA, 519-91100 machakos, has been
permitted to conduct research in
Machakos County

on the topic: IMPLEMENTATION OF
INTEGRATED ENVIRONMENTAL
EDUCATION IN SECONDARY SCHOOLS
CURRICULUM AS A MEASURE TO
ALLEVIATE ENVIRONMENTAL
DEGRADATION IN MACHAKOS
SUB-COUNTY, KENYA

for the period ending:
30th June, 2016

[Signature]

Applicant's

[Signature]

Director General
National Commission for Science,
Technology & Innovation
The Presidency
Ministry of Interior and Coordination of National Government

Office of the
County Commissioner
P.O. Box 1 - 90100
Machakos.

When replying please quote

Ref CC ADM 5/9 VOL 1/89

6th May 2015

Deputy County Commissioner
Machakos

Re: Research Authorization

This is to confirm that Timothy Mandila Chikati of Catholic University of Eastern Africa has been authorized to carry out a research on "Implementation of Integrated Environmental Education in Secondary Schools Curriculum as a Measure to Alleviate Environmental Degradation in Machakos Sub County" for a period ending 30th June 2016.

Kindly accord him the necessary support to enable him achieve his goal.

Thank you

A.G. Kimani
For: County Commissioner
Machakos
MINISTRY OF EDUCATION, SCIENCE &TECHNOLOGY
STATE DEPARTMENT OF EDUCATION

Telegrams: ‘SCHOOLING’ Machakos
Telephone: Machakos ( 
Fax: Machakos
Email –cmachakos@yahoo.com
When replying please quote
MKS/ED/CD/U/1/VOL.1

7TH May, 2015

Timothy Mandila Chikali
Catholic University of Eastern University
P.O. Box 62157 -00200
NAIROBI

RE: RESEARCH AUTHORIZATION

In reference to a letter NACOSTI/P/15/4286/5924 dated 5th May, 2015 from the National Commission for Science, Technology and Innovation regarding the above subject, you are hereby authorized to carry out research on, “Implementation of Integrated Environmental Education in Secondary schools curriculum as a measure to alleviate environmental degradation in Machakos Sub – County, Kenya” for a period ending 30th June, 2016.

Chacha C. Mwita
County Director of Education