UNIVERSITY OF EDUCATION, WINNEBA

INVESTIGATING THE TEACHING OF BASIC ELECTRONICS IN BASIC SCHOOLS IN THE JIRAPA MUNICIPALITY

ANTHONY BABATEGREMINE YUONI

7160130009

A THESIS IN THE DEPARTMENT OF SCIENCE, FACULTY OF SCIENCE EDUCATION, SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES, UNIVERSITY OF EDUCATION, WINNEBA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR AWARD OF THE MASTER OF EDUCATION DEGREE

DECEMBER 2018

DECLARATION

Student's Declaration

I, Anthony Babategremine Yuoni, declare that this Thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE………………………………………………………………….

DATE…………………………………………………………………………….

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 OF SUPERVISOR: Prof. Ruby Hanson

SIGNATURE……………………………………………………………

DATE………………………………………………………………………

ACKNOWLEDGEMENT

I am most grateful to my supervisor Prof. Ruby Hanson for her patience, hard work, gentleness and her professional guidance in seeing me through this project. I also thank my wife Leticia Gyebuni for her support and encouragement. I thank all my siblings for their great support. To my course mates and all those who supported me to write this project, I say a big thank you.

DEDICATION

I dedicate this work to my little girl Mwnibarika.

TABLE OF CONTENTS

CONTENT	PAGE
DECLARATION	ii
ACKNOWLEDGEMENT	iii
DEDICATION	iv
TABLE OF CONTENTS	v
LIST OF TABLES	viii
ABBREVIATIONS	ix
ABSTRACT	x
CHAPTER ONE: INTRODUCTION	1
1.0 Overview	1
1.1 Background of the study	1
1.2 Statement of the problem	3
1.3 Purpose of the study	4
1.4 Objectives of the study	4
1.5 Research questions	4
1.6 Significance of the project	5
1.7 Delimitation of the study	5
1.8 Limitation of the study	5
1.9 Organisation of the chapters	6
CHAPTER TWO: LITERATURE REVIEW	7
2.0 Overview	7
2.1 Science Education	7
2.2.1 Challenges teachers face in teaching science	8

2.2.2 Challenges students face in learning science 10

2.3 Instructional materials 11

2.4 Initial teacher training 13

2.5 Language of instruction 14

2.6 Content and pedagogical content knowledge of science teachers 15

2.7 Students' Misconceptions 17

CHAPTER THREE: METHODOLOGY 20

3.0 Overview 20

3.1 Research design 20

3.2 Study Area 20

3.3 Population of the Study 21

3.4 Questionnaire items 22

3.5 Validity of the Instrument 22

3.6 Reliability 23

3.7 Administration of questionnaire 23

3.8 Connection of an amplifying transistor circuit 23

3.9 Data analysis 24

CHAPTER FOUR: RESULTS AND DISCUSSION 25

4.0 Overview 25

4.2 Attitude of teachers to the teaching of basic electronics 30

4.2.1 Research Question 1 32

4.2.2 Research Question 2 34

4.2.3 Research Question 3 35

4.2.4 Research Question 4 37

4.3Rural, urban, public and private schools 46

CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS 52

5.0 Overview 52

5.1Summary of findings 52

5.2Conclusion 53

5.3Recommendations 53

5.4 Suggestion 53

REFERENCES 54

APPENDIX A 65

APPENDIX B 70

APPENDIX C 77

LIST OF TABLES

TABLE **PAGE**

1: The gender of participants 25

2: The ages of participants 25

3: Programmes read at SSS/SHS and 26

4: Highest academic qualification of teachers 27

5: Professional qualification of teachers 28

6: Teaching experience of teachers 29

7: Challenges teachers face in teaching basic electronics 33

8: Gender and ages of students 38

9: Test score of students on circuit symbols of some electronic components 39

10: Test score of students on the function of electronic components 41

11: Analysis of students score on the function of electronic components based on gender 43

12: Analysis of students' scores on circuit symbols of electronic components based on gender 44

13:Comparing performance of students on circuit symbols from rural and urban schools 47

14: Comparing scores of students on functions of components from rural and urban schools 48

15: Comparing students' scores on circuit symbols in public and private schools 50

16:Comparing scores of students on functions of components from public and private schools 51

ABBREVIATIONS

BECE	Basic Education Certificate Examination
CK	Content Knowledge
GAST	Ghana Association of Science Teachers
GES	Ghana Education Service
GMO	Genetically Modified Organism
LED	Light Emitting Diode
NGO	Non-Governmental Organisation
PBL	Problem Base Learning
PCK	Pedagogical Content Knowledge
PTA	Parents Teachers Association
SSSCE	Senior Secondary School Certificate Examination
SMK	Subject Matter Knowledge
WASSCE	West African Secondary School Certificate Examination
WHO	World Health Organisation

ABSTRACT

This study sought to identify the challenges teachers and students face in the teaching and learning of basic electronics in the Jirapa Municipality of Ghana. Descriptive survey was employed and questionnaire was the instrument used to collect data on thirteen science teachers and one hundred and sixty-one 2018 BECE candidates. The teachers were also given an amplifying electronic circuit to connect. The study revealed that; lack of electronic components, insufficient practical knowledge of majority of the science teachers in electronic circuit connections and low cognition of students on concepts in basic electronics were the major challenges confronted by the teachers and students. The implication is that students' further learning of basic electronics could be impeded.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter presents the background, the purpose of the study, objectives of the study, the problem statement, the research questions, the significance, delimitations and limitations of the study, definition of terms and organization of the chapters as follows.

1.1 Background of the study

Electronics is indispensable in all spheres of life; be it industry, commerce, education or medicine. It is also applied in communication, defense, instrumentation, entertainment and in automobiles. The modern car is an embodiment of electronics (Denton, 2014; Singhal, Shukla, Gupta, Iqbal, Singh, & Gupta, 2015). Devices used to efficiently charge the batteries of vehicles, the ignition, braking systems and the monitoring and evaluation of the efficiency of car engines are all electronic in nature. The safety and security of vehicles and passengers revolve round electronic equipment (Hegde, Mishra, & Gurumurthy, 2011;

https://www.researchgate.net/publication/294118825). These days, vehicles can be monitored via the use of mobile phones. It would therefore be difficult for thieves to steal or temper with such vehicles. Also, air bags come in handy to protect passengers from serious injuries in the event of an accident. The safety of passengers is somewhat assured.

Aside automobiles, electronics are applied heavily in industries for almost every activity in the value chain of production. For instance, electronic circuits are employed in the irradiation of hospital equipment and agriculture produce, where a conveyer belt carries the items to the source to be exposed. This activity would have been too dangerous for any person to carry out, but electronics has made it much easier and safer.

The health of a nation is its wealth. From the outpatient department to the operation theatre, medical electronic equipment is used in the diagnosis and treatment of diseases. The advent of the Electronic Health Record System in some health facilities across the world has improved the quality and accuracy of patients' medical history (WHO, 2006). This has contributed immensely to the efficient health delivery systems in many countries in the world.

The application of electronics is not limited to hospitals, industries or schools but also finds space in the home. Many electronic gadgets can be found in the bedroom, hall, kitchen, bathroom and in the toilet. This equipment brings much comfort in the home.

In the Ghanaian school curricula, the study of basic electronics starts from primary one to senior high school final year. A proper understanding of basic electronics by basic school pupils will not only develop their curiosity, creativity and critical thinking skills, but will also assist them to wisely use electronic gadgets. In addition, some pupils may avail themselves to the many career opportunities that electronics brings.

The understanding of concepts of basic electronics at this stage of the child's learning depends heavily on the teacher. The knowledge, interest, attitude, qualification and experience of the teacher will greatly affect pupils' learning and appreciation of basic electronics (Tella, 2008).

Considering the enormous benefits of electronics in the development of a nation, the Ghanaian child cannot be left out. They should be given the opportunity to contribute their quota to the future development of electronics for the betterment of the world. This cannot be possible if the study of electronics in basic schools in the Jirapa Municipality is not given the proper attention it deserves.

This study therefore seeks to investigate how the concepts in basic electronics are taught and learnt in the Jirapa Municipality.

1.2 Statement of the problem

In 2011 the researcher was elected as the Upper West Regional Secretary for the Ghana Association of Science Teachers (GAST). This gave him the opportunity to interact with many teachers in both the basic and senior high schools in the region. During these interactions, many teachers complained that they had great difficulty in teaching basic electronics. GAST intervened by organising workshops for basic school teachers to assist them to effectively teach basic electronics. During these workshops it was observed that the teachers indeed had a point. Many teachers could not however attend these purposely organised workshops because they were expected to pay a registration fee. The researcher under the auspices of Young Scientists Movement (a local NGO) also started conducting quiz competitions for primary and junior high schools in the Jirapa Municipality. The quiz had three sections; one of which was the connection of electronic circuits. In the said quiz, participants were provided with an electronic circuit and asked to connect the given parts together. Almost all the participants could not carry out the actual connections. If care is not taken, pupils in the Jirapa Municipality may be deprived of the opportunities that abound in the study of basic electronics. This makes the study pertinent by investigating why pupils cannot undertake quizzes in basic electronics and how they could be assisted to understand concepts in basic electronics.

1.3 Purpose of the study

The study seeks to investigate the challenges students and teachers encounter in the teaching and learning of basic electronics and how they could be helped to overcome.

1.4 Objectives of the study

The objectives of this study were to:

- Identify challenges teachers encounter in the teaching of basic electronics.
- Determine the practical knowledge of teachers in basic electronics circuits.
- Determine pupils' understanding of basic electronics.
- Assist teachers to overcome their difficulties in the teaching of basic electronics.

1.5 Research questions

The questions this study seeks to answer are:

1. What challenges do junior high school teachers face in teaching basic electronics in the Jirapa Municipality?
2. What practical knowledge do teachers have about basic electronics circuits?
3. What level of understanding do pupils have about basic concepts in electronics?
4. What assistance could be given to teachers to help them to overcome the challenges they face in teaching basic electronics?

1.6 Significance of the project

This study identified and proposed solutions to the challenges teachers and pupils face in the teaching and learning of basic electronics. It is hoped that this study will also serve as a foundation for further research on basic electronics to be carried out in the Upper West Region of Ghana.

1.7 Delimitation of the study

This study is delimited to both private and public Junior High Schools in the Jirapa Municipality. Participation in the study is delimited to JHS final year students who sat the 2018 Basic Education Certificate Examination (BECE). This group was chosen because students were expected to have studied basic electronics in their previous classes. Also, only science teachers who taught the 2018 BECE candidates took part in this study. Finally, the study is delimited to determining the knowledge of JHS students on concepts in basic electronics and the practical knowledge of JHS science teachers on electronic circuit connections. This study, however, did not determine the content knowledge of teachers because it was practically impossible to do so considering the limited time and resources available to the investigator.

1.8 Limitation of the study

The study intended a sample size of two hundred (200) BECE candidates from twenty (20) schools; fifty percent being boys and fifty percent girls from each school. This however did not happen because some of the schools had less than five boys in form three (3) classes. The number of schools chosen also dropped by two because the researcher was not allowed entry into these schools. The practical knowledge of students in connecting electronic circuits could not be tested. This was due to lack of time and the large number of students who participated in the study.

Only thirteen (13) out of the twenty science teachers took part in the study. Two teachers refused to participate in the study while five teachers took the questionnaire but failed to return them despite the countless follow-ups. The teachers were provided with an amplifying circuit, an npn transistor, connecting wires, 9 V battery, crocodile clips, LEDs and standard resistors and were asked to connect the circuit in the presence of the researcher. Some teachers were not comfortable to connect the amplifying circuit in the presence of the researcher when they were asked to do so. This could have affected their output. It must be stated however that, apart from the participating teacher and the researcher no one was allowed to witness the connection of the electronic circuit by the participants. This was done to protect the integrity of the teachers and also to encourage them to do their best.

1.9 Organisation of the chapters

This work consists of five chapters. Chapter one discusses the background to the study, the statement of the problem, the purpose of the study, the objectives of the study, the research questions, significance of the project, delimitation and limitation of the study.

Chapter two reviews relevant literature on the study. The methodology of the study is discussed in chapter three. Chapter four deals with the presentation and discussion of the results. Finally, chapter five presents the findings, conclusion, recommendation and suggestion for further studies.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter reviews the goals of science education as well as the challenges that teachers and students face in the teaching and learning of electronics. Literature on the impact of instructional materials, initial teacher training, language of instruction, students' misconceptions, and the content and pedagogical knowledge of science teachers have on students' outcome.

2.1 Science Education

Science can be viewed as the study of the universe through systematic observation and experimentation. Science education seeks to inculcate in students the nature of science, the scientific processes, the contribution of science and technology to the very existence of man and how they can apply science in solving basic problems confronting them now and the future. The junior high school teaching syllabus for Integrated Sciences, (Curriculum Research and Development Division (CRDD), 2012) stated two major goals of science education. First of all, science education infuses scientific literacy and culture for all. This would assist people to make informed decisions and systematically solve problems in all their endeavours. Secondly, science education is aimed at producing competent professionals to man the different scientific disciplines in Ghana thereby contributing immensely to the economic development of the country. The syllabus also hopes that students would develop positive attitudes and values after they have been taken through it. Bull, Gilbert, Barwich, Hipkins and Baker (2010) in their paper Inspired by Science, commissioned by the Royal Society and the Prime Minister's Chief Science Advisor, New Zealand, outlined four purposes of science education. These are:

- Training students to work in a science discipline
- Inculcating in students a practical knowledge of science
- Making students scientific literates so that they could contribute to issues and debates related to science and
- Training students to develop their scientific thinking skills and knowledge.

The National Research Council, (2007) stated the following as the goals of science education for students in grades K-8 in the United States of America:

- Students should acquire scientific knowledge, use it, and interpret scientific explanations of natural phenomena
- Students should be able to generate and evaluate scientific evidence and explanations
- Students should understand the nature and development of scientific knowledge and
- Students should be capable of taking part in scientific practices and intelligent discussions pertaining to science.

The goals, aims and purpose of science education are similar in many countries across the world. The differences however lie in the processes of achieving these goals and the challenges each country is likely to face.

2.2.1 Challenges teachers face in teaching science

The teacher is the implementer of the science curriculum and hence the success or otherwise of the curriculum depends to a very large extend on the teacher (Ball & Forzani, 2009; UNESCO, 2010). Teachers are bedeviled with challenges in carrying out their professional duties (Nomxolisi & Maphosa, 2016). These challenges are varied and may adversely affect the overall output of the teacher.

Ngman-Wara, (2015), in a study of Ghanaian junior high school science teachers' knowledge of contextualized science instruction in the Upper West Region of Ghana concluded that majority of the JHS science teachers did not have adequate content knowledge and they could not also identify and remedy pupils' misconceptions using contextualized instructional strategies. Adu-Gyamfi (2014), identified lack of science materials and equipment, nature of examination test items, and the attitude of students towards the learning of science as the major challenges science teachers face in teaching science at the JHS level. Mtsi and Maphosa (2016), summarized the problems in science education as lack of infrastructure and resources for teaching science.

They further mentioned limited time allotted to the teaching of science, lack of parental support and language barrier as contributory factors to the challenges in science education. Content knowledge is very important in the teaching and learning business. It is the most important ingredient in transmitting knowledge or in guiding students to acquire knowledge. In the absence of content- the core of the science- no meaningful teaching can take place. Stakeholders in education must rise to assist teachers to acquire the requisite knowledge and skills to enable the teachers implement the science curriculum to the letter. Inadequate content knowledge does not give the teacher the needed confidence to teach science. Parents play a vital role in educating their wards. When parents show no interest in the education of their children, the teacher alone cannot unearth the potentials of the future leaders of this country.

A study on the factors influencing the ineffective teaching and learning in primary schools in Zimbabwe (Mupa & Chinooneka, 2015) contented that teachers do not vary their teaching methods and that the use of multimedia is absent in teachers' teaching. The study also pointed out that aside the textbooks and the syllabi teachers do not read other sources for information to teach their students and that teachers have low morale. In addition, students study in poor conditions and parents lack interest in their children's education. The lack of parents' interest in their children's education is a great disincentive to students learning.

2.2.2 Challenges students face in learning science

Fook and Kaur (2015) investigated the challenges faced by students in higher education and came out with eight major challenges. These are cognitive challenge, becoming active learners, coping with reading materials, instructional problems, language barrier, time management, burden of assignments and culture difference. Many of the problems identified by Fook and Kaur are not peculiar to students in the universities but cut across all the levels of education. A similar study by Ekici (2016) on why students perform poorly in Physics reported that students perceive the content of Physics as difficult. Students at all levels of education want to be involved in the teaching and learning process. Students are interested in discovering knowledge and not to be given facts to commit to memory. It is interesting to note that the challenges students encounter in their studies in the tertiary institutions were the same challenges they faced at the basic and second cycles institutions. Unless the base of education (primary and junior high schools) is strengthen no much progress in education would be realized.

A similar study on the difficulty faced by technical school students in learning the transistor reported that students had difficulty in committing formulae to memory, difficulty in the cognition of electronic circuits, difficulty in the application of formulae in solving problems and poor knowledge of the topic (Mustapha, Rahim, & Azman, 2014). Student teachers in University of Zambia had several misconceptions about basic electronics (Kaulu, 2015). These misconceptions could adversely affect the effective teaching and learning of basic electronics in Senior Secondary Schools in Zambia when the trainees become teachers. When teachers of Science or Physics are not very knowledgeable in basic electronics it would have a negative rippling effect on the students as they progress in the educational system. Chen, Wei and Cao (2015) acknowledged the difficulty in the teaching and learning of transistors and proposes three areas teachers could focused on to remedy the situation. They suggested that teachers should concentrate on helping their students to understand the behaviour of various electronic components very well, acquire the skill of analyzing and applying electronic components and assist their students to have firsthand application experience of some electronic circuit function module. This will require the provision of appropriate instructional materials.

2.3 Instructional materials

Instructional materials are very important in conveying the right message to students. They make the teaching and learning process more exciting and meaningful. Amadioha (2009) defined instructional materials as those alternative channels of communication, which a class teacher uses to concretise a concept during teaching and learning process. Accoding to Amadioha, instructional materials constitute the media of exchange through which a message transaction is facilitated between a source and a receiver. There are many studies on the importance of instructional materials and the academic achievement of students (Adebayo & Adigun, 2018; Igiri & Effiong, 2015; Ikwuka & Chukwuemeka, 2016; Olayinka, 2016; Okhakhu, Oladiran, & Omoike, 2016). These studies have all confirmed that the effective use of instructional materials significantly enhance academic performance of students. The lack of instructional materials in schools will therefore affect teaching and learning.

According to (Mbugua, 2011) the poor performance of Kenya secondary school students in mathematics is due to inadquate instuctional materials. In teaching basic electronics the most important instructional materials are electronics components.

Electronic components are the units that constitute electronic circuits. At the basic level the components required are light emitting diodes (LED), colour coded resistors, power diodes, capacitors, inductors and transistors. The function of each component can be understood much better in an electronic circuit. For example, the function of a resistor can be investigated by the students using resistors of different resistances, LED and dry cells. This will not only make the lessons interesting but would also develop the critical thinking skills of the students. Sadly however, many schools do not have these components. This makes lessons in basic electronics boring and intimidating. There cannot therefore be any meaningful teaching and learning without the effective use of these components (Pambid, 2015). The availability of electronic components will enable the students to carry out the many practical activities prescribed by their science textbooks.

Textbooks are the most widely used teaching learning materials in developing countries (Kumar & Subramaniam, 2015; Mohammad & Kumari, 2007; Ong'amo, Ondigi, & Omariba, 2017; Sikorova, 2011). They serve as guide to both pupils and teachers. Science textbooks provide content and suggested methodology for the use of the teacher (Sikorova, 2011). Teachers give assignments and homework from the textbooks to their students. In schools where there are no science teachers, the students depend solely on their textbooks for information. Textbooks are not perfect teaching aids. Teacher trainees are therefore trained to be able to identify the gaps in textbooks. However teachers do not make maximum use of textbooks to teach their students (Mohammad & Kumari, 2007). The lack of this important learning aid in schools, to say the least, could be frustrating to the science teacher. The teacher would definitely not be able to give his/her best to the students. It is important for Government of Ghana to provide science textbooks to all schools and also ensure that teachers are properly trained to be able to effectively use the textbooks supplied.

2.4 Initial teacher training

In Ghana two major institutions train teachers. These are the colleges of education and universities. The colleges of education train teachers for basic schools. Teacher educators concentrate much on the content and methodology of science but little attention is paid to the trainee's personal philosophy of science and teaching science (Crawford, 2007). Prospective teachers' personal beliefs in science influences greatly their approach to teaching and learning of science when they eventually become teachers (Crawford, 2007). The duration for training is three (3) years. Students who graduate from the colleges of education are awarded Diploma in basic education. The universities train teachers to teach at all levels of education. Initially, University of Cape Coast and University of Education- Winneba were the only universities producing teachers. Today, many more private and public universities are training teachers. University of Ghana-Legon and University for Development Studies are also producing teachers.

The universities have increased access to teacher education through their distance and sandwich programmes. Many teachers have taken advantage of this opportunity to upgrade their knowledge and skills in teaching and learning science. Ghana has indeed made great strides in providing access to teacher education. However, what is not certain is the quality of teachers churned out from the training institutions each year. All teacher training schools do not usually agree on a particular standard of training teachers (Creasy, 2015). This is common in the universities. University of

Cape Coast's programmes in education are somewhat different from the educational programmes run by the University for Development Students. The disparity in the standard of training teachers could affect the teaching of some topics like basic electronics. It is hoped the T-Tel unified teaching standards come into force soon to address such disparities.

2.5 Language of instruction

The medium of instruction for lower primary schools is indigenous Ghanaian languages (Klu & Ansre, 2018; Ansah, 2015). There are nine Ghanaian Languages studied in Ghanaian schools. The lingua franca for upper primary to the tertiary level is English Language (Ansah, 2015). The medium of instruction plays a crucial role in the academic performance of students (Civan & Coşkun, 2016; Halder, 2018; Kola, 2013; Sabri, üstünlüoğlu, & Aysel, 2005). Sabri, üstünlüoğlu and Ayel (2005) studied the effect of teaching in native and foreign language on students' conceptual understanding in science and reported that students who were taught the topic Energy in a foreign language had more misconceptions than those who were taught in their indigenous language. Halder (2018) found significant negative correlation between English Language anxiety and academic achievement.

Teaching students in a foreign language adversely affect their academic success (Civan & Coşkun, 2016). Findings from Kola (2013) indicated that English Languge influences academic performance in Physics.This means that the medium of instruction coud affect the teaching and learning of basic electronics.Some students cannot speak, read, write or comprehend the English Language. This situation is common in rural schools. The science teacher is at a lost as to how to communicate effectively with such students. The case may be worsen if the teacher cannot speak the language of the community they teach. This can seriously affect the teaching and learning process even if the teacher has high content and pedagogical content knowledge.

2.6 Content and pedagogical content knowledge of science teachers

Every profession has a distinguishing element(s) that make that profession unique. In the teaching of science, the specialised knowledge that differentiates a science teacher from other professionals is the content knowledge (CK) and pedagogical content knowledge (PCK) of the science teacher. The science teacher is expected to have deep understanding of the scientific concepts. The knowledge the teacher possesses in a subject is sometimes called the subject matter knowledge (SMK). The teacher also has that specialised skill that enables him to transmit this knowledge to students in a much easier and practical manner. The teacher makes abstract concepts concrete. These two elements CK and PCK have dominated the research space over the years. In this section, the importance of CK and PCK to learning outcomes would be reviewed.

Studies have shown that content knowledge of the teacher plays an important role in the academic achievement of students (Owolabi & Adedayo, 2012; Dodeen, Abdelfattah, Shumrani, & Hilal, 2012). Other studies have also revealed that content knowledge of student teachers correlated positively with their pedagogical content knowledge (Gess-Newsome, Taylor, Carlson, Gardner, Wilson, & Stuhlsatz, 2017; Özden, 2008; Rollnick, Bennett, Rhemtula, Dharsey, & Ndlovu, 2008; Şen, Öztekin, & Demirdöğen, 2018). This means that for a teacher to develop PCK then that teacher must possess good CK (Iserbyt, Ward, & Li, 2015). Another study supports a concentration on professional development of teacher's content knowledge as evidence- based practice for improving the PCK of teachers (Kim, Ward, Sinelnikov, Ko, Iserbyt, Li, & Curtner-Smith, 2018). Ball and Forzani (2009) defined teaching as everything that teachers do to support the learning of their students. They emphasised that teachers must know the subject matter. They concurred the notion that CK is prerequisite for PCK development. However, some other studies disagree with the notion that the academic qualifications of the teacher is a function of the students' performance (Maphoso & Mahlo, 2015; Buddin & Zamarro, 2010; Kosgei, Mise, Odera, & Ayugi, 2013). Appleton (1995) concludes in a study that deep science content does not affect student teachers' confidence to teach science. Though content knowledge is very important, the teachers must also have PCK.

Shulman (1986), defined PCK to include content knowledge (CK) and pedagogical knowledge (PK). Shulman argues that a good blend of CK and PK would result in effective teaching. He concluded that PCK was the unique specialized body of knowledge that distinguished the teaching profession from all other professions. Kind (2009) concurs with the concept of PCK as a tool for describing and contributing to the understanding of teachers' professional practice but thinks that the meaning of PCK is much more complex than the one proposed by Shulman. In order to comprehend the importance of PCK and its relevance to science education, Kind (2009) recommends that:

1. A model of PCK should be designed to transform initial teacher training, and for experienced teachers who venture into teaching new subjects.
2. It is prudent for teacher education courses to explicitly define PCK.
3. The emotional challenges of teachers associated with teaching should be given a second look.

There are many studies on the relationship between pedagogical content knowledge of teachers and students' academic achievements (Ergönenç, Neuman, & Fischer, 2014;

Iserbyt, Ward, & Li, 2015; Olasehinde-Williams, Yahaya, & Owolabi, 2018; Putra, Sopandi, & Widodo, 2017). Putra, Sopandi and Widodo (2017) observed that, teachers with high PCKs have an impact on the way they present integrated teaching. They added that PCK of the teacher influences the content selected and the method of delivery employed, the amount of the content and the rationale for selecting the teaching procedures. All these factors impact students' learning. Ergönenç, Neuman and Fischer (2014) confirmed that teachers' PCK influence congnitive activation but however concluded that there was no relationship between teachers PCK and student learning. Olasehinde-Williams, Yahaya, & Owolabi (2018) agreed that the pedagogical and content knowledge of teachers were significant indicaters of students academic achievement. They also found that teachers with bachelor of science degrees showed mastery of subject content knowledge, pedagogical content knowledge, and subject content knowledge and professional knowledge. It is evidenced from the discussion that effective teachers must have adquate content and pedagogical knowledge of the subject(s) they teach. Deep content and pedagogical knowledge of teachers would enable them to identify and remedy the misconceptions of their students.

2.7 Students' Misconceptions

Studies on students and teachers misconceptions about some scientific concepts abound (Bayuni, Sopandi, & Sujana, 2018; Bull, Gilbert, Barwick, Hipkins, & Baker, 2010; Kaulu, 2015; Küçüközer & Kocakülah, 2007; Nelson, Mckenna, Brem, Hilpert, Husman, & Pettinato, 2017; Trotskovsky, Sabag, Shlomo, & Hazzan, 2013). Trotskovsky, Sabag, Shlomo and Hazzan (2013) identified three levels of misconception of engineering students. According to them the first level was that students did not usually understand the topics taught them in class. The second was the inability of students to interpret and integrate knowledge and the last level related to misunderstanding characteristics of students in many engineering field.The findings of Nelson, et al. (2017) showed that engineering students had misconceptions about semi-conductor phenomena- diffusion, drift and excitation. A study on misconceptions in learning about diodes revealed that there were seven misconcptions about semi-conductor concepts of a diode, four misconceptions about the features of diodes bias, seven misconceptions about simplified models of a diode and ten misconceptions about basic circuits of a diode (Chen, Pan, Sung, & Chang, 2012). A recent study on students' conception and perception of simple electrical circuit found that students had six misconceptions about electrical circuit (Setyani, Suparmi, Sarwanto, & Handhika, 2017). The alternative conception of the students were:

1. A high-voltage wire has a potential difference, and it can cause electric shock.
2. Conducting wire has a current that produces voltage and causes an electric shock.
3. The potential difference and resistance in a circuit are influenced by electric current. If the circuit is open, there is no electric current; then there are no potential difference and resistance.
4. The thin filament causes the lamp to have less resistance, so it has more current
5. The current that is coming out from the positive pole of the voltage source is constant, independent of the type of circuit arrangement (series or parallel circuits)
6. The resistor consumes the current through it, and the current at any resistor in the series circuit is influenced by the resistor used.

Misconceptions emanate from students' perceptions, lessons delivered in schools and students' concept and scientific language. Misconceptions impede students' interpretation and application of scientific concepts. Teachers must therefore make conscious efforts to identify students' alternative conceptions and use experiments, models and computer simulations to help students overcome their misconceptions of certain scientific ideas.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter describes the research design, the study area and population, sampling technique used, the questionnaire items and the administration of questionnaire, and the data analysis processes employed.

3.1 Research design

This study is a descriptive survey. A survey is the process of gathering data at a particular point in time with the intention of describing the nature of existing conditions, or identifying standards against which existing conditions can be compared, or determining the relationships that exist between specific events (Cohen, Manion, & Morrison, 2007). According to Cohen, Manion and Morrison, a survey has several advantages. They pointed out that, in a survey, data could be gathered on a one-shot basis; thus making it economical and efficient, a true representation of a large population can be achieved and numerical data could be generated. They added that surveys provide descriptive, inferential and explanatory information, gather standardized information and could be a basis for generalization.

Descriptive survey was chosen because it was economical to use, efficient, and the probability of the chosen sample being the true representation of the population was high. Survey also provided the avenue for the collection of data from many sources and the generation of the findings of this study.

3.2 Study Area

The Jirapa Municipality was established by a legislative instrument (LI 1902) in 2007 with Jirapa as the administrative capital. It is located in the north-western part of the

Upper West Region of Ghana. It is located between latitude 10.25^0 and 11.00^0 north and longitudes 20.25^0 and 20.4^0 west and a total land size of 1188.6 square kilometers. This represents 6.4 % of landmass of the Upper West Region.

3.3 Population of the Study

The number of junior high schools that were selected for the study by simple random sampling method was 18. Only the final year students who were to sit the 2018 BECE were sampled. Permission was sought from the head teachers to have access to their students for this exercise in their schools. Ten students, five boys and five girls were expected to be selected from each school. Information on the total number of boys and girls from each school was provided to the researcher by the head teachers. This information was used to generate random numbers using the scientific calculator. For example if 20 candidates were from a school with 7 boys and 13, the scientific calculator was used to generate five numbers out of the 7 numbers. The same procedure was repeated for the girls and again five numbers randomly produced by the calculator. The previously determined numbers are mentioned and the boys with those numbers are asked to stay in the classroom while the rest of the boys leave the classroom. The same procedure is repeated for the girls.

In schools where the candidates were less than ten, all the candidates could take part in the study. In situations where there were more girls than boys, and the boys were not more than five, all the boys participated, and the girls randomly selected to make up the number (ten). If a school had more than 10 boys or girls, five boys were randomly chosen from the boys and five girls were also randomly chosen among the girls. For schools that had a larger number of candidates, more than ten students were taken from those schools. This was to ensure that the sample was the true representation of the desired population.

A total of 168 questionnaire was administered and collected but 7 questionnaire sheets were rejected because no meaning could be made from the students' response to the questionnaire items. Finally, 66 boys and 95 girls questionnaire sheets were accepted and used for the data analysis. In all, 18 schools participated 3 of which were private schools. A total of thirteen teachers and one hundred and sixty-eight students participated in this study.

3.4 Questionnaire items

The questionnaire for the students consisted of four sections: A, B, C and D. Section A covered the background of students. For example, their school, gender, age and others. Section B concentrated on the availability of electronics components in the schools. Section C tested their basic knowledge in basic electronics and section D contained questions that tested the ability of the candidates to apply their knowledge in basic electronics. The items in the questionnaire were derived from the objectives of the teaching syllabus and the Integrated Science textbooks for primary and junior high schools.

The teachers' questionnaire also had four sections. The questions covered the professional and academic qualification of the teachers, their interest and attitude towards the teaching of basic electronics and their practical knowledge in basic electronics.

3.5 Validity of the Instrument

My supervisor assessed the instrument for face and content validation. She made some suggestions for the improvement of instrument. The corrections were duly effected.

3.6 Reliability

A pilot test on the questionnaire was carried out on some 2018 BECE candidates, and science teachers who taught the 2018 BECE candidates but who were not part of the sample of this study. The data collected was used to calculate the co-efficient of reliability, which was found to be 0.88.

3.7 Administration of questionnaire

Twenty students and two teachers from St. Francis Girls' Senior High School were trained on the administration of the questionnaire. Permission was sought from the head teachers to have access to their students.

The consent of each candidate was sought and no student was compelled to take part in the study. Participants were taken through the questionnaire item by item and any student who had difficulty in understanding any of the questions was immediately attended to.

Distributing the questionnaire to the teachers was very difficult. The researcher had to visit each school more than two times. In every school the researcher took permission from the head teacher to interact with the science teacher who prepared the candidates for the BECE. The teachers who willingly agreed to participate in the study were given the questionnaire to complete within 24 hours. Many of them could not finish within the stipulated time. They were given additional time to complete the questionnaire.

3.8 Connection of an amplifying transistor circuit

The teachers who completed the questionnaire in good time were given an amplifying transistor circuit to connect. They were provided with 2 LEDs, 12 V battery, 2 resistors, 12 connecting wires, 16 crocodile clips and 2 capacitors. They were expected to carry out the connection in the presence of the researcher only. This was done in order to provide a conducive environment for the teachers to do their best.

3.9 Data analysis

The Statistical Package for the Social Sciences (SPSS) version 20.0 was used for the data analysis. The data on the teachers was analysed based on the age and gender of the teachers. This was done to access the interest of the teachers in teaching and to examine the impact of gender on science teaching. The programmes teachers read at SSS/SHS, their highest academic and professional qualifications were also looked at. This was to access the background of the teachers teaching science. The challenges teachers faced in teaching basic electronics was also analysed. Teachers' practical knowledge in electronic circuit interpretation was critically examined.

The students' data was also looked at based on age and gender. The performance of students on electronic circuit symbols and functions of electronic components was also analysed based on gender, location of the schools and whether the schools were public or private.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter presents the results of the study and discussions of findings based on gender, rural and urban schools, and public and private schools. The practical knowledge of basic school science teachers in basic electronics is also discussed.

The gender and ages of the teachers are presented in Tables 1 and 2 respectively.

Table 1: The gender of participants

Gender	Frequency	Percentage (%)
Male	11	84.6
Female	2	14.4
Total	**13**	**100**

Table 2: The ages of participants

Ages (years)	Frequency	Percentages (%)
18-20	3	23.1
21-30	6	46.2
31-40	4	30.8
Total	**13**	**100**

Tables 1 and 2 show the gender and ages of participants. The Table 1 reveals that only 15.4% of the participants were women. The role of female teachers in Science education has been highlighted in scores of studies (Atta, 2015; Dasgupta & Stout, 2014; Udeani, 2012). Udeani (2012) identified enrolment, social barriers and lack of role models as the major factors militating against the participation of females in science and technology carriers. Table. 2 reveals that none of the teachers was above 40 years. This is a positive development because we have young and energetic teachers teaching our students. Since the participants are young they can easily learn both the practical and theoretical aspects of basic electronics. They would therefore be able to effectively teach the topic and also guide the students to choose appropriate careers in electronics. Alufohai and Ibhafidon (2015) in their study have revealed that students' academic achievement is significantly influenced by the age of the teacher. Younger teachers were found to be more effective than older teachers. A similar study showed that age and gender biases influenced the evaluation of teaching by students (Joye & Wilson, 2015). Age was also found to moderate the effect of teachers' perceived usefulness of Education Video Games (EVGs) (Sánchez-Mena, Martí-Parreño, & Aldás-Manzano, 2017). Some studies however have shown that teachers' gender had no effect on their ability to impact knowledge (Owolabi & Adedayo, 2012; Alufohai & Ibhafidon, 2015). They belief that experience and qualifications of the teacher are determinants of good students' outcome. They stressed that the gender of an instructor has no relationship with the quality of instruction or teaching.

The academic background of the participants is presented in Tables 3 and 4.

Table 3: Programmes read at SSS/SHS

Programme	**Frequency**	**Percentage (%)**
Science	8	61.5
Business	2	15.4
Home Economics	1	7.7
Agric Science	2	15.4
Total	**13**	**100**

Table 4: Highest academic qualification of teachers

Highest Academic Qualification	Frequency	Percentage
SSCE/WASSCE	12	92.3
BSc	1	7.7
Total	**13**	**100**

Table 3 reveals that eight teachers read General Science, one teacher read Home Economics, two read Agricultural Science and two of the teachers read Business at the SSS/SHS level. Business students, apart from Integrated Science, did not study any of the science subjects. When such students eventually become professional science teachers without proper orientation, they would surely lack pedagogical and content knowledge in basic electronics. Teachers who read Home Economics in SHS/SSS did not read Physics. Students who read Home Economics either studied Biology or Chemistry. Some Agriculture Science students studied Physics but others did not. It could therefore be stated that basic school science teachers who did not study Physics at the senior high school level are more likely to be challenged in the practical teaching of basic electronics than those who read Physics. It must however be pointed out that teachers who are zealous to learn could teach basic electronics well, independent of their initial field of study at the senior high level.

The number of teachers with BSc was one and the highest academic qualification of the twelve remaining teachers was SSSCE/WASSCE as shown in Table 4. Teachers acquire content knowledge of science or basic electronics not only in teacher training institutions but also in the first and second cycle institutions. It was therefore important to explore the courses teachers read at SSS/SHS level. Student teachers' pedagogical knowledge in science is influenced by their content knowledge of the scientific concepts or topics (Ozden, 2008). Studies have shown that academic qualification of teachers correlate positively with students' outcome (Dodeen, Abdelfattah, Shumrani, & Hilal, 2012; Owolabi & Adedayo, 2012). Some studies have corroborated the fact that academic content knowledge is pivotal in acquiring and applying pedagogical content knowledge (Gess-Newsome, et al., 2017; Özden, 2008; Rollnick, Bennett, Rhemtula, Dharsey, & Ndlovu, 2008; Şen, Öztekin, & Demirdöğen, 2018). However, some other studies disagree with the assertion that the academic qualification of the teacher is the greater determinant of the students' performance. (Maphoso & Mahlo, 2015; Buddin & Zamarro, 2010; Kosgei, Mise, Odera, & Ayugi, 2013). Appleton (1995) concludes in a study that more science content does not influence student teachers' confidence to teach science. Voogt and McKenney (2017) stated that teacher educators are not preparing pre-service teachers to use technology for early literacy because the educators themselves have little knowledge and skills in Information and Communication Technology (ICT). Although academic qualification and content knowledge of science teachers are important, they do not solely determine students' outcome.

The professional qualifications of participants is presented in Table 5.

Table 5: Professional qualification of teachers

Professional qualification	Frequency	Percentage (%)
Dip. Ed	8	61.5
B.Ed.	4	30.5
Non professional	1	7.7
Total	**13**	**100**

Only one teacher was not a professionally trained teacher. This teacher teaches in a private junior high school. The percentage of teachers with Diploma in Basic Education as their highest professional qualification was 61.5 % and 30.5 % have

Bachelor in Education as shown in Table 5. This means that all the participants teaching in public schools were professionally trained teachers. Owolabi and Adedayo (2012) pointed out that students performed better when they are taught by professional teachers. It was however observed from this study that the professional qualification of the teachers did not have any significant impact on the performance of the students in basic electronics. This is in line with the findings of Buddin and Zamarro (2010) that stated that students' achievement was not affected by advance degrees of the class teacher.

The teaching experience of the teachers is presented in Table 4.

Table 6: Teaching experience of teachers

Number of years taught	Frequency	Percentage (%)
Under 1 year	2	15.4
1-3	5	38.5
4-7	3	23.1
8-11	3	23.1
Total	**13**	**100**

From Table 6, one teacher has taught for eleven (11) years, five (5) of them have taught for more than five (5) years, and four of them have taught for less than two years. The number of teachers who taught science between two (2) and four (4) years was three (3). All the teachers have taught basic electronics except one. The average teaching experience of the participants is 4.6 years with a standard deviation of 3.8. Teaching experience is associated with students' outcome (Buddin & Zamarro, 2010; Kini & Podolsky, 2016; Lee & Luft, 2008; Nilsson, 2008; Owolabi & Adedayo, 2012). More experienced teachers produce the best results. This means that a teacher with 20 years' experience in teaching Chemistry is expected to perform much better than the one with just one year experience in teaching Chemistry. Kini and Podolsky (2016) emphasised that, the benefits of an experienced teacher go beyond test score of students but that it has the tendency of influencing positive students' behaviours. They added that teachers become more effective when they teach in a supportive and collegial working environment or accumulate experience in teaching the same class or subject over a period of time. They also stated that more experienced teachers become mentors to their less experienced colleagues and this helps to improve performance in the school as a whole. The teacher with the eleven years of experience is likely to be the most effective science teacher, followed by the two teachers with nine years of teaching experience. The least effective teachers may be those with eight months experienced in teaching. Teaching is a complex profession and many factors come to play in determining the effectiveness of a teacher. It must be stated that some teachers may therefore be on the job for many years but may be less experienced than their junior colleagues. The age of the teacher is not necessary synonymous to the teaching experience of the teacher.

4.1 Attitude of teachers to the teaching of basic electronics

When the teachers were asked to state whether they liked teaching basic electronics or not, seven (7) of them said they enjoy teaching the topic, three (3) did not like teaching it and three (3) were not sure. From this data it can be inferred that 53.8 % of the teachers have positive attitude towards the teaching and learning of basic electronics. About 46 % of the teachers were either indifferent or did not like teaching the topic. The tendency for teachers to avoid topics they do not like is high. It could therefore be said that such teachers either skipped basic electronics or taught it anyhow. There are scores of studies on the effect the attitude of teachers has on teaching and learning (Al-Harthy, Jamaluddin, & Nabeel, 2013; Erdamar, Aytaç, Türk, & Arseven, 2016; Kisanga, 2016; Tezci, 2010). There is a direct relationship between the attitude of teachers and their professional performance (Al-Harthy, Jamaluddin, & Nabeel, 2013). This implies that, teachers with positive attitude towards teaching are more productive than those who regret for being teachers. A study of the attitude, self-efficacy, effort and academic achievement of City University students towards Research Methods and Statistics revealed that there was a positive correlation between attitude towards Research Methods and Statistics, self-efficacy, effort and academic achievement (Li, 2012). This means that attitude counts in almost all human endeavours. The 53.8 % of the teachers who had positive attitude towards basic electronics are more likely to be effective in teaching the topic than the 46 % of the teachers who have negative attitude towards basic electronics. The association between knowledge and attitude was also found to be significant in some studies (Zeidan & Jayosi, 2015; Essa & El-Zeftaway, 2015). Torres and Ballado (2014) however reported that there was no significant relationship between attitude to teaching and work values.

Another study on the relationship between knowledge of teachers on genetically modified organisms (GMOs), their attitude towards GMOs and their readiness to accept GMOs reported that there was no correlation between knowledge and attitude but that a strong correlation existed between attitude and readiness to accept GMOs (Šorgo & Ambroži-Dolinšek, 2009). There should be a deliberate effort to encourage basic school teachers to teach basic electronics. This could be in a form of organising practical and effective workshops on basic electronics for the teachers. Science fairs should be made attractive so that both teachers and students would work hard to apply basic electronics to solve problems in the society. The science coordinators at the districts, regional and national levels should find innovative ways of improving upon the teaching, learning and applications of basic electronics.

A little over 50 % of teachers in the Jirapa Municipality are positive about basic electronics. All basic schools science teachers in the study area therefore need the support of stakeholders in order to be able to effectively teach basic electronics.

4.2.1 Research Question 1: What challenges do junior high school teachers face in teaching basic electronics in the Jirapa Municipality?

The teachers were asked to answer the question: "What problems do you face in teaching basic electronics?" The participants enumerated various challenges. The challenges teachers encountered in teaching basic electronics were grouped under six headings. These problems were: 1 lack of electronic components, 2 inadequate content and pedagogical knowledge, 3 inability of students to understand basic electronics, 4 no space or laboratory, and 5 no computers and projectors. The tallying was done under each heading. For example twelve (12) teachers stated the lack of electronic components as one of their challenges and two teachers mentioned inadequate content and pedagogical knowledge as their challenge. These two teachers were indeed part of those who did not have electronic components to teach basic electronics. A teacher could therefore write more than one challenge and would be captured under each challenge he/she has stated. The challenges of the teachers in teaching basic electronic is presented in Table 7.

Table 7: Challenges teachers face in teaching basic electronics

Challenges	Frequency
Lack of electronic components	12
Inadequate content and pedagogical knowledge	2
Students inability to understand basic electronics	2
No space or laboratory	2
No computers and projectors	1
No problem	1

The number of teachers who did not have electronic components to teach basic electronics was 12. Those who wrote that they did not have adequate content or pedagogical knowledge and skills to teach basic electronics were 2. The number of teachers who said that their challenge was the inability of the students to understand the topic was 2. This could mean that the content was above the level of the students. The teachers who complained of the lack of space to carry out practical activities in basic electronics so as to make the teaching and learning of the topic interesting and rewarding was 2. The lack of computers and projectors to teach the topic was mentioned by one teacher. The number of teachers who had no challenge in teaching basic electronics was one. No teacher mentioned the lack of text books as one of the challenges they face in teaching basic electronics. This might mean that the schools have enough Integrated Science books for the teachers and students.

Many studies have highlighted the importance of teaching with learning materials in the academic achievements of students (Nwike & Onyejegbu, 2013; Okongo, Ngao, Rop, & Nyongesa, 2015; Oladejo, Olosunde, Ojebisi, & Isola, 2011; Olatoye, 2017; Olayinka, 2016). There is a direct relationship between the use of instructional materials and the test score of students (Nwike & Onyejegbu, 2013; Olayinka, 2016). Olatoye (2017) insists that real specimen and videos are the best instructional materials that enhance students' achievement. However, a similar study revealed that the use of improvised instructional materials improves the academic performance of students better than the use of standard instructional materials (Oladejo, Olosunde, Ojebisi, & Isola, 2011). Lack of teaching learning materials could hinder the smooth implementation of the curriculum (Okongo, Ngao, Rop, & Nyongesa, 2015). A study conducted by Edessa (2016) on the impacts of insufficient instructional materials and higher education systems of teaching biology on the qualification of graduates as outputs concluded that, the impact of insufficient inputs of instructional materials and poor education systems resulted in the great gap between theory and practice and that, the competence of many graduates was low and hence many of them became jobless. From the above discussion, we can conclude that the concerns of the teachers are genuine and need urgent attention.

4.2.2 Research Question 2: What practical knowledge do teachers have about basic electronics circuits?

The study revealed that only one teacher from a rural junior high school was able to connect the amplifying circuit presented to the teachers to connect in the presence of the researcher. This points to the fact that over 90% of the teachers lack practical knowledge in basic electronics. Two of the participants did not take part in the connection because it was difficult meeting them in their school. The findings of this study agrees with the outcome of a classic study to determine the knowledge of Ghanaian Junior High Schools science teachers on contextualized science instructions (Ngman-Wara, 2015). He concluded that, a greater number of Ghanaian JHS science teachers lacked both content knowledge and the competencies needed in contextualized science instructions. The study of Adu-Gyamfi and Ampiah, (2016) on the actual teaching process of Integrated Science in some Ghanaian Junior High Schools corroborated with the outcome of this study. They stated among other things that Ghanaian Junior High School science teachers do not usually include the application stage of science lessons delivery. The findings of this study is also similar to that of Osei-Poku and Yeboah (2017), who reported that majority of Junior High School pupils graduate with no practical skills and experience in Basic Design and Technology. This must be a wake-up call to all stakeholders in science education to begin to think outside the box on the innovative measures to employ to improve upon the teaching and learning of science, especially basic electronics in Junior High Schools in Ghana.

Ghana cannot therefore expect any massive innovations in her quest to develop if nothing is done about the training and re-training of science teachers (Anamuah-Mensah, 2004).

4.2.3 Research Question 3: What level of understanding do pupils have about basic concepts in electronics?

The students like their teachers complained about the lack of electronic components in their schools. They claimed that lessons on basic electronics are abstract and boring due to the absence of these components. Many studies have reported the importance of teaching and learning materials in the academic achievements of students (Okongo, Ngao, Rop, & Nyongesa, 2015; Oladejo, Olosunde, Ojebisi, & Isola, 2011; Nwike & Onyejegbu, 2013; Olatoye, 2017; Olayinka, 2016). They therefore find it difficult to understand the topic and have lost interest in studying basic electronics. Some other students pointed accusing fingers at their science teachers for not teaching them basic electronics well. There are many studies on the effect the attitude of teachers has on teaching and learning (Al-Harthy, Jamaluddin, & Nabeel, 2013; Erdamar, Aytaç, Türk, & Arseven, 2016; Kisanga, 2016; Tezci, 2010). A few of the students mentioned that they had no science teacher to teach them basic electronics.

It was however observed that some of the students had some misconceptions about basic electronics. For instance they mentioned electric shock and fire outbreak as challenges they faced in learning basic electronics. The voltages used at this level are low and are not likely to cause fire or any harm to the students. This confirms the findings of Kaulu (2015) who said that many student teachers in University of Zambia has several misconceptions about basic electronics. Teachers are encouraged to identify the misconceptions their students have in studying basic electronics and find solutions to those misconceptions.

None of the students knew the unit of the capacitance of a capacitor. This implies that students do not pay attention to the units of physical quantities. Mustapha, Rahim and Azman (2014) reported that the major challenge technical students faced in using the transistor to solve basic practical problems was that students had limited knowledge in transistors. Teachers should explain to students the importance of units of physical quantities and assist their students to use the units well.

The students when asked to propose solutions to their problems said their schools should be provided with enough electronic components for practical activities. They also said their teachers should be trained on how to teach basic electronics. Some other students wished that teachers who have specialised in teaching basic electronics should go round the schools in the municipality to teach the students. It is evidenced from the suggestions by the students that they want to learn by doing (Hackathorn, Solomon, Blankmeyer, Tennial, & Garczynski, 2011; Park, 2003; Dhanapal & Shan, 2014).

4.2.4 Research Question 4: What assistance could be given to teachers to help them to overcome the challenges they face in teaching basic electronics?

When asked to suggest solutions to their challenges; one teacher wrote about the need for teachers to improvise. This proposition resonates with the recommendation by many studies to use improvised materials in the absence of the real object to teach students (Mboto, Udo, & Utibeabasi, 2011; Eze, 2017; Ifeoma, 2013). Onasanya and Omosewo (2011) insist that standard instructional materials should be used to teach Physics. Since basic electronics is a topic in Physics, actual electronic components should be used to teach basic electronics.

Many of the teachers suggested that stakeholders such as Government, Ghana Education Service (GES), Parents Teachers Associations (PTAs), NGOs among others should supply electronic components to schools. One of the participants proposed that senior high schools in the catchment area should lend some electronic components to the basic schools.

In 1990 the Government of Ghana started the Science Resource Projects. The aim was to enhance the effective teaching and learning of Science in senior secondary schools. By 1995, 110 Science Resource Centres were established across the length and breadth of the country (GES, 2004). As at 2016, 300 schools had benefitted from this project. Though the primary objective of this project was for the benefit of secondary schools, it did not exclude basic schools. Basic schools teachers could therefore make full use of both material and human resources in senior high schools in the Jirapa Municipality. It appears many basic school science teachers in the Municipality are not aware that they could use the laboratories in the senior high schools to enhance their teaching and learning of basic electronics.

The gender of the students who participated in the study is presented in Table 8.

Table 8: Gender and ages of students

Gender	Age/years					Total
	13	14	15	16	17+	
Male	4	7	9	20	26	66
Female	1	12	15	17	50	95
Total	**5**	**19**	**24**	**37**	**76**	**161**

The number of students who were thirteen years old was five; four of whom were boys and one was a girl at the time of the survey. The number of students who were fourteen years old were nineteen; twelve of whom were girls and seven (7) were boys. Those who were fifteen years old were twenty four students comprising nine (9) boys and fifteen (15) girls. The sixteen year old students were thirty seven; twenty being boys and seventeen were girls. The percentage of the students above sixteen years was 52.6 % for girls and 27.1 % for boys.

This may be the result of the students starting school late (they might have entered class one at the age of 8 years or more). The current educational system in Ghana requires that children at the age of six should be in primary one. It could also be that these students were not doing well academically and were therefore repeated in a class for at least two times. Chances are also that some of the girls were withdrawn from school but pressure from the society might have forced their parents to take them back to school. Another factor that could cause the late enrolment of these students is poverty. It is also possible that some of the girls might have dropped out of school for some time due to pregnancy. A study on the factors affecting pupils' enrolment in basic education in Ghana (Mohammed, 2014) identified family income, cultural values and practices as major factors. The study also revealed that late and over age enrolment contributed to drop out rate.

A similar study on factors affecting enrolment to higher institutions of learning in South Africa (Matsolo, Ningpuanyeh, & Susuman, 2018) showed that poverty and unplanned pregnancies were the main contributing factors. Whatever the reasons might be, it is no good news for more than fifty percent of girls sitting BECE to be above the age of 16 years.

The performance of students on their ability to draw electronic circuit symbols is presented in Table 9.

Table 9: Test score of students on circuit symbols of some electronic components

Component	Correct	Wrong
LED	2	159
Power diode/diode	5	156
Inductor	5	156
Capacitor	10	151
Resistor	44	117
Dry cell	67	94
PNP transistor	19	142
Connecting wire	60	101

Only two of the students could draw the circuit symbol of LED. The number of students who were able to draw the circuit symbols of a power diode was five and five students could draw the circuit symbol of an inductor as shown in Table 9. The number of students who were able to draw the symbol for a capacitor was ten while 44 students had the symbol of a resistor right. The number of students who got the symbol of a connecting wire right was 60, 67 students could draw the circuit symbol for a dry cell and 19 students correctly drew the circuit symbol for a PNP transistor.

Pupils are introduced to light emitting diode (LED) in primary two. The pupils are expected to state by word of mouth the parts of an electronic circuit. In primary three pupils begin to study colour coded resistors. They are expected to investigate the behaviour of a resistor in an electronic circuit. Pupils revisit LED but this time pupils are asked to describe the behaviour of a p-n junction diode in an electronic circuit in primary 4. Pupils investigate the behaviour of a capacitor in class 5. Pupils are introduced to the inductor in class 6. Also the circuit symbols of LED, dry cell, connecting wire, inductor and a capacitor are first introduced in this class. Junior High School form one students are supposed to study LED, resistors and capacitors again. In JHS 2 and 3 the students are expected to learn about the transistor.

The number of students who were never taught basic electronic in school was seventeen (10.6%). This means that over 80 % of the students studied the topic in at least one class. What then could be the cause of their poor performance in drawing circuit symbols of electronic components? Bacon and Steward (2006) said that the frequency of knowledge tested in a course has a direct relationship with retention. The more the same knowledge is tested over a period of time the more likely students would remember that piece of information. This means that the students might have never be tested or tested only once on electronic circuit symbols in a term. Klemm (2007) discovered that many students do not do well in school because teachers fail to instruct them on how to memorise. Another study revealed that the learning environment has definite effects on academic achievement (Kandarakis & Poulos, 2008). There may still be other explicit and implicit factors.

Students who might have studied basic electronics in primary 6 or form one might have forgotten what they might have studied. These students might have forgotten because they did not apply the knowledge acquired and hence the information naturally was lost with time. It could also be that, their teachers did not place emphasis on electronic circuit symbols and hence the students did not find it necessary to study the circuit symbols of electronic components. Chances are also that teachers did not effectively teach the topic from primary to JHS. When this happens students may have poor cognition of the concepts in basic electronics in general and electronic circuit symbols in particular. For the 10.6% of students who were never taught basic electronics in basic school, they may have the opportunity to study it when the gain admission into Senior High Schools or when they become apprentices in an electronic establishment.

The test score of students on the functions of some electronic components is presented in Table 10.

Table 10: Test score of students on the function of electronic components

Component	Correct	Wrong
LED	31	130
Power diode/diode	8	153
Resistor	15	146
Capacitor	4	157
Inductor	1	160
Transistor	14	147

Table 10 reveals interesting results. While only two students could draw the circuit symbol for LED, as many as 31 students were able to state the functions of LED. Students knew the function of LED because of its unique ability to emit light. When teachers demonstrate forward biasing using LED, they excite their students and therefore students can easily remember the function of LED. Only five students could draw the circuit symbol for power diode but 8 students knew the function of power diode. It is easy for students to transfer their knowledge in LED to power diode since both are diodes and may share some similar characteristics. In addition, this situation may be a sign of rote learning; where students commit theories and facts to memory without actually understanding those facts or theories. This cannot lead to any meaningful innovation in the electronic world and may therefore not yield much dividend for the nation Ghana. It is hoped that many teachers are conscious of this fact and are making great efforts towards the use of project based learning (PBL).

In PBL the teacher becomes a facilitator and a co-learner thereby empowering the students to be live long learners. The number of students who correctly stated the function of the resistor in an electronic circuit was 15, while 44 of them could draw the symbol of a resistor. The circuit symbol of a resistor is quite easy to draw, therefore the 44 students did not have any problem in drawing the circuit symbol. The resistor is found in all the basic school science text books except in primary one and two. Indeed the function of the resistor was mentioned only in the class three pupils' science text book.

The number of students who were able to state the function of a capacitor was 4 although ten (10) students drew the right circuit symbol of a capacitor. The symbol of a capacitor is not difficult to draw and perhaps the students who were taught the circuit symbol of a capacitor were those who got it right. It was observed that many of the students stated that capacitors store current instead of charges. It must be emphasised that electric current is charges that are in motion. Teachers who teach science are therefore encouraged to point out the difference between electric current and charges to their students. Only one student got the function of an inductor correct. This is not surprising because the students are expected to study inductors only in primary six. Those who were not taught basic electronics in class six might miss out on inductors. The students who stated the functions of a transistor correctly were 14.

This was quite surprising because students were expected to have studied transistors in forms 2 and 3 and could not have easily forgotten the concepts within that short period of time.

The performance of the boys and girls on the functions of electronic components is presented in Table 11.

Table 11: Analysis of students score on the function of electronic components based on gender

Component	Male		Female	
	Correct	Wrong	Correct	Wrong
LED	18	48	13	82
Power diode	4	62	4	91
Resistor	6	60	9	86
Capacitor	3	63	1	94
Inductor	0	66	1	94
Transistor	5	61	9	86

Table 11 indicates the performance of students on the functions of some basic electronic components based on gender. The percentage of the boys who got the function of LED right was 27.3 % while only 13.7 % of the girls correctly stated the function of LED. The percentage of the boys who knew the function of a power diode was 6.4 % while 4.2 % of the girls got the function of power diode correct. With resistors, 9.1 % of the boys and 9.5 % of the girls were able to state the function of the resistor. The percentage of boys and girls who stated the function of a capacitor rightly was 4.5 % and 1.1 % respectively. No boy could rightly state the function of the inductor. Finally, 7.6 % of the boys and 9.5 % of the girls could state the functions of the transistor correctly.

The girls performed better than the boys in stating the functions of a resistor, an inductor and a transistor, however, the boys dominated in stating the functions of LED, power diode and capacitors. The overall percentage pass for the boys was 9.1 % and that of the girls was 6.5 % with a difference of 2.6 %. The difference in percentage pass by the boys and girls is due to their individual brilliance and not their gender. This confirms the assertion that the academic achievement of a student does not depend on the gender of the student (Oladejo, Olosunde, Ojebisi, & Isola, 2011; Nwike & Onyejegbu, 2013; Olayinka, 2016).

The test scores of the boys and girls on circuit symbols of electronic components is presented in Table 12.

Table 12: Analysis of students' scores on circuit symbols of electronic components based on gender

Component	Male		Female	
	Correct	Wrong	Correct	Wrong
LED	1	65	1	94
Power diode	2	64	3	92
Capacitor	5	61	5	90
Resistor	17	49	27	68
Dry cell	31	35	36	59
PNP transistor	10	56	9	86
Inductor	1	65	4	91
Connecting wire	28	38	32	63

The study wanted to determine the knowledge of students in writing electronic circuit symbols. Circuit symbols are mostly used on mother boards of computers and other electronic devices. It is therefore imperative for students to be able to interpret electronic circuits and even built their own. This would enhance their ability to communicate ideas in either analog or digital electronics across the world. Table 12 shows the results of students' ability to draw the circuit symbols of basic electronic components according to their gender. The percentage of boys who were able to draw the circuit symbol for LED was 1.5 % while 1.1 % of girls could do same. The percentage of girls who were comfortable with writing the circuit symbol for power diode was 3.2 % and 3.0 % of boys got that right. It was also evidenced from Table 12 that 7.6 % of boys and 5.3 % of girls got the circuit symbol for capacitors right. A higher percentage of girls (28.4 %) knew the circuit symbol of a resistor than the percentage of boys (25.8 %). The percentage of the boys who had no problem writing the circuit symbol for dry cell was 47.0 % and 37.9 % of girls showed the same understanding. When it came to the circuit symbol of a pnp transistor, 15.2 % of boys had it right, also, 9.5 % of girls got it right. Although no boy got the function of an inductor correct, 1.5 % of the boys were able to draw the inductor's circuit symbol and 4.2 % of the girls showed mastery in drawing the circuit symbol for an inductor. The last component the students were asked to draw was the symbol for a connecting wire. The percentage of boys and girls who drew the right symbol of a connecting wire was 42.4 % and 33.7 % respectively.

The average percentage of boys who were able to draw the symbol of at least one electronic component was 18.0 % and that of the girls was 15.4 % with a percentage difference of 2.6 %. A cursory look at Tables 11 and 12 show that the performance of the students followed almost the same trend. For example the girls had a higher percentage score regarding the resistors and inductors from both Tables. However the variation occurred with the function and symbol of a pnp transistor. About 9.5 % of the girls were able to correctly state the functions of the transistor while 7.6 % of the boys were able to do same. The girls maintained the same percentage when they were asked to draw the circuit symbol of a pnp transistor. The boys, however, increased their percentage pass in their understanding of transistors from 7.6 % in Table. 11 to 15.2 % in Table. 12. In all, the boys had a higher average percentage score than the girls. This may point to a low interest of girls in basic electronics. A careful examination of Tables 11 and 12 show that the understanding of basic concepts in basic electronics by these students was quite shallow. This confirms the findings of Osei-Poku and Yeboah (2017).

4.3 Rural, urban, public and private schools

A rural school in this project is defined as all basic schools outside the Jirapa Township but are within the Municipality. Nine of such schools participated in this project with a total student's population of eighty-one (81). An urban school in this study means a junior high school located within Jirapa town. There were also nine urban schools three of which were private schools. A private school is a school owned by an individual or a group of people but not the government of Ghana. Three private schools with 28 students took part in this survey. Public schools are schools that are owned wholly or partly by the state. The public schools were 15 with a total student population of 133.

The scores of students from rural and urban schools on circuit symbols of some electronic components are presented in Table 13.

Table 13: Comparing performance of students on circuit symbols from rural and urban schools

Components	Scores of students		Scores of students in percentages	
	Rural schools	Urban Schools	Rural	Urban
LED	2	0	2.5	0.0
Power diode	3	2	3.7	2.5
Inductor	4	1	4.9	1.3
Capacitor	3	7	3.7	8.8
Resistor	19	25	23.5	31.3
Dry cell	35	32	43.2	40.0
PNP Transistor	11	8	13.6	10.0

Table 13 compares the scores of students on electronic circuit symbols based on the location of their schools; whether rural or urban. No student from the nine urban schools could draw the circuit symbol of an LED. Incidentally, two students from the rural schools were able to do that. This represented 2.5 % of the students from the rural schools who were the subjects of this study. The number of students who were able to draw the symbol for power diode was three from the rural schools and two from the urban schools. With regard to the symbol of an inductor, four students from the rural schools and only one student from the urban schools got it right. Also, seven students from the urban schools representing 8.8 % of the urban students in this project correctly drew the symbol of a capacitor and three rural students also got the symbol correct. The percentage of students that got the symbol of a resistor right was 23.5 % of the rural students and 31.3 % of the urban students. In addition, 43.2 % and 13.6 % of the rural students understood the symbols of a dry cell and a pnp transistor respectively. However, 40 % of the urban students understood the symbol of a dry cell and 10 % of them could draw the symbol of a pnp transistor. This means that aside the circuit symbols of a resistor and a capacitor, the rural students beat their urban colleagues in drawing the circuit symbols of LED, power diode, dry cell and pnp transistor. This agrees with the findings that, rural students performed significantly better than urban students (Ajai & Imoko, 2013; Weir, Errity, & McAvinue, 2015).

The overall average percentage pass of the rural schools was 13.6 % and that of the urban schools was 13.4 %. This resulted in a percentage difference of 0.2 %. The percentage difference though small, points to the fact that the study of electronics circuit symbols is independent of geographic location. The critical variables are a committed teacher and serious students (Tayyaba, 2012).

The performance of students from rural and urban schools on circuit symbols of some electronic components are presented in Table 14.

Table 14: Comparing scores of students on functions of components from rural and urban schools

Component	Students score		Percentage scores of students	
	Rural schools	Urban schools	Rural schools	Urban schools
LED	9	22	11.1	27.5
Power diode	2	6	2.5	7.5
Resistors	5	10	6.2	12.5
Capacitors	0	4	0.0	5.0
Inductors	0	1	0.0	1.3
Transistors	3	11	3.7	13.8

Although none of the urban students could draw the circuit symbol of an LED, 22 of them stated the function of LED correctly. The number of rural students who got the function of LED right was 9. The number of students who correctly stated the function of a power diode was two from the rural schools and six from urban schools.

Those students who had no problem stating the function of a resistor were five rural students and 10 urban students. No rural student could state the functions of a capacitor and an inductor. The students who knew the functions of the transistor were three rural students and 11 urban students. The overall average percentage score was 3.9 % for the rural schools and the urban schools had 11.3 %. The percentage difference in favour of the urban schools was 7.4 %. The rural students could not match their urban colleagues in stating the functions of electronic components. This might be due to language barrier. Many of the rural students are not able to communicate well in the English Language and could have difficulty in writing their thoughts clearly.

The solution to this challenge was to have set multiple choice questionnaire items. This was however not done because the researcher wanted to eliminate any event of chance. Majority of the urban students had a much better command of the English Language. They therefore had no challenge in stating what they wanted to write. It must however be pointed out that some of the students in the urban schools had the same challenge as their rural friends.

The scores of students from rural and urban schools on circuit symbols of some electronic components are presented in Table 15.

Table 15: Comparing students' scores on circuit symbols in public and private schools

Component	Scores of students		Percentage scores of students	
	Public schools	Private schools	Public schools	Private schools
LED	2	0	1.5	0.0
Power diode	5	0	3.8	0.0
Inductor	5	0	3.8	0.0
Capacitor	10	0	7.5	0.0
Resistor	40	4	30.1	14.3
Dry cell	64	3	48.1	10.2
PNP transistor	19	0	14.0	0.0

Table.15 compared the scores of students' ability to draw electronic circuit symbols in public and private schools. No student from the private schools could draw the circuit symbols of LED, power diode, capacitor and pnp transistor. The percentage of students who rightly drew the symbol of a resistor from the public schools was 30.1 % and 48.1 % of them could draw the symbol of a dry cell. Also, the percentage of students who rightly drew the symbol of a resistor was 14.3 % and 10.2 % of the private students were able to draw the circuit symbols of a dry cell.

The public schools performed much better than the private schools. This results does not agree with studies that private schools perform better academically than public schools (Ahemed, Ahmed, & Butt, 2017; Rong'uno, 2017; Iddi, 2016; Nwafor, 2015; Kivenule, 2015; Adeyemi, 2014). The results also disagrees with Bonsu, 2016 who reported that there was no difference in the academic performance of students in private and public schools. The notion by many Ghanaians that private schools perform better than public schools academically, should be given a second thought.

Efforts should be made to assist both private and government schools to improve upon their teaching and learning of basic electronics rather than tagging them.

The performance of students from public and private schools on the functions of some electronic components are presented in Table 16.

Table 16: Comparing scores of students on functions of components from public and private schools

Component	Scores of students		Percentage scores of students	
	Public schools	Private schools	Public schools	Private schools
LED	28	3	21.1	10.7
Power diode	8	0	6.0	0.0
Resistor	14	1	10.5	3.6
Capacitor	3	1	2.3	3.6
Inductor	1	0	0.8	0.0
Transistor	13	1	9.8	3.6

Table. 16 compares the performance of public and private schools on the functions of electronic components. The percentage of students who correctly stated the function of LED was 21.1 % from the public schools and 10.7 % of the students from the private schools. No student from the private schools could state the functions of a power diode and an inductor. The percentage of students who correctly stated the function of a transistor was 9.8 % from public schools and 3.6 % from private schools. The public schools scored a total percentage average of 8.4 % and the private schools had 3.6 %. The percentage difference was 4.8 %.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.0 Overview

This chapter presents the summary of the major findings, conclusions and some recommendations based on the findings.

5.1 Summary of findings

The purpose of the study was to investigate the teaching and learning of basic electronics in some selected junior high schools in the Jirapa Municipality. The study objectives were to: 1 identify the challenges JHS science teachers face in teaching basic electronics, 2 determine the practical knowledge of teachers in basic electronics circuits, 3 assess the understanding of students on basic concepts in basic electronics and 4 assist teachers to overcome their difficulties in the teaching and learning of basic electronics. To achieve these objectives, interview and questionnaire were used in this study.

The questionnaire was used to collect data from 161 2018 BECE candidates, and 13 science teachers who were preparing the students for the examination. The analysis of the data revealed that the participating schools did not have adequate electronic components for the effective teaching and learning of basic electronics. Also, majority of students did not understand basic concepts in basic electronics. The practical knowledge of the teachers was tested by presenting them with an amplifying transistor circuit to connect. Over 90% of the teachers could not carry out the connection. This showed that majority of the science teachers had low practical knowledge in basic electronics circuit connections.

5.2 Conclusion

It is evidenced from the findings that basic electronics is poorly taught in the study area. This is because a greater number of the teachers did not have sufficient knowledge in electronic circuit connections. The implication is that, their students did not gain adequate knowledge and practice in basic electronics. This resulted in the students' low cognition of the concepts in basic electronics and hence could be a hindrance to further learning. In addition the teachers did not have the opportunity to practice circuit connections because their schools lacked electronic components.

5.3 Recommendations

The following recommendations are made based on the findings from this study and are limited to the study area.

1. The head teachers from the participating schools should use part of their capitation grant to purchase enough electronic components for their schools.
2. The head teachers and their teachers should take advantage of workshops organised on basic electronics by competent organisations in the Municipality.
3. The schools that took part in this study should organise regular quiz competitions on basic electronics for their students.
4. The JHS head teachers should occasionally invite professionals in the field of electronics to their schools to share their knowledge and skills with both teachers and students.

5.4 Suggestion

Further studies on this topic in the study area may be required in order to confirm or otherwise the findings of this study.

REFERENCES

Adebayo, O. O., & Adigun, S. Q. (2018). Impact Of Instructional Aids On Students' Academic Performance In Physics In Secondary Schools In Federal Capital Territory (FCT) Abuja, Nigeria. *European Scientific Journal, 14*(4), 366-376.

Adeyemi, S. B. (2014). Comparative Study of Pupils' Academic Performance between Private and Public Primary Schools. *World Journal of Education, 4*(4), 55-60.

Adu-Gyamfi, K. (2014). Challenges faced by Science Teachers in the Teaching of Integrated Science in Ghanaian. *Junior High Schools. Journal of Science and Mathematics Education, 6*(2), 58-80.

Adu-Gyamfi, k., & Ampiah, J. G. (2016). The Junior High School Integrated Science: The Actual Teaching Process in the Perspective of an Ethnographer. *European Journal of Science and Mathematics Education, 4*(2), 268-282.

Ahemed, S. Z., Ahmed, H. Z., & Butt, M. N. (2017). Comparative Study of Students Academic Performance between Private and Public Higher Secondary Schools of Wah Cantt. *Journal of Education and Practice, 8*(16), 24-26.

Ajai, J., & Imoko, B. I. (2013). Urban and Rural Students' Academic Achievement and Interest in Geometry: A Case-Study with Games and Simulations Method. *Taraba State University Journal of Education Research and Production, 1*(2), 56-63.

Al-Harthy, S., Jamaluddin, S., & Nabeel, A. (2013, September 1). Teachers' Attitudes and Performance : An Analysis of Effects Due to Teaching Experience. *International Interdisciplinary Journal of Education, 2*(9), 889-894.

Alufohai, P. J., & Ibhafidon, H. E. (2015). Influence of Teacher's Age, Marital Status and Gender on Students' Academic Achievement. *Asian Journal of Educational Research, 3*(4), 60-66.

Amadioha, S. W. (2009). The Importance of Instructional Materials in our Schools An Overview. *New Era Research Journal of Human, Educational and Sustainable Development*, 61-63.

Anamuah-Mensah, J. (August 2004). Enhancing the teaching and learning of science and technology for nation building. *GAST Annual Conference.* Sekondi : Ghana. Ansah, M. (2015). GHANA LANGUAGE-IN-EDUCATION POLICY: THE SURVIVAL OF TWO SOUTH GUAN MINORITY DIALECTS. *Per Linguam, 1*, 89-104.

Ansah, M. (2015). Ghana Language-In-Education Policy: The Survival of two South Guan Minority Dialects. *Per Linguam, 1*, 89-104.

Appleton, K. (1995). Student teachers' confidence to teach science: is more science knowledge necessary to improve self-confidence? *International Journal of Science Education, 17*(3), 357-369.

Atta, G. P. (2015). Education Inequality: How Patriarchy and Policy Collide in Ghana. *International Journal of Humanities and Social Science, 5*(7), 11-18.

Bacon, D. R., & Stewart, K. A. (2006). How do Students Forget What they Learn in Consumer Behaviour? A Longitudinal Study. *Journal of Marketing Education, 28*(3), 181-192.

Ball, D. L., & Forzani, F. M. (2009). The Work of Teaching and the Challenge for Teacher Education. *Journal of Teacher Education*, 497-511.

Bayuni, T., Sopandi, W., & Sujana, A. (2018). Identification misconception of primary school teacher education students in changes of matters using a five diagnostic test. *Journal of Physics: Conf. Series*, 1-8. doi::10.1088/1742-6596/1013/1/012086

Bonsu, H. D. (2016). A Comparative Analysis of Academic Performance of Public and Private Junior High Schools in Basic Education Certificate in Sekondi/Takoradi. *European Journal of Basic and Applied Sciences, 3*(1), 21-32.

Buddin,R.,&Zamarro,G.(2010).*https://www.rand.org/content/dam/rand/pubs/reprints/2010/RAND_RP1410.pdf.* Retrieved from www.rand.org.

Bull, A., Gilbert, J., Barwick, H., Hipkins, R., & Baker, R. (2010). *Inspired by Science.* New Zealand: Council for Educational Research.

Chen, G., Wei, D., & Cao, Q. (2015). An Innovation of Teaching Plan About BJT Transistor Amplifier. *International Journal of Advanced Research in Coputer Science & Technology, 3*(2), 220-223.

Chen, Y.-L., Pan, P.-R., Sung, Y.-T., & Chang, K.-E. (2012). Correcting Misconceptions on Electronics: Effects of a simulationbased learning environment backed by a conceptual change model. *Educational Technology & Society, 16*(2), 212-227.

Civan, A., & Coşkun, A. (2016). The Effect of the Medium of Instruction Language on the Academic Success of University Students. *Educational Sciences: Theory & Practice, 16*, 1981–2004.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research Methods in Education.* (6, Ed.) New York: Routledge.

Crawford, B. A. (2007). Learning to Teach Science as Inquiry in the Rough and Tumble of Practice. *Journal of Research in Science Teaching, 44*(4), 613-642.

Creasy, K. L. (2015). Defining Professionalism in Teacher Education Programs. *Journal of Education and Social Policy, 2*(2), 23-25. Retrieved August 18, 2018

Curriculum Research and Development Division (CRDD). (2012). *National Syllabus for Integrated Science (Junior High School).* Accra.

Dasgupta, N., & Stout, J. G. (2014). Girls and Women in Science, Technology, Engineering, and Mathematics: STEMing the Tide and Broadening Participation in STEM Careers. *Policy Insights from the Behavioural and Brain Sciences, 1*(1), 21-29.

Denton, T. (2004). *Automobile Electrical and Electronic Systems.* London: Elsevier Butterworth-Heineman.

Dhanapal, S., & Shan, E. W. (2014). A Study on the Effectiveness of Hands-on Experiments on Learning Science Among Year 4 Students. *International Online Journal of Primary Education, 3*(1), 29-40.

Dodeen, H., Abdelfattah, F., Shumrani, S., & Hilal, M. A. (2012). The Effects of Teachers' Qualifications, Practices, and Perceptions on Student Achievement in TIMSS Mathematics: A Comparison of Two Countries. *International Journal of Testing, 12*(1), 61-77. doi: 10.1080/15305058.2011.621568

Edessa, S. (2016). Impacts of Insufficient Instructional Materials and Higher Education Systems in Teaching Biology. *Natural Science Education, 13*(3), 114-121.

Ekici, E. (2016). "Why Do I Slog Through the Physics?" Understanding High School Students' Difficulties in Learning Physics. *Journal of Education and Practice, 7*(7), 95-104.

Erdamar, G., Aytaç, T., Türk, N., & Arseven, Z. (2016). The Effects of Gender on Attitudes of Preservice Teachers Towards the Teaching Profession: A Metata-Analysis Study. *Universal Journal of Educational Research, 4*(2), 445-456. doi:10.13189/ujer.2016.040219

Ergönenç, J., Neuman, K., & Fischer, H. (2014). The impact of pedagogical content knowledge on cognitive activation and student learning. In H. Fischer, & P. L. Viiri (Eds.), *Quality of Instruction in Physics - Comparing Finland Germany and Switzerland* (pp. 145-160). Waxmann.

Essa, H. A.-G., & El-Zeftaway, A. M. (2015). Teachers' Knowledge, Attitudes and Reported Strategies to Assess and Support the Students with Learning Difficulties. *IOSR Journal of Nursing and Health Science, 4*(2), 79-92.

Eze, P. I. (2017). Effectiveness of Improvisation of Instructional Materials on Students Academic Achievement and Retention in Christian Religious Studies. *International Academic Journal of Innovative Research, 4*(1), 51-57.

Fook, Y. C., & Kaur, S. G. (2015). Investigating Learning Challenges faced by Students in Higher Education. *Procedia- Social and Bahavioral Science*, 604-612.

Gess-Newsome, J., Taylor, J. A., Carlson, J., Gardner, A. L., Wilson, C. D., & Stuhlsatz, M. A. (2017). Teacher pedagogical content knowledge, practice, and student achievement. *International Journal of Science Education*. doi:10.1080/09500693.2016.1265158

Ghana Statiscal Service. (2014). *2010 Population and Housing Census District Analytical Report Jirapa District.*

Hackathorn, J., Solomon, E. D., Blankmeyer, K. L., Tennial, R. E., & Garczynski, A. M. (2011). Learning by Doing: An Empirical Study of Active Teaching Techniques. *The Journal of Effective Teaching, 11*(2), 40-54.

Halder, U. (2018). *English Language Anxiety and Academic Achievement* (Vol. 4).

Hegde, R., Mishra, G., & Gurumurthy, K. (2011, September). Software and Hardware Design Challenges in Automotive Embedded System. *International Journal of VLSI & Comminication Systems (VLSICS), 2*(3).

https://www.researchgate.net/publication/294118825

Iddi, A. (2016). *A Comparative Assessment of the Academic Performance Among Public and Private Junior High Schools in the Tamale Metropolis of Ghana* (Master’s thesis,

Ifeoma, M. M. (2013, October). Use of Instructional Materials and Educational Performance of Students in Integrated Science (A Case Study of Unity Schools in Jalingo,Taraba State, Nigeria). *IOSR Journal of Research & Method in Education, 3*(4), 7-11.

Igiri, C. E., & Effiong, O. E. (2015). Impact of instructional materials in teaching and learning of biology in senior secondary schools in Yakurr LG A. *International Letters of Social and Humanistic Sciences*, 27-33.

Ikwuka, O., & Chukwuemeka, A. (2016). Effect of Improvised Instructional Materials on Senior Secondary Students' Academic Achievement in Mathematics in Oshimili South Local Government Area. *Journal of Science Education and Technology, 3*(1), 69-77.

Iserbyt, P., Ward, P., & Li, W. (2015). Effects of improved content knowledge on pedagogical content knowledge and student performance in physical education. *Physical Education and Sport Pedagogy*, 1-18.

Joye, S. W., & Wilson, J. H. (2015). Professor Age and Gender Affect Student Perceptions and Grades. *Journal of the Scholarship of Teaching and Learning, 15*(4), 126-136. doi:10.14434/josotl.v15i4.13466

Joyonline. (2015, May). Retrieved November 23, 2018, from myjoyonline.com: https://www.myjoyonline.com/news/2015/May-13th/ghana-ranks-bottom-in-latest-maths-science-survey-report.php

Kandarakis, A. G., & Poulos, M. S. (2008). Teaching Implications of Information Processing Theory and Evaluation Approach of learning Strategies using LVQ Neural Network. *WSEAS Transactions on Advances in Enginnering Education, 5*(3), 111-119.

Kaulu, G. (2015, September). Physics student teachers' misconceptions about basic electronics: A case of BSc. Ed and BEDMAS students at UNZA. *International Journal of Multidisciplinary Research and Development, 2*(9), 155-160.

Klemm, W. R. (2007). What Good Is Learning If You Don't Remember It? *The Journal of Effective Teaching, 1*, 61-73.

Klu, K. E., & Ansre, M. A. (2018). An Overview of the Language-in-Education Policy in Ghana: Emerging Issues. *The Social Sciences, 13*(3), 596-601.

Kini, T., & Podolsky, A. (2016). *Does Teaching Experience Increase Teacher Effectiveness? A Review of the Research.* Palo Alto: Learning Policy Institute.

Kisanga, D. H. (2016). Determinants of Teachers' Attitudes Towards E-Learning in Tanzanian Higher Learning Institutions. *International Review of Research in Open and Distributed Learning, 5*, 110-125.

Kim, I., Ward, P., Sinelnikov, O., Ko, B., Iserbyt, P., Li, W., & Curtner-Smith, M. (2018). The Influence of Content Knowledge on Pedagogical Content Knowledge: An Evidence-Based Practice for Physical Education. *Journal of Teaching in Physical Education, 37*(2), 1-35.

Kivenule, G. (2015). *School Performance: A Comparative Study Between Public and Private Secondary Schools in Kinondoni Municipal Council* (Master's thesis, Mzumbe University). Retrieved from http://scholar.mzumbe.ac.tz/bitstream/handle/11192/1759/MSc.HRM_%20Gloria%20 Kivenule_2015.pdf?sequence=1

Kind, V. (2009). Pedagogical Content Knowledge in Science Education: Potential and Perspectives for progress. *Studies in Science Education, 45*(2), 169-204.

Kola, A. J. (2013). Importance of Science Education to National Development and Problems Militating Against Its Development. *American journal of Educational Research*, 225-229.

Kosgei, A., Mise, J. K., Odera, O., & Ayugi, M. E. (2013). Influence of teacher characteristics on students' academic achievement among secondary schools. *Journal of Education and Practice, 4*(3), 76-82.

Küçüközer, H., & Kocakülah, S. (2007). Secondary School Students' Misconceptions about Simple Electric Circuits. *Journal of TURKISH SCIENCE EDUCATION*, 101-115.

Kumar, R. S., & Subramaniam, K. (2015). From 'Following' to Going Beyond the Textbook: Inservice Indian Mathematics Teachers' Professional Development for Teaching Integers. *Australian Journal of Teacher Education, 40*(12), 86-103.

Lee, E., & Luft, J. A. (2008). Experienced Secondary Science Teachers' Representation of Pedagogical Content Knowledge. *International Journal of Science Education, 30*(10), 1343-1363. doi:10.1080/09500690802187058

Li, L. K. (2012). A Study of the Attitude, Sef-efficacy, Effort and Academic Achievement of City University Students towards Research Methods and Statistics. *Discovery-SS Student E-Journal, 1*, 154-183.

Maphoso, L., & Mahlo, D. (2015). Teacher Qualifications and Pupil Academic Achievement. *Journal of Social Sciences, 42*(1-2), 51-58. doi: 10.1080/09718923.2015.11893393

Matsolo, M. J., Ningpuanyeh, W. C., & Susuman, A. S. (2018). Factors Affecting the Enrolment Rate of Students in Higher Education Institutions in the Gauteng Provience, South Africa. *Journal of Asian and African Studies, 53*(1), 63-80.

Mboto, F. A., Udo, N. N., & Utibeabasi, S. (2011). Effects of Improvised Materials on Students' Achievement and Retention of the Concept of Radioactivity. *An International Multi-Disciplinary Journal, 5*(1), 342-353.

Mbugua, Z. K. (2011). Adequacy and the Extend to which Teaching and Learning Resources for Mathematics are Available and used for Achievement in the Subject in Secondary School in Kenya. *American International Journal of Contemporary Research, 1*(3), 112-116.

Mohammad, R. F., & Kumari, R. (2007). Effective Use of Textbooks: A Neglected Aspect of Education in Pakistan. *Journal of Education for International Development*, 1-12.

Mohammed, T. (2014). Factors affecting Pupils' Participation in Basic Education: Evidence from Ghana. *The International Journal Of Humanities & Social Studies, 2*(6), 342-347.

Mtsi, N, & Maphosa, C. (2016). Challenges Encountered in the Teaching and Learning of Natural Sciences in Rural Schools in South Africa. *Journal of Social Science,* 58-67.

Mupa, P., & Chinooneka, T. I. (2015). Factors contributing to ineffective teaching and learning in primary schools: Why are schools in decadence? *Journal of Education and Practice, 6*(19), 125-130.

Mustapha, R., Rahim, Z. L., & Azman, M. N. (2014). Exploring the Probles Faced by Technical School Students in Learning Engineering Courses. *Journal of Engineering Science and Technology, 9*(6), 690-701.

National Research Council. (2007). *Taking Science to School: Learning and Teaching Science in Grades K-8.* Washington DC: The National Acadamies Press.

Nelson, K. G., Mckenna, A. F., Brem, S. K., Hilpert, J., Husman, J., & Pettinato, E. (2017). Students' Misconceptions about Semiconductors and Use of Knowledge in Simulations. *The Research Journal for Engineering Education, 106*(2), 218-244.

Ngman-Wara, E. I. (2015). Ghanaian Junior High School Teachers' Knowledge of Contextualised Science Instructions. *Journal of Curriculum and Teaching, 4*(1). doi:10.5430/jct.v4n1p167

Nilsson, P. (2008). Teaching for Understanding: The complex nature of pedagogical content knowledge in pre-service education. *International Journal of Science Education, 30*(10), 1281-1299. doi:10.1080/09500690802186993

Nomxolisi. M., & Maphosa, C. (2016). Challenges Encountered in the Teaching and Learning of NaturalSciences in Rural Schools in South Africa. *Juornal of Social Sciences*, 58-67.

Nwafor, C. (2013). Comparative Study of Students Academic Performance in Junior Secondary School Certificate Basic Science in Public and Private Secondary Schools in Ebonyi State Nigeria. *Academic Discourse*, 1-15.

Nwike, M. C., & Onyejegbu, C. (2013). Effects of Use of Instructional Materials on Students Cognitive Achievement in Agricultural Science. *journal of*

Educational and Social Research, 3(5), 103-106. doi:10.5901/jesr.2013.v3n5p103

Okhakhu, D. O., Oladiran, M. D., & Omoike, D. A. (2016). Instructional materials as determinants of students' academic performance at the secondary school level In Ikorodu local government, Lagos State, Nigeria. *Journal of Information and knowledge management, 7*(1), 138-149.

Okongo, R. B., Ngao, G., Rop, N. K., & Nyongesa, W. J. (2015). Effect of Availability of Teaching and Learning Resources on the Implementation of the Inclusive Education in Pre-School Centres in Nyamira North Sub-County, Nyamira County, Kenya. *Journal of Education and Practice, 6*(35), 132-141.

Oladejo, M. A., Olosunde, G. R., Ojebisi, A. O., & Isola, O. M. (2011). Instructional Materials and Students' Academic Achievement in Physics: Some Policy Implications. *European Journal of Humanities and Social Sciences, 2*(1), 112-126.

Olasehinde-Williams, F., Yahaya, L., & Owolabi, H. (2018). Teachers' Knowledge Indices as Predictors of Secondary School Students' Academic Achievement in Kwara State, Nigeria. *AFOR Journal of Education, 6*(1), 73-90.

Olatoye, R. A. (2017). Effects of Teaching using Charts, Real Specimen and Video on Scondary School Students' Achievement in Mammalian Skeletal System Concepts. *ENSAYOS, Revista de a Facultad de Educación, 32*(2), 63-75.

Olayinka, A.-R. B. (2016). Effects of Instructional Materials on Secondary School Students' Achievement in Social Studies in Ekiti State, Nigeria. *World Journal of Education, 6*(1), 32-39.

Onasanya, S., & Omosewo, E. (2011). Effect of Improvised and Standard Instructional Materials on Secondary School Students' Academic Performance in Physics in Ilorin, Nigeria. *Singapore Journal of Scientific Research, 1*(1), 68-76.

Ong'amo, B. L., Ondigi, S. R., & Omariba, A. (2017). Effect of Utilization of Biology Teaching and Learning Resources on Students' Academic Performance in Secondary Schools in Siaya District – Kenya. *International Journal of Education and Research, 5*(1).

Osei-Poku, P., & Yeboah, O. B. (2017). Assessment of Teachinf and Learning Activities of Basic Design and Technology in Selected Junior High Schools in Ashanti Region. *British Journal of Education, 5*(6), 1-12.

Owolabi, T. O., & Adedayo, J. O. (2012). Effect of Teacher's Qualification on the Performance of Senior Secondary School Physics Students: Implication on

Technology in Nigeria. *English Language Teaching, 5*(6), 72-77. doi:10.5539/elt.v5n6p72

Özden, M. (2008). The Effect of Content Knowledge on Pedagogical Content Knowledge:The Case of Teaching Phases of Matters. *Educational Sciences: Theory & Practice, 8*(2), 633-645. Retrieved December 2018

Pambid, R. C. (2015, February). Pre-Service Teachers Method of Teaching Science. *Asia Pacific Journal of Multidisciplinary Research, 3*(1), 73-78.

Park, C. (2003). Engaging Students in the Learning Process: the learning journal. *Journal of Geography in Higher Education, 27*(2), 183-199.

Putra, M. J., Sopandi, W., & Widodo, A. (2017). Science Teachers' Pedagogical Content Knowledge and Integrated Approach. *Journal of Physics: Conference Series, 895*, 1-6.

Rollnick, M., Bennett, J., Rhemtula, M., Dharsey, N., & Ndlovu, T. (2008). The Place of Subject Matter Knowledge in Pedagogical Content Knowledge: A case study of South African teachers teaching the amount of substance and chemical equilibrium. *International Journal of Science Education, 30*(10), 1365-1387. doi: 10.1080/09500690802187025

Rong'uno, S. K. (2017). A Comparison of Academic Performancd Between Public and Private Secondary Schools Wareng District, Kenya. *British Journal of Education, 5*(11), 58-67.

Sabri, K., üstünlüoğlu, E., & Aysel, K. (2005). The effect of teaching in native and foreign language on students' conceptual understanding in science courses. *Asia-Pacific Forum on Science Learning and Teaching, 6*(2).

Sánchez-Mena, A., Martí-Parreño, J., & Aldás-Manzano, J. (2017). The Effect of Age on Teachers' Intention to Use Educational Video Games: A TAM Approach. *The Electronic Journal of e-Learning, 15*(4), 355-366.

Şen, M., Öztekin, C., & Demirdöğen, B. (2018). Impact of Content Knowledge on Pedagogical Content Knowledge in the Context of Cell Division. *Journal of Science Teacher Education, 29*(2), 102-127. doi:10.1080/1046560X.2018.1425819

Setyani, N., Suparmi, Sarwanto, & Handhika, J. (2017). Students conception and perception of simple electrical circuit. *Journal of Physics: Conf. Series 909012051*, 1-12. doi::10.1088/1742-6596/909/1/012051

Shulman, L. (1986). Those who Understand: A conception of Teacher Knowldge. *American Educator*, 9-15.

Sikorova, Z. (2011). The role of textbooks in lower secondary schools in the Czech Republic. *IARTEM e-Journal*, 1-22.

Singhal, A. K., Shukla, L., Gupta, A., Iqbal, M., Singh, D., & Gupta, M. K. (2015, September). Solar Electric Powered Hybrid Vehicle. *Journal of Electronic Design Technology, 6*(3), 1-12.

Šorgo, A., & Ambroži-Dolinšek, J. (2009). The relationship among knowledge of, , attitudes toward and acceptance of genetically modified organisms (GMOs) among Slovenian teachers. *Electronic Journal of Biotechnology, 12*(3), 1-13. doi: 10.2225

Tayyaba, S. (2012). Rural-urban gaps in academic achievement, schooling conditions, student, and teachers' characteristics in Pakistan. *International Journal of Educational, 26*(1), 6-26.

Tella, A. (2008, October). Teacher Variables As Predictors of Academic Achievement of Primary School Pupils Mathematics. *International Electronic Journal of Elementary Education, 1*(1).

Tezci, E. (2010). Attitudes and knowledge level of teachers in ICT use: The case of Turkish teachers. *International Journal of Human Sciences, 7*(2), 20-44.

Torres, M. T., & Ballado, R. S. (2014, December). Attitudes Towards Teaching and Work Values of Pre-Service Teacher Education Students. *International Journal of Education and Research, 2*(12), 33-42.

Trotskovsky, E., Sabag, N., Shlomo, W., & Hazzan, O. (2013). Students' Misunderstanding and Misconception in Engineering Thinking. *International Journal of Engineering Education, 29*(1), 1-12.

Udeani, U. (2012). Increasing Female Participation in Science and Technology Careers: Problems and suggested Interventions from Nigeria. *Developing Country Studies, 2*(5), 87-91. Retrieved October 1, 2018

UNESCO. (2010). *Current Challenges in Basic Science Education.* Paris: UNESCO Education Sector.

Voogt, J., & McKenney, S. (2017). TPACK in teacher education: are we preparing teachers to use technology for early literacy? *Technology, Pedagogy and Education,, 26*(1), 69-83. doi:10.1080/1475939X.2016.1174730

Weir, S., Errity, D., & McAvinue, L. (2015). Factors Associated with Educationan Disadvantages in Rural and Urban Areas. *The Irish Journal of Education*, 94-110.

WHO. (2006). *Electronic Health Records Manual for Developing Countries.*

Zeidan, A. H., & Jayosi, M. R. (2015). Science Process Skills and Attitudes toward Science among Palestinian Science Process Skills and Attitudes toward Science among Palestinian. *World Journal of Education, 5*(1), 13-24. doi:10.5430/wje.v5n1p13

APPENDIX A

UNIVERSITY OF EDUCATION WINNEBA

DEPARTMENT OF SCIENCE EDUCATION

QUESTIONNAIRE FOR THE COLLECTION OF DATA ON THE TOPIC:

AN INVESTIGATION INTO TEACHING BASIC ELECTRONICS IN BASIC SCHOOLS IN THE JIRAPA MUNICIPALITY

Questionnaire for Junior High School pupils

Your response to this questionnaire is your contribution to improving the quality of science education in the Jirapa Municipality. Your answers to these questions will be used solely for academic purposes and would be treated with the greatest confidentiality. Thank you for participating.

SECTION A: Background information

Please tick when you find the bracket [ ]

1. Gender: A. Male [ ] B .Female [ ]
2. Age: A.13 years [ ] B.14 years [ ] C.15 years [ ] D.16 [ ] E. 17+
3. Name of school

   ……………………………………………………………………
4. Have you ever been taught basic electronics in school? A. Yes [ ] B. No[ ]
5. In which classes were you taught electronics?

   ....
6. Did your teacher show you the actual electronic components? A.Yes [ ] B. No [ ]
7. Did your teacher connect electronic circuits for you to see? A. Yes [ ] B.No [ ]
8. Did your teacher allow some of you to connect the circuit? A.Yes [ ] B.No [ ]
9. Did your teacher explain to you how the circuit works? A.Yes [ ] B.No [ ]

10. Did your teacher show you any video/ animation on basic electronics? A.Yes [ ] B. No [ ]

11. Has your teacher ever asked you to bring electronic components to school? A.Yes [ ] B. No [ ]

12. Did your teacher tell you where you could get the electronic components? A.Yes [ ] B. No [ ]

13. Do you think you can connect an electronic circuit when you are provided with all the components? A. Yes [ ] B. No [ ] C. Not sure

14. Did you understand the lesson(s) ? A. Yes [ ] B.No [ ] C. Not sure

15. If yes why? ....

16. If no why?

....

SECTION B: Teaching Learning Materials

17. Are the following available in your school?

i. L E D A. Yes [ ] B. No [ ] C. Not sure [ ]

ii. Power diode (Diode) A. Yes [ ] B. No [ ] C. Not sure [ ]

iii. Resistor A. Yes [ ] B. No [ ] C. Not sure [ ]

iv. Inductor A. Yes [ ] B. No [ ] C. Not sure [ ]

v. Transistor A. Yes [ ] B. No [ ] C. Not sure [ ]

vi. Power supply A. Yes [ ] B. No [ ] C. Not sure [ ]

vii. Capacitor A. Yes [ ] B. No [ ] C. Not sure [ ]

viii. Connecting wires A. Yes [ ] B. No [ ] C. Not sure [ ]

ix. Cell case A. Yes [ ] B. No [ ] C. Not sure [ ]

x. Breadboard A. Yes [ ] B. No [ ] C. Not sure [ ]

18. What do you like about basic electronics?

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

19. What problems do you face in learning basic electronics?

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

20. Suggest some solutions to the problems you have stated above

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

SECTION C: Basic knowledge in electronics

21. Draw the circuit symbols of the following

a. LED……………………………………………………………………

b. Power diode (Diode)…………………………………………………

c. Inductor…………………………………………………………………

d. Capacitor………………………………………………………………

e. Resistor…………………………………………………………………

f. Dry cell…………………………………………………………………

g. PNP Transistor…………………………………………………………

h. Connecting wire………………………………………………………

22. What are the functions of the following components in an electronic circuit?

a. LED……………………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

b. Power diode (diode)………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

c. Resistor…………………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

d. Capacitor…………………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

e. Inductor…………………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

f. Transistor………………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

23. The unit for measuring the capacitance of a capacitor is?

…………………………………………………………………………

…………………………………………………………………………

SECTION D: Application

24. State the importance of basic electronics in your daily life.

………………………………………………………………………………

………………………………………………………………………………

………………………………………………………………………………

………………………………………………………………………………

………………………………………………………………………………

………………………………………………………………………………

25. Draw the circuit diagram for a transistor used as a switch in the space below.

APPENDIX B

UNIVERSITY OF EDUCATION WINNEBA

DEPARTMENT OF SCIENCE EDUCATION

QUESTIONNAIRE FOR THE COLLECTION OF DATA ON THE TOPIC:

AN INVESTIGATION INTO TEACHING BASIC ELECTRONICS IN BASIC SCHOOLS IN THE JIRAPA MUNICIPALITY

Questionnaire for Junior High School Science Teachers

Your response to this questionnaire is your contribution to improving the quality of science education in the Jirapa Municipality. Your answers to these questions will be used solely for academic purposes and would be treated with the greatest confidentiality. Thank you for participating.

SECTION A BACKGROUND INFORMATION

Please tick the appropriate bracket

26. Gender: A. Male [ ] B .Female [ ]
27. Age: A.18-20 years [ ] B.21-30 years [ ] C.31-40 years [ ] D.45+ [ ]
28. How many years have you been teaching?

    ....

29. How many years have you taught Science?

    ....

30. Which class(es) do you teach?

    ....

31. What course did you read at SHS/ SSS? A .Arts [ ] B .Science [ ] C .Business [ ] D. Home Economics [ ] E. Agriculture Science [ ] F .Others [ ]. Specify

    …………………………...

32. What is your highest academic qualification? A SSSCE/WASSCE [ ] B.HND [ ] C.BSC [ ] D. Masters [ ] E. Others[ ] Specify

……………………………………………………………..

33. What is your highest professional qualification? A.Cert "A"[ ] B. Dip Ed [ ] C. BEd [ ] D. PGDE [ ] E .Med [ ] F. Others [ ] SPECIFY

……………………………………………

34. Have you ever attended any workshop on basic electronics? A. Yes [ ] B. No [ ]

If no please go to question 13.

35. When did you attend that workshop?

....

36. Who were the oganisers of the workshop?

……………………………………………………………………………………

……………………………………………………………………………………

37. How did the workshop help you in your teaching of basic electronics?.

....

....

....

38. Why?

....

SECTION B: Teaching Learning Materials

39. Which of the following are available in your school? Tick all that apply

a. LED [ ]

b. Power diode (diode) [ ]

c. Capacitor [ ]

d. Inductor [ ]

e. Connecting wire [ ]

f. Switch/key [ ]

g. Cell case [ ]

h. Transistor [ ]

i. Resistor [ ]

j. None [ ]

If you ticked j, why don't you have any of the components above? ………

………

………

………

SECTION C: TEACHING BASIC ELECTRONICS

40. Have you ever taught your pupils basic electronics? A. Yes [ ] B. No [ ]
41. Which class(es) have you taught basic electronics ?A.JHS 1[ ].B. JHS 2 [ ] C. JHS 3 [ ]
42. Do you ask your pupils to bring electronic components to school? A. Yes [ ] B. No [ ]
43. Do you tell your pupils where they can find the components? A. Yes [ ] B. No [ ]
44. Do you show your pupils the actual electronic components? A. Yes [ ] B. No [ ]
45. Do you enjoy teaching basic electronics? A. Yes [ ] B. No [ ] C. Not sure [ ]

    Why? ……………………………………………………………………………..
46. Do you always connect electronic circuits for your pupils to see? A. Yes [ ] B. No [ ]
47. Do you explain to your pupils the functions of each component in the circuits that you connect? A. Yes [ ] B. No [ ]
48. Do you allow some of your pupils to connect the circuits? A. Yes [ ] B. No [ ]
49. How did you grade your pupils' understanding after teaching them basic electronics?

    A. Excellent [ ] B. V Good [ ] C. Good [ ] D. Fair [ ] E. poor [ ].
50. State the importance of teaching your pupils basic electronics

    ………………………………………………………………………………

    ………………………………………………………………………………

    ………………………………………………………………………………

51. Which of the following do you consult before teaching basic electronics? Tick all that apply.

a. Integrated Science Syllabus [ ]

b. Integrated Science text book [ ]

c. Internet [ ]

d. Resource persons [ ]

e. pamphlets [ ]

f. Others [ ]

Specify………………………………………………….

52. What problems do you face in teaching basic electronics?

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

53. Suggest some solutions to the problems you have stated above

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

SECTION C: BASIC KNOWLEDGE IN ELECTRONICS

54. Draw the circuit symbols of the following

i. LED……………………………………………………………………

j. Power diode (Diode)…………………………………………………

k. Inductor………………………………………………………

l. Capacitor……………………………………………………

m. Resistor……………………………………………………………

n. Dry cell……………………………………………………………………

o. PNP

Transistor………………………………………………………………

p. Connecting

wire……………………………………………………………

55. What are the functions of the following components in an electronic circuit?

g. LED……………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

h. Power diode

……………………………………………………………………………

i. Resistor……………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

j. Capacitor…………………………………………………………………

……………………………………………………………………………

k. Inductor…………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

l. Transistor………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

56. The unit for measuring the capacitance of a capacitor is?

………………………

SECTION D: APPLICATION

57. Draw the circuit diagram for a transistor used as a switch in the space below.

APPENDIX C

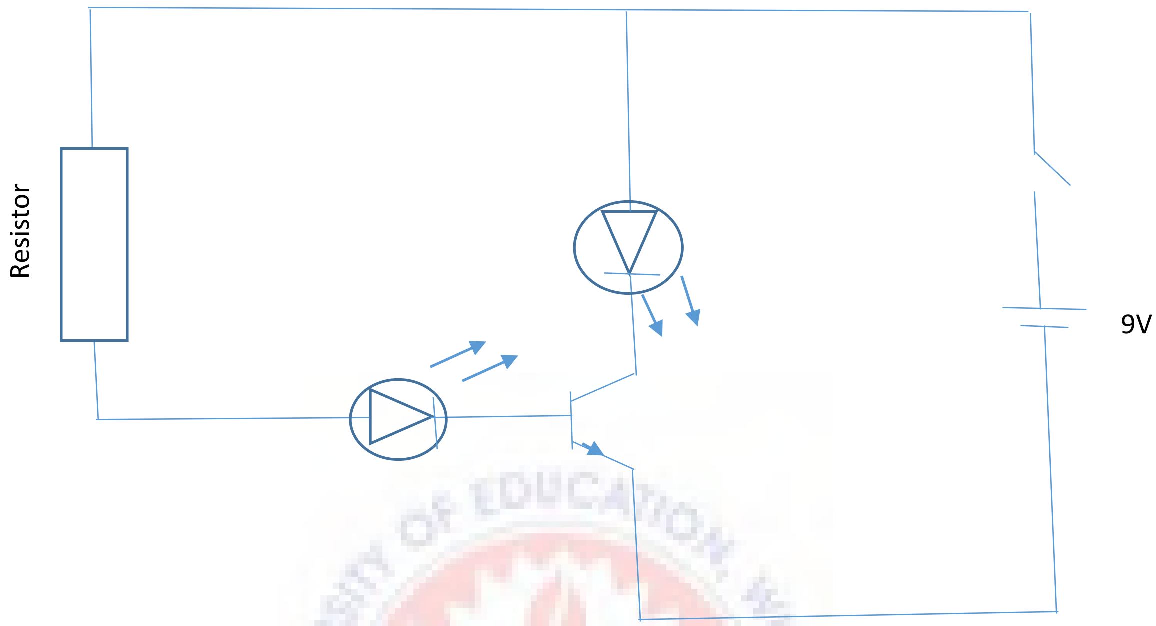

Fig 1: An amplifying transistor circuit