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THE EFFECT OF SCIENCE TECHNOLOGY AND MATHEMATICS EDUCATION CLINICS ON THE PERCEPTION AND ATTITUDES OF JHS PUPILS TOWARDS SCIENCE IN SELECTED DISTRICTS IN THE ASHANTI REGION

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SEPTEMBER, 2014

CANDIDATE'S DECLARATION

I declare that this research is my own work, and that it has not been submitted for any degree or examination in any other university and that all the sources of information I have used or quoted have been indicated and acknowledged in the references.

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SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of thesis as laid down by the University of Education, Winneba.

Name: Dr. Yaw Ameyaw

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Date:.....

DEDICATION

This thesis is dedicated to my mother, father and brothers.

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ABSTRACT

This study assessed the effect of STME clinics on the perception and attitudes of JHS pupils in selected districts towards science in the Ashanti region. The population included all JHS 2 and 3 pupils totaling 100 from five districts in the region. The districts, schools and respondents were chosen through random, and convenience sampling method. The research instrument adopted was the Relevance of Science Education questionnaire (ROSE instrument) with a 4-point Likert-type scale which was administered and supported with interview. The data gathered was analyzed by SPSS version 16 with t-test statistics. Reliability calculated using Cronbach's alpha coefficient was (0.76). The study revealed the following: a satisfaction for STME clinic activities; the exposure of the participants to STME clinic shaped their attitude, interest, and aspirations for STM subjects; also participants consider Science and Technology as the engine for growth, development of nations and lives, and so valuable for every country and individual, though it comes with its merits and demerits; higher preference for STME clinic activities like excursions, interaction with role models, discussions and hands on activities; different perceptions about science in terms of aspirations, easiness and difficulties; significant disparity in the perception of those exposed to and those not exposed to STME clinic; and teachers practical/unrealistic/theoretical teaching methodologies due to competence and or incompetence coupled with inadequate/lack of TLMs. It was recommended that for effective implementation of the clinic where by majority of JHS pupils would be given opportunity to participate. Moreover, STM teachers are to be given regular training and support. For a well-planned and implemented science, technology and mathematics education clinic today would play a great role in the development of vital skills, positive attitude and perception in science and technology to aid self employment and self-reliant.

CHAPTER ONE

INTRODUCTION

Overview

The chapter discusses the background to the study, statement of the problem, purpose of the study and the Research questions. The assumptions/hypotheses, significance of the study, delimitations of the study, limitations of the study are also presented. The chapter ends with of definition of terms, abbreviations and the description of how the research report was organized.

Background to the study

As a result of increasing development of Science and Technology, the world is growing at a fast pace. Students' affection dimensions about science learning have been studies for decades, and the research results (Gardner, 1975, 1996; Schibeci, 1984) all showed the importance of understanding and cultivating students' learning interests about science and their relationship to learning achievement (Simpson, Koballa, Oliver & Crawlley, 1994). Yet, the theme running through much of the recent science education literature has been the increasing reluctance of young people in many parts of the world to participate in science, technology, engineering and mathematics (STEM). Awareness of this disinclination emerged in the early 1990s with several national reports identifying shortages of science graduates and declines in student interest in school science.

Hence, it is important to realize the current scientific orientation of the world. And for that everybody needs to have some basic scientific and technological knowledge to understand the scientific technological language around us. Actually, no country can

achieve industrialized status without much attention to science and technology. As has been affirmed, Technology is a principal way in which science impact on society (Prime, 1998, p.116). Consequently, to ensure environmental sustainability and quality science and technology education, it will be very essential to develop the basis of science and technology in our institutions.

Science and Technology have long been recognized as central to the growth and development of Ghana. Several attempts have therefore been made in the past concerning development efforts to promote the role of Science, Technology, and Innovation (STI) in the socio-economic development of the country. However, these past attempts have had limited successes.

Soon after independence in 1957, Ghana's recognition of the role of Science and Technology in national development was evidenced by the establishment of what is currently known as the Council for Scientific and Industrial Research (CSIR). The Council with its thirteen institutes, in addition to the Universities in Ghana, undertakes research and services in Science and Technology. In addition, other technology institutes such as Ghana Regional Appropriate and Industrial Service (GRATIS) and Intermediate Technology Transfer Unit (ITTU) have been established over the years because science and technology (S & T) is recognized worldwide as the vital tool for a nation's overall socio-economic development.

Notwithstanding the apparently considerable science and technology infrastructure and institutions established, science showed little progress and development in Ghana. One of the primary reasons has been inadequate political commitment and financial support for effective planning and implementation of strategies for the development of STI. Also lacking has been the absence of a definitive and prescriptive National STI policy to define the vision, goals, objectives and priorities for investment in STI. Such a

policy would have committed government, public and private sector organizations, as well as Science and Technology Institutions to targets for production, processing, research and development (R & D) and innovation.

Science Education is one of the fields to achieving the desired curriculum attitudes and perception of pupils towards science and technology. Awareness of these areas would enable science curriculum planners to develop better and appropriate curricula. Indeed, concerning element of learner in curriculum development is based on the theoretical background that considers learner, knowledge and society as science education (Eisner, 1984). On the other hand, there is low enrolment of girls in school, and the consequent low representation of women in certain spheres of life - school system, work place, political spheres and other sectors of the economy magnifies itself significantly in science and technology. But, ideally, Knowledge – based society is one in which science and technological knowledge affects all social levels. Therefore knowledge becomes a strategic resource for everyone (Beijing Declaration, 1995). Knowledge in science and technology, as commonly understood, provides the intellectual capital or mental labour that can be exchanged for earning a living.

Gardner (1975) has noted that gender has been characterized as the most significant variable towards students' attitude to science". Again, previous research has shown that boys have a consistently more positive attitude to science than girls. Thus, as a means of curbing the situation STME clinic for girls was instituted as a project with the main objective of bridging the gender gap that existed in the field of science and technology as well as promoting gender balance in the study and application of science. It has also meant to create awareness, increase and sustain girl's participation in Science and Technology, hence, contributing to the emergence of a new generation of women leaders in Science and Technology. The Ghana Education Service (GES),

recognising the important role women play both in the family and society started this clinic in 1987.

United Nations Educational Scientific and Cultural Organisation (UNESCO), in promoting girls education in Science and Technology have also made significant contributions. On their part, GES was urged to make the study of science related subjects practical to fight under development, ignorance, poverty, illiteracy, disease and environmental degradations, which serve as barriers to rapid socio-economic development. The Science, Mathematics and Technology (SMT) project is also part of the Forum for African Women Educationalists (FAWE) initiatives to improve the learning of girls in SMT, which is being implemented in a number of FAWE chapters in Africa. The involvement of FAWE in SMT for girls began in 1996, when the Female Education in Mathematics and Science in Africa (FEMSA) Project was launched.

The institution of STME programme is an integral part of the wider national campaign aimed at developing and maintaining a science and technology culture among the Ghanaian citizenry, particularly girls for national development. It provides an ideal atmosphere for exposing the youth to STM, brings out the best in them, helps them to develop their endowed potentials and exposes them to the opportunities available to them in the area of Science and Technology.

In recent years, the international community has been focusing attention on the important role STI can and should play in achieving growth and poverty reduction in developing countries. All recent development policy frameworks of Ghana have acknowledged the expected role of STI in assisting Ghana attain a middle income country status.

Though STME clinic have been in place for the past twenty (20) years, however,

BECE results over the years have shown very little improvement in Mathematics and Science as compared to the other subjects. For instance, in 2009/2010 the BECE results showed that 60% and 60.2% of the candidates passed in mathematics and science respectively. In the 2010/2011 academic year, the percentage passes were mathematics 59.5% and 50.7% for science. Some excerpts of the BECE results compiled in Ashanti Region 2010- 2011 were as follows: Sekyere East 47.8% and 42.5%, Ejisu Juaben 65.6% and 50.7% and Offinso Municipal 41.8% and 36.6% for mathematics and science respectively. Again, some regional analysis of the BECE results recorded within the same period (2010/2011) in the Northern Region were 39.05% and 48.0%, Volta Region 38.2% and 43.9%, and Upper West 37.5% and 50.7% passed mathematics and science.

In a similar mode, report on TIMSS revealed that a total of 5,114 JSS 2 (eighth grade) pupils from 150 schools sampled across the country took part in the TIMSS 2003. The JSS 2 pupils in the sample were made up of 45 percent girls and 55 percent boys. Ghana performed poorly and ended up in the 44th position among 45 countries that participated in the test. The overall performance of Ghanaian pupils in the mathematics and science test was poor, placing them on average scores of 276 in mathematics and in science 255 with the International Average scores pegged at 466 and 473 respectively for maths and science. These two scores placed the nation second from the bottom for the two subjects on results table (Anamuah- Mensah *et al.,* 2004). Though, a little progress has been made in this direction, the current rate at which pupils enter Science and Technology and science-related programmes at the second cycle and tertiary institutions may not lead to the attainment of the projections documented in Vision 2020.

A study conducted in 2002 showed that enrolment in a bachelor of arts and

management programmes as a percentage of total enrolment in the universities has been above 65 per cent and is increasing, from 65 % in 1994/95 to 68 per cent in 1999/2000. During the period 1994/95–1999/2000, the share of total courses increased by 4.1 percentage points, while courses in medicine, engineering and other sciences declined by 0.3, 0.5 and 3.3 points respectively. As well, research from earlier this decade reported a decline in engagement with science, technology, engineering and mathematics (STEM) study and subsequent choices to pursue STEM-related careers (e.g. Roberts, 2002; Stagg, Laird & Taylor, 2003).

The most upsetting part of the situation that has led to this study is the abysmal BECE candidates performances in science and mathematics compared to other courses. One would expect better performances/results to be recorded in mathematics and the sciences but on the contrary. Though there is a little progress not much has been chopped despite the many years of STME clinic for JHS pupils. This has culminated low enrolment figures recorded in second cycle and tertiary institutions of students pursuing mathematics and the sciences. This raises serious questions about the quality of learning in schools most especially Junior High Schools. The impact of STME clinic since its initiation and how it has imparted on the pupil's attitudes, interests and perceptions in science, technology and mathematics.

Statement of the problem

As a nation, it demands on us to ensure that we get along with the rest of the world. Science and technology place responsibilities on the educational sector to provide opportunities for human resource development, which will properly manage the rapid socio economic growth of the nation. But, due to lack of adequate instructional resources and equipment, poor teacher preparation and remuneration and uninspired curricular neither boys nor girls perform well in science, mathematics nor technology

subject at both primary and secondary level (Family Education in Science and Mathematics in Africa [FEMSA], 1995). Correspondingly, in the curriculum reforms of 1982 one of the two major issues to address was scientific and technological training which was insufficient for Ghanaians to make use of their countries resource to students' needs and interests. The investigation of students' attitudes towards studying science has been a substantive feature of the work of the science education research community for the past 40 years (Osborne, Simon & Collins, 2003). Students' increasing reluctance to choose science courses, and physical science courses in particular, in their final years of secondary education has important implications not only for the continuity of scientific endeavor but also for the scientific literacy of future generations. As a result, development of positive attitudes towards science is increasingly a subject of concern (Trumper, 2006). Students' learning interests and attitudes toward science have both been studied for decades. However, the connection between them with students' life experiences about science and technology has not been addressed much (Chang, Yeung & Cheng, 2009).

Despite the growing importance of science and technology in all realms of life in any society, many young people appear to lose their interest for it in schools. In view of this, strategies and programmes such as STME clinic has been in commencement for years to create awareness, increase and sustain girls' participation in science. In addition develop pupils/students attitude, perception and interest in science and technology. However, girl's/women representation, participation and involvement in STM fields are still low, also, there is low enrolment of students in the sciences at the higher levels. Moreover, BECE results over the years have revealed low performance in Science and Mathematics subjects in the region and Ghana as a whole. This study therefore, examines Junior High School pupils in the Ashanti region, the effect that

STME clinic have on their attitudes, interest and perception towards science.

Purpose of the study

Science is an investigative in nature whereby a scientific method is used to discover the answer to a problem. In view of this, STME clinic allows students to identify a problem in the locality and develop a means of solving it in the form of a project development.

The study sought to assess STME clinic activities and strategies, and see whether they arouse JHS pupil's interest in science or not. And examine their attitudes and perception on STME clinics activities/science and how STME programmes have benefited JHS pupils and Ghanaians as a whole.

Research questions

The study was guided by the following research questions:

1. What is the attitude of the JHS pupils towards STME clinic activities?
2. What benefits have the past participants of STME clinics in the selected schools acquired acquired?
3. What is the effect of science and technology on the pupils' attitudes towards in science?
4. Have there been any changes in the pupils' perceptions of and attitudes towards science after participating in STME clinics?

Null Hypotheses

1. $H_{01:}$ there is no significant difference in the perceptions of science of JHS pupils who are participated in the STME clinics and their colleagues who have not.

2. $H_{02:}$ there is no significant difference in the perceptions of science of females and males who are participated in STME clinic.
3. $H_{03:}$ there is no significance difference in the perceptions of female (JHS pupils) of the utility of STME clinics and that of their male counterparts.

Significance of the Study

Rutherford (1985) has noted that the continued progress of the developed countries in respect of economy, security global status and attractiveness to human society would continue to be dependent on science education. The study by examines the relationship between the activities of STME clinics and JHS pupil's participation and how it affects their attitudes, perception and interest in science, would contribute to the socio-economic development of the nation. Again, the recommendations that would be made may help Ghanaian science educators address the problem of declining interest in science among males and particularly females at all levels. Once more, it can also boost the confidence of pupils to choose science as elective subject and pursue it even at higher levels to secure science professions in future. Furthermore, it will help science and mathematics teachers to adopt best and effective measures to ensure excellence and effective teaching and learning of the subjects. Noting the shortcomings of STME clinic would help in successful planning and implementation. It will also guarantee provision of the needed materials and services to promote successful SMT teaching and learning in schools.

Finally, the study is likely to help raise the awareness level on some aspects of our culture that particularly affect the choice of science as elective subject by boys and mostly girls to help policy makers to draw pragmatic policies.

Delimitation

The research was conducted at selected JHSs in five districts in the Ashanti Region. The sample comprises 4 pupils each from five schools in the preferred districts. All JHS 2 and 3 pupils were my target because they are considered for STME clinics. But, 100 pupils were used due to accessibility, time and funds.

Limitations of the Study

According to Best and Kahn (1989), limitations are conditions beyond the control of the researcher that will place restriction on the conclusion of the study and its application.

STME clinics are organized yearly in the 10 regions of Ghana at National and Regional levels and sometimes at the District level. Although the target population was all JHS pupils in Ashanti region, only five districts were involved. The total sample consisted of 100 pupils (50 boys and 50 girls). The restriction is as a result of financial constraints, time factor, proximity and convenience.

Abbreviations

STME	Science, Technology Mathematics and Innovation Education
STI	Science, Technology and Innovation
JHS	Junior High School
SHS	Senior High School
DSTMEO	District Science Technology and Mathematics Education Officer
DDE	District Director of Education

SMT	Science, Mathematics and Technology
FEMSA	Female Education in Mathematics and Science in Africa
GES	Ghana Education Service
FAWE	Forum for African Woman Educationist
MOWAC	Ministry for Women and Children Affairs
UNESCO	United Nations Educational Scientific and Cultural Organisation
GES	Ghana Education Service
ROSE	Relevance of Science Education
SEU	Science Education unit
GEU	Girls Education Unit
MOESS	Ministry of Education Science and Sports.
SAS	Science and Scientist
OECD	Organisation for Economic Co-operation and Development
IEA	International Association for the Evaluation of Educational Achievement
PISA	Programme for International Student Assessment
TIMSS	Trends in International Mathematics and Science Study
NSF	National Science Foundation
PIRLS	Progress in International Reading Literacy Study
GAST	Ghana Association of Science Teachers

JICA Japan International Co-operation Agency

MAG Mathematics Association of Ghana

OECD Organisation for Economic Co-operation and Development

Operational Definition of Terms

Interest Is expressed curiosity in or attitudes toward a subject for study and a career choice.

Perception Ideas pupils have about the learning of science which determines their attitudes towards the learning of science. It further elucidates differences in perceptions among males and females and those who are exposed to STME clinic and those not, and find the factors that affects their attitude, interest and performance in science.

Attitude Ary *et. al*. (1972, 1996) claimed that, "Attitude is the sum total of a person's inclination toward a certain type of an object, institution or idea". Again, Gronlunds (1976) provided the widest meaning of attitude as that which embraces all aspects of personality development such as individual interest, motives, values, vocational adjustment derived from vocational pursuits and other phases of one's daily lives.

Organization of the report

The study consists of five chapters. Introduction comprises of the background to the study, statement of the problem, purpose of the study, significance of the study, research questions and hypothesis, delimitation and limitation of the study, and operational definition of terms and abbreviations.

Chapter two deals with the literature review. The Views of Researchers and

educationist on Science and STME clinic and education are discussed. The third chapter which is on methodology focuses on the design of the study, population and sampling, the instrument for data collection, data collection procedures and data analysis.

Analysis of the results gathered from the instrument is in chapter four. Lastly, chapter five takes account of the discussion of the results, conclusion, recommendations and suggestions for further research.

CHAPTER TWO

LITERATURE REVIEW

Overview

The chapter reviews the literature about situations that influence student's attitudes, perceptions and interest towards science. In regard to this the effects of STME clinic on pupil's attitude towards science and views have been discussed. The literature was reviewed under the following sub-headings:

The concept of Science and Science Education; Rationale for teaching Science; General aims of the JHS Science syllabus; The concept of Science, Technology and Mathematics Education (STME); History of Science, Technology and Mathematics Education (STME) in Ghana; Rationale behind organisation of STME clinic; Benefits/Achievement of STME clinic; JHS Science, Technology and Mathematics Education in Ghana; Attitude and interest of pupils towards Science; Gender and Science, Mathematics and Technology Education (STM/STME) in Ghana; The changing concept and gender equity in STME clinic; Pupil's perceptions and performance/Achievement in science; Gender difference in STM Education/Current state of Girls Achievement in STEM and the Challenges faced in the field of Science, Technology and Mathematics Education

The concept of science and science education in Ghana

What is Science?

There has been much discussion in the literature about the exact definition of science; in most instances the word "science" has, either explicitly or implicitly, taken on a much broader contemporary meaning than just "pure science. In the context of science

communication, science is deemed to include "pure science, mathematics, statistics, engineering, technology, medicine, and related fields. On the other hand, Natural sciences deal with the study of nature and human life. The studies of natural and artificial sciences reveal the relationship between nature and human life. Likewise, many authors, philosophers and scientist have come up with definitions though, they confirm to difficulty in coining its meaning or definition due to ones perceptive of its involvedness. Weinburgh (2003) defines science as a human endeavor and that people of all ages, races, sexes, and nationalities engage in this enterprise. Again, Science is a way of knowing, and there are values and beliefs inherent to the development of scientific knowledge (Lederman, 1998). Based on some philosopher's viewpoint, science is well thought-out as the state or fact of knowing, cognizance of something specified or implied; and also with wider reference, knowledge (more or less extensive) as a personal attribute. Moreover, it is also argued as the systematic enterprise of gathering knowledge about the world and organizing and condensing that knowledge into testable laws and theories. Thus, distinction of sciences is concerned with theoretic truth or dependent on knowledge and conscious application of principles. Therefore, the success and credibility of science is anchored in the willingness of scientists to expose their ideas and results to independent testing and replication by other scientists and abandon or modify accepted conclusions when confronted with more complete or reliable experimental evidence. Many dictionaries (e.g. *New Shorter Oxford English Dictionary*, 1993) amplify this definition by highlighting the use of the scientific method as the way of identifying any activity as part of science. So, Scientists develop their ideas based on evidence and they change their ideas when new evidence becomes available or the old evidence is viewed in a different way. Hence, some philosophers portray, Science as having two products. That

is truth and understanding.

Truth involves Facts which are known to be true such as Empirical, Reliable, Multiple Converging Evidence, Consensually Validated, Operationally/functionally, described Explicit, Ontologically Valid, Referential Correspondence, Testable, Minimal Error, Systematic, and Comprehendible. Whereas Understanding entails Knowing the relationship of facts to each other so that you can: Describe, Predict, Control, Synthesize**,** Explain**,** Truthful**,** Explicit**,** Testable**,** Minimal Error**,** Comprehendible and Systematic or Principled.

However, it is argued by McComas, Clough, and Almazroa (1998) that the philosophy, history, sociology, and psychology of science affect science teaching and learning. This implies that, the teaching and learning of science should be necessitated and governed by the principles, philosophies and psychology to ensure effective and successful achievement of learning objectives (that is the needed skills, attitudes, knowledge and understanding essential in the allotted topics.)

The report "Science for all Americans" also identifies the fact that science is carried out in, and consequently influenced by, its social context. More often than not, many other terms are often grouped together under the banner of science. For example, mathematics is viewed as the language of science. Technology and medicine are frequently considered as applications of pure science, with engineering, often regarded as the link between pure science and technology. In recognition of this, acronyms such as S&T (Science and Technology), SME (Science, Mathematics, and Engineering), S&E (Science and Engineering), STM (Science, Technology and Mathematics) and SET (Science, Engineering, and Technology) are used to describe more accurately or to group together science-related endeavors.

Science Education

Based on the educational setting in Ghana today, science and mathematics are among the basic core subjects. And so, science mathematics and technology are taught rightly from the basic level to tertiary level. At the Lower Primary it is termed Natural Science. At the upper Primary, JHS and levels SHS and in the Colleges of Education it is known as Integrated Science. They are core subjects which one needs to get at least a pass/credit before progress can be attained into second cycle as well as tertiary institution.

Rationale for Teaching Science (Science Education)

Modern life requires general scientific literacy for every Ghanaian citizen, a requirement that will result in the creation of a scientific culture in line with the country's strategic programme of achieving scientific and technological literacy in the shortest possible time. Scientific culture should therefore become the common property of every citizen of this country because it is the antithesis to superstition and the catalyst that will help us toward faster development. The fast advances in science and technology have influenced the rate of economic development of nations, improved the quality of life in most parts of the world, and provided solutions to some major problems and needs of societies.

However, research data gathered clearly show that the greater benefits that science brings are unequally distributed. The Declaration of Budapest proclaim that what distinguishes poor people or countries from rich ones is that not only do they have fewer possessions but also that the large majority remain excluded from the creation and the benefits of scientific knowledge.

The focus of the study of Science is to understand the natural world because of this there are generally two major goals of Science education:

1. It inculcates scientific literacy and culture for all, so that people can make informed choices in their personal lives and approach challenges in the workplace in a systematic and logical order.
2. Secondly, it aims to produce competent professionals in the various scientific disciplines who can carry out research and development at the highest level.

So for meaningful scientific education, it is important for pupils to be trained in the investigative process of seeking answers to problems. This requires pupils to physically explore and discover knowledge within their environment and in the laboratory to be able to contribute new scientific principles and ideas to the body of knowledge already existing in their culture. To guarantee that the needed goals are achieved, the 2007 revised pre-tertiary curriculum puts greater emphasis on critical and scientific thinking as pre- conditions for developing the new type of Ghanaian who will become a problem solver and be able to function effectively in a society.

The Integrated Science syllabus for JHS create a conscious effort to raise the level of scientific literacy of all students and equip them with the relevant basic integrated scientific knowledge needed for their own survival and for the development of the country. It is also expected that scientific experiences in Junior High School will cultivate in pupils an interest and love for science and it related courses that will urge some of them to seek further studies in science as preparation for careers in science. The study of science will also provide excellent opportunities for the development of positive attitudes and values which comprise:

1. Curiosity to explore their environment and question what they find
2. Keenness to identify and answer questions through investigations
3. Creativity in suggesting new and relevant ways to solve problems
4. Open mindedness to accept all knowledge as tentative and to change their

view if the evidence is convincing

5. Perseverance and patience in pursuing a problem until a satisfying solution is found
6. Concern for living things and awareness of the responsibility they have for the quality of the environment
7. Honesty, truthfulness and accuracy in recording, and reporting scientific information, love, respect and appreciation for nature and desire to conserve natural balance.

So, one must possesses the required knowledge, skills, and attitude enshrined in the syllabus after learning in order to fit well in the technological society to solve societal problems and be self-reliant.

Jenkins and Pell (2006) studied English students views on science and technology, school science and environmental issues. The sample of schools was drawn to reflect as far as possible the geographical distribution and type of secondary schools within the English education system. A total of 1,284 questionnaires were eventually received from 34 schools. The results showed that most students agree that science and technology are important for society and are optimistic about the contribution that these disciplines can make to curing diseases such as HIV/AIDS and cancer.

Manninen, Miettinen and Kiviniemi (2005) examined conceptions of students about technology and environmental issues and school science. Their results showed that girls show more concern towards environmental issues. The results also illustrated that both boys and girls believe in science and technology capacities and capabilities. Moreover, Stefánsson (2006) examined the Icelandic students' views about science and technology and also school science. He suggested that students consider school sciences interesting, easy to learn and believe that everyone should learn science in

school. Again, they believed everyday life usefulness of school science.

The General Aims of the JHS science syllabus

The syllabus is designed to help the pupil to:

1. Develop a scientific way of life through curiosity and investigative habits
2. Appreciate the interrelationship between science and other disciplines.
3. Use scientific concepts and principles to solve problems of life.
4. Use basic scientific apparatus, materials and appliances effectively.
5. Take appropriate measures for maintaining machinery and appliances used in everyday life.
6. Acquire the ability to assess and interpret scientific information and make inferences.
7. Recognize the vulnerability of the natural environment and take measures for managing the environment in a sustainable manner.
8. Appreciate the importance of energy to the living and non living things and adopt conservation methods to optimize energy sources.
9. Take preventive measures against common tropical diseases
10. Live a healthy lifestyle.

Based on the Aims and Goals for the teaching of science, the syllabus comprises/covers the following Topics/ Content scope:

The content envelops the basic sciences and embraces topics in Health, Agriculture and Industry. The course has been designed to offer a body of knowledge and skills to meet the requirements of everyday living, and provide adequate foundation for those who want to pursue further education and training in science and science related vocations. Specific issues covered are: Science for all students, Science as an active inquiry process, Science and the satisfaction of individual needs, Science as a

profession and Science and culture. As a result, at the end of JHS education the pupils are expected to acquire the basic skills and attitudes needed, and hold right perception about science and technology.

The concept of Science, Technology and Mathematics Education (STME)

Science, Technology and mathematics has become an integral part of our daily life; in view of this its effect on students and society as a whole cannot be over emphasized. It is perceived the world over as major tool for rapid social and economic development. STME in some countries such as USA is termed as STEM (science technology and engineering mathematics.) but the focus, and content areas are similar. Besides, other acronyms such as S&T (Science and Technology), SME (Science, Mathematics, and Engineering), S&E (Science and Engineering), STM (Science, Technology and Mathematics) and SET (Science, Engineering, and Technology) are used interchangeably as far STM education is concerned.

Science, Technology and Mathematics Education; STME as is simply termed, is used to imply those aspects of the educational process involving the study of the pure Sciences including Mathematics and their applied forms such as Agriculture, Engineering, Home Economics, Health, Information Technology, Material Science and its application in the art and crafts, transport and allied occupations. Science and Technology Education also encompass Vocational and Technical Education. Moreover, STEM education is an approach to teaching and learning that integrates the content and skills of science, technology, engineering, and mathematics. Moreover, science, technology, engineering, and mathematics (STEM) education is used to identify individual subjects, a standalone course, and a sequence of courses, activities involving any of the four areas and a STEM-related course, or an interconnected or integrated program of study. Also Science, Technology and Mathematics Education

(STME) have been called a Meta discipline, the creation of a discipline based on the integration of other disciplinary knowledge into a new whole. This interdisciplinary knowledge bridging among discrete disciplines is now treated as an entity known as STM Education (Morrison, 2006). Thus, STM Education offers students one of the best opportunities to make sense of the world holistically, rather than in bits and pieces. So the independent parts of a larger whole relate or are brought into harmonious relationship with each other according to Oliver (1965) cited in Adentwi (1999).

STEM education has also being defined once again as an interdisciplinary or trans-disc plinary approach to learning where rigorous academic concepts are coupled with real-world problem-based and performance-based lessons. It should be noted, however, that STM Education is an interdisciplinary approach to learning; where rigorous academic concepts are coupled with real world lessons as students apply STM in the context that make connections between schools, community, work and the global enterprises enabling the development of STM literacy and self reliance skills, and with it, the ability to compete in the new economy (Tsupros *et al.,* 2009).

Conversely, the four STEM subjects are defined by the National Research Council as follows:

Science: the study of the natural world, including the laws of nature associated with physics, chemistry, and biology and the treatment or application of facts, principles, concepts, or conventions associated with these disciplines. Secondly**, Technology** is the application of scientific knowledge and processes to produce materials, goods and services. Therefore, technology comprises the entire system of people and organizations, knowledge, processes, and devices that go into creating and operating technological artifacts, as well as the artifacts themselves. On the other hand**,**

Engineering implies a body of knowledge about the design and creation of products and a process for solving problems. Thus, Engineering utilizes concepts in science and mathematics and technological tools. Whereas **Mathematics** is about study of patterns and relationships among quantities, numbers, and shapes. Mathematics also includes theoretical mathematics and applied mathematics. While science tries to explain things, technology is what has enabled mankind to improve his standard of living, not only to build houses, supply food, health, travel and communications but arts, sculpture, music and literature as cited by Mutasa in Nwachuku (2009). Accordingly, the purpose of technology is the application of human knowledge for the betterment of human life. Hence, technology, therefore, seems to be a cultural activity and every society is technological and scientific in varying degrees and mathematics is the vehicle for doing science and a tool for technologies (Wasagu, 2009).

STEM as it often termed as central to the federal policy conversation. In view of this, some federal agencies, such as the NSF, use a broader definition of STEM that includes psychology and the social sciences (e.g., political science, economics) as well as the so-called core sciences and engineering (e.g., physics, chemistry, mathematics). On the other hand, others, including the Department of Homeland Security (DHS), U.S. Immigration and Customs Enforcement (ICE), use a narrower definition that generally excludes social sciences and focuses on mathematics, chemistry, physics, computer and information sciences, and engineering. Moreover, The America COMPETES Act of 2010 also defines the term STEM/STME for the agencies it authorizes, including the NSF as defined by P.L. 111-358, Section 2: the term STEM means "the academic and professional disciplines of science, technology, engineering, and mathematics." In practice, NSF funds research in the supposed core sciences (e.g., mathematics and physical sciences) and engineering as well as psychology and the

social sciences. The Maryland State Board of Education (2012) also defined STEM education as an approach to teaching and learning that integrates the content and skills of science, technology, engineering, and mathematics.

In United States of America for instance, President Bill Clinton on recognizing the need of Science and Technology established the NSTC by Executive Order 12881 on November 23, 1993. The NSTC aims to coordinate science and technology policy across the federal government. To enforce his commitment, STEM education programs are funded at about $3.8 billion.

On the part of Ghana, a Science and Technology (S&T) policy was made and adopted by cabinet in 2000. Subsequently in 2001, a working document on the management of science and technology policy was prepared. Furthermore, Ministry of Environment, Science and Technology (MEST) was also established owing to imperative function of science and technology. In January 2009 a consensus was strongly built for the re-established Ministry of Environment, Science and Technology (MEST) to be the sector ministry which should be responsible for the management and implementation of Ghana's science and technology policies under the Presidency.

The acquisition of appropriate skills for self-reliant nation/Self-reliance is an expression which has become conceptually and practically attractive, particularly in developing countries, wrestling with the economic forces of meeting numerous needs with limited resources (Jimbo, 2009). Self-reliance is one of those euphemistic terms bandied about, like bridging the gap; meeting basic needs; and eco-development in the international effort to reduce hunger, disease, unemployment and general poverty.

History of Science, Technology and Mathematics Education (STME) in Ghana (Public Research and Science and Technology Development Institutions):

It is the role that science and technology has played in transforming traditional European economies to the present high income levels. Ghana, as nation recognizes the importance of science and technology in national development. Due to this, soon after independence in 1957, Ghana's recognition of the role of science and technology in national development was evidenced by the establishment of what is currently known as the Council for Scientific and Industrial Research (CSIR). In addition, other technology institutes such as Ghana Regional Appropriate and Industrial Service (GRATIS) and Intermediate Technology Transfer Unit (ITTU) were also set up.

Ghana, like most of post independent countries, especially in Africa, was faced with the problems of malnutrition, poverty, disease, illiteracy, low life expectancy and low industrialization. Science and Technology Education were accepted by the nation as the engine that could drive the move to overcome these problems associated with underdevelopment. For that reason, the government, in early 1960s, established economic and educational policies, which resulted in an increased access to education (Anamuah-Mensah, 1994). The emphasis was on science teaching and the establishment of industries and institutions in both urban and rural communities. So in the 1960s Ghana has many public institutions dedicated to Research services and development. The largest and oldest public Research and Development institution is the Council for Scientific and Industrial Research, established in 1968. It evolved out of the National Research Council, which had been established in 1958 to coordinate scientific research. The overall mandate of the CSIR was to generate and apply science and technologies for the socio-economic development of the country. The CSIR coordinates all aspects of scientific research in the country, and aims to encourage and

promote the commercialization of research results. The CSIR has 13 research institutes covering agricultural, industrial, natural resources and policy research areas. These are: Science and Technology Policy Research Institute (STPRS), The Animal Research Institute (ARI), Crop Research Institute (CRI), Food Research Institute (FRI), Oil Palm Institute (OPI), Savannah Agricultural Research Institute (SARI), Building and Road Research Institute (BRRI), Institute for Scientific and Technological Information (ISTI), Soil Research Institute (SRI), Plant Genetic Resources Centre (PGRC), Forestry Research Institute of Ghana (FRIG), and Water Research Institute (WRI).

These institutes and the CSIR as a whole hold the biggest pool of scientists in Ghana. The Kwame Nkrumah University of Science and Technology in Kumasi, was also borne out of the policy to train engineers, architects and scientists to operate these industries. KNUST together with the University of Ghana in Accra (Legon), University of Cape Coast in Cape Coast (UCC) Polytechnics, Diploma Certificate awarding Institutions, Colleges of Education and Technical Schools instituted admission policy that privileged the admission of more pupils into the sciences and science education. But, the quota allocation was hardly filled. Once more, the government instituted some incentive package to move human resource development in the direction of science and technology.

Furthermore, there was an easy access to scholarships for science courses. Science and mathematics students in the universities as well as science and mathematics teachers in secondary schools were offered inducement allowances. This period also witnessed massive inflows of voluntary service corps and a number of financial aids from the international developed communities both in the former Eastern and Western European blocks. These services went mostly into improving on science teaching and learning.

As the local industries saw expansions in their activities and increase in profits, many

of the industries established scholarship schemes to provide assistance to the needy but brilliant pupils at both secondary and tertiary levels of education. Some of the industries also offered opportunities to students, especially students of the University of Science and Technology and the polytechnics whose areas of studies have direct bearing on the activities of those industries, to have technical training during the long vacations. This was meant to raise their competences in the use of scientific and technological skills prior to their engagements with the industrial activities. The foreign exchange earnings from the cocoa industry, which was one of the major backbone on which the nation rely on to boost the economy, provided some science students and other students at the secondary schools with bursaries. This was to reduce the burden of financial commitments of the rural farmer.

During this period a closer relationship was sought between the culture practices of the people, their environment and workplace and the science subject taught in the schools (Anamuah-Mensah, 1998). Science as a unit (Physics, Chemistry, Biology and Agriculture) were combined and was made compulsory at all levels of pre-tertiary education. Many other initiatives have been instituted to boost the teaching and learning of science.

But, upon all the measures laid females were lagged behind. This assertion is affirmed by (Linver, Davis-Kean & Eccles, 2002; Spelke, 2005; Watt, 2006), that the impact, lack of interest in mathematics among girls is directly related to fewer women pursuing degrees in math-related careers, including science, technology, and engineering. To curb the situation, Ghana Education Service (GES), in 1987 on recognising the important role played by women both in the family and society launched the Science, Mathematics and Technology Education (STME) clinic. So the Ministry of Education established the Girls Education Unit of the Ghana Education Service (GES), purposely

to serve the interest of the girl child. The unit was tasked to increase girls' enrolment in schools to equal that of boys by the year 2005. It was also tasked to reduce the dropout rate for girls from 30% to 20% in the primary schools and in the JSS from 29% to 15% and increase girls choosing science and mathematics courses to equal that of boys. In addition, the Girl Child Scholarship programme began in the year 2001 by the Ghana Education Service with the appointment of a Minister of State for Primary, Secondary and Girl-child education. The programme was initiated with the main objective of bridging the gender gap that existed in the field of science and technology and promoting gender balance in the study and application of science. Moreover, to create awareness, increase and sustain girl's participation and interest in Science and Technology. In consequence, address the gender imbalance and misconceptions about girl's participation in Science, Technology and Mathematics Education in general. Overall, this, according to (Barnett & Rivers, 2004; National Academy of Engineering, 2008) can lead to more balanced gender representation among individuals pursuing careers that require adequate mathematics preparation, such as those in STEM fields.

Rational behind Organization of STME clinics

The theme for different year's STME clinic therefore summarizes the aspiration of the government. Though, the programme was instituted for girls at SHS the need to introduce it at JHS became necessary after some years organization of the clinic. So by 1999, STME clinics were extended to include girls at JHS and organized in all the ten regions of Ghana.

During these clinics, female pupils get the chance of meeting and interacting with female role models who have made it in science, mathematics and technology. They are given leadership training and also visit industries to acquaint themselves with the industrial process of production. This is to motivate and improve upon the number of

girls pursuing science and technology related courses in our secondary schools as well as the universities. According to the theories of constructivism, learning is an active and constructive process; learners not only construct knowledge, but the knowledge they already possess affects their ability to gain new knowledge (Etkina & Mestre, 2004). Therefore, STME clinics which are characterized by hands on activities/practical's and fruitful interactions with role models and science expects seeks to improve student performance, satisfaction, and retention by constructivist approach to teaching and learning. So, the STME programme helps girls and boys to realise their endowed potentials. The programme in many ways, therefore, affords the pupils opportunities to:

1. Erase negative attitudes and misconceptions about science, technology and mathematics
2. Increase girls and boys knowledge on career opportunities available to them
3. Motivate boys and girls to aspire to greater heights in science and mathematics related fields.

The World Declaration on Education for all arising from the international meeting in Jomtien (Thailand, 1990) stressed that sustainable development depends on a scientifically and technologically literate population. So, Governments, public and private sector interest groups were urged to review educational provision for achieving STI for all.

Benefits/Achievements of STME clinic

The ultimate goal for the organization of STME clinics is to achieve a target of 30% of female students at the tertiary level taking Science, Technology and Mathematics related courses. According to a speech delivered by Azumah- Mensah (2011), even though the goal is yet to be achieved the clinics have produced the following results:

1) Students (girls in particular) are better ever able to deal with gender stereotypes associated with female participation in the so-called non-traditional careers' while misconceptions and psychological barriers to female participation in Science, Technology and Mathematics subjects are gradually being broken.
2) Student enrolment in the science and mathematics is now higher than before the programme started. At the inception of the STMIE clinics, only 12% of students were enrolled in science and 2% in mathematics. Currently, female students constitute 25% of students studying science and technology related programmes in the Universities and Polytechnics.
3) Recent SHS examination results also indicate that girls are achieving better grades compared to previous years.
4) Some schools have also report higher number of girls participating in science programmes, and the females are also performing better than their male counterparts.
5) STME clinic intervention has seen a total of 40,908 girls at the clinics and camps from 1986-2010. Following this, success, the focus of the clinics has shifted since 2010 towards building the capacity of both boys and girls.

In addition, the results of Andam, Amponsah and Kaufman (2001) also indicate increase in the number and performance of girls in physics.

Junior High School Science, Mathematics and Technology Education in Ghana

At the Junior Secondary School level, science is taught as Integrated Science and is compulsory for all pupils at this level. The subject areas of general science are physics, chemistry, agriculture (including earth/soil science) and biology (including botany,

zoology, and health science) with very little on technology; this is because technology is taken as a subject on its own (technology/vocational technical). All pupils at this level of education are required to pass general science in their National examination called Basic Education Certificate Examination (BECE) before they are able to secure admission to senior secondary school. Meaning, for West African Examinations Council, among other subjects, pupils are expected to pass the general science and mathematics. This extends to WASSCE and SSSCE prior to admission into tertiary institution.

More often than not, in an attempt to complete the expected content, teachers teaching methods are not varied to suit learners. However there is great variety of teaching methods which have different capacities of motivating and attracting pupils' interests. But instructional methods that are based on inquiry and construction of knowledge are encouraged such that pupils can probe or investigate both their physical and biological environments and find meanings to the natural occurrences. This may lead to both knowledge construction and validation. However, according to Fredua-Kwateng and Ahia (2005), occasionally such investigation or activities are not about what pupils can observe in their environment. As a consequence, Ghanaian JHS pupils are likely to view school science as a body of concepts, scientific terms and facts which are to be learned, but have no personal or societal relevance. It is usually presented as reliable and authoritative knowledge so much of such contents of school science are soon forgotten by the pupils. In order to motivate and attract the interests of Ghanaian young learners in science, it is argued for the Ghanaian physical and biological environments use as entry point to science education.

Attitudes and Interests of Pupils towards Science

The investigation of students' attitudes towards studying science has been a substantive feature of the work of the science education research community for the past 40 years. (Osborne *et. al.,* 2003). Students' increasing reluctance to choose science courses, and physical science courses in particular, in their final years of secondary education has important implications not only for the continuity of scientific endeavor but also for the scientific literacy of future generations. As a result, development of positive attitudes towards science, scientists, and learning science, which has always been a constituent of science education, is increasingly a subject of concern (Trumper, 2006).

Students' learning interests and attitudes toward science have both been studied for decades. However, the connection between them with students' life experiences about science and technology has not been addressed much (Chang *et. al.,* 2009).

Ary *et al*. (1972) claimed that, "Attitude is the sum total of a person's inclination toward a certain type of an object, institution or idea", while Gronlunds (1976) provided the widest meaning of attitude as that which embraces all aspects of personality development such as individual interest, motives, values, vocational adjustment derived from vocational pursuits and other phases of one's daily lives. Studying about students' attitudes towards science or science learning has become a key component of science education in the past three to four decades. From those research results (Lichtenstein *et. al.,* 2008; Simpson, Koballa, Oliver and Crawley, 1994), all pointed out that attitude should be considered as an essential indicator of the quality of science education.

Lavonen *et. al.* (2008) studied the interests and experiences of students in physics and chemistry based on the ROSE study in Finland. Their research conducted on 3626

secondary students with average of 15 years old. Based on their results, students have many experiences in outside the school and were related to science and technology. However, they had little experience in using technology tools such as mechanical. These results showed diversity of science and technology experiences between students. However, there is a problem that the number of students who are taking science subjects at secondary and higher secondary level is declining and most of them discontinue studying science whenever they have a choice (Lyons, 2006). Correspondingly, according to a report of House of Commons (2002), students‟ interest in school science is declining with an accompanied declining number of students taking science, which consequently causes shortage of science literates in different science-based professions. In the same perspective, Lyons (2006) summary indicates that enrolment rates in the natural sciences have been steadily declining in Australia, Canada, India, Japan, and the USA, as well as nearly every country in the European Union, Ghana and Africa as a whole. As indicated by some researchers, beginning as early as elementary school, boys have typically possessed more interest in studying science than girls (Clarke, 1972; Clark & Nelson, 1972; 1971; Kotte, 1992). So, there is the need to get a broader picture of the reasons that hinder learners from entering this field and developing a less positive attitude and interest over time.

In an initial study of gender and students' science interests, Kahle examined data from the National Assessment of Educational Progress (NAEP) and found that girls described their science classes as "facts to memorize," and "boring" (Kahle & Lakes, 1983). By middle school, girls' attitudes toward science tend to decline and this decline may persist through high school (Sullins, Hernandez, Fuller, & Tashiro, 1995). Kotte (1992) also reported that, for students, the differences between males and females' attitudes toward science widens as students move from elementary to

secondary school. In an examination of data from 19,000 eighth grade students who participated in the National Educational Longitudinal Study, Catsambis (1995) found that males were more likely to look forward to science class and to think science would be useful to their future, and were less afraid to ask questions in science classes than their female peers. In addition, Catsambis also found that over twice as many middle school boys as girls are interested in a future career in science.

Therefore, a comparative investigation between nations about pupils affective dispositions toward the learning of school science could be a good starting point to move in this direction by assessing JHS pupil's attitudes, interest and perceptions towards the study of science and mathematics so far as participation of STME clinic is concerned.

In the database of attitudes research, there are some very comprehensive review studies, like "Gender Differences in Student Attitudes Toward Science: A Meta-Analysis of the Literature from 1970 to 1991" by Weinburgh (1995), "Attitudes Towards Science: A Review of the Literature and its Implications" by Osborne, Simon, and Collins (2003), and In Pursuit of Validity: "A Comprehensive Review of Science Attitude Instruments 1935-2005" by Blalock *et. al.* (2008). Other studies have also identified the commonalities and variations in students' attitudes and their interest in science in developing and some developed countries. In some countries, where there is the teaching of the sciences as separate subjects at the eighth grade level, and there is a apprehension that attitudes are most positive toward biology (32% in the high category) and least positive toward chemistry and physics - 23 and 10%, respectively (Martin *et. al.*, 2000). The same is the case in TIMSS 2003 with a bit improved percentages, as greater percentages of students are in the high index category for Biology (37%) and Physics (31%) and lower percentages for Chemistry (29%). TIMSS

2007 shows a big increase in percentage of students who are in the high index level in Biology (66%) and in Chemistry and Physics (both 50%). Even these performances cannot match that of other social subjects.

Fifteen-year olds in the programme for international students assessment (PISA, 2006) study showed a similar picture as the majority of students (68% on average) report an interest in human biology and they report less interest in astronomy, chemistry, physics, the physiology of plants, and the ways in which scientists design experiments (between 46 and 53% on average). This assertion has been given reinforcement by Whitfield's (1980) analysis of the data in English students about their preferences for science showed that physics and chemistry were two of the least popular subjects which were disinterest in pupils mind as biology.

However, it is found that attitudes are not the same. They vary remarkably in different parts of the world and a student's nationality does affect his attitude (Ye, Wells., Rennie, 1998, & Talkmitt). The first striking finding is that compared to developed countries, children in developing countries in TIMSS such as Malaysia, Thailand, Philippine, Singapore, Botswana, Kuwait and Tunisia appear to be more interested in science and science-related topics. On the other hand, students in developed countries show little interest in the subject (Beaton, Martin, Mullis, Gonzales, Smith & Kelly, 1996; Martin, Mullis, Beaton, Gonzalez, Smith & Kelly, 1997; Martin, Mullis, Gonzalez & Chrostowski, 2004; Martin, Mullis & Foy, 2008; Mullis, Martin, Beaton, Gonzalez, Kelly & Smith, 1999; OECD, 2006; Sjøberg, 2002; & Schreiner & Sjøberg, 2007). Moreover, according to Anderson (2006), on the average, the majority of young learners across countries were somewhat interested in school science. However, in the developed countries, pupils' interests were lower than their counterparts in the less developed countries. It further revealed that many young learners in the developing

countries would want a career in science and technology. For example, they would like to become scientists and also opt for a job in technology.

Consequently, analysis of a study results based on TIMSS, ROSE, SAS and PISA; the study revealed that some students of developed countries such as Norway, England, Denmark, Sweden, Finland and others have low interest and attitudes for science whiles students in most of the developing countries such as Ghana have high interest for science.

An analysis of studies selected for this review also makes it clear that overall internationally, students show their interest in science. This is evident from the results of PISA 2006 with an average of 63% of the students reporting that they are interested in science and have fun doing so. This result also is consistent with TIMSS 2003 where the international average of eighth graders having a highly positive attitude (57%) and 31% in the medium category. Only 12% of the students are in the low category, and similarly, TIMSS 1999 and 2007.This means that although a certain percentage of pupils do not express their high liking for school science, the subject does attract the curiosity of many pupils and retains them in the field.

Nonetheless, as far as small-scale studies are concerned, findings from Murphy and Beggs (2001) study also indicates that eight to eleven year old pupils in Northern Ireland significantly display more positive attitudes to school science than those from schools in the English sample. Besides, Murphy and Beggs (2001) and Murphy, Ambusaidi & Beggs (2006) try to determine changes in enjoyment of science over time between Oman, English, and Northern Ireland students. The results demonstrate that nine year old children show significantly more positive responses to the statements relating to enjoyment of science than the older students, especially in the Omani and the Ireland samples. This is also clear in TIMSS (1995 and 2003) results showed

higher percentages of the fourth graders enjoying the subject compared eighth graders. Lyons (2006) reviews three studies – Lindahl's longitudinal study in Sweden, Osborne and Collins focus group interviews in England, and Lyons surveying and then conducting a series of individual interviews of students and teachers in Australia. He quotes that the most common remarks by the English, Australian, and Swedish pupils are that science content is often boring and irrelevant to students interests and aspirations without trying to engage their interest or establish relevance with familiar "every-day life" contexts, just like US students who think there is too much memorization (Ye *et.al.*, 1998). For the reasons stated above, Lyons reports that in Sweden and Australia, "students turn to non-science subjects to satisfy interests that should be catered by science courses" (Lyons, 2006, p. 599).

An important finding in this regard is that East Asian pupils indicate a remarkably low interest in science, with preference to the girls in particular. Whereas Japan, Korea, China, and Hong Kong usually come out on the top in international comparisons on science achievement tests, but lowest on attitude and self-concept scales, and not particularly liking science (Beaton *et. al*., 1996; Leung, 2002; Martin, Mullis, Gonzalez, Gregory, Smith, Chrostowski, *et. al*., 2000; Martin *et.al.,* 2004; OECD, 2006; Sjøberg, 2002; Schreiner & Sjøberg, 2007; & Ye, *et. al.*, 1998).

Several studies have reported that there are gender differences in attitude towards mathematics with girls showing more negative attitudes than boys. In general, most of the studies reported that, compared with boys, girls lacked confidence, had debilitating causal attribution patterns, perceived mathematics as a male domain, and were anxious about mathematics (Casey *et. al.*, 2001; Hyde *et al.*, 1990; Ma, & Kishor, 1997; Sayers, 1994; Vermeer *et al.*, 2000). The causes of the gender differences in mathematics attitude were found to be multifaceted. Researchers have identified

parental and societal attitudes (Papanastatsiou, 2000; Wong, 1992), and students' classroom experiences (Fisher & Rickards, 1998; Forgasz & Leder, 1996), as being influential in making girls internalize the feeling that they are inferior to boys in mathematics. Moreover, studies that have considered classroom environments consider teachers' classroom behaviours to be a factor associated with students' attitudes. Fisher and Rickards (1998) found that students attitudes towards mathematics tended to be more positive in classrooms where students perceived greater leadership and helping/friendly behaviors in their teachers, and more negative in classrooms where students perceived their teachers as admonishing and enforcing strict behaviors.

Besides, other researchers have compared the effect of single-sex and co-educational classrooms upon students' attitudes (Forgasz & Leder, 1996; Norton & Rennie, 1998). To this effect students in single sex schools were found to have more positive attitudes than students in the co-educational schools. For example, Norton and Rennie's (1998) study of grades 8 to 12 in four secondary schools (one private single-sex girls and boys school, one private single-sex boys' school, one co-educational state high and one co-educational private school) in Queensland and Australia, found that boys in the single-sex schools had the most positive attitudes.

Gender and Science Mathematics and Technology (SMT/STME) Education in Ghana

As already mentioned, girls and women constitute more than half of the world's population and of the total burden of work, women carry on average 53% in developing countries and 51% in industrial countries (UNDP 1995). But when it comes to education in general and science and technology education, girls and women have the lowest access/less represented. Upon this Zeldin *et. al.,* (2008) and Zeldin and Pajares (2000) found differences in the ways young women and men develop their self

efficacy related to science and mathematics education and STEM careers:

Whereas men's self efficacy arises most strongly from actual (perceived) achievement in tasks, women rely more heavily on interaction with others to build their self efficacy. There are also stereotype threats related to girls' and women's abilities in some STEM areas. In their American study of how stereotype threats interfere with women's performance on a mathematics test, Quinn and Spencer (2001) found that women performed better if the stereotype threat was reduced, that is, if they were told that men and women have proved to score equally well on the test. However,

Dar-Nimrod and Heine (2006) showed that the stereotype threat had much less influence if the stereotype was presented as a result of different experiences rather than genetics. In view of this interventions have been put in place In spite of the various actions and inputs by government as well as intervention by Non-Governmental Organisations (NGOs), religious organizations and international organizations, girls still lag behind boys at all levels of education. They continue to avoid courses, which lead to careers in science and technology.

The masculine nature of the sciences deters girls from entering into the programmes as indicated by (Mulemwa, 1999 & Njoku 2005). Besides, Hall (2009) reviewed literature which attributed the inferior performance and under-representation of women in mathematics and science to innate biological factors. Other research she reviewed however questioned it, examined other issues and pointed out that no sex differences exist on these grounds. She concluded like Fennema (2000) that differences are not innate, but are linked to societal perceptions. Moreover, deeper forces in society that extends well beyond the boundaries of educational systems, institutions and processes cause gender inequality in science, mathematics and technology (SMT). As observed in some studies (Alele-Williams, 1988; Adelman, 1991; Erinosho, 1994; Kahle and

Meece, 1994), however, the basic causes of gender discrimination against women involvement in education generally, are deeply rooted in socio-culturally determined attitudes.

Though, Girls now take as many high school science classes as do boys (though fewer girls than boys take Physics), and girls' achievement levels are roughly the same as boys' (National Assessment of Educational Progress, 2001). Among all racial and ethnic groups, including Whites, Asians, Blacks, Hispanics and Native Americans, male scientists outnumber female scientists. Indeed, women of color are the most under represented group in mathematics and science Warigia and John (2002). Exploration of research literature in science education reports of boy/girl differences in interest in many aspects of science, Boys tend to have relatively more interest in physical science and girls more interested in biological science topics (Kahle & Meece, 1994; Anamuah-Mensah, 1995; Rennie *et. al.,* 1996; Jones *et. al.,* 2000).

In most rural African societies, women interact with the environment more than men do in the realm of agriculture and the tapping of other natural resources for domestic uses; hence women become the primary users of science in daily living (Avotri, *et. al.*, 2000). Therefore, science and technology education for girls and women is a national asset for a developing nation in particular and any nation in general. Yet, Harding and Parker (1995) found in their research that everywhere, women are poorly represented in areas of employment that require science-related qualification, except biology and health-related subjects, like medicine and nursing.

As a major concern of the country, policies, programmes and other initiatives were taken to mention a few is STME clinic, and science related courses of study in tertiary institutions. With the inclusion of UNESCO, other measures are put up in the quest for science technology and vocational education. In this context a special project on

"Scientific, Technical and Vocational Education for Girls in Africa" was launched in 1996 by UNESCO with the aim of reducing gender disparities in science and technology education and in technical and vocational training. This project was started September in 1997.

In 1987, Ghana launched the Science, Mathematics and Technology Education (STME) clinic, designed to address the gender imbalance and misconceptions about girl's participation in Science, Technology and Mathematics Education in general. Accordingly STME clinic were organized for girls to help sustain this process. Still, the Ministry of Education in 1991 set up a desk for the coordination of STME activities nationwide. Subsequently the clinics were decentralized into zonal levels where two or three regions were combined in clusters for each clinic. By 1999, clinics were extended to include girls at JHS and organized in all the ten regions of Ghana.

So for successful implementation and organisation of the clinic, Science Technology and Mathematics unit schedule is maintained at the regional and district levels. The programme is organized yearly at regional, national and sometimes at the district level. Through the intervention of STME clinic a total of 40,908 girls at clinics and camps from 1996-2010 have had an experience. Girls tend to have lower expectation of success and perceive a higher cost associated with studying science and maths.

The changing concept and Gender Equity in STME Clinic

The experiences gained from these clinics served as a foundation for the establishment of Girls Education Unit (GEU) and Science Education Unit (SEU) in 1997 and 2001 respectively to assist and affirm the role of STME unit. The maximum involvement and cooperation of these units in steering the affairs of the STME unit has contributed to the successes being reap in access and performance under STM Education after 20 years organization. Following this success, the focus of the clinic has shifted since

2009, towards building the capacity of both girls and boys in creative thinking, hence the new programme: Science Technology and Innovation Education (STME) camp for students. Organized under the theme "Ensuring Gender Equality in Science, Technology and Innovation Education for a better Ghana", these camps were targeted at selected JHS in the various regions (excerpts on report; 55th Session of the United Nations Commission on the Status of Women delivered by Hon. Juliana Azumah-Mensah; MOWAC (2011). In 2009, the percentage participation for boys and girls at the regional clinic was 30% and 70% correspondingly. However, since 2011 the percentages have been 50%, 50%. Names denoting acronyms such as STI, STMIE and STMI are used. Reports/ analysis of WASSCE/SSSCE results indicate that there have been improvements in girl's performance as well as enrolment of girls in the sciences which is now 25% instead of 12% at the universities and polytechnics. Likewise, girls are better off to deal with gender stereotypes, misconceptions and participation barriers to STM subjects.

Pupils' perception and performance/achievement in science education

At the compulsory education level (Basic Education), science education is obligatory. Nonetheless, further studies by Durndell and Lightbody (19196a) in one school, using sophisticated preference ranking system has shown that boys were far more likely to report science more liking than girls- a finding given additional salience by the work of Jovanic and King (1998), which suggest that one of the major factors in girls antipathy towards science is their perception that they are better at other subjects.

There are numerous studies confirming that boys have greater interest in many aspects of science than girls have (Clark, 1972; Mc Guffin, 1973; Gardner, 1985 & 1998) with boys performing better than girls in most of the sciences (Avotri, *et. al.,* 2000). An available data in general science, taken at BECE for the period of 1995 to 1997 show

that, there are gender differences in performance in favour of boys. The performance over the period in general science for boys and girls who obtained grades 1-6 are: In 1995, 80.6% of boys as against 73.7% of girls, in 1996, 76.3% and 69.2% of the boys and girls respectively. Similar pattern is seen in 1997, but girls showed some improvement in performance, 78.2% of boys as against 75.3% (Avotri, *et. al.,* 2000).

The gender gap in the choice of science and science-related discipline in Ghana is clearly seen at post-compulsory schooling, and this gap is most marked in physics in favor of boys. Also scores from TIMSS 2003 test in Ghana indicated that the strong content areas in the science curriculum for the pupils were in chemistry and environmental science, while their weakest area was in physics, and that in all the five content areas, the boys achieved higher scores than the girls (Anamuah-Mensah, *et. al.,* 2004). However, the 2003 TIMSS results for Ghana were not differentiated by urban/rural location.

Currently, girls are entering into science and science-related subject areas which hitherto had been perceived as the preserve of boys for many years. Girls now take as many high school science classes as do boys (though fewer girls than boys take physics), and girls' achievement levels are roughly the same as boys' (National Assessment of Educational Progress, 2001). However, the present challenge is how to motivate, increase and sustain the interest of girls in science education and this has become an issue of concern within the Ghanaian educational system.

In as much as official government policy is for the nation to achieve a ratio of 60:40 sciences to humanities manpower base by the year 2020, unfortunately, the present enrolment at tertiary institutions is heavily skewed towards humanities: for universities only 38% are enrolled in science subjects, 32% for polytechnics, and 36% overall. So fortunately or unfortunately production of graduates in Ghanaian universities is supply

driven instead of demand driven.

Moreover, a study conducted by Tindall and Hamil (2008) bring into being that school children studying science and technology subjects like Mathematics, Physics and Chemistry find it much harder to achieve the best exam grades than candidates of similar ability studying subjects like Media Studies and Psychology. In their study, they collected, analysed and compared data from nearly one million schools children sitting GCSE and level exams and reviewed 28 different studies of cross subject comparison conducted in the UK since 1970. They found significant differences studies in the relative difficulty of exams in different subjects of the sciences among the hardest. On average, subjects like Physics, Chemistry and Biology at A-Level are a whole grade harder than Drama, Sociology or Media Studies and three-quarters of grade harder than English, RE or Business Studies. They revealed that a student who chooses Media Studies instead of English Literature could expect to improve their result by half a grade. They preferred choosing Psychology instead of Biology and that would typically result in over half a grade's advantage. These researchers voiced concerns that students will be more likely to study 'easier' subjects and will not opt to study science subjects that are desperately needed by employers in the knowledge economy. Also, between 1991 and 2005 figures show that the numbers of students sitting a Level Physics dropped by more than a third (Stacy, 2009).

Gender Differences in STM Education

Current State of Girls' Achievements in STEM

Ogawa and Shimode (2008), in their study on 560 Japanese students (268 female and 292 male) with average of 15 years old, examined their views about the various components of ROSE project. Result showed that there was not meaningful difference

between girls and boys in attitude toward science. They consider school science important and easy to learn but were opposite to increasing the science content in science curriculum.

Studies have shown that while there have been impressive increases in the number of women achieving bachelor's and advanced degrees (Bureau of Labour Statistics, 2004), there continues to be a shortage of female students trained in science, technology, engineering, and mathematics (STEM) fields (Herzig, 2004). For instance, women account for 22% of graduate students in engineering fields and 25% of graduate students in computer science (National Science Foundation [NSF], 2007), and women make up only 24.8% of workers in computer and mathematical occupation (e.g. computer scientists, systems analysts, computer software engineers, and statisticians), 33.1% of workers in the chemical and material sciences, 2.6% of aircraft pilots and flight engineers, and 13.5% of workers in architecture and engineering occupations (e.g. civil engineers, architects, industrial engineers, and mechanical engineers) (U.S. Bureau of Labor Statistics, 2008)). Thus, a great "gender gap" continues to exist in STEM fields, and researchers have spent considerable effort attempting to identify both biological and social explanations for such differences.

A study conducted by (Anderson, 2006) revealed that compared with other school subjects, most boys in particular, preferred school science and girls on the other hand, saw school science as a difficult subject despite the claimed relevance of science. In his studies during the interview session, a boy in rural school, for example, elaborated on the importance of science to himself and his everyday life but, asserted to the fact that some of his colleagues find science very difficult. Also, the result from a study conducted by (Dawson, 2000; Osborne and Collins, 2001; Colley, *et. al*., 2003) confirms earlier studies in science education indicating that boys have greater interest

in science than girls. It is also in line with that of Jones *et al*. (2000) study, which revealed that more females than males perceived science as difficult to understand and as involving experiments. As mentioned, the perception of girls that science is somehow difficult was probably demonstrated in the TIMSS 2003 study. In Ghana, there was large gender difference in science achievements.

In a study in Nigeria, respondents gave their subjective opinions about the level of gender disparity in science, mathematics and technology (SMT) at the community level. The majority held the general belief that more girls than boys were disadvantaged. More than 70% of the household heads, 61.2% of mothers and 64.4% of children accepted that there was gender disparity in SMT education in favor boys in their communities. Again, Chamdimba (2003) showed that the proportion of female enrolment at the University of Malawi in the Mathematics and Science related faculties was less than 30 %. This proportion of low female enrolment in mathematics and science has remained the same to date as indicated by the annual statistics by the University of Malawi.

The origin of this under representation of women has been largely structural: it is created in and through the social structures of institutions and the segmentation of the labour market, and internalized in values and beliefs about appropriate roles and expectations. According to Swarbrick 1986, these factors are manifested in a host of barriers to women's participation, both general and specific to the technological domain. Teachers have also been mentioned as contributed partly to these barriers aside others mentioned. Boys also are attended to by teachers more than girls are, receive more help from teachers on areas in which they have problems academically, and are called on more often to give answers in class (Becker, 1981; Epperson, 1988; Fennema & Reyes, 1981; Koehler, 1990; Simpson & Erikson, 1983).

In most countries such as Ghana, girls' mathematics and science skills are not at proficient levels. The percentage of girls scoring at or above proficient levels on the National Assessment of Educational Progress (NAEP) mathematics and science exams decreases substantially by 12th grade. Girls continue to lag behind boys in science in grades 4 and 8, and in mathematics in grades 8 and 12. As a result, Jenkins and Pell (2006) finally classified the English students in terms of school science preference in four categories: pro-science, latent pro-science, anti-science and apparent pro-science.

Challenges faced in field of Science Technology and Mathematics Education (STME)

Notwithstanding the apparently considerable science and technology infrastructure and institutions established, policies and strategies put in place, science showed little progress and development. One of the primary reasons since independence has been:

1) Poor political commitment
2) Inadequate financial support for effective planning and implementation of strategies for the development of STI.
3) Insufficient number of qualified people to address the scientific and technological needs of the global society in this 21st Century
4) Lack of effectiveness on decision makers in society, and in particular those with political responsibilities have insufficient scientific, technological and mathematical understanding to make valid decisions on science and technology based issues.

Owing to this, after many years of independence and despite the various actions such as policies, programmes and initiatives by successive governments, not very much has been achieved in our effort at developing the nation through science and technology education, and so Ghana still faces the problems of underdevelopment.

Although the status of science education and application of modern technology for industrial and agricultural purposes have increased, but is not to the expected levels when compared to some Asian countries, like Malaysia, who had independence around the same time as that of Ghana. While, there may be other contextual factors that might have contributed in propelling Malaysia into an emerging industrial country. Incidence of diseases, unsanitary conditions, and environmental degradation are common occurrences. So it is clear to deduce that the introduction of science and technology education as a vehicle to facilitate Ghana's development has not been very much successful. As a matter of concern, many Ghanaian science education researchers have elaborated on the causes for the present state of science education (Anamuah-Mensah, 1994; 1998, Anamuah- Mensah, *et. al.*, 2004; Fredua-Kwateng & Ahia, 2005).

Prominent among the causes are the neglect of the indigenous culture in the development of science curriculum and in instruction. Anamuah-Mensah writes: Science (like the traditional culture) has its own values, norms, practices, and beliefs and is therefore a culture in its own right. Some researchers such as Aikenhead (1997), for example, also argue for a cross-cultural science curriculum that permits pupils to move between various cultures and sub-cultures.

Another area of concern is the teaching methodology. The teaching methodology in Ghana appears to consist more of straight lectures or direct-teaching, which requires the pupils to listen attentively throughout the duration of the instruction. It is likely that the pupils' interest might not be stimulated enough to enjoy science as a form of knowledge construction but function more as a validation of a given knowledge as its avowed by (Fredua-Kwateng & Ahia, 2005). The result is that science learning is reduced to rote learning and memorization. This form of science education in Ghana

only reproduces and reinforces our economic and technological underdevelopment. But looking at the range of problems that confront Ghana, the most appropriate science pedagogy must be knowledge construction for problem-solving and problem-posing.

Another area which has affected the country's science and technology efforts, relates to coordination of these activities. Essentially, there was no coordination mechanism to make it possible for activities to be integrated to reduce duplication of efforts and to promote synergy. Others include Weak linkage between policy formulation and national development planning, lack/ inadequate textbooks, teaching and learning materials, laboratories and fully equipped Science Resource Centre's Weak mechanisms for implementation, evaluation and review, Weak linkages between various agencies and organizations in S & T, Weak linkage between industry and S & T, The lack of relevance of the S & T curriculum one of the greatest barriers for good learning as well as for interest in the subject, Over reliance on the use of foreign expertise to the neglect of the use and development of local expertise and narrow base of quality in our pre-tertiary education system just to mention a few.

Today, buttressing the countries' stance and quest for STME is envisaged in the Vision 2020 Ghana's long-term programme of objectives, which regards the adoption of science and technology as the tool by which socio-cultural and economic problems of the individual, the community and the nation will be solved. It is this aspiration of Vision 2020, which has called for the formulation of a science and technology policy for the country. The implementation of this policy is visualized to move the country's economy to a middle-income status and an immensely improved standard of living by the year 2020. The policy calls for the establishment of mechanisms for the finance, management and evaluation of the performance of science and technology. And it is to be reviewed periodically to meet the challenges of change. Nations that have control of

science and technology have been able to cope with global issues such as conditions of poverty, poor sanitation, illiteracy, disease, rapid increase in population and malnutrition. These challenges are similar and peculiar to all the developing countries. And so Nigerians contention is just like Ghana according to Nwachuku (2009) and Oriafo (2000) enumerated some of the problems confronting STM education in Nigeria to include, lack of funds to purchase equipment/materials, lack of adequate textbooks to mention just a few.

Equally a number of reviewers (Roberts, 2002; Rasekoala, 2001) have suggested that Science, Engineering and Technology (SET) related subjects suffer from a worrying range of problems which need to be addressed if the supply of people with high quality science and engineering skills is to improve in the UK a failure of the National Curriculum to facilitate practical/investigation sessions, a lack of positive role models in the fields of science and engineering, lack of effective careers advice that affect school students' aspiring to study SET after compulsory education, and girls' apparent disinterest in school-based science and technology to name a few.

The official government policy for Ghana is for the nation to achieve a ratio of 60:40 sciences to humanities manpower base by the year 2020. However, the country appears to lack strategic forward planning to promote science and technology as a vehicle for economic development. Science and Technology education is not responding adequately to development needs due to numerous challenges mentioned above. Unfortunately, the present enrolment at the universities and polytechnics is heavily skewed towards humanities. For this outstanding, the enrolment ratio for 2006/2007 stands at: 34-60% for Sciences versus Arts at the Tertiary. What is more, are the private universities, for the 2006/2007 academic year has the following enrolment ratios 87.6% Humanities and 12.4% Science and Technology with roughly 70%

pursuing courses in Business Administration and Management Studies including Accounting, Banking and Finance *(Sector Performance Report 2008 MoESS)*.

CHAPTER THREE

METHODOLOGY

Overview

This chapter focuses the research design used for the study. Again, it describes the population, sampling procedures, research instruments and its design as well as reliability and validation of the main instrument. The chapter ends with the description of the data collection and analysis.

Research Design

The research design used in the study was descriptive survey design. It expresses the effect of STME clinics on the perception and attitudes of JHS pupils towards science. This method of survey involved collecting of data in order to test hypothesis and answer questions regarding the current status of STME clinic and its effect on science. Moreover, the survey is the only method through which the researcher can obtain the opinions attitudes and suggestions for improvement (Khan, 1990). It has also been described by Best (1974) as a useful tool to employs when one is interested in the opinions, beliefs and attitudes of people. Since the purpose of the research was to find out the effects that JHS pupils' participation in STME clinic had on their perception, attitudes and interest towards science this design was well utilized. Furthermore, the use of the descriptive survey was also meant for the purpose of gathering a lot of information and generalization. Conversely, the use of quantitative and qualitative technique was also adapted. Because the concentration is on the current state of STME clinics only the years 2009 up to date was considered. As the years, saw the inclusion of boys in the programme.

Population

The participants were drawn from 25 JHS in 5 districts from the 30 districts in Ashanti region, with target population of all JHS 2 and 3 pupils in Ashanti region. The 5 accessible district used as the sample comprised Sekyere East District (Effiduasi), Sekyere Kumawu (Kumawu), Ejisu Juaben Municipal (Ejisu), Bosomtwe (Kuntanase) and Asanti Akyem south (Dwarso). Participant's confidentiality was ensured. These districts were chosen as a result of convenience and familiarity. In addition, follow up was made on few STME participants who are now at the SHS.

Sample and Sampling Technique

The third and second year JHS pupils were selected from each school in the 5 districts mentioned earlier in Ashanti region. Specifically, 4 pupils each were chosen from the 5 schools forming a sample size of 100. The districts and the schools were picked by convenience and purposively. Convenience sampling was considered because it saves time, money and effort but the lowest in credibility as indicated by Patton (2002). However, the pupils without exposure to STME clinics were selected at random to eliminate bias. The selection was done as follows:

1) The schools selection was done so that we have at least one or two pupils exposed to STME clinic/camp in a school.
2) A number of yes and no were written on pieces of paper, then folded and put in a box.
3) The papers were well shaken and randomly selected separately (by boys and girls).
4) Two pupils each, a boy and a girl exposed to STME clinic either in JHS 2 and

or 3 together with a boy and a girl who picked yes took part in the investigation.

5) Each school consisted of 4 pupils. However there were instances of 6 or 2 pupils being selected from a school.

The rationale behind the selection of hundred pupils from 25 schools from 5 districts out of the 30 districts in Ashanti region encompassing 50 boys and 50 girls was to ensure gender balance, and enable the researcher to employ various data collecting instruments to vary the data. Also, the small sample allowed the researcher to use less time to collect and organized detailed study on the sample.

Research Instruments

The data gathering instruments used in obtaining views and opinions were questionnaires and interview schedules. According to Hanan (2007), questionnaires are straightforward written questions requiring an answer by ticking the appropriate box. A questionnaire is normally used for the collection of data in educational research when information is to be obtained from a large number of subjects in diverse locations (Leedy, 1980). They are very efficient ways of gathering facts and information about individuals' opinions. Gay (1987) also described an interview as the overall in person (personal) administration of a questionnaire to a group or an individual in order to obtain a visual and written record of transactions that took place. So in addition, interviews were conducted in a naturally occurring situation, that is, during classes' time through which considerable time was spent probing participant responses, encouraging them to provide details and clarification. The main instrument adopted in this study was the ROSE questionnaire (Schreiner & Sjøberg, 2004) developed in Norway by Norwegian partners of ROSE team. To collect student data on

their interests, attitudes, views, and motivation in the affective domain of science education (Gardner 1975; Crawley and Koballa 1994; Simpson *et al.,* 1994; Osborne *et al.*, 2003), The ROSE questionnaire mostly consisted of closed structured items. The semi-structured interviews and structured-questionnaires had 6 sections which embraced information on personal records, thirty-four (34) close structured items that aimed at testing the effects of STME clinic on the pupils attitude, interest and perceptions towards science of 4- point likert scale used for scoring (consisted of Strongly Agree, SA, Agree, A, Strongly Disagree, SD and Disagree, D). The Likert scale was developed by Rensis Likert in 1932. It requests the respondents to make a judgment about their level of agreement, most often, on a 5-point scale with a statement. The Likert scale was considered the most appropriate because is the most widely used method of scaling in the social sciences today and efficient for assessing attitudes and perceptions. Besides, the Likert scale type was preferred to other attitudinal scales such as Thurnstone and Guttmman scales. Robson (2002) and Neuman (2000) favour the use of likert type scales. Robson (2002) intimates that Likert scales look interesting to respondent and people completing a scale of this kind. Neuman (2000) on the other hand, considers the simplicity and ease of the use of this scale. The responses were analyzed using SPSS with t-test statistics quantitatively. Besides, open- ended questionnaires devised allowed free expression of views from past STME participants at SHS and the 5 district STME co-ordinators. The interview schedule consisted of 13 questions which were considered on the five (5) scale/themes used in designing of the questionnaires. However, the researcher asked a follow up questions as the need arose. The interview schedule consisted more of open questions, although some were closed. Close-ended questions are more specific and more possible to communicate similar meaning thereby enhancing the reliability of the

interview schedule. Moreover, the open questions were to allow the researcher to gain more information on attitudes, views and reasons behind the attitudes and perceptions they hold about science.

According to Silverman (1993), one way of controlling reliability is to have a highly structured interview with the same format and sequence of words and items for each respondent. He states further that, reliability can be improved by careful piloting of the interview schedules and the comprehensive use of close questions. There was neither measurement nor experimentations; therefore, the qualitative research method was also employed to analyze the responses.

Validity of the instrument

The instruments used in the investigation were sent to the supervisor and experts who have scholarly opinion for scrupulous examination to ensure that it measured the total content area of the study. The supervisor and expects carefully scrutinized the questionnaire items and interview guide, discarded the invalid ones and suggested correct ones. They further provided some valuable assistance in the organization of the questionnaire items. This was done to ensure face and content validity of the items. Content validity is defined by Waltz, Strickland and Lenz (1991) as the extent to which an instrument adequately samples the research domain of the interest when attempting to measure phenomena. Similarly, Carminnes and Zeller (1991) also termed it as the extent to which a measurement reflects the specific intended domain of content. Face validity pertains to whether the test "looks valid'' to the examinees who take it, the administrative personnel who decide on its use and other technically untrained observers (Anastasi, 1988).

Reliability of the Instrument

A pilot-test was conducted on the instrument using twenty (20) JHS pupils from 5 schools in the Seniagya circuit in Effiduasi district (Sekyere ast) in the Ashanti Region of Ghana. The pupils involved in the pilot test did not form part of the sample for the study. Cronbach's alpha was determined on the data gathered using statistical package for social sciences (SPSS) version 16 and excel. Cronbach's Alpha reliability value/coefficient of 0.76 was obtained for the instrument used in the study. This value is considered significant since according Cronbach, the alpha reliability level between 0.3 and 1.0 was deemed reliable (Amoah & Onivehu, 2002). Besides, according to Borg, Gall and Gall (1996) co-efficient of Reliability values above 0.75 are considered reliable. On the other hand, the reliability of interview protocol was enhanced by the fact that the interviewer held one-to-one interview sessions with the various respondents using almost the same questions.

Pilot Study

The thirty-four structured-questionnaires were first given to twenty (20) JHS 2 and 3 pupils from 5 different schools (10 males and 10 females) at the Seniagya circuit in Sekyere East District. The Seniagya schools were most preferred because the researcher could get easy access to the schools since is in the same district with the researcher. The head teachers and science teachers of the schools were present to help in supervision. After the pilot study, it was realized that the time for the administration of the questionnaire items should be 15-25 minutes. The wording and the number of some questionnaire and interview items were amended.

Data Collection Procedure

In the first place the researcher asked permission from the STME Co-ordinators of the district's where the study was conducted. They were issued permission letters which explained clearly the objectives and the pupils involved in the study. Further elaboration of the purpose of the study was given. Secondly, the head teachers together with science and mathematics teachers of the various JHS were informed about the objectives of the research and their co-operation was solicited with the assistance of the STME Co-ordinators. The questionnaires were distributed to the pupils and administered by the researcher with the assistance of the co-ordinators and the science teachers which required the respondents to supply their answers. Their responses were then collected. For the respondents to be honest about their responses they were assured of confidentiality. In addition the STME Co-ordinators of the district involved also gave their response. Four pupils were interviewed in each District.

Data Analysis

The questionnaires were analysed using frequency counts, percentages and independent sample t-test in the form of tables and graphs. It consisted of items on attitudes, interest, benefits, perception, effects and preference of STME clinic activities. Moreover, responses from the semi-structured interviews were analysed using interpretations, relations and explanations.

CHAPTER FOUR

RESULTS

Overview

This chapter describes the results obtained from the analysis of the data gathered from the questionnaire and interviews. Results gathered from the analysis of the questionnaires are presented first followed by that of the interview results. It also includes the analysis of the three null hypothesis. The chapter is in two sections. Section One describes the background information/ bio-data of the respondents while section two presents results on the research questions.

Section one: Background information on the sample

The characteristics of the respondents were collected to enable the researcher know the gender, age, class and participation to determine how they relate to pupils attitude and perception. The detailed results are displayed in Figures1- 4.

Gender: Fifty (50) of the respondents' males and 50 females representing 50% each was sampled to take part in the study as depicted in Fig. 1. So gender fairness was ensured in agreement with current STME clinic statutory.

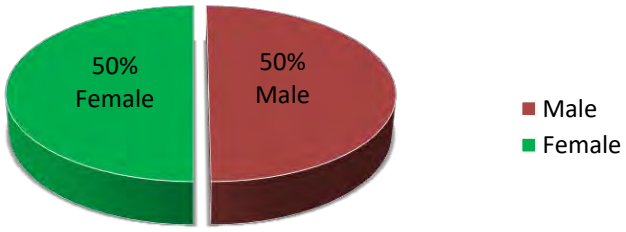

Fig. 1: Gender distribution of the Respondents

Age range of the respondents: The ages of the 100 pupils involved in the study were grouped as 12-15 (group 1) and 16-19 (group 2). Out of the groupings, 23 boys and 14 girls fall under group 1 constituting 37% and 27 boys and 36 girls were captured under group 2 that forms 63% of the respondents as shown in Fig. 2. Therefore, majority of the respondents fall within age group two. This reveals the presence of over-age and under-age among the respondents as indicated by Towse, *et.al.,* (2005) study conducted with Ghanaian JSS3 pupils.

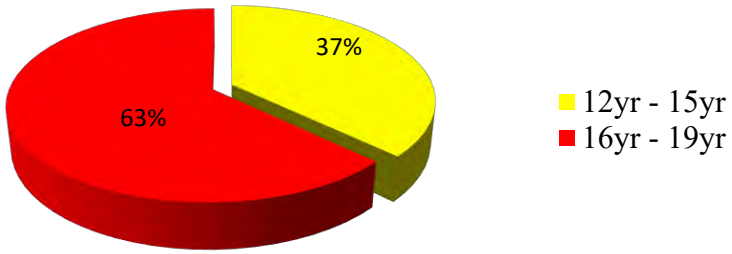

Fig. 2: Age Range of the Respondents

Class of the respondents: As illustrated in Fig. 3, 25 (25%) JHS2 and 75 (75%) JHS3 pupils formed the class of the respondents. This consisted of 11% boys and 14% girls at JHS2, and 39 boys and 36 girls in JHS3.

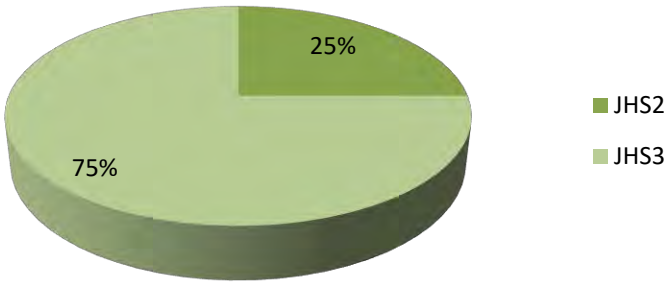

Fig. 3: Class allocation of the respondents

Participation in STME clinic

To make certain that quality, justice and vivid data is gathered to ascertain true reflection of what is on the ground equality was ensured too in terms of exposure to or not to STME clinic.

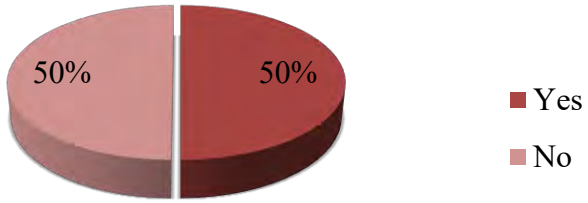

Fig 4. Participation in STME clinic ration

According to Fig. 4, 50 (50%) of the respondents apiece were exposed to and not exposed to STME clinics. This is of equal numbers (males and females) of each respectively.

Section Two: Responses to the Research Questions

This section presents the results or responses that the participants in the study gave to the relevant questions in the survey of the questionnaire and interview that used to address the five research questions.

Research Question 1: What is the attitude of the JHS pupils towards STME clinic activities?

Item1: I do not like the more practical activities carried out at STME clinics.

Table 1: Dislike of more practical activities carried out at STME clinics.

Scale	Male (n)	%	Female (n)	%	Total (n)	T
SA	3	12	1	4	4	
A	4	16	7	28	11	2
SD	13	52	9	36	22	2
D	5	20	8	32	13	4
Total	**25**	**100**	**25**	**100**	**50**	**1(**

According to the Table 1, a total of 70% of the respondents disagreed, thus refuted the statement that they dislike the more practical lessons carried out at STME clinics. But, it was also noted that 30% of the respondents agreed with statement.

Item 2: Due to STME clinic exposure, like to do more science in school

Table 2: Likeness to do more science in school

Scale	Males (n)	%	Female (n)	%	Tot.	Total %
SA	16	64	20	80	36	72
A	8	32	3	12	11	22
SD	0	0	0	0	0	0
D	0	0	0	0	0	0
No. Resp.	1	4	2	8	3	6
TOTAL	**25**	**100**	**25**	**100**	**50**	**100**

Table 2 reveals that an overall total of 94% of the respondents attested that their participation in STME clinic have made them like science and want to do more science in school. Besides, a total of 6% failed to express their position to item 2.

Item 3: Science practical lessons are interesting/exciting and help me to understand science topics better.

Table 3: Excitement in science practical lessons enhances understanding of science topics.

	Males(n)	%	Female (n)	%	Total (n)	%
SA	21	84	18	72	39	78
A	4	16	6	24	10	20
SD	0	0	1	4	1	2
D	0	0	0	0	0	0
TOTAL	**25**	**100**	**25**	**100**	**50**	**100**

As shown in the Table 3, 98% of the respondents (almost all) stated that their

excitement in science practical lessons enhanced understanding of topics. On the other hand, a 2% (thus, one girl) gave no response.

Item 4: I find science practical lessons difficult.

Table 4: The difficulty of science practical lessons.

	Males (n)	%	Females (n)	%	Total(n)	%
SA	1	4	0	0	1	2
A	3	12	8	32	11	22
SD	13	52	8	32	21	42
D	7	28	9	36	16	32
NO RESP	1	4	0	0	1	2
TOTAL	**25**	**100**	**25**	**100**	**50**	**100**

According to Table 4, 80% of the boys disproved/disagreed that science practical lessons are difficult, likewise 68% of girls, thus making a total of 74% of the respondents. On the contrary, 24 % agreed that they find science practical lessons difficult.

Item 5: I learn science quickly now because examples are taught at STME clinics/camps.

Table 5: Quickness of learning science

	Males (n)	%	Females (n)	%	Total(n)	%
SA	15	60	14	56	29	58
A	9	36	10	40	19	38
SD	1	4	1	4	2	4
D	0	0	0	0	0	0
TOTAL	**25**	**100**	**25**	**100**	**50**	**100**

From Table 5, it was noted that a total of 96% of the respondents agreed that they learn science quickly due to the difficult topics taught at the STME clinics. However, 4% disagreed.

Pupil's preferences towards STME clinic activities.

Item 6: award numbers 1-7 according to the order of activities you like/prefer most.

Table 6: Respondents preference to STME activities.

ITEM	ORDER OF PREFERNCE OF ACTIVITIES in (%)						
	1	2	3	4	5	6	7
Film show/Documentaries	10(5)	12(6)	8(4)	26(13)	14(7)	8(4)	22(11)
Interaction with Role M.	20(10)	18(9)	30(15)	6(3)	18(9)	4(2)	4(2)
Visits/ Excursions	28(14)	26(13)	20(10)	12(6)	12(6)	2(2)	0(0)
Talks	2(1)	6(3)	10(5)	20(10)	8(4)	32(16)	20(10)
Discussion/Sd. skills	30(15)	14(7)	10(5)	12(6)	20(10)	8(4)	4(2)
Closing Durbars	0(0)	2(1)	8(4)	8(4)	16(8)	26(13)	40(20)
Hands on activities	18(9)	18(9)	12(6)	12(6)	16(8)	18(9)	6(3)

Table 6 shows that 5, 6, 4, 13, 7, 4 and 11 of the respondents representing 10%, 12%, 8%, 26%, 14%, 8% and 22% correspondingly selected film show/documentary in order of likeness (that is from 1, the most preferred to 7 the least). On the other hand 10 pupils representing 20% preferred role model interaction the most, followed by 9(18%), then 15(30%), 3(6%), 9(18), 2(4%), and 2(4%) of the respondents least preferred it. For excursion/visits, 28% of the respondents most liked it and so ranked it 1. This is followed by 26%, 20%, 12%, 12%, and 2% respectively. Moreover, on

considering talks; only 2%, out of the 50 respondents expressed it as the most preferred, followed by 3, 5, 10, 4, 16 and 10 respondents of percentages 6%, 10%, 20%, 8%, 32% and 20% in order of likeness. However, 15 respondents; that is 30% liked discussion/studying skills most, followed by 14%, 10%, 12%, 20%, 8% and 4% in that order. None of the respondents categorized closing durbar as 1 or the most preferred, this is directly followed by 2% who ranked it as two (second most liked), next by 8% as third and fourth, 16%, 26%, and 40% in descending order. Lastly, hands on activities: recorded 9, 9, 6, 6, 8, 9, 3 of percentages 18%, 18%, 12%, 12%, 16%, 18% and 6% out of the 50 respondents for each in order of preference.

Research Question 2. What benefits have past participants of STME clinics acquired?

Item 1: STME clinic has exposed me to female role models in science.

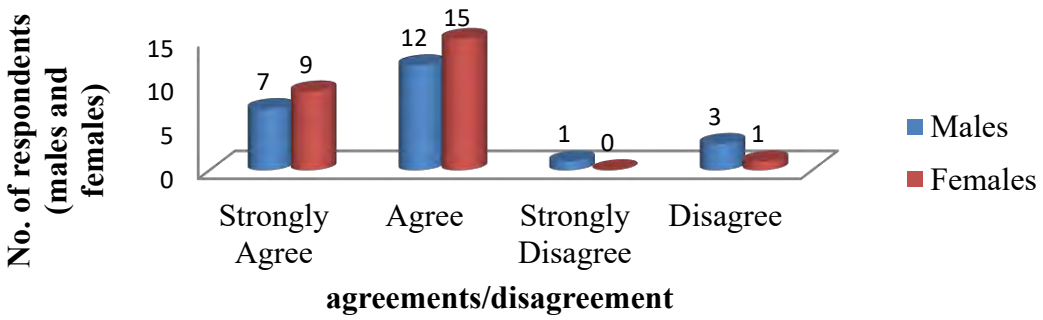

Fig. 5: Respondents view on Role Models exposure

As shown in Fig 5, 19 boys and 24 girls, thus 86% of the respondents completely agreed that STME clinic has exposed them to female role models, whereas 4 boys and a girl making 10% of the respondents hold a disagreeing view. Moreover, two boys (4%) failed to provide a response to the item.

Item 2: STME clinic has helped me to realize the practicality of science.

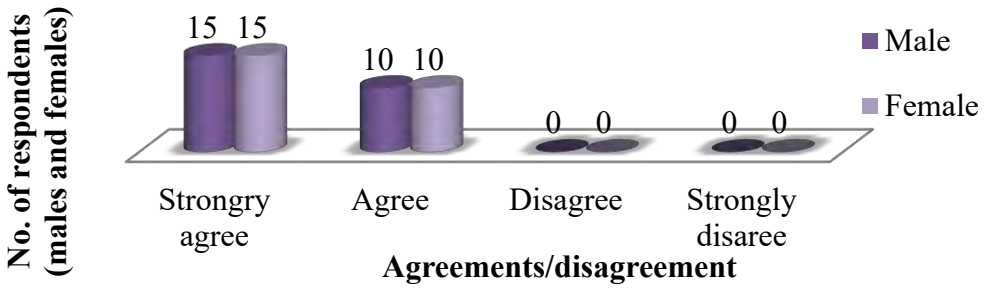

Fig. 6: Realisation of the practicality of science

According to Fig. 6, an equal number; that is 15 boys and girls each strongly agreed, whiles the rest of the respondents agreed. Hence, 25 (100%) all validate to the statement that STME clinic aids the realization of the practical nature of science.

Item 3: I do not want to aspire higher in science

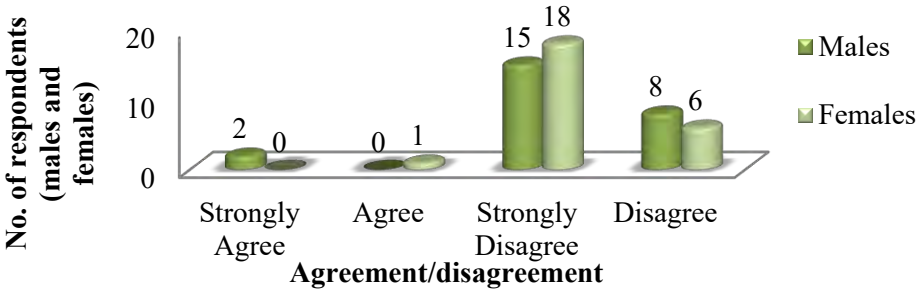

Fig. 7: Respondents aspirations in science

From Fig. 7, 94% (23 and 24 girls) of the respondents expressed disagreement to the statement. However, 2 males and a female, thus a total of 6% agreed that they did not want to aspire higher in science.

Item 4: STME clinic has made me develop an idea that science is for males

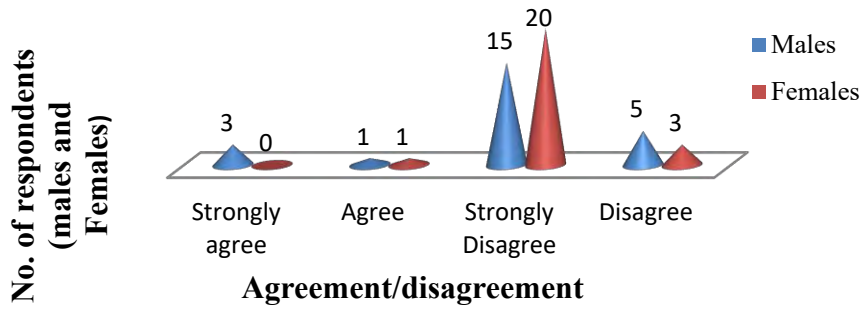

Fig. 8: Science and gender

As indicated in Fig. 8, 20 boys and 23 girls (86%) of the respondents showed their disagreement to the declaration that science is for males. Although, 4 boys and 1 girl (10%) agreed that science is for males, 2(4%) of the respondents gave no response to the item.

Item 5: STME clinic has denied me the chance to interact and study from other pupils.

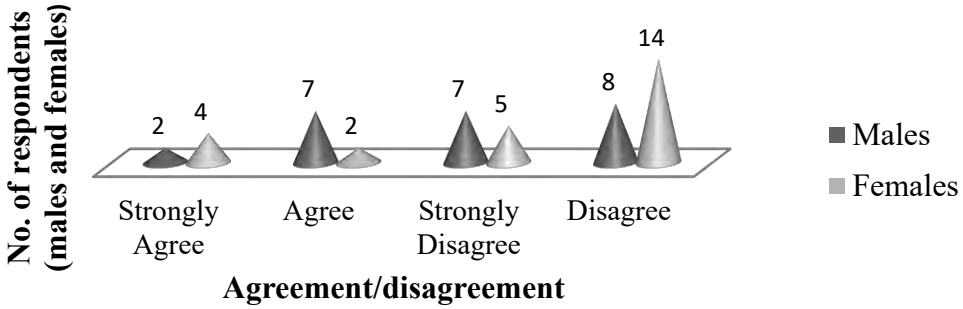

Fig. 9: Opportunity to interact with other pupils at STME clinic

On how to interact with and study from other pupils, 9 boys agreed while 15 disagreed completely, and 1 failed to give a response. Likewise, 6 girls agreed with 19 of them disagreed with the statement given in item 5 as illustrated in Fig. 9.

Item 6: STME clinic/camp has helped me to realize the different areas and opportunities in science.

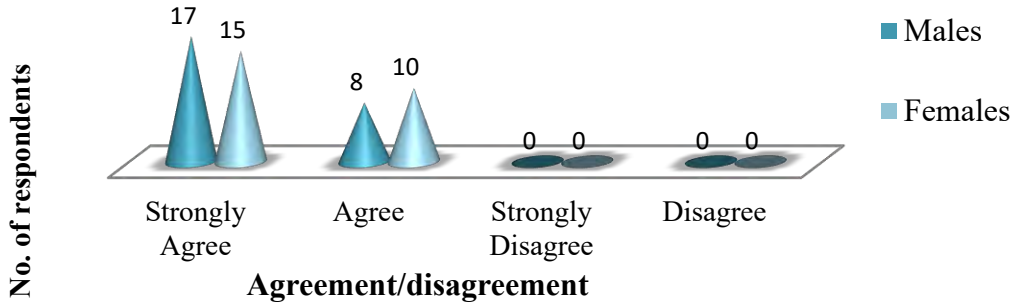

Fig.10: Respondents awareness of different opportunities in science

In Fig 10, 17(68%) males agreed strongly and 8(32%) of them agreed. In terms of the girls, 15(60%) females strongly agreed and 10(40%) agreed. Thus, 25 (100%) of both sex agreed that STME clinic has exposed them to the different opportunities in science and none objected to it.

Research Question 3. What is the effect of the Science and Technology on the pupil's interest/attitude in science?

Item1: A country does not need science and technology to develop

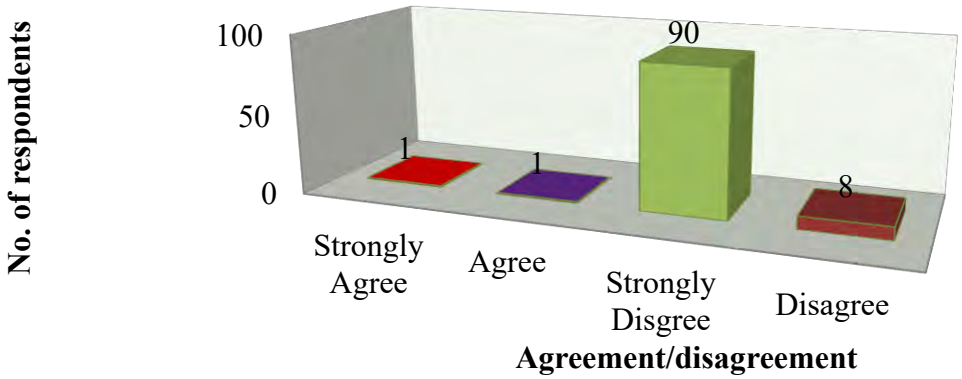

Fig.11: Science and technology is needed for a nations development

As reflected in Fig 11, 2% of the respondents agreed that a country does not need science and technology to develop while 98% established strong disagreement.

1tem 2: Science and technology are important for our society

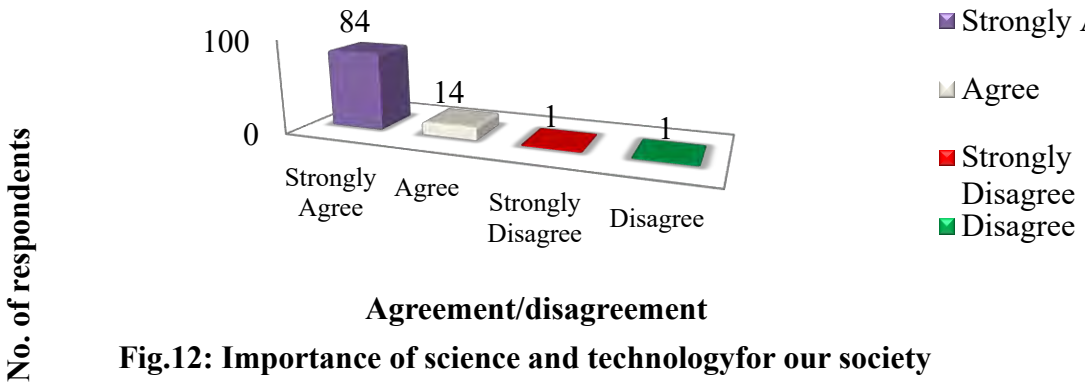

Fig.12: Importance of science and technologyfor our society

As observed in Fig 12, 98(98%) of the respondents indicated strong agreement to the idea that science and technology are important for our society and only 2(2%) disagreed to the item 2. Meaning we are in a technological era.

Item 3: Science and technology benefits only the developed countries

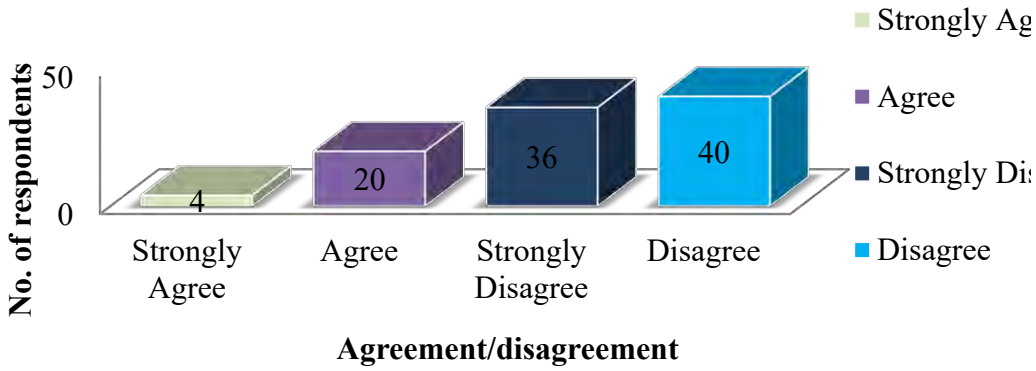

Fig. 13: Benefits of science and technology to countries

As noted in Fig 13, 24 (24%) of the respondents agreed whiles 76 (76%) demonstrated total disagreement to the item 3.

Item 4: Science and Technology makes our lives healthier, easier and more comfortable

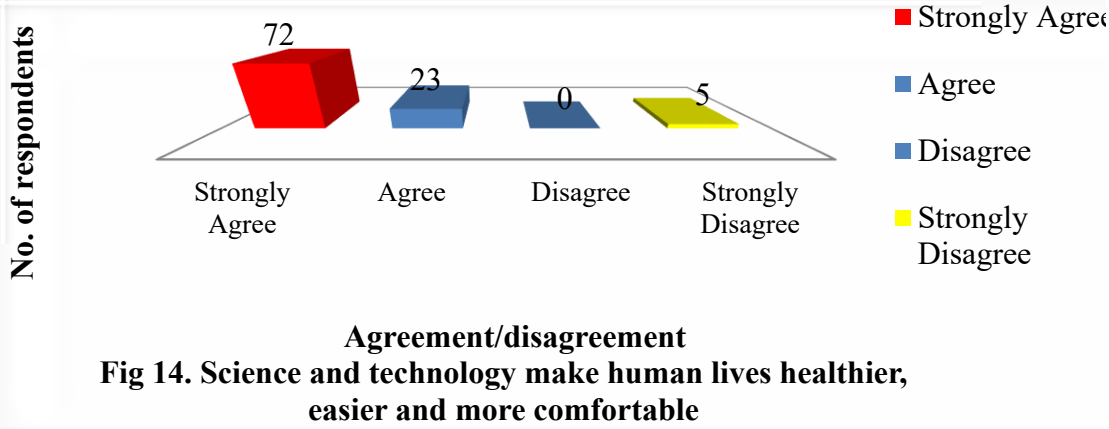

Fig 14. Science and technology make human lives healthier, easier and more comfortable

Figure 14 indicates that 95(95%) of the respondents disclosed (agreed) that science and technology makes our lives easier, healthier and more comfortable with 5(5%) saying is not.

Item 5: Science and technology are the cause of environmental problems

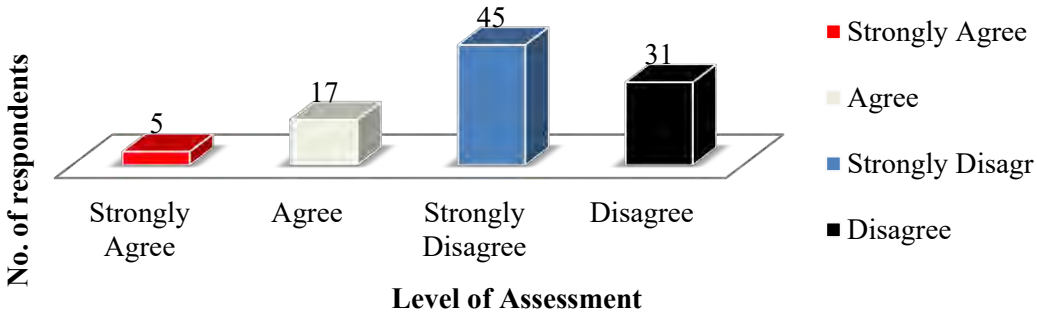

FIG. 15: Level of assessment of science and technology as the cause of environmental problems

As shown in Fig 15, 22(22%) of the respondents agreed that science and technology are the main cause of environmental problems, and the remaining 76(76%) expressed a disagreement to the issue.

Research Question 4. Have there been any changes in the pupil's perception/attitude towards science after participating in STME clinic?

When 20 respondents were interviewed it was revealed that practical lessons carried on at STME clinics have helped them to like science and hope to do more science, carry out practicals with ease, understand and solve topics which were considered difficult. These have motivated them not to miss mathematics, science and technology class. In summary they confirmed that they now have positive attitude towards science and technology.

Item: Pupils attitude towards science after participating in STMIE clinic

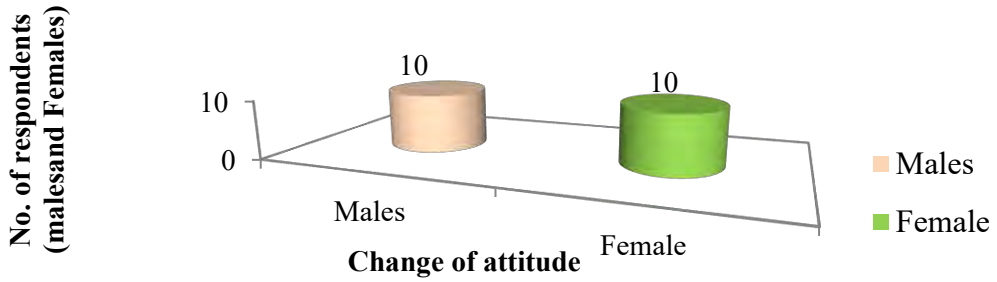

Fig.16: Attitude towards science after participating in STME clinic

Figure 16 portrays that equal number of the respondents interviewed (10 boys and 10 girls) are of the view that their participation in STME clinic has changed their attitude towards science.

The perceptions of JHS pupils as whole are discussed down this Section.

Pupil's perceptions of science

Item 1: Science is a difficult subject

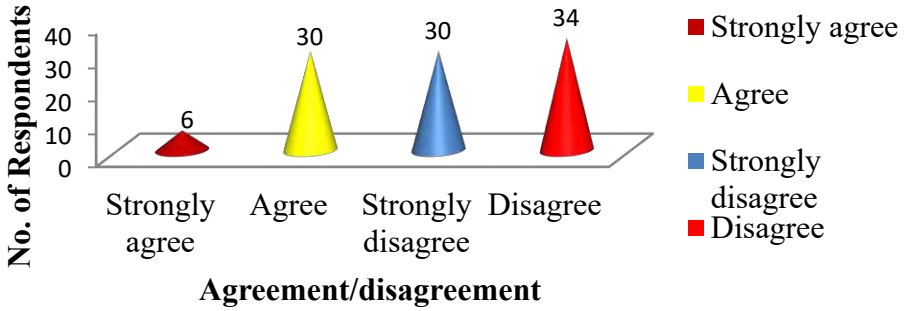

Fig. 17: Science as a difficult subject

In Fig. 17, 36% as against 64% of the respondents bear out that science was difficult.

Item 2: Science is not interesting.

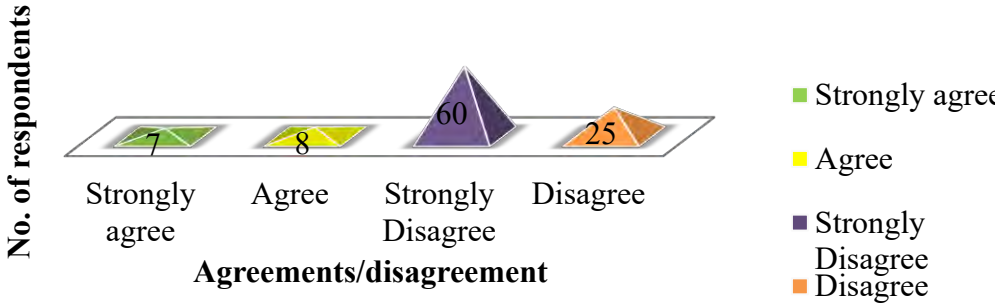

Fig. 18: Science is not interesting

As shown in Fig 18, 15% agreed while the remaining 85% disagreed, and this implies that science is rather interesting not vise versa.

Item 3: science has increased my appreciation of nature.

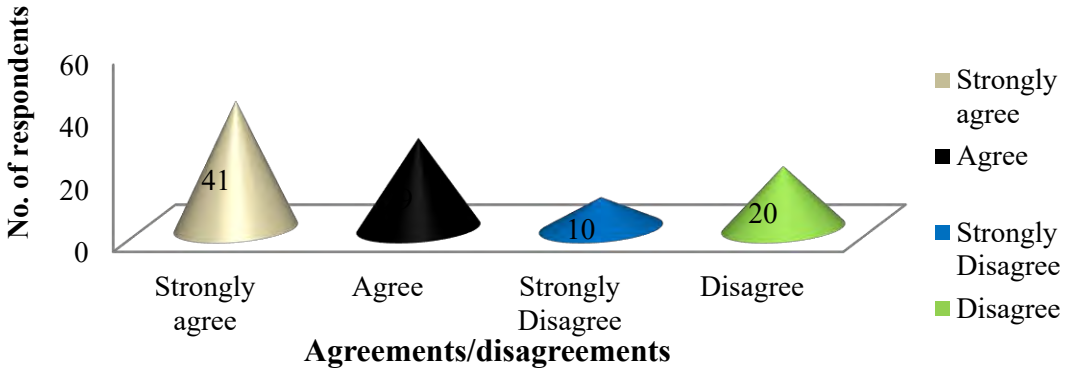

Fig. 19: Science increase appreciation of nature

Seventy (70%) of the respondents confirmed that science has really increased their appreciation of nature, as against 30% who disagreed as in Fig. 19.

Item 4: I can't become a scientist

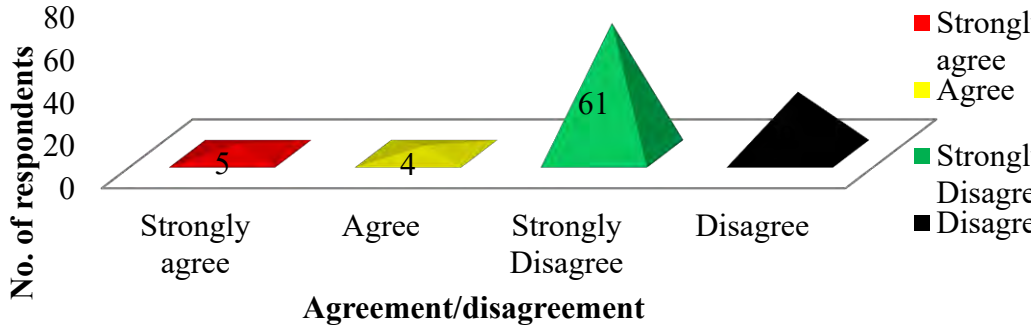

Fig. 20 :I cant become a scientist

In Fig. 20, 90% of the respondents disagreed to the statement that "I cannot become a scientist". However, 9% stated that they agree. Only 1 % (1) did not agree or disagree.

Item 5: Science has shown me the importance of science for our way of living.

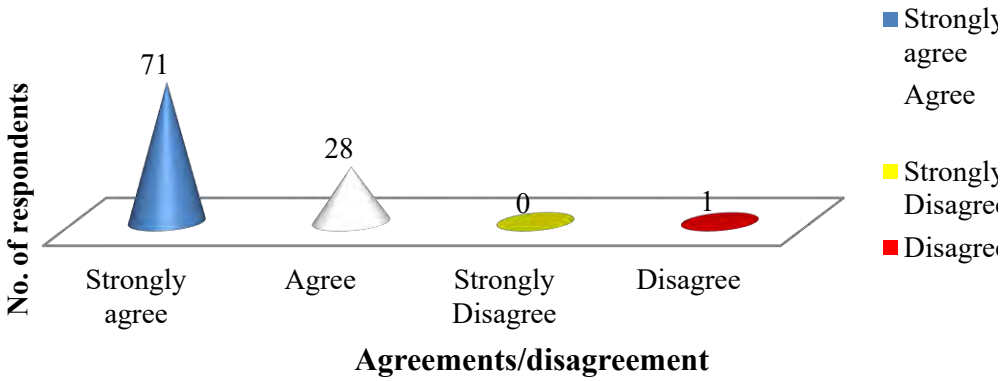

Fig. 21: Science has shown its importance for our way of living

As indicated in Fig. 21, almost all the respondents (thus 99%) agreed that the learning of science has really shown them its importance for our way of living with exception of 1(1%) who provided no response.

Differences in perception

Table 7: Differences in perception of Science

Item		S. Agree %	Agree %	S. Disag %	Disagree %	Total %
1.	**Science teachers relate differently with boys and girls**	21(21)	20(20)	26(26)	33(33)	100
2.	**Science lessons are dominated by boys**	3(3)	9(9)	46(46)	42(42)	100
3.	**I understand science lessons taught in school**	54(54)	40(40)	2(2)	3(3)	99(99)
4.	**Science teachers make science abstract**	16(16)	37(37)	16(16)	31(31)	100
5.	**Science teachers give equal attention to boys and girls**	59(59)	32(32)	4(4)	5(5)	100
6.	**I like school science better than most other subjects**	38(38)	42(42)	8(8)	12(12)	100
	Mean score	**32.8**	**30.0**	**17.0**	**21.0**	**25**

In Table 7, 41% of the respondents agreed that science teachers relate differently to boys and girls where-as 59% disagreed. Moreover, 88% of the respondents disagreed that science lessons are dominated by boys as against 12% of them who agreed. Again, 94% agreed that they understand science lessons taught in class, but, 5% disagreed and 1% failed to answer. As well, 47% disagreed that science teachers make science abstract and 53% agreed. Moreover, 91% agreed that science teachers give equal attention to boys and girls whereas 9% of them disagreed. Lastly 80% agreed that they like science and mathematics better than any other subject with 12% disagreeing. Meanwhile, the mean score for the items under the section as indicated are 32% for strongly disagree, 30 agree, 17 strongly disagree and 21% for disagreed.

Differences in perception in terms of Gender (males and females):

Item 1: Science teachers relate differently to boys and girls

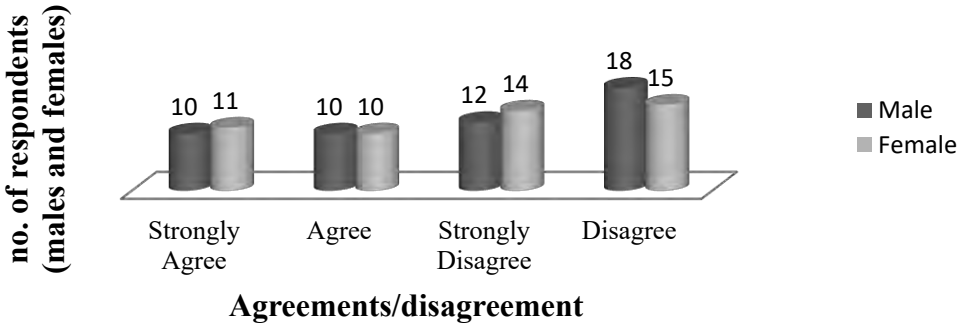

Fig. 22: relationship between science teachers pupils

Figure 22, indicates that, 20 (20%) boys agreed while 30 (30%) disagreed to the item 1. In the meantime 21 (21%) girls agreed with 29 (29%) disagreed, signifying that science teachers show no partiality in their relation with both males and females.

Item 2: boys dominate science lessons.

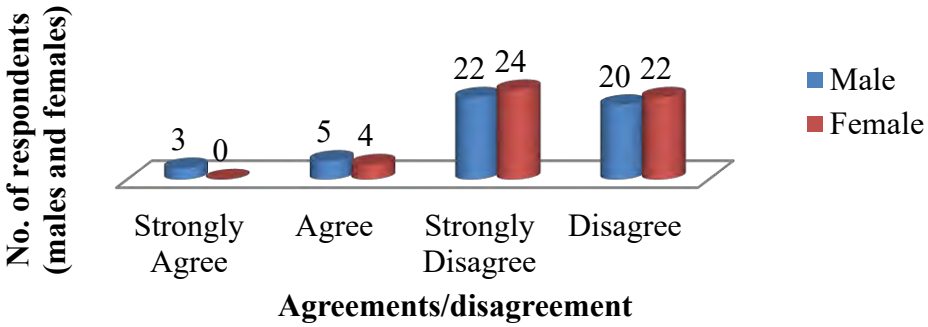

Fig. 23: boys dominate science lessons

According to Fig. 23, only 8% of the boys agreed that boys dominate science lessons while 42% disagreed. Nevertheless 4% girls agreed to the item whereas 46% disagreed implying that boys do not take over science lessons in class.

Item 3: I understand science lessons taught in class.

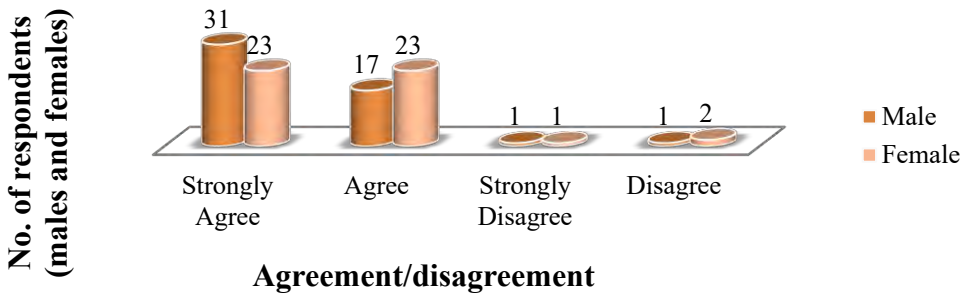

Fig. 24: Understanding of science lessons taught in class

From Fig. 24, 48% boys agreed that they understood science lessons science teachers taught in class, however, 2% of them disagreed. On the part of the girls 46% of them agreed while 3% disagreed. Yet a respondent (1%, a girl) failed to indicate her stance.

Item 4: science teachers make science abstract

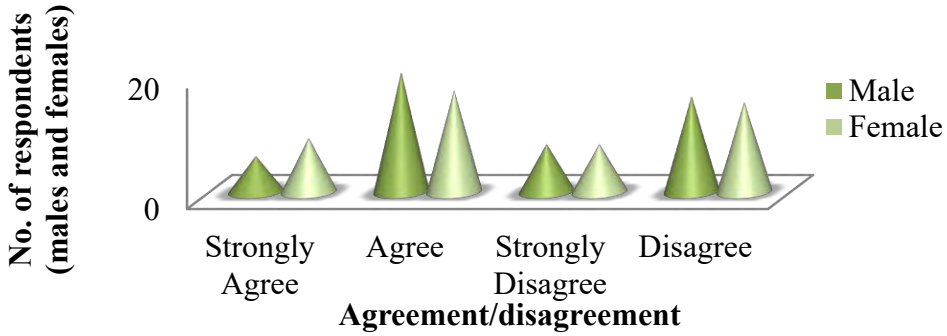

Fig. 25: Science teachers make science abstract

As indicated in Fig. 25, out of the 100 respondents, 26 (26%) boys agreed that science teachers make science abstract and 24 (24%) disagreed. On the other hand, 27 (27%) girls agreed but 23 (23%) disagreed implying that science is taught to them in abstract thereby making understanding difficult.

Item 5: science teachers give equal attention to boys and girls

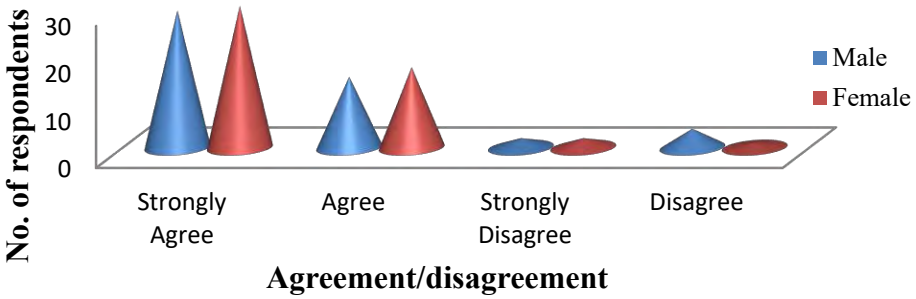

Fig. 26: Science teachers give equal attention to boys

Figure 26 shows that 44 (44%) boys agreed that science teachers give equal attention to boys and girls while 6 (6%) expressed disagreement. Conversely, 3 (3%) girls indicated a disagreement, but 47 (47%) agreed signifying that science teachers treat both sex equally and offer the needed support to each.

Item 6: I like school science and mathematics better than most other subjects.

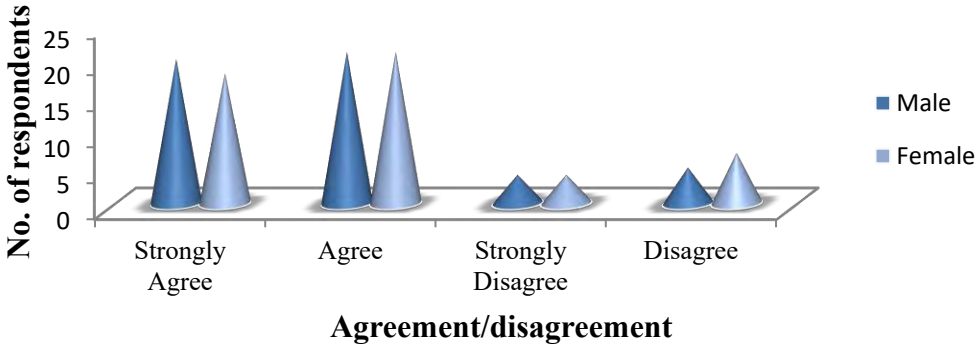

Fig. 27: Likeness of science and mathematics than any other subject

As shown in Fig. 27, 41 boys representing 41% of the respondents agreed that they like science and mathematics than the other subjects but 9 (9%) of them disagreed. However, 39 (39%) girls agreed and 11 (11%) of them disagreed to the item.

Testing of Null hypothesis associated with research questions

Null hypothesis one (1)

H_{01}: there is no significant difference in the perceptions of science of JHS pupils who have participated in the STME clinics and their colleagues who have not.

Table 8: Perceptions in science of JHS pupils participated and those not participated in STME clinics.

Compared group (participation in STME clinic)	N	Mean	Standard D	DF	t	p-valu
Yes	50	3.19	.220	89	3.713	.0193
No	50	2.86	.249		3.713	

*p>0.05

The independent sample 2-tailed t-test was used to determine whether there are any significant differences in the total mean of JHS pupils who have participated and those who have not participated in STME clinic with respect to perceptions of science at p-value of 0.05. The results of the t-test are displayed by Table 8. The t- test results indicated that statistically there is significance difference between the JHS pupils perceptions of science of those who have and those who have not participated in STME clinic; is (t (3.713)= 0.019, P>0.05). Therefore the null hypothesis is rejected. It can therefore be inferred that there are differences in perceptions of science held between those exposed to and those not exposed to STME clinic.

Null hypothesis two (2)

H_{02}: There is no significant difference in the perceptions of science of females and males who have participated in STME clinic

Table 9: t-test results on differences in perceptions of JHS males and females who have participated in STME clinics.

Compared group (males and females exposed to STME clinic)	N	Mean	Standard D	DF	t	p-valu
Males	25	3.35	.269	48	-.724	5.194
Females	25	3.40	.192		-.724	

*p<0.05

The independent sample 2-tailed t-test was used to test hypothesis 2 at p-value of 0.05 and the results are presented in Table 9. The t-test results confirmed a statistically no significance difference between JHS males and Females who are participated in STME clinic as ($t(-.724) = 5.194$, $p<0.05$). As a result, the null hypothesis is accepted.

Null Hypothesis three (3)

H_{03}: there is no significance difference in the perceptions of JHS females of the utility of STME clinics and that of their male counterparts.

Table 10: t- test results on difference in perceptions of JHS females of the utilities of STME clinics and that of their male counterparts.

Compared Group (males and females Of the utility of STME clinics)	N	Mean score	S.D	t	d.f	p-v
Male	25	3.38	.370	−.583	98	7.2
Female	25	3.43	.236	−.583		

*p<0.05

The independent sample 2-tailed t-test was used to test hypothesis 3 at p-value of 0.05 and the results are presented in Table 10. The result as indicated by Table 10 is statistically no significance at 5% (0.05) p. The result of the t-test confirmed a statistically, no significance difference between the perceptions of JHS males and females of the utility of STME clinics, (t (−.583) = 7.258, p<0.05). In effect the null hypothesis is accepted.

INTERVIEW DATA

The interview of the respondents constituted the second phase/segment of data collection of the study. The purpose was to find out some clarification of pupils responses to the questionnaire items as well as validate the data obtained from the questionnaires. Again, to find an in-depth understanding of how pupils perceive science and STME activities. The following sections present a detailed report on the major themes based on which the questionnaire was designed, namely: Pupils attitude towards STME clinic activities, preference in STME activities, benefits of STME clinics/camps, effects of STME on interest/attitude towards science and perceptions of science.

Pupils' Attitude towards STME Clinics.

The interviewees view on their attitude towards STMIE clinic, most of them revealed that more practical lessons carried out at STME clinics have helped them to like science and science practical's because it makes science real and meaningful; science is not considered difficult anymore but exciting. And their attitudes towards science now have changed positively. Two of them remarked:

Participant interviewee- 1: A lot of practicals are done at the clinics more especially at science and magic time and hands on activities time. I enjoy the activities so much.

In fact STME clinic make science real through activities like science and magic time (discussion) where we do so many experiments; excursions where we see things for ourselves and hands- on activities (*Participant Interviewee- 2*).

On preference to STME activities: the interviewees expressed strong responses on their great likeness for STME clinic activities such as educational visits/excursions, hands on activities, studying skills, role models interaction, talks and film shows. Two

indicated:

Participant Interviewee- 4: I like visits/excursion (1), discussion/studying skills (2), role models interaction (3), hands on activities (4), film show (5), talk (6) and closing durbar (7) in order of preference.

For me, I prefer interaction with role models (1), talk (2), hands on activities (3), discussion (4), excursion (5), closing durbar (6) and film show (7) (*Participant Interviewee- 5*).

Benefits of STME Clinics

On how they have benefited from the clinic, they mentioned that because of STME clinic science is no more abstract; science practicals are done with ease; they can make liquid soaps, creams, batik and tie and dye to earn a little income in support of their education. Again, have developed interest for science and maths, know many science and technology sites, and perform science and maths calculations with ease. Moreover, interactions with role models have boost their moral and made them apprehend possibilities in determination. Two commented:

Participants Interviewee- 2: I have realized that science is not difficult because I now understand, and it's many opportunities. I understand the life stories of the role models. It has inspired me and I know I can do well in science.

Participant Interviewee- 4: I have gained experience, skills and knowledge in liquid soap making and cream. I will teach my mother so that she will raise funds in support of my SHS education.

Effect of Science and Technology on Pupils' Interest and Attitude in science.

On the effects of Science and Technology, almost all the interviewees admitted that every country and individual needs Science and Technology, since it is the engine for growth and development of society/country and lives. They cited that mobile phones, cars, television and radios just to mention a few in uses that have improved humans lives are all science and technological gadgets. However, they elucidate to it merits and demerits. Explaining further, they argued that though it has made live healthier, easier and more comfortable it has aided cyber fraud and other crimes, cause immorality among the youth, pollution of our natural environment and others. One remarked:

Really, we are in a technological age so is very important to all. I talk to my brother in London with ease. Anyway, there are negative effects. For example we deceive and lie with mobile phone, cyber fraud on the internet and other bad attitudes among the youth because of what we watch from the internet (*Participant Interviewee -10).*

On the meaning of science: The interviewees gave their views about science based on the number of definitions put forward by some scientist learnt in school. One of them noted:

Science is the study of nature", solving of problems by scientifically means *(Participant Interviewee eight- 8).*

On the difficulty level of science: some of the interviewees attested that science is difficult while others disagreed, but to others their colleagues find it difficult. Two of them commented:

Participant interviewee 8: "All though science is not difficult is not easy".

Science is difficult *(Participant Interviewee- 12)*

Perception of pupils of science

Almost all the interviewees confirmed that science teachers treat boys and girls equally. However, some alleged that girls dominate science lessons in class but to others is vise versa. Majority expressed that science teachers teach well. While others argued that they teach abstractly and therefore creating a perception that it is difficult thus reducing/destroying their interest in science. And hence, develop a pessimistic attitude towards it. One of them mentioned:

Science teachers treat us the same and like all of us. Science is for all, so everyone can become a scientist when we study hard and determined. Teachers teach well, but at times no TLMs so we don't understand. *(Participant Interviewee- 7).*

Responses for Questionnaire items for Past Participants of STME Clinics at SHS

Item 1: what have you gained from attending the STME camp/clinic?

It revealed that the clinic has helped to discover so many things especially through the excursions. Once more, they have gained experience and interest in STM, improved learning skills, opportunity to socialize and learned from others.

Item 2: On how to use the knowledge and experience gained from attending STME clinic to help the family, school, friends, community and Ghana. They

Noted:

Family: enlighten them about science, its importance, how to use scientific method to identify problems and solve it, develop science and study hard, work in science fields to help overcome financial problems in their families.

School: to help colleagues to be cautious of the difficulties in science, take part in science programmes/activities for the school and advice them to study science effectively.

Friends: They do assist and encourage them not to fear maths or science by sharing with them experience gained in science to help wipe out the perception about the difficulty of science. Again, not to show partiality in subjects, but to consider all subjects as the same.

Community: Use of technology in their daily lives, thus introducing the community to modern technologies in farming and other development projects as well as the copious importance of science.

Lastly Ghana as a whole: Developing the country by studying hard to become a great scientist and facilitates the training of more pupils to become doctors and nurses and engage in research work in science for advancement/development.

Item 3**:** Preference to STME clinic activities

For preference of activities, 50% gave excursions/visits by explaining that it aids in the exploration of the outside world by learning and discovering new things which were unknown. Again, 30% like studying skills /discussion most because it made them enjoy science and appreciate its reality/authenticity. 20% selected role model interaction. However, one of them made mention of talks in addition to excursions.

Item 4: Why do you prefer the activities mentioned in three?

They expressed that excursion help to acquire knowledge, see new things and explore the outside world, discussions the practicals make them see and realize that science is real. Role model interactions motivate them to be determined and work hard.

Item 5: How has STME clinics affected your life?

The responses indicated that it has improved performance and their learning skills in all subjects and wherever they find themselves. They are now attracted to maths and science and relate well with others.

Item 6: In your view what deter males and females from studying the sciences at the higher levels?

They affirmed that most pupils, in particular girls indicate that the presence of maths (more calculations) threatens them, and therefore leave science for the boys. On the other hand, they pointed out that both sexes do so because of the assertion of science becoming more difficult as one progress (that is at higher levels), inadequate laboratories, apparatus and equipment, skilled personnel as well as practical nature of science. Besides, one of the respondents attributed it to the fear of a person becoming insane, when it is studied at higher levels due to much learning. Six of the participants specified that science at the higher level is expensive and if your parents cannot meet the expenses, it becomes difficult.

Items 7: Subject's Preference for some past participants of STME clinics at SHS

Table 11: Subjects Preference of some past participants of STME at SHS

Subjects	Order of preference in percentage (%)						
	1	2	3	4	5	6	7
Mathematics	-	**30(3)**	**30(3)**	**30(3)**	**10(1)**	-	-
Science	**10(1)**	**40(4)**	**20(2)**	**30(3)**	-	-	-
English	**70(7)**	**10(1)**	**20(2)**	-	-	-	-
Social studies	**10(1)**	-	**10(1)**	**30(4)**	**40(4)**	**10(1)**	-
RME	**10(1)**	**20(2)**	**10(1)**	**10(1)**	**20(2)**	**20(2)**	**10(1)**
BDT	-	-	**10(1)**	**10(1)**	-	**50(5)**	**30(3)**
ICT	-	-	-	**10(1)**	**10(1)**	**30(3)**	**50(5)**

As indicated in Table 14, the interaction with the ten respondents also unveiled that 40% are doing Elective Science at SHS. Among them, a participant explained that almost all his family members are in Science fields and needed a variety; hence due to his father's assent he opted for General Arts. Moreover, follow-up made on some of the past STMIE participants revealed that a lot more of them are studying elective science at the SHS level. Jenkins and Pell (2006) finally classified the English students in terms of school science preference in four categories: pro-science, latent pro-science, anti-science and apparent pro-science. Jenkins and Pell assertion explains why the preference for the various subjects as indicated. However, it could be as a result of

the factors already suggested by other respondents and other study results discussed.

Discoveries made from the questionnaire responses from the DSTME Co-odinators indicated that the rationale behind the activities carried out during STME clinic was to develop the pupils' interest in learning maths and science at higher level and eliminate the 'phobia. Similarly, they expressed their satisfaction on the activities that it appeals equally to both sexes. They further explained that, pupils are always put together for lessons in the clinic and has foster tolerance in them. They pronounced that STME clinic has developed confidence in the pupils. Again, it has removed the fear of maths and science. In addition, they demonstrated that many of our science teachers, doctors, pharmacists and mechanical engineers to mention a few, benefited from the clinic and further claimed that other beneficiaries are also into science and technology.

CHAPTER FIVE

DISCUSSION, CONCLUSION, RECOMMENDATIONS AND FURTHER SUGGESTIONS

Overview

This chapter involves discussion, conclusion, recommendations and suggestions for further research.

Discussion

Research Question 1. What is the attitude of the JHS pupils towards STME clinic activities?

Effective science education implies the creation of environments for maximizing learning success. From the interviewees they admitted that at STME clinics Role models and resource persons take pupils through science projects development, practicals lessons and hands-on activities in their area of expertise. Also, they visit industries, schools/institutions, science and technological sites and are exposed to a lot of new things, which make them appreciate and develop interest for science and technology.

As the result clearly reveals, majority of them disclosed that more practical activities done at STME clinics has made them like science The few who held a contradicting view has arisen as a result of less active involvement, and the higher number of participants at the regional level clinic deprive them from taking active part in the activities. Moreover, inadequate materials and other resources as well as well as funds which are enumerated by researchers as Anamuah-Mensah in Ghana and Oriafo (2002) and Nwachuku (2009) in Nigeria as the major challenges confronting STM education.

Meanwhile, pupils are likely to learn better when learning is related to real life situations. In other words, pupils might learn science with better understanding when there is a closer connection between classroom learning, the environment and the practical experiences of the pupils.

The participants (both boys and girls) agreed that their participation and the experience from STME clinic activities have made science very real and practical because they have discovered and learned new things. And that they like to do more science. This corresponds with the position of Whitelaw *et. al.,* (2000) study which confirms that no achievement differences were found between the young men and women in science. Likewise, (Matayas, 1987) assert that the elementary students of both sexes like science and hope to study science again. The few who provided no answer might have not involved themselves in the activities well nor did not understand. The results also divulge that pupils now consider science practicals exciting and interesting with less intricacy in science topics. This is in conformity with what has been said by (Duckworth, 1995) that teachers, (Jarvis, 2002; Clarke *et al.,* 2008) and children enjoy working with science ideas, especially when they have the opportunity to investigate their own ideas and compare them with the ideas of standard science. Again, it is in agreement with the theories of constructivism, where learning is considered as an active and constructive process; learners not only construct knowledge, but the knowledge they already possess affects their ability to gain new knowledge, Etkina and Mestre (2004).

The responses by most pupils testify that they like doing science practicals and hands–on activities. The reasons offered for this view is in accordance with study findings centered on experiments being fun, discovery of new things, understanding of how things happen and works, collaborative and the feeling of satisfaction they experienced

when they learn by doing. The assertion is also in line with reports by Campbell (2001) in which upper primary science students signified that doing experiments is the best part of science for them. This indicates quite convincingly that pupils like to learn by being active participants in the science learning process. Concurrently, Osborne and Collins (2000) have shown that students find practical sessions stimulating and more meaningful largely because practical sessions offer them more autonomy and control over their own learning. This thereby adds much to the significance of activities undertaken during the clinics which goes far to reinforces understanding of what is taught in the classroom.

In general, the results imply that both males and females are happy with the activities organized at the clinic, they have now developed positive attitude towards STME clinic activities and has resulted to development of positive attitude towards science. Furthermore, their excitement, likeness, quickness/easiness, interest and achievement in the science and mathematics have also being improved. It is also evident, from the results of PISA 2006 with an average of 63% of the students reporting that they are interested in science and have fun doing so. Besides, it is consistent with TIMSS 2003 which indicates that international averages of eighth graders have highly positive attitude for science and maths. This affirms why most of the respondents are no more "science phobia".

Lichtenstein *et. al.,* (2008) and Simpson *et. al.,* (1994), pointed out that attitude should be considered as an essential indicator of the quality of science education. However, the findings bear out the existence of disparity between females and males when it comes to attitude towards the learning of the STM. Girls' have less positive attitudes, according to Catsambis (1995) it existed even though they performed as well or better than boys and receiving better grades in science classes. Cavas *et. al.,* (2009), noted

that statistically significant differences were found in environmental attitudes and interests in learning about environmental protection mean scores of students regarding gender. In agreement, society in general has a preconceived notion that males are more successful in maths and science classes while females are more successful in language arts, foreign languages, arts, and humanities classes. However, despite the general agreement of our data with previous studies, the result proves that, Girls had a tendency to affirm more frequently than boys, their interest in STME activities and in science as a whole. Though, results like that of Catsambis (1995) bear out that Girls' have less positive attitudes towards science. Once more, girls are found to be more responsive to instructional methods that are context-based, activity-oriented and those that foster collaboration and co-operation (Khale, 1996; Erinosha, & 2000).

Besides, there are other studies results which despite the fact that science informs our thoughts and behaviors, many people do not seem to place a high value on science. A study by Rogers and Ford (1997), report that the general public (that is, non-science majors) does not generally have positive feelings toward science and scientists is in correlation. Also, Jenkins and Pell (2006) finally classified the English students in terms of school science preference in four categories: pro-science, latent pro-science, anti-science and apparent pro-science. The reason attributed for those who consider science practicals still difficult and boring after exposure to the clinic. This raises a question on the quality, magnitude and efficiency of the activities, and its effects on the pupils? Is it effective? Does it appeals equally to both boys and girls? Are the activities and the resources adequate? Thus, big questions, and really, matters of concern.

On preference to STME activities, the pupils indicated much preference for excursions, role models interactions, discussion, hands on activities and talk better comprehend

and affirms what is mentioned earlier. The low preference for film show and closing durbar is due to the less interaction and practicality nature. Besides, the impact of the more preferred activities (excursions, discussion/studying skills, role models interaction and hands on activities) indicated to quality of education can be illustrated by the Chinese proverb quoted by Zaney (2004): "when 1 see, I remember; I hear and forget; I do and understand" (p.3). Obviously, the situation experience during these activities is ideal.

In summary, the results reveal and confirm that the relevance of STME clinic such as a positive attitude toward science may improve students' academic performance in science, maths and technology as well as other subjects. It is therefore in the interests of society, and the responsibility of educators, to improve students' attitudes toward science, and to prepare students to live in a highly scientific and technological society. Since, the future of our society will be determined by citizens who are able to understand and help shape the complex influences of science and technology on our world as is said by (Ungar, 2010).

Research Question 2: what benefits have the past participants of STME clinics acquired?

At Science, Technology, Mathematics and Innovation Education (STME) clinic is organised yearly at the district, and most particularly, at the regional and national levels. Pupils from different schools are brought together to interact and learn from peers, teachers, role models, parents and resource persons. Furthermore, pupils are taught and directed to develop projects, which they mount for public to see and appreciate. Above and beyond project expect judges inspect, judge and award prizes. Role models and resource persons also take the pupils through some practicals, hand-

on activities and exercises in their area of expertise. In addition pupils visit industries, institutions and other scientific and technological sites where they are exposed to a lot of new things. This truly corresponds with the view of the pupils affirming their exposure to female role models and many science and technological sites that have enthused them. However, the very few who are with different view did not comprehend the statement well nor experienced less involvedness due to the higher number of participants at the regional level. It could be as a result of the assertion like the non-science majors. Again, one may question why the district level which exposes majority of pupils is not organised yearly? This calls for serious study to ascertain remedy for the situation.

On the other hand, most of the respondents remarked that they want to aspire higher in science so that they can acquire jobs and leadership roles in the sciences. Similarly, Catsambis (1995) found that over twice as many middle school boys as girls are interested in a future career in science. The results further pointed out that the clinics have exposed pupils to the different opportunities in science, science and technological sites, preparation of hands on such as liquid soap, cream and batik tie and dye. In addition, they (mainly girls) expressed progress in performance in STM subjects, understanding in science lessons and interest for STM. These are in accordance with a speech delivered by Azumah-Mensah (April, 2011) when she put forward that, STMIE clinic has produced the following results:

1) Students (girls in particular) are better ever able to deal with gender stereotypes associated with female participation in the so-called non-traditional careers' while misconceptions and psychological barriers to female participation in Science, Technology and Mathematics subjects are gradually being broken.

2) Student enrolment in the science and mathematics is now higher than before the programme started. This is because before the inception of the STME clinics, only 12% of students were enrolled in science and 2% in mathematics at SHSs. Currently, female students constitute 25% of students studying science and technology related programmes in the Universities and Polytechnics.
3) Recent SHS examination results also indicate that girls are achieving better grades compared to previous years.
4) Some schools have also report higher number of girls participating in science programmes, and the females also performing better than their male counterparts.
5) STME clinic intervention has seen a total of 40,908 girls at the clinics and camps from 1986- 2010.

Moreover, results of a study conducted by Andam, *et. al. (2001)* on "the Performance of Ghanaian Girls in Physics: The Way Forward", established that between 1995 and 2000, there was an increase in the number of Ghanaian girls participating in Physics. Again, the performance of the girls participating in physics improved between 1995 and 2000. Thus, a greater percentage of passes in Physics.

These results are also in agreement and accomplish what the objectives of the JHS science syllabus seeks to achieve. Thus: the development of a scientific way of life through: curiosity and investigative habits; Appreciate the interrelationship between science and other disciplines; Use scientific concepts and principles to solve problems of life; Use basic scientific apparatus, materials and appliances effectively; Erase negative attitudes and misconceptions about science, technology and mathematics;

Increase girls and boys knowledge on career opportunities available to them and Motivate boys and girls to aspire to greater heights in science and mathematics related fields.

However a few respondents hold the view that, although STME clinic has enabled the citizens and the country achieved a lot, yet, the existing gender gap as well as enrolment in STM courses has not been closed definitely. This according to the findings of the study is linked to less/lack of exposure to STME clinic activities (very few got the probability to participate), poor science background, inadequate TLMs and resources, poor knowledge and background of teachers, poor teacher and pupils relation and teachers attitude towards science and other issues put forward and confirmed as a major problem confronting Ghanaians STM education. Thus, the fact that these lead to poor performance, interest, poor perception and negative attitude towards science can't be overlooked. As is assumed by Anamuah-Mensah (2004), Oriafo(2000) and Nwachuku (2009) who enumerated some of the problems which include, lack of funds to purchase equipment/materials, lack of adequate textbooks, overcrowded classrooms/laboratories, poor time table, lack of cooperation from administrator, the pressure of external certificate examinations, etc. Concurrently, (Roberts, 2002; Rasekoala, 2001) too have suggested that Science, engineering and Technology (SET) related subjects suffer from a worrying range of problems which need to be addressed. Furthermore, Anamuah-Mensah (1994; 1998), Anamuah-Mensah *et. al.* (2004) have also added to the challenges faced in STM education citing methodology as one of them as well as Fredua-Kwateng and Ahia, (2005) that have raised their voice to indigenous culture too as one of the challenges being faced.

Research question 3: What are the effects of science and technology on pupils interest in science?

With regards to the effects of science and technology on interest and attitude in science, almost all the pupils clearly indicated that every country needs science and technology to develop, because its advent have made lives now healthier, easier and more comfortable. Despite the fact that according to Sjøberg and Schreiner (2005b), the position of science and technology in a society changes through time from one society to another. Pupils participating in this research generally supported the notion that learning science was valuable for both individuals and society. This is experienced as a result of the STM subjects who are taught as a whole in all levels of education (pre-tertiary level). The results again attest to pupils interest for Science and Technology. In addition, the findings made bear that STM Education offers students one of the best opportunities to make sense of the world holistically, rather than in bits and pieces. This corresponds with assertion of Morrison (2006) that Science, Technology and Mathematics Education (STME) have been called a meta discipline, the creation of a discipline based on the integration of other disciplinary knowledge into a new whole.

Some of the pupils further avowed that science and technology is what runs/fuels the world today, and so no one should be exempted from acquiring the knowledge and skills involved. Because, Science in general embraces subjects namely Biology, Chemistry, Physics and Mathematics, therefore, is a subject that cuts across the school curriculum and needed in all branches of science, applied science and social science (Adewumi, 1982). Besides, Newton (1988: 7) shares comparable view that Relevance is the very reason for its existence, and it should be the very backbone of science teaching. This implies that no student should be denied of the proper grasp of Science

and technology at the primary and the junior secondary levels. This matches up with Weinburgh (2003) when he defines science as a human endeavor and that people of all ages, races, sexes, and nationalities engage in this enterprise. Again, it agrees with the idea that 'Science is a way of knowing, and there are values and beliefs inherent to the development of scientific knowledge (Lederman, 1998). The results is also in line with study of Stefánsson (2006) when he suggested that students consider school sciences interesting, easy to learn and believe that everyone should learn science in school. They also believed that the science which they learn in school is useful in everyday life. The results noted again that fast advances in science and technology have influenced the rate of economic development of nations, improved the quality of life, and provided solutions to some major problems and needs of societies. Similarly, other studies also which are in agreement show that pupils in basic education (Jarvis, 2002), teachers in initial education and those working in the classroom (Osborne & Collins, 2000; NFER 2008), all overwhelmingly agree that science and technology are interesting and important and should be included in basic education. Consequently, the results is consistent with affirmation that good foundation is therefore necessary in the early years of any Ghanaian child Anderson (November, 2006), because nations that have control of science and technology have been able to cope with global issues such as conditions of poverty, poor sanitation, illiteracy, disease, rapid increase in population and malnutrition. On the other hand, a minority indicated that science and technology benefits only the developed countries.

Upon all the relevance and 'importance' of science elaborated by most pupils, others (boys and more especially girls) dislike it as much as other subjects. This may be regarded as a result of the "generally perceived phobia for science." It again, connected to incompetence on the part of the teacher's, poor teaching strategies and

methodologies applied in teaching, as well as lack of teaching learning materials. Moreover, the results substantiate that notwithstanding the numerous significance, there are others who make plain to its demerits claiming that frequent use of science and technological gadgets such as computer causes heavy diseases such as brain tumor, cancer and nervous problem. Moreover, vibrations from mobile phones affect our hearts and brain. Likewise, screen touch ones can cause finger cancer. Still, it is established that it has grabbed human and live and other living creatures smaller. Besides it has increased land, water and air pollution. And made people (principally the youth) resorted to cyber fraud, lying, cheating, immoral behaviors and lawlessness. These indications correspond with the assertion of Einstein (1921) that the rapid rise of modern science has created major social problems.

Research question 4: Have there been any changes in the pupils perception and attitude towards science after participation in to STME clinics?

Attitudes towards science

The results wholly established that JHS pupils attitude toward science, technology and mathematics have changed after the exposure to STME clinic. From the interview, there was a disclosure that the different activities carried on at the clinics have kept their interest and motivated them in learning the subjects efficiently. It is evident with the results of PISA (2006) with an average of 63% of the students reporting that they have interest in science have fun doing so. The result also conforms to TIMSS (2003) where the international average of eight graders having positive attitude were 57% and 31% in the medium category. But, some indicated that the aspect of its involvedness can't be overlooked because one needs to study hard, be more focused and be determined.

Studies have indicated that the attitudes of males and females toward science courses differ (Banya, 2004). Similarly, the results exposed gender differences in their attitude towards science with males showing more positive attitude than girls even though they unanimously affirm their positive attitude towards the subjects. This conforms to study reports that affirm gender differences in attitudes towards science and mathematics with girls showing more negative attitude than boys. Kotte (1992) as well reported that the differences between male and female students attitude towards science widens as students move from elementary to secondary school. Others studies such as (Sullins, Hernandez, Fuller & Tashiro, 1995) report that by middle school, girls attitudes towards science tend to decline and this may persist through high school. Likewise, (Clarke, 1972; Clarke & Nelson, 1972, 1971; Kotte, 1992) studies too avow that, beginning as early as elementary school, boys typically possessed more interest in studying science than girls.

However there are those who have been exposed to the clinic and still possess the fear and dislike for STM subjects. Some reasons proffered for the low enrolment of female students in the sciences as well as low academic performances are the existence of strong gender biases in science curricula and instruction (Okeke, 1990: Erinosha, 1997, Njoku 2000, Olagunju 2001, Njoku 2006). Other reasons include child - rearing practices, which impede girls readiness for scientific and technological studies (Njoku, 1993). The masculine nature of the sciences deters girls from entering into the programmes as indicated by (Mulemwa, 1999 & Njoku 2005). Besides, Hall (2009) reviewed literature which attributed the inferior performance and under-representation of women in mathematics and science to innate biological factors. Other research she reviewed however questioned it, examined other issues and pointed out that no sex differences exist on these grounds. She concluded like Fennema (2000) that

differences are not innate, but are linked to societal perceptions.

Pupils Perceptions of science

The findings of the study make clear that JHS pupils have various perceptions as far as science and technology is concerned. According to study comparisons made across countries on how learners relate to science and technology, it was revealed that many young learners in the developing countries perceive science as interesting and special and would want a career in it. For example, they would like to become scientists and also opt for a job in technology Anderson (2006). A confirmation is made when the results pointed that, with positive attitude and perception everyone can become a scientist. The study also discloses that pupils perceive science as a hands-on-discipline/activity oriented. Again, it is considered as less difficult, meaningful, interesting, and very important. Respondents recognize and appreciate the value of the knowledge science to understanding nature (their bodies, their environment, and the world in which they live). These affirm what is enshrined in the rational and the objectives of the science syllabus for JHS. This is as a result of the exposure to STME clinic, fairness and competence of some SMT teachers. Research works and Articles show that students at the upper primary level and JHS level have wide-ranging perceptions about science, and that these perceptions may be linked, in large part, to the methods by which science instruction is delivered at the levels.

Some (more especially those without exposure to STME clinic) indicated a contrasting view perceiving science as the most difficult subject and so dislike it. Although, majority articulated that they have come to appreciate nature because of science others hold a differing view with less regard for nature because it's difficult. Zeldin *et. al.* (2008) and Zeldin and Pajares (2000) found differences in the ways young women and

men develop their self efficacy related to science and mathematics education and STEM careers: Whereas men's self efficacy arises most strongly from actual (perceived) achievement in tasks, women rely more heavily on interaction with others to build their self efficacy. This clearly point to gender disparity that pertains to the study of science and technology. So, according to (Clarke, 1972; Clarke & Nelson, 1972, 1971; Kotte, 1992) beginning as early as elementary school, boys typically possessed more interest in studying science than girls. Again, the assertion match up with studies of (Beaton, *et. al.,* 2000; Leung, 2002; Martin, Mullis, Gonzalez, Gregory, Smith, Chrotowski, *et al*., 2000; Martin *et. al.,* 2004; OECD, 2006; Sjoberg, 2002; Shreiner & Sjoberg, 2007; & *et. al.,* 1998) which indicates that there is low interest in science, with preference to girls in particular, and also lower performance in science attitude and self-concept scales in comparism with achievement tests. This raises a question about how far the objective and the aim of SEU and GEU for the organization of STME clinic is achieved. Is a matter of concern and must be dealt with. Is it because a higher percentage is achieved, the reason for boys inclusion in the clinic? Or naturally boys are to do better than girls as indicated by researchers?

Moreover, the results also confirm that boys and girls learn mathematics and science together and none dominates each. In support of this a survey conducted by (Moletsane & Reddy, 2011) indicated that Seventy three per cent (73%) of participating educators disagreed that boys are naturally more inclined to excel in mathematics and science. However, almost all the teachers (93%) agreed that boys and girls should receive equal treatment in the mathematics and science classrooms. This is consistent with results on recognition that STM teachers offer equal treatment, relation and attention to both males and females.

Besides, there are studies reports indicate that teachers have the tendency to engage in practices that create unhealthy instructional environment (Sadker, Sadker & Klein, 1991). Examples were given as: directing more questions to boys than girls, allowing for longer wait time for boys than girls and giving more encouragement to boys than girls. Boys also are attended to by teachers more than girls are, receive more help from teachers on areas in which they have problems academically and are called on more often to give answers in class (Becker, 1981; Epperson, 1988; Fennema & Reyes, 1981; Koehler, 1990; Simpson & Erikson, 1983). To add to it, there are other studies which also dwell on insensitive teaching methods: which is regular use of didactic teaching methods that are mainly talk-chalk, that make classroom environment abstract, competitive and alienating for students (Erinosho, 2008). This accords what the results portray. That is others with different opinions that, some teachers teach science abstractly while others involve practicals/activities to a lesser extent; this seem that teachers' content knowledge, which determines the degree of confidence with which they teach science, can also impact on students' perceptions. That is, if a teacher is very knowledgeable and comfortable with a subject, he/she would deliver that subject topics with greater ease and confidence for which content knowledge is relatively weaker. In this perspective, it is easy for students to develop positive perceptions of subjects that are passionately and well delivered and negative perceptions of another subject that is not delivered with equal passion.

Similarly studies result by other researchers is conventional with this study finding which amongst those who prefer science; the key reason is because they find the subject interesting. In many cases they like it since it explains how things work, its logicality, factualism and variety. In addition, because it is worthwhile, it makes a difference and has an impact on the world around them. According to studies by Levy,

Wubbels, Den Brok, and Brekelmens (2003) on pupils perception of their classroom environment towards their attitude in science the study showed that male students thought that their male teachers were more helpful, friendly, and understanding than their female teachers. In line with this a few respondents specified that, some science teachers do exercise unequal treatment and attention on them.

Meanwhile, a minority of the boys hold a perception that girls dominate science lessons in class because they cooperate in science lessons. However, it is noted, compared with boys, girls lacked confidence, had debilitating causal attribution patterns, and perceived mathematics as male domain (Casey *et. al*., 2001; Hyde *et. al*., 1990; Ma & Kishor, 1997; Sayers, 1994; Vermeer *et. al*., 2000). In accordance, a section of both males and females expressed that males perform better in science and maths than girls. Besides, Kerr and Robinson (2004) found that fewer females than males enroll as science and mathematical majors in college. In addition, the National Center for Education Statistics (2000) found that more males are employed in science and mathematical careers as cited in (Mitchel & Hoff, 2006, p.10). Some females perceive that they are incapable of succeeding in science and maths because science and maths are believed to be "male" subjects.

One would conclude that some teachers still exhibit incompetence, gender inequity/unevenness in class and it must be dealt with. Correspondingly, the report of House of Commons (2002) indicates that students' interest in science is declining with accompanied declining number of students taken science, which consequently causes shortage of science literates. So as established by Fensham (2008 pp21-21), it is not surprising that many students in considering the Senior Secondary years are saying: Why should I continue studying science subjects when there are more interactive,

interesting and less difficult ones to study?

Null hypothesis one (1)

The result proved that there is significance difference between the perceptions of science of those who are participated and those not participated in STME clinics. Really based on the responses and follow ups made on past participants, it came to light that most students studying science at SHS are those exposed to STME clinics.

However, a lot of studies attest to the interesting and difficulty nature of science. For instance a study on engineering students' perceptions in learning mathematics at Universities Technology Malaysia and some schools in Johor, the results proved that mathematics subject was one of the interesting and important subject to learn but it was difficult one to learn (Aziz, 1992).

Null hypothesis two

The results established that statistically there is no significant difference between the perceptions in science of males and females who are exposed to STME clinics at JHS.

Results from studies prove that, Girls now take as many high school science classes as do boys (though fewer girls than boys take physics), and girls' achievement levels are roughly the same as boys' (National Assessment of Educational Progress, 2001). Besides, Matayas (1987) as well indicate that the elementary students of both sexes like science and hope to study science. In the same way, the results of Ogawa and Shimode (2008) showed that there was not meaningful difference between girls and boys in attitude toward science.

Correspondingly, STME clinics success enjoyed include improvement in enrolment and performance in the sciences of both sex.

Conversely, there are other studies such as Kotte (1992), who reported that the

differences between male and female students attitude towards science widens as students move from elementary to secondary school. Cavas *et. al.,* (2009) study statistically reported that significant differences were found in environmental attitudes and interests in learning about environmental protection mean scores of students regarding gender. This assertion is supported by Stake (1984), that Individual's, national and international students have confirmed the notion that girls have less confidence in their science abilities and are less likely to participate in the extracurricular activities. In addition, Eccles (1987) has also avowed that there is a common belief that females are less mathematically capable than males, and this belief is fairly constant across populations. It is also in accordance with a study conducted by (Anderson, 2006) which revealed that compared with other school subjects, most boys in particular, preferred school science and girls on the other hand, saw school science as a difficult subject despite the claimed relevance of science. Moreover, other reasons for girls less likeness for STM education like works of Jovanic and King (1998), suggest that one of the major factors in girls antipathy towards science, is their perception that they are better at other subjects.

Null hypothesis three

From the study, the result of the t-test confirms that statistically there is no significance difference between the perceptions of JHS males and females of the utility of STME clinics. The study of Whitelaw *et. al.,* (2000) affirms the result, according to his study conducted on males and females achievement in science, the results confirms that no achievement differences were found between the young men and women in science. This goes positively with the respondents (both males and females) who perceive that science is interesting, appreciative and affirms that it improves our way of life.

On the other hand, a study of Catsambis (1995) found that males were more likely to

look forward to science class and to think science would be useful to their future, and were less afraid to ask questions in science classes than their female peers. His results further validate that girls' have less positive attitudes, and existed even though they performed as well or better than boys and receiving better grades in science classes

Conclusion

Majority of the JHS pupils illustrated great likeness and excitement to the activities carried out at the clinics and for science in general. They consider science and technology as important to society as the results of Trumper (2006) indicates. Again, they perceive the diverse and greater opportunities in science and technology for them and making lives becoming healthier, easier and more comfortable. This conception is congruent with the results of Stefansson (2006). The Results further indicated that pupils articulate the much benefits of science than its harmful effects/problems to the environment. Again, they believe that the exposure to role models motivates them to develop interest and positive attitude, higher aspirations and eliminate biases associated with science and technology. This as well is consistent with the results of Jenkins (2006) which demonstrated that, about attitude towards science and technology; generally the girls have lower average than boys, although the differences are not large. Therefore, identifying and defining of science and technology in terms of assessing students' attitudes to science and technology would be important (Osborne & Collins, 2000).

This is in line with the results of Schreiner and Sjoberg (2005) which proved that students had a high degree of agreement that Science and technology are perceived to be important for society, more so both males and females perceive it as not difficult, but with greater opportunities for future generations and refuted the idea that science and technology are the cause of environmental problems.

Respondents further expressed some science teachers neutrality and or unfairness attitude exhibited in class. It is therefore inferred that, JHS pupils in Ashanti region embraces STME clinic activities and science and technology in general with likeness and satisfaction. This summarizes the impact so far that STME clinic has made since its inception and so needed to be continued, improved and modified in order to benefit majority of the JHS pupils.

Moreover, the STME Co-ordinators, expressed their satisfaction with the activities at the clinic and its numerous benefits although the number of pupils exposed to the clinic yearly is small and so suggested for many to be given the opportunity. It is further mentioned that, the district level STMIE clinic should be intensified by yearly organization as it guarantees participation of majority.

Recommendations

The strategies and actions being taken to address the under-representation of JHS pupils (especially girls) in Science, Mathematics and Technology Education specifically appear to be somewhat effective. However, since the main objective for implementation of STMIE clinic has not been attained completely, the need for recommendations/suggestions. Nevertheless, to realize the goal of improving pupils access to and participation in mathematics, science and technology education, the following recommendations underpin the objectives.

- The programme must be expanded to accommodate more pupils/students in order to develop positive attitude and good perception towards science.
- Curriculum developers, teachers and all who matters in education should work together in building a Gender-Fair Learning Environment. In view of this

teachers must be trained to cultivate Gender-Fair Learning Environment in class.

- Though, JICA in connection with GES, MAG and GAST organize in-service training for science and maths teachers, much still needed to be done. So, training of STM teachers must be regular to promote their knowledge and skills to enable them teach effectively and help solve daily life problems
- Teachers should make the teaching and learning of STM with thoughtful and practical activities comprising hands on activities and excursions to science and technological sites to augment pupils understanding.
- Parents must be educated on the benefits and the relevance of the STME clinic and STM education as a whole so that they can provide desirable assistance and support for their wards at JHS, and in selection of courses since they play a critical role.
- In addition, much emphasis should be placed on STME clinic activities that arouse pupils' interest and aid development of positive attitude and perceptions such as Role model exposure, excursions, hands on activities talks and studying skills. Besides, opportunity must also be granted to needy pupils and their parents to participate so that they can learn to earn a little income from the hands-on-activities in support of education.
- Governments should prioritize policies to attract talented teachers, more especially female teachers, and retain them through attractive packages of conditions, salaries and career development in STM education.
- Further research with more schools, district, and other regions countrywide need to be conducted as a follow up to this study.

Research has publicized that there are distinct disadvantage to closed-ended questions.

For example, respondents tend to confine their answers to the choices offered (Presser, 1990). The respondents are generally deprived of the opportunity to suggest a response and simply select among those listed, even if the best answer is not included. However, Osborne and Collins (2001) have noted that there are relatively few studies of pupils' attitudes to science, which have adopted a qualitative approach to elicit in some in-depth pupils' views. According to them, in adopting solely a qualitative, interviewed-based approach seeking to explore pupils' views of their experience of school science will add fresh insights into its nature and quality. So interview was further used to the questionnaires to foster the quality and nature of the responses. Therefore, I am of the view that the science curriculum cannot be in a form, which respects solely the attitude and interests and perceptions of pupils; and to base teaching of school science on opinions of pupils. Nevertheless, this study has added to the needed information on the effect of STME clinic on the perception and attitudes of JHS pupils towards science. This may guide the enduring deliberation among STME clinic effect on science education research community on the search for a local science curriculum that to some degree recognizes the voice of the pupils/learners who are the beneficiaries of the school science. Governments therefore, should develop strategies to implement education systems that encourage innovation and experimentation in STM education.

Suggestion for further research

The following are suggestions for further research. Other researchers should:

Study the effects of STME clinics on the perception and attitudes of SHS students towards science in the region and the country as a whole

Conduct the research in other regions among JHS pupils and compare the results

Conduct further study specifically on the effects of the clinics on males and females

performance and achievement in science at JHS and SHS.

Study the challenges confronting STM education in Ghana and its effect on the teaching and learning of science.

The effect of challenges affecting effective STME clinic organisation and its impact on teaching and learning of science at JHS.

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APPENDIX A

UNIVERSITY OF EDUCATION, WINNEBA

DEPARTMENT OF SCIENCE EDUCATION

QUESTIONNAIRE ITEMS FOR PUPILS/STUDENTS

Please kindly provide truthful responses to each item. You are to indicate the extent to which you agree with the items below. Please in each case tick in the appropriate box or write. Your effort will be a useful contribution to knowledge. The information you provide will be treated with confidentiality.

APPENDIX Ai

SECTION-A (BIODATA)

NAME: SCHOOL:

AGE: DISTRICT:

CLASS:

SEX: MALE FEMALE

I HAVE PARTICIPATED IN STME CLINIC/CAMP BEFORE: YES NO

Read the items in this part and select an option that best suit your view by ticking.

Key: Strongly Agree (SA), Agree (A), Strongly Disagree (SD) and Disagree (D).

If your answer is **Yes** in section A above continue with section B set of questions, if **No** continue with section C to the last section.

SECTION B: ATTITUDES TOWARDS STME CLINIC ACTIVITIES

Item	Strongly Agree (SA)	Agree (A)	Strongly Disagree (SD)	Disagree (D)
1. I do not like the more practical lessons carried out at STME clinics				
2. My participation in the STME clinic has made me like science				
3. Science practical lessons are exciting and interesting and help me to understand science topics better				
4. I find science difficult				
5. I learn science quickly now due to examples taught at the STME clinics.				

SECTION C. BENEFITS OF STME CLINIC

Item	Strongly	Agree	Strongly	Disagree

	Agree (A)	(A)	Disagree (D)	(D)
1. STME clinic have exposed me to female role models in science				
2. STME clinics have helped me to realize the practicality of science				
3. I do not want to aspire higher in science				
4. STME has helped me to develop an idea that science is for males				
5. STME clinics have denied me the chance to interact and study from other pupils				
6. STME clinics have helped me to realize the different areas and opportunities in science				

SECTION D: ATTITUDE AWARD TOWARDS STME CLINIC ACTIVITIES

Award numbers 1-8 according to the order of activities you liked most (where 1 means the most preferred as follows, and so on).

- Film shows/ Documentaries (……)
- Interaction with role models (……..)
- Visits/ Excursions (…….)
- Talks (……)
- Discussion (Studying skills ……..)
- Closing Durbars (…….)
- Hands on activities (……..)

SECTION E: EFFECTS OF SCIENCE AND TECHNOLOGY ON INTEREST IN SCIENCE

Item	Strongly	Agree	Strongly	Disagr

	Agree (SA)	(A)	Disagree (SD)	(D)
1. A country does not need science and technology to develop				
2. Science and technology are important for our society				
3. Science and technology benefit only the developed countries				
4. Science and technology make our lives healthier, easier and more comfortable				
5. Science and technology are the causes of environmental problems				

SECTION F: PERCEPTIONS OF SCIENCE

Item	Strongly Agree (SA)	Agree (A)	Strongly Disagree (DA)	Disagree (D)
1. Science is a difficult				
2. Science is not interesting				
3. Science is has increased my appreciation of nature				
4. I can't become a scientist				
5. Science has shown me the importance of science for our way of living.				

SECTION G: DIFFERENCES IN PERCEPTIONS OF SCIENCE

Item	Strongly	Agree	Strongly	Disagre

	Agree (A)	(A)	Disagree (D)	(D)
1. Science teachers relate differently with boys and girls				
2. Science lessons are dominated by boys				
3. I understand science lessons taught in school				
4. Science teachers make science abstract				
5. Science teachers give equal attention to boys and girls				
6. I like school science and maths better than any other subject				

Aii

PAST STME PARTICIPANTS AT SHS

SECTION A: (BIODATA)

SCHOOL NAME: **DISTRICT:**

AGE: **CLASS:**

SEX: **MALE** **FEMALE**

SECTION B: ATTITUDES TOWARDS SCIENCE/PREFERENCE TO SUBJECTS

Award numbers 1-7 according to the order of subjects you like most.

Mathematics ……. ( )

Science ……. ( )

English ……. ( )

Social Studies ……. ( )

RME …….. …….. ( )

BDT …… ( )

ICT …….. ( )

SECTION C: PROVIDE YOUR VIEW

1. a) What have you gained by attending the STME camp?

b) How would you use the experience and the knowledge gained to help the

   a) Family
   b) School
   c) Friends
   d) Community
   e) Ghana

2. Which of the STME activities do you prefer?.....
3. Why do you prefer the activities mentioned in item 3 above…….
4. How has the STME clinic affected your life?.....
5. In your view what deter male/female students from studying the sciences at the higher levels …….

Aiii

For District/ Municipal Science Technology and Mathematics Education (D/MSTME Co-ordinators.)

1. What is the rationale behind the activities carried out during the clinic? .....
   .
2. Do the activities appeal equally to male and female participants?

……

3. Explain
   …….
4. How has STME clinic benefited the children?

.....

How has it affected the pupils attitude towards science?

……

Do you make a follow up on the participants?

.....

5. Do the beneficiaries continue by studying science at the senior high school level? ……How many of them do you know?.....

APPENDIX B

INTERVIEW GUIDE

Pupils attitude towards science

1) Do you do more practical lessons at STME clinics?
2) What is your view about science after your participation in the STME clinic?
3) Why is science practical lessons important/what are the benefits of science practical lessons?

Preference in STME activities

4) Give a list of STME activities in order of likeness and give reasons.

Benefits of STME clinic

5) During STME clinics you are exposed to role models and colleagues from other districts. What did you learn from them?

Effects of science and technology

6) Does a country need science and technology? Why?
7) Who benefits from science and technology and why?
8) What are the effects of science and technology?

Perceptions of science

9) What do you make of science?
10) Why is science termed as a difficult/ an easy subject?
11) How do science teachers treat boys and girls during science lessons?
12) How is science lessons taught in class?
13) Which pupils dominate science lessons: Boys or Girls? Why?

APPENDIX C

INTERVIEW RESPONSES

Pupils attitude towards STME clinic activities

1) Do you do more practical lessons at STME clinics?

Participant interviewee- 1: A lot practicals are done at the clinics more especially at science and magic time and hands on activities time. I enjoy the activities so much. Science practicals have helped me not to fear any science topic.

Participant interviewee- 2: yes, we perform a lot of activities/ practicals.

Participant interviewee- 18: yes we do more practicals and it has made me like the subject.

Participant interviewee- 4: oh yes there is more practicals that we perform there

Participant interviewee- 5: yes we perform more practicals such as soap making batik tie and die, science magic and more.

Participant interviewee- 9: yes, so many practicals are done than such as soap making, batik tie and dye, magic and more.

Participant interviewee- 11: yes we perform more activities/practicals

Participant interviewee- 13: aaa we do so many practicals there and it's so nice

Participant interviewee- 14: yes more practicals are done

Participant interviewee- 16: yes we do a more interesting activites/practcals that makes you understand science and appreciate it more.

2. What is your view about science after participation in STME clinic?

Participant interviewee- 1: The STME I attended has made me gain interest in science because at first I did not like it at all, but now I like it and have new friends too.

Participant interviewee- 2: In fact STME clinic make science real through activities like science and magic time where we do so many experiments; excursions where we see things for ourselves and hands- on activities. Now I have gained more experience

that science is not difficult the reason is that without materials it is difficult. But now I know that science is not difficult but you only need practicals to help you understand what you are learning very well.

Participant interviewee- 4: I have gained experience, skills and knowledge in liquid soap making and cream. I will teach my mother so that she will raise money/funds in support of my SHS education.

Participant interviewee- 5: It has made me know that Science has improved our social and economic development

STME camp has improve my learning skills (Participant Interviewee- 9)

Participants Interviewee- 11: I have realized that science is not difficult because a lot of the topics I did not understand and was difficult, I now understand, also the life stories of the role model has inspired me and I know I can do well in science.

Participants Interviewee- 13: The exposure to the STME clinic has strengthened me study hard so that I can become a scientist because when I study it well I can become one. Also I can do practicals with ease which helps me to understand topics better.

Participants Interviewee- 14: My participation in the STME clinic has made me realised that science is real and interesting if you understand it well. And it also helps to acquire skills and make money through soap making, cream and batik tie & dye in support of our education.

Participants Interviewee- 16: It has made me like science and realise that science is not as difficult us we students think it is. The clinic has opened my eyes that with lot practicals science is interesting. I also know about the more areas and opportunities if you study science well science.

Participants Interviewee- 18: The STME clinic I attended has helped me to understand some science topics I considered difficult. I now know places of science and technology and opportunities in science, role models and colleagues from other schools as well as batik tie & dye and soap making.

3. Why are science practical lessons important/what are the benefits of science practical lessons?

Participants Interviewee- 1: With the practicals I have gained more experience that science is not difficult the reason is that without materials it is difficult. But now I know that science is not difficult but you only need practicals to help you understand what you are learning very well.

Participants Interviewee- 2: Practicals make science easier and even faster to understand

Participants Interviewee- 4: Practicals help me to get more skills about science

Participants Interviewee-5: Science practicals make us understand science because you remember if you see it and do it

Participants Interviewee- 9: Science practicals help students to understand and write theory and practical exams well.

Participants Interviewee- 11: Practicals help in developing the country fast and help to understand what science can provide

Participants Interviewee- 13: Practicals make students understand well and know details

Participants Interviewee- 14: Science practicals help students to understand and write theory and practical exams well.

Participants Interviewee- 16: Practicals help us to know the real facts about a topic and understand.

Participants Interviewee- 18: Science practicals help to understand science, real and interesting.

Preference to STME activities

4. Give a list of STME activities in order of likeness and give reasons.

Participant interviewee -1: Visits/excursion (1), talk (2), interaction with role models (3), hands on activities (4), film show/documentary (5), discussion (6) and closing durbar (7). Because I am exposed a lot of places of interest and learn new things. I learned more from the role models and it encourages me to study hard and become one of them.

Participant Interviewee- 2: I will give discussion/studying skills (1), role models interaction (2), hands on activities (3), excursion (4), talk (5), film show (6) and closing durbar (7). The discussion with practicals makes me understand science topics, like it and make it real

Participant Interviewee- 4: I like visits/excursion (1), discussion/studying skills (2), role models interaction (3), hands on activities (4), film show (5), talk (6) and closing durbar (7) in order of preference. The excursions make me know new things and places, the discussions makes me understand science topics and develop have develop interest for it and I have learned to study well from the role models.

Participant Interviewee- 5: For me I prefer interaction with role models (1), talk (2), hands on activities (3), discussion (4), excursion (5), closing durbar (6) and film show (7). I have leaned to be humble and hardworking to succeed in life. With the hands on activities I can make a little income to support my parents to cater for my education.

Participant Interviewee- 9: Visits/excursions (1), interaction with role models (2), discussions (3), talk (4), film show/documentary (5), closing durbar (6) and hands on activities (7). The excursion exposed me to new places of interest and opportunities in science. Discussions made me understand science topics well.

Participant Interviewee- 11: Hands on activities (1), discussion (2), excursions (3), talk (4), film show (5), interaction with role models (6) and closing durbar (7). Because teaches not to indulge in immoral activities but to generate a little income in support education, during discussion we more experiments and I learn new things for myself.

Participant Interviewee- 13: Hands on activities (1), excursions (2), film show (3), discussion (4), interaction with role models (5), closing durbar (6) and talk (7). I learned to make soap and batik tie & dye that I can use, also the excursions made me learn new things for myself.

Participant Interviewee- 14: Discussion (1), hands on activities (2), excursions (3), closing durbar (4), interaction with role models (5), talk (6) and film show (7).

The discussions make science real and understandable. I can now make liquid soap and use as well as tie & dye.

Participant Interviewee- 16: Discussion/ studying skills (1), role model interaction (2), visits/ excursion (3), hands on activities (4), closing durbar (5), film show (6) and talk (7). Studying skills make science interesting and real. The role models exposure motivates me to study well.

Participant interviewee -18: I prefer discussion first (1), then interaction with role models (2), talk (3), film show (4), hands on activities (5), excursion (6) and closing durbar (7). This is because the discussion (science and magic time) makes science real and understandable. The role models too have made me know that I can also be a scientist in future if I am determined.

Benefits of STME clinic

5. *During STME clinics you are exposed to role models and colleagues from other districts. What did you learn from them?*

Participant interviewee -1: Role models interaction: I learnt how to achieve my goals that I don't have to sleep and eat but study hard. Also, I was shy at first but interaction with colleagues we learnt now to live with strangers.

Participant interviewee -2: Role models interaction has taught me that when you have problems in life it is not the end but you have to try hard. Exposure to colleagues has taught me how to mingle with pupils in different ways.

Participant interviewee -4: Role models interaction made me happy and motivated to study hard. With other pupils it has taught to know and make good and bad friends.

Participant interviewee -5: Role models: I learnt that everybody who wants to become a scientist can be as we share ideas. I thank them and I am sure that in future we can be like them since they were like us. Interaction with colleagues made me know that we are different and we can learn from each other.

Participant interviewee -9: For role models I have selected somebody as my role model, and learnt that women can become scientist because at first I did not know that

women can be scientist. Interaction with colleagues has helped me to socialize with other pupils.

Participant interviewee -11: The interaction with role models has encouraged me to study hard and remove the idea that females are not good in science. I have learnt to accept other pupils.

Participant interviewee -13: I have learnt from the role models that everyone can become a scientist if only you humble yourself and determine to study hard no matter the hardships.

Participant interviewee -14: My exposure to the role models made me develop likeness and interest for science, and want to become a scientist in future. I have learned to work together with other pupils and share ideas.

Participant interviewee -16: I have selected a role model and I want to be a pharmacist like her. I made new friends and did group practicals with them.

Participant interviewee -18: The meeting with the role models has assured me the many opportunities in science that I can venture if I remain respectful, work hard and stop involving in myself in bad pupils and attitudes. The meeting with other pupils from other places has taught me to make new friends and treat each other well.

Effects of science and technology

6. *Does a country need science and technology? Why?*
7. *Who benefits from science and technology and why?*

Participant interviewee -1: Yes everyone needs it, because a country without science and technology does not develop much.

Participant interviewee -4: Yes, because of science and technology there are so many means of transport like the aeroplanes and the car

Participant interviewee -5: Every country and anyone who study science benefit from it because if you want to improve knowledge and skills in science and technology you have to do science

Participant interviewee -7: Yes we all need science and technology because it is the way to improve. All who study science benefit from it and improve.

Participant interviewee- 10: Really, we are in a technological age so is very important to all. I talk to my brother in London with ease. Anyway, there are negative effects. For example we deceive and lie with mobile phone, cyber fraud on the internet and other bad attitudes among the youth are all because of what we watch and learn from the internet

Participant interviewee -11: Science and technology is needed in every country and by everyone since it is beneficial to everyone's life.

Participant interviewee -12: Science and technology is important because some things are hidden but due to science and its investigations it is revealed. It benefits all peoples.

Participant interviewee -13: It is important to everyone in the world because we all use mobile phones, TV, tape, computers and other machines.

Participant interviewee-16: Each country and its peoples need science and technology. It benefits all of us because we are in technological age. So, we all use it.

Participant interviewee -19: Yes every country and everybody needs science and technology. Yes we are in computer age and so everybody make use of science and technology.

Participant interviewee -20: Everybody and every country need it so that they can work effectively and develop easily and very fast.

8. *What are the effects of science and technology?*

Participant interviewee -4: It help develop a country faster and do things faster such as searching for information when learning, talking to some in abroad, travelling, food preparation and others. It has also cause harm such us cyber fraud, lying and bad behavior among the youth.

Participant interviewee -5: Science and Technology improve community status and society because at first they did not know that they can use cement and sand, so used only clay in building but now because they now use cement and sand to make bocks

for building. The machines they use for mining destroy the land. The land can be used for other important thing but because of the mining they destroy it.

Participant Interviewee- 6: Mobile phones, internet, computers are all technological gadgets and improve life, output and saves time, energy and money. This is because we don't have to take the risk of travelling for business which could be done with fewer resources by technology.

Participant Interviewee- 7: Science and technology help a country to develop socially, politically and economically. In the health centre if a country does not have science and technology there will be no x-rays, and there will be problems like loss of lives and retard development and the country cannot move (develop) faster. Mobile phones make communication easy and faster which was difficult at first. It also helps in the manufacture of drugs and other machines. For negative side of it, use of weapons such as guns and affects pupils, cars and other machines also cause accidents.

Participant Interviewee- 9: Due to science and technology work is made easier with less time energy and resources. But it is expensive to use because the technological tools and machines are expensive. More so money is involved in its training before it is used. It can also cause severe injuries.

Participant interviewee -10: I talk to my brother in London with ease. Anyway, there are negative effects. For example we deceive and lie with mobile phone, cyber fraud on the internet and other bad attitudes among the youth are all because of what we watch and learn from the internet

Participant Interviewee- 12: Science and technology has made our world interesting simple to stay in get because we get information with ease. Some bad effects are: people lie much, cheat each other create bad things in the community.

Participant Interviewee- 13: Science and technology has communication, learning and work simpler and easier. On the other side it has given rise to laziness, indecent behavior among the youth and cyber fraud through the use of the internet.

Participant Interviewee- 15: Science and technology has made the world simple by the use of mobile phones, computer, internet, television, cars, airplanes and other machines used at industries and work places. The negative aspect of it is that, the

smoke, bad water, bad chemicals pollute our water, land and air which give us health problems.

Participant Interviewee- 16: Science and technology aids economic and social development. But the use of the tools such as computer, mobile phones for longer time puts human beings in danger.

Participant Interviewee- 19: Science and technology make us know new things in the world and learn it faster. The use of internet has caused cyber fraud and other forms of indecent attitude among the youth when we watch pornographic films and other bad movies which portrays stealing and cheating.

Perceptions of science

9. *What do you make of science?*

Participant Interviewee- 1: Science is studying, that is by observing, experimenting and solving or given an answer.

Participant Interviewee- 2: Science is the use of science skills to gain knowledge through experiments

Participant Interviewee- 4: Science is a method of obtaining knowledge through observation and experiments.

Participant Interviewee- 8: Science is the study of nature", solving of problems by scientifically.

Participant Interviewee- 11: Science is making things real through experiments or practicals

Participant Interviewee- 12: Science is the study of things around us through a lot of activities.

Participant Interviewee- 14: Science is studying about things around us

Participant Interviewee- 15: Science is the study of our environment by experimenting into it

Participant Interviewee- 16: Science is using more practicals and activities to gain skills and understand things

Participant Interviewee- 18: Science is about studying about life and how things are and works.

Pupils perceptions of science

10. Why is science termed as a difficult/an easy subject?

Participant Interviewee- 2: Practicals help us understand more than when it is theory only. So it becomes easy when there are more practical's but when is theory only it becomes difficult.

Participant Interviewee- 4: It is considered difficult because of no practical laboratories to practice and acquire knowledge. Those who have the labs and things they make use in learning it's easy.

Participant Interviewee- 5: They consider it difficult because you need to learn more and hard and do practicals too to understand. Easy since the teachers teach well and perform more practicals with them.

Participant Interviewee- 7: It is considered difficult because of the practicals and how they are. When you learn more it becomes perfect so its easy.

Participant interviewee 8: All though science is not difficult is not easy".

Participant Interviewee- 9: Some consider science as difficult because they do not have apparatus to do practicals

Participant Interviewee- 10: For me I consider science to be easy. Science is a subject that you need to be focused, studying hard and paying attention.

It is difficult if they do not do it Science is difficult (*Participant Interviewee- 12*)

Participant Interviewee- 14: Science is easy for the good ones but those who are not good it's difficult.

Participant Interviewee- 15: Me I see science to be difficult because there is too much to learn and it is hard. For those who think its easy they are intelligent.

11. How do science teachers treat boys and girls during science lessons?

Participant Interviewee- 2: They treat all of us equal

Participant Interviewee- 4: They treat us equally

Participant Interviewee- 6: Some of the male teachers are fond of the girls than us and so treat them better

Participant Interviewee- 8: Science teachers treat all of us well but if you are bad and they advise you and you don't stop they may not like you and so treat you badly.

Participant Interviewee- 10: The teachers treat us equally.

Participant Interviewee- 11: They treat us the same

Participant Interviewee- 14: Our teachers treat both boys and girls equally

Participant Interviewee- 16: Our teachers are not bias, but some are closer to the girls than us.

Participant Interviewee- 17: All our science and maths teachers treat us good and well

Participant Interviewee- 20: Science teachers like all of us and attend to us when we need help.

12. How is science lessons taught in class?

Participant Interviewee- 1: The teachers make lessons interesting with examples

Participant Interviewee- 2: Some teachers take topics and explain with no practicals because we do not have apparatus. Sometimes I understand the lessons that need no practicals but, those that need practicals I do not understand.

Participant Interviewee- 4: I understand what teachers teach in class because they explain more.

Participant Interviewee- 7: Science teachers teach with questions, examples and with practicals.

Participant Interviewee- 8: The good teachers use practicals to help you understand more.

Participant Interviewee- 9: It makes it real with examples and practicals

Participant Interviewee- 10: Some of the science teachers just teach orally without activities

13. Which pupils dominate science lessons (boys or girls) and why?

Participant Interviewee- 1: All of us, no one dominates each other.

Participant Interviewee- 3: I think is girls because there is a girl in our class who is very good in science. She talks more and score higher marks.

Participant Interviewee- 5: Girls dominate science lessons in class because they have faster mind and they rush to answer questions in class, also they are in the house and do everything which some are science.

Participant Interviewee- 8: None, the reason is that all of us are good and times bad at science.

Participant Interviewee- 9: Boys dominate girls because boys ask and answer more questions during science lessons.

Participant Interviewee- 10: No one dominates each one we all do well in science

Participant Interviewee- 13: We are all the same because anytime we are having science we are happy and bring our ideas.

Participant Interviewee- 15: Girls dominate in science lessons because they perform better than boys and contribute more during science lessons.

Participant Interviewee- 16: We all contribute when we are having science

Participant Interviewee- 19: The same. At times we score higher marks and at times lower marks.

APPENDIX D

INTRODUCTORY LETTER