UNIVERSITY OF EDUCATION, WINNEBA

IMPACT OF IN-SERVICE TRAINING ON JUNIOR HIGH SCHOOL SCIENCE TEACHERS' SELF- EFFICACY BELIEFS AND CONTENT KNOWLEDGE COMPETENCIES IN BASIC ELECTRONICS IN KASSENA NANKANA MUNICIPAL

OSCAR KUBIRIZEGAH ABAGALI

2015

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A Thesis in the Department of Science Education, in the Faculty of Science Education submitted to the School of Graduate Studies, University of Education, Winneba, in partial fulfilment for award of Master of Philosophy (Science Education) degree.

OCTOBER, 2015

DECLARATION

STUDENT'S DECLARATION

I, OSCAR KUBIRIZEGAH ABAGALI, declare that this thesis with the exception of the 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 ....

(Candidate)

SUPERVISORS' DECLARATIONS

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.

Signature .... Date ....

Principal Supervisor: Dr. Victor Antwi

Signature .... Date ....

Supervisor: Dr. Ishmael K. Anderson

ACKNOWLDEGEMENT

I want to thank Dr. Victor Antwi the principal supervisor of this study for his timely, genuine concern, brotherly advice and meticulous guidance to bring to fruition this research study. I owe lots of gratitude to Dr. Ishmael Kwesi Anderson for continuously influencing my conscience toward credible presentation of the work. In addition, I extend my deepest gratitude to Dr. Ernest I. D. Ngman-ara for carefully revisiting every work piece I put on paper and converting pieces of data into useful research information. Another person of worthy recognition is the Headmistress of Navrongo Senior High School, Madam Francisca Yizura, whose encouragement gave me the morale strength towards completing this study.

I am very grateful to my late father; retired RSM Abagali John, who invested into this study but did not live to witness its attainment. I extend much appreciation to my children, maam Bridget Tipura Abagali, uncle Timothy Akansor (and his family), all siblings and friends who invested into the study.

I further express my sincere gratitude to Mrs. Cynthia Anyana of Bencyn Pharmacy Ltd., and Lardi kanchesi all in Navrongo for their support towards financing the JHS science teachers‟ workshop for this research study.

To fellow Master of Philosophy students, Peter Krah, Rukaya R. Bawure, and Dorsah Philip, I am very grateful for all your encouragement and support. To all and sundry who contributed in diverse ways to make this research study a success, I express my deepest gratitude to you.

DEDICATION

I dedicate this work to my late father Abagali Anyagri John (RSM retired)

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ABBREVIATIONS

GES – Ghana Education Service

ICT4AD - Ghana ICT for Accelerated Development

IN-SET - In-Service and Educational Training

JHS – Junior High School

JSS – Junior Secondary School

KNM – Kassena Nankana Municipal

KNWD – Kassena Nankana West District

MESTI - Ministry of Environment Science Technology and Innovation

MOE – Ministry of Education

MOESS – Ministry of Education Science and Sports

MOEYS - Ministry of Education Youth and Sports

MTI - Ministry of Trade and Industry

NDPC - National Development Planning Commission

NPN – Negative- Positive – Negative

PNP – Positive – Negative –Positive

SHS – Senior High School

SSS - senior Secondary School

WASSCE – West African Senior Secondary Certificate Examination

ABSTRACT

Many students with good favourable attitudes and high interest in science soon see these qualities eroded by their experience of school science; some resulting from science teachers" low level of content knowledge, poor methods of teaching and exhibition of low levels of self-efficacies. One topical area in science content that Junior High Schools (JHS) science teachers" exhibit lack of interest and poor attitudes is in JHS basic electronics. This is because many of them did not receive adequate tuition in basic electronics during pre-service and in-service training programmes. This study therefore, was to determine the level of influence that in-service training workshop have on JHS science teachers" self-efficacy beliefs and content knowledge competencies towards JHS basic electronics. The study involved 7 females and 39 males JHS science teachers in Kassena Nankana Municipal. Two sets of data were collected, one in December 2014 and another in January 2015, using pre-workshop questionnaires and post-workshop questionnaires respectively. Each data was a measure of these JHS Science teachers" self-efficacy beliefs and content knowledge competencies towards JHS basic electronics. The two sets of data were analysed qualitatively and quantitatively; using inferential t-test analysis for paired (dependent) samples. The findings of the study showed that before the in- service training science teachers had moderate self-efficacy beliefs towards basic electronics but developed high self-efficacy beliefs towards basic electronics after the in-service training. The study further showed that, after the in-service training JHS science teachers" had a high content knowledge competencies as compared to the low content knowledge competencies exhibited before the in-service training. Again, the difference in post-workshop and pre-workshop content knowledge competencies is statistically significant ($t(45) = 16.477$, $p = 0.000$). Nonetheless, there was a weak correlation

between science teachers‟ post-workshop self-efficacy and post-workshop content knowledge competencies (r = 0.0257, p = 0.287). The findings suggests that regular and continual in-service training targeting specific sensitive challenging content areas in JHS basic electronics can assist teachers to develop coping abilities to teach that content area and meet the specific task needs of pupils. Therefore, JHS science teachers‟ education programs should promote continual teacher development in basic electronics to meet teachers‟ performance and pupils‟ achievement needs.

CHAPTER ONE

INTRODUCTION

Overview

This chapter includes the background to the study, the statement of the problem, the purpose and objectives for the study, research questions and hypothesis as well as the significance of the study. Limitations, delimitations of the study, and the operational definitions of terms used in the study are also considered. The chapter ends with the organisation of the study.

Background to the Study

Electronics engineering, information and communications technology (ICT) and electronic systems appear to have drastically changed the mode of storage, retrieval, transmission and reception of information. It is also seen to have changed the outlook of all sectors of engineering, industries, transportation and modern development of goods and services. Other areas that electronics studies appear to have impacted also include alternative energy sources, human security and natural safety, health and agro business (Bandura 2009; Held, 2001; Jabdar, n.d; Synder, 2003; Vodovozov, 2010).

Also, modern information technology and educational technology are seen to have transformed the global educational system to the extent that students are expected to exercise greater personal control over their own learning via electronic route through the World Wide Web (www) internet such as e-libraries, museums, and multimedia instruction regardless of their geographical position (Bandura, 1999, 2001; Held, 2001). There is therefore the likelihood that "people fluent with information technology" (Synder, 2003), knowing how to process and evaluate this information would be vital for “knowledge construction and effective functioning” (Bandura, 1999).

The Government of Ghana recognising the benefits that the citizenry and the economy could derive in the studies of basic electronics and ICT, initiated the ICT policy through the Accelerated Development [ICT4AD] policy, ICT in Education Policy and the ICT policy for trade and industry (Republic of Ghana, 2003; Ministry of Education, Science and Sports [MOESS], 2006; Ministry of Education [MOE], 2008; Ministry of Environment, Science and Technology [MOEST], 2009; Ministry of Youth and Sports, 2010; National Development Planning Commission [NDPC], 2010; Ministry of Trade and Industry, 2011).

In order for the MOESS to implement the ICT4AD policy goals on education (MOESS, 2006), ICT and basic electronics were included in the 2007 curricula of the Junior High School (JHS) and Senior High School [SHS] (MOESS, 2007a, 2007b). The two curricula aimed at ensuring that every Ghanaian pupil/student acquired general technological and scientific literacy necessary for their personal use and the economic needs of Ghana"s modern industrial market development (MOE, 2012b, MOESS, 2007a).

As a result of the inclusion of the basic electronics in the JHS science syllabus, the Ghana Education Service (GES) developed a quasi-specialist syllabus in Science for pre-service teacher trainees in the designated Science and Mathematics Colleges of Education in Ghana. However, this quasi-specialist science syllabus had no content items on basic school electronics (Ghana Education Service, 2007). Therefore, an inference could be drawn that many of the science teachers trained on this quasi-specialist syllabus, including those from the Kassena Nankana Municipal (KNM), could face challenges in teaching JHS basic electronics. Again, it could be presumed that the challenges teachers face in using the former JHS science syllabus (MOE, 2007a) led to a release of a revised JHS science syllabus (MOE, 2012b) in which the revised content on the basic electronics is made much more easy-to-teach.

However, analysis of the integrated science syllabuses used in the JSS/JHS and SSS/SHS before and after the 2007 Ghana education reforms (MOE, 2001; 2003a; 2003b; 2010a; 2010b; MOESS, 2007a; 2007b; 2008) seem to reveal that the current JHS science teachers should have learnt some content of JHS basic electronics. Nonetheless, casual interactions with some of the JHS science teachers in the KNM indicated that most of them had not read General Science or Agricultural Science programme. Thus, some of the JHS science teachers expressed sentiments of inadequacy in content knowledge in teaching some physics topics in the JHS integrated science programme. Also, some of these science teachers acknowledged that they could not teach some topics in the basic electronics at JHS. Upon further inquiry, it was realised that the KNM Education directorate had organized several institutionalized school-based in-service (SBI) or clustered-based in-service (CBI) training for the development of professional competencies of Primary school teachers (Ghana Education Service, 2012). However, the JHS science teachers have not been offered these institutionalised and regular in-service training (IN-SET) opportunities (Ghana Education Service, 2015; MOE, 2012a).

Nonetheless, the officers in charge of training and supervision in the KNM Education Service directorate indicated that they had organised few IN-SET workshops to develop the professional capacity of many JHS teachers in the Municipality. These workshops were meant to assist JHS teachers to teach the core subjects (mathematics, English language, social studies and integrated science) as required of the 2007 Ghana

Education reforms. However, the officers did indicate that the workshops could not provide the teachers the benefit of tuition on JHS basic electronics due to lack of resource persons.

Therefore, some of the JHS science teachers who might be seen teaching basic electronics might do so using prior knowledge gained from pre-tertiary education and others sources of self-motivational learning characterized by their self-efficacy beliefs; the "I too, can do it" philosophy (Bandura, 1977, 1986, 1999; Pajares, 1996; Schunk & Pajares, 2001). Self-efficacy beliefs could probably play some roles in teachers" teaching effort; as some JHS science teachers in KNM did not read General Science nor its related programmes at the SHS/SSS, Colleges of Education or in the Universities.

In order to ascertain whether the science teachers teach the practical aspects of basic electronics, the Researcher made some preliminary visits to some JHS in Navrongo, the capital town of the Kassena Nankana Municipality in the Upper East Region of Ghana. The visit was to find out from the teachers about the availability of any teaching and learning materials (TLMs) which are used in science lessons in basic electronics. However, some of the JHS science teachers did not have TLMs on basic electronics whilst others said they had sent the TLMs back to their houses after the lessons. Conversely, many of the JHS science teachers who said they had taught basic electronics could not produce documented evidence of schemes of work on basic electronics. Nevertheless, from the lesson notebooks I observed on my visit to some of the JHS indicated that some of the JHS science teachers might have organised good theoretical basic electronics lessons with their pupils.

Statement of the Problem

In order to be abreast with the world‟s trends in modern technological development, basic electronics was introduced into the basic schools‟ science curricular during the Ghana Education reforms in 2007 (MOESS, 2007a). However, in 2012 the Junior High School (JHS) integrated science syllabus was reviewed, especially the contents of the basic electronics (MOE, 2012b). On the other hand, oral interactions with some JHS science teachers in the KNM revealed that many of them have not received any or adequate IN-SET to develop their capacity to teach basic electronics at the JHS. Therefore, many of these teachers expressed disbeliefs and misgivings about their ability to deliver lessons, especially handling practical activities, on some topics of the JHS basic electronics as required by the JHS integrated science syllabus (MOE, 2012b).

It is believed that teachers who strengthen their knowledge base are better prepared to teach (Liceaga, Ballard & Esters, 2014). According to the social cognitive theorist Bandura (1999), "people are not only knowers and performers; they are also self-reactors with the capacity to motivate, guide and regulate their activities" (p27). Therefore, many of the JHS science teachers who did not have any IN-SET on JHS basic electronics for some time now may find ways of developing their own capacity to teach topics on it. Also, some JHS science teachers‟ drive for self-development towards basic electronics could stem from the current high rate at which pupils and teachers alike, are exposed to modern electronic and computerized technologies. Again, some JHS science teachers‟ are of the view that when they possess sufficient content knowledge in basic electronics it was possible to reinforce pupils‟ knowledge to appreciate the nature of electronic devices, understand how to maintain and reduce risks involved in using electronic devices. It was also possible that some JHS science teachers knew that possessing adequate content knowledge had the possibility of exposing more JHS pupils to good quality tuition on basic electronics. It could further be a motivation to these pupils to consider careers in the field of electronics (MOE, 2012b). Hence, the Researcher‟s observation of some JHS science teachers in KNM expressing sentiments of misgivings and disbeliefs in their capacity to teach topics on basic electronics could not have been out of place, when they were not given any formal education on it.

However, among the factors that motivate teachers to engage in self-learning is self-efficacy beliefs which are known to influence teacher‟s choice of task, level of input of effort, ability to persist, degree of resilience and level of achievement (Bandura, 1997, 1999; Schunk & Pajares, 2001). Studies have further shown that teachers who possess high personal self-efficacy beliefs towards certain academic tasks, subject content knowledge and skills, are more successful in executing them in collaborative classroom environments and management (Bandura, 1986, 1993, 1997; Pajares, 1996; Schunk & Pajares, 2001).

Also, according to Bandura (1999) and McGuire (2011, citing Pajares, 2006), the determinants of the triadic reciprocal causation model (Bandura, 1986) such as the social environment, the individual‟s personality and the person‟s modes of behaviour interact to influence one another bidirectionally to shape and control behaviour. The interactions of reciprocal causality factors enable people to also act as products (of knowledge) and producers (of knowledge) of social systems. Hence, it is within these three determinants that teachers can interact to increase their self- efficacy beliefs and content knowledge as social beings in a collaborative environment which could be offered by a well organised science IN-SET workshop. Again, in light of the concept of social collaborative environment many educational programmes were disseminated to learners in controlled and collaborative IN-SET workshop environments (Ministry of Education, Youth and Sports, 2004; UNESCO, 2006).

Some studies have shown that in-service training workshops are supposed to serve as fertile grounds for collaborative social-cognitive learning (Bandura, 1997, 1999). However, as to how much influence IN-SET workshops have on initiating, sustaining and influencing JHS science teachers‟ self-efficacy beliefs towards basic electronics and its content knowledge acquisition in Kassena Nankana Municipality had not been documented. It is also known that self-efficacy beliefs expectations have influence on teachers‟ desire to acquire content knowledge competency as well as sustain their motivation to learn new tasks (Asabere-Ameyaw, 2008; Bandura, 1997; Elliott, Kratochwill, Cook, & Travers, 2000; Passer & Smith, 2004). Again, the extent to which JHS science teachers‟ engagement in IN-SET workshops influence their content knowledge competencies (CKC) in basic electronics in relation to self-efficacy beliefs in Kassena Nankana Municipality is not adequately documented. These inconsistent issues make this study pertinent in finding out the extent to which in-service training workshop could influence JHS science teachers‟ self-efficacy beliefs and content knowledge in basic electronics in JHS of KNM. Thus, in the light of these unanswered queries, the study is focused on assessing the impact of in-service training workshop on JHS science teachers‟ self-efficacy beliefs and content knowledge competency in basic electronics in JHS of KNM.

Justification for the Study

This research study attempts at knowing how best the role of JHS science teachers‟ self- efficacy beliefs influence their content knowledge competency towards basic electronics in JHS of the KNM. The study also focused on how JHS science teachers‟ self-efficacy beliefs were likely to determine their behaviours within the classroom;

hence, the delivery of basic electronics lessons (Bandura, 1997; Elliott et al., 2000). It is of further interest to know that JHS pupils needed foundation knowledge of basic electronics to pursue further studies/engineering courses in electrical and electronics and ICT at the SHS, Technical and Vocational institutions, Polytechnics, and Universities. Therefore, any research that seeks to identify the strengths and weaknesses of teaching and learning basic electronics at basic schools under Ghana Education Service should be of great interest to individuals, stakeholders of education, industry, entrepreneurs and/or the Government of Ghana.

Purpose of the Study

The purpose of this research was to investigate the impact of in-service and educational training (IN-SET) workshop on JHS science teachers‟ self-efficacy beliefs and content knowledge competency in JHS basic electronics.

Assumptions of the Study

The following assumptions were made that:

1. the entry level of competence in teachers‟ pedagogical knowledge is same for JHS science teachers since they have had training and school mentorship in teaching. Hence, it is expected that these teachers could apply many teaching strategies in any style of teaching.
2. almost all current JHS science teachers attended SSS/SHS and Colleges of Education hence they have some basic knowledge in teaching JHS basic electronics.
3. all JHS science teachers are matured enough and likely to have the self-worth for improving self-efficacy beliefs and content knowledge competencies.

4. each JHS science teacher, as much as possible, should be able to carry out independent hands-on activities (first-hand experiences), observe, read and record data in workshop manuals when given the opportunity.
5. each JHS science teacher would exhibit some fair and trustworthy self-assessment of themselves to obtain credible data.

Objectives of the Study

The objectives that guided the study were to:

1 ascertain the differences in the levels of self-efficacy beliefs of the JHS science teachers in basic electronics before and after an IN-SET workshop.

2 determine the differences in the JHS science teachers‟ content knowledge competencies in basic electronics before and after an IN-SET workshop.

3 determine the relationship between the JHS science teachers‟ self-efficacy beliefs and the content knowledge competency in basic electronics after an IN-SET workshop.

Research Questions

The research study focused on these research questions:

1. What are the differences in JHS science teachers‟ self- efficacy beliefs towards basic electronics before and after an IN-SET workshop?
2. What are the differences in JHS science teachers‟ level of content knowledge competencies in basic electronics before and after an IN-SET workshop?
3. What is the relationship between JHS science teachers‟ self-efficacy beliefs and content knowledge competency in basic electronics after an IN-SET workshop?

Research Hypothesis

H_1: There is no significant difference in the JHS science teachers" self-efficacy beliefs towards basic electronics before and after an IN-SET workshop.

H_2: There is no significant difference in the JHS science teachers" content knowledge competency in basic electronics before and after an IN-SET workshop.

H_3: There is no relationship between JHS science teachers" self-efficacy beliefs and content knowledge competency in basic electronics after an IN-SET workshop.

Significance of the Study

1. It is expected that the IN-SET workshop would improve JHS science teachers" content knowledge and thereby develop pragmatic skills in teaching basic electronics.
2. The JHS pupils are likely to benefit from quality teaching and learning of both theory and practical skills in basic electronics from JHS teachers.
3. It is envisaged that when the findings of this study are made accessible to stake-holders of education in the KNM Education Directorate resources may be provided to constantly organise IN-SET workshops on basic electronics for successive newly trained JHS science teachers.

Delimitation of the Research

Delimitations are choices made by the researcher to set boundaries or scope for the study (Dusick, 2011). It also defines the parameters of the investigation such as the population and sample, treatment(s), setting, and instrumentation (Dusick, 2011).

This study was focused on only JHS integrated science teachers in Kassena Nankana Municipality because the Researcher had some prior oral interactions with some of the JHS science teachers that enabled him to obtain some prior information about JHS science teachers‟ challenges and attitudes toward teaching JHS basic electronics. Again, JHS science teachers under the same Education Directorate were likely to have similar school conditions and educational/curricula logistics support.

However, to enable the Researcher provide adequate supply of basic electronics resource materials for hands-on activities, forty-six JHS science teachers (7 females and 39 males), were selected out of 41 JHS. There were fifty-three (53) JHS science teachers in KNM as at the period of the study (2014/2015 academic year).

Again, the context of the study was based on the content topics of Years 1 and 2 basic electronics of the JHS integrated science syllabus (MOE, 2012b). Therefore, generalizing the findings to other JHS integrated science content and JHS environments could be done with caution.

Limitations to the Study

Limitations are the potential weaknesses or challenges identified with the study which the researcher cannot control (Ellis & Levy, 2009, as citing Creswell, 2005) even though these weaknesses are likely to place restraints on the methodology used and conclusions to be drawn (Dusick, 2011). Again, Ellis Levy (2009) envisaged limitations as essential factors that constrain the extent to which findings of a study could be generalized to other situations in a field of research.

1. The Researcher developed the questionnaires and the JHS science teachers‟ workshop manual and was also the facilitator for the IN-SET workshop. There was therefore, the likelihood of introducing bias into the selection of the

content material and mode of instruction during the workshop. Nonetheless, the Researcher was very objective to ensure maximum credibility in the data collected.

2. Some of the teachers in the study still might not express honest reflections of their self-efficacy beliefs and content knowledge competencies in answering some items of both questionnaires. This could also affect the results of the study in one way or the other.

Operational Definitions

1. **Discrete Electronic (circuit) components**: these are the simple basic isolated units that are interconnected together by wires (conductors) to form a closed loop(s) of circuit(s). Examples are the resistors, capacitors, rectifier diodes, connecting wires, bipolar transistor, coiled wire inductors, light emitting diode.
2. **Electronic circuit**: this comprises correct interconnection of electronic circuit components in a loop formation to allow current flow and appropriate exhibition of components characteristics in a closed (switched on) or opened (switched off) circuit states.
3. **Integrated science teacher:** any teacher who was teaching integrated science at the JHS at the time of this study.
4. **In-Service and Educational Training (IN-SET) workshop** – a framework that successfully helps to bring people together in a common venue to undergo training that assists them to model conceptual insights and practices with feedbacks to build proficiency (Satterfield, 2007).

Organisation of the Research

The research entails five main chapters. In chapter 1, the introduction of the situational analysis that necessitated the need for the study was described. In the second chapter, previously related research literature needed to direct the theoretical and conceptual frameworks for the research was reviewed. In addition, how the data was collected and analysed is explained in chapter three, whereas in chapter four the collected data, how it was coded and analysed was described. The analysed data was presented in tables, graphs and charts with explanations. Again, the chapter five presents the findings of the research, the suggestions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

Overview

The literature review identified some related research works that give exposition to the concepts of teacher self-efficacy beliefs, competencies and content knowledge competencies, as well as teacher capacity and professional development through in-service training. The review further explored related research literature on the relation between self-efficacy beliefs, and content knowledge acquisition and the role of in-service workshops in promoting such relationships. Also a literature on some scope of content knowledge JHS science teachers‟ needed in order to teach basic electronics and some scales used in measuring self-efficacy beliefs were also discussed.

Theoretical Framework of the study

The theoretical framework of this study was based on Albert Bandura‟s social-cognitive learning theory of self-efficacy beliefs (SEB) and reciprocal determinism model in developing SEB towards learning (Bandura, 1977; 1986; 1993; 1997, 1999). The research also relies on in- service and education training (IN-SET) as means of improving teachers‟ competency and continual professional development (Satterfield, 2007; Jahangir, Saheen & Kazmi, 2012).

An IN-SET–SEB model developed by the researcher shown in Fig. 2.1, on pages 15, indicates the relationship between IN-SET as a social environment that will enable teachers interact with the four sources of information to build their self-efficacy beliefs (Bandura, 1977) and content knowledge competency (CKC) in JHS basic electronics. The researcher believes that a well organised IN-SET workshop can draw at a time any two of the sources of information bidirectionally to interact effectively (Bandura, 1999) on the science teacher to develop a specific self-efficacy belief towards improving his/her competence in specific content knowledge in JHS basic electronics.

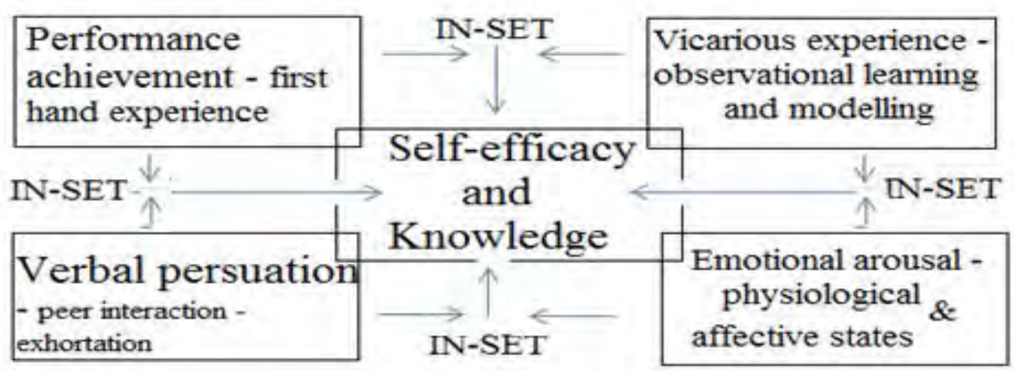

Figure 2.1: IN-SET to Promote Self-Efficacy Beliefs (adapted from Bandura, 1977, in Passer & Smith, 2004)

Also, it is expected that IN-SET workshops for JHS science teachers will encourage effective social interactions among teachers and the workshop facilitator. In this study, the JHS science teacher will interact with the hands-on activities kits to promote first hand experiences and performance achievement. They can also interact with the „facilitator" or „peers" and through verbal persuasions, encourage them to improve on their content knowledge competence and self-efficacy beliefs. Again, the JHS science teachers can be inspired emotionally through complementary (friendly) support from the facilitator or peers to develop high self-efficacy beliefs that they can also learn/teach basic electronics. It is further presumed that the motivational effect of socially mediated SEB developed through workshops could hasten JHS science teachers" capacity to develop content knowledge competence in basic electronics.

Again, the science teacher has the opportunity to gain knowledge by vicarious experience through observing, modelling or role mimicking of workshop activities performed by the facilitator and peers. Although vicarious experiences "are generally weaker than direct ones, vicarious forms can produce significant enduring changes through their effects on performance" (Bandura, 1986, 1999). Therefore, an IN-SET workshop which aims at developing performance skills of JHS science teachers in basic electronics could be promoted through vicarious learning.

Reciprocal Determinism Factors that strengthen self-efficacy beliefs

Bandura (1981, 1986, as cited in Feldman, 1995) proposed a model called reciprocal determinism in which the social environment affects people"s personality just as people"s behaviours and personalities produce feedbacks that modify the social environment in a web of bidirectional reciprocity (Bandura, 1999; Pajares, 1996; Elliott et al., 2000). Albert Bandura, the cognitive theorist also postulated that Self-efficacy beliefs which are critical indicators of human achievements depend largely on interactions between one"s behaviours, personal factors (e.g., thoughts, beliefs) and the social environment; which could be structured, imposed or selected (Bandura, 1986, 1997, 1999; Schunk & Pajares, 2001).

Consequently, to acquire self-efficacy beliefs, it is recommended that the appropriate, contextual, socio-material resources and physiological environments are provided to facilitate the socio-cognitive processes of self-efficacy beliefs and task competencies in individuals. A report on a study carried out by Tschannen-Moran and Woolfolk Hoy (2007, as cited in Gür, Çakiroğlu & Çapa-Aydin, 2012) indicated that more novice in-service teachers" senses of self-efficacy beliefs were influenced by some contextual factors in their (school) environment. These were availability of teaching and learning resources, support from parents, principals, mentors and colleagues. They also realised that whenever there was a drastic change in teaching tasks such as instructional methods, teaching resources and teaching environment there was an equivalent change in the in-service teachers" self-efficacy beliefs, too.

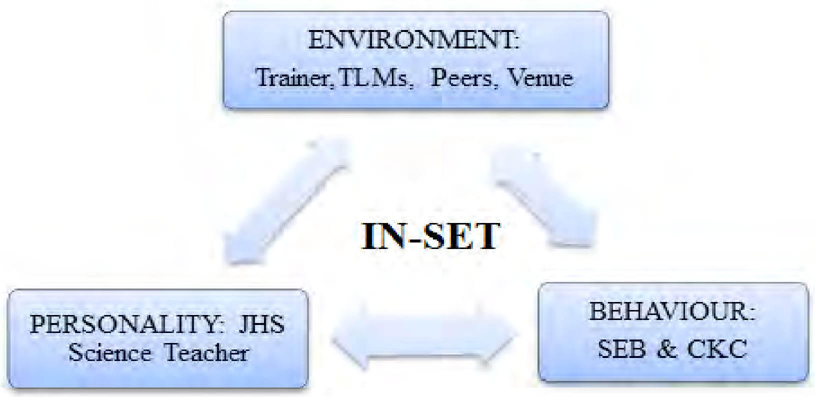

Figure 2.2: IN-SET in Reciprocal Determinism Triadic Cycle (adapted from Pajares, 1996).

The Bandura"s reciprocal determinism model framework (Bandura, 1986, as cited in Pajares, 1996) shown in Figure 2.2 was adapted for this study by including IN-SET workshop as an axle to propel interactions between the determinants of the Triadic Cycle. In this model a well organised IN-SET workshop should promote the interplay of personality factor (personal disposition), environment (models – facilitator/peers and kit materials) and behaviour patterns (content knowledge competency and self-efficacy beliefs) in the triadic cycle (Bandura, 1986, 1999). With this model the researcher believes that IN-SET workshop will help the JHS science teachers" to adapt positive self-efficacy beliefs needed to improve on their content knowledge and pedagogical strategies towards teaching JHS basic electronics.

Action Research

According to Ellis and Levy (2009), the aim of action research, especially in education, is to determine causes of localized and concrete challenges faced by teachers. It involves giving suggestions of plausible and practicable ways of reducing side effects of teaching and learning challenges. Again, action research is a collaborative activity among teachers searching for solutions to everyday, real problems experienced in schools in order to improve instruction and increase student achievement" (Ferrance, 2000). It allows teachers to address those challenges that they can exhibit some influence over through empowerment, collaboration, knowledge acquisition and then make changes where necessary. However, Hall and Keynes (2005) stated that action research cyclical process with four inter-related stages such as plan, act, observe and reflect on the observation.

In order to promote effective action research, Ellis & Levy (2009, as citing DeLuca, Gallivan, and Kock, 2008) suggested five major interventional steps to follow:

- The first step was to establish the problem by identifying the nature, possible cause-effects and what interventions had already been taken yet could not manage the situation.
- The Second step was to plan other intervention mode(s) by considering various contextual challenges, material and human resources to engage the group of subjects (teachers) to work out on their own possible strategies to find solutions to their problems.
- The third step was to take action to organise the group of subjects (teachers), material and human resources together at a central venue where teachers can interact meaningfully at each plausible strategy identified as means of solving problems they faced.
- However, the fourth step was to evaluate the results of activities carried out by the subjects to identify those strategies that needed strengthening and those that needed elimination in order to achieve the aims of organising the resources.

- The final step was concerned with evaluating the feedbacks and make follow-ups to enable further collaboration between subjects (teachers) to carry away workable solutions they deem necessary to implement in classroom or schools.

Considering the key steps stated above, an IN-SET workshop for JHS science teachers should be collaborative enough to enable JHS science teachers become active participants in finding ways to promote their SEB and CKC to teach JHS basic electronics with ease in the KNM. Silverman and Davis (2009) affirmed that many research works had proven that in-service teachers' efficacy beliefs often enhance by participating in action research where they reviewed lessons with colleagues, received prompt and regular feedback on goals they set. Again, action research which engaged teachers in self-reflections also helped them to identify and interpret mastery experiences developed along-side self-regulatory skills to improve on their self-efficacy beliefs.

Self-Efficacy Beliefs

Self-efficacy belief is an operational concept of social-cognitive learning theory that links personal efficacy expectations to the ability or competence possessed by a person to initiate behaviour, cope with the behaviour, determine how much effort will be expended, and how long the behaviour will be sustained in the face of obstacles and aversive experiences (Bandura, 1977, 1986, 1997, 2009; Pajares, 1996). Self-efficacy belief is also understood as a learned expectation that one is capable of exhibiting certain specific behaviours or producing a desired outcome (Bandura, 1999). Hence, it underpins people‟s confidence in their ability (competency) to carry out a particular task/behaviour successfully in a given environment (Bandura, 1977, 1997, 2009; Pajares, 1996; Feldman, 1995).

Also, Bandura (1997, 2009) confirmed that converging evidence "from controlled experimental and field studies verifies that belief in one„s capabilities contribute uniquely to motivation and action". To him motivation is presided over by ones‟ "expectation that a given behaviour will produce certain outcomes and the value" the person had placed on those outcomes. He emphasized that "People act on their beliefs about what they can do, as well as on their beliefs about the likely outcomes of performance". Additionally, Bandura (1986, 1997, 2009) proposed that personal self-efficacy beliefs are derived from four major sources of information associated with personal or social mediated experiences such as performance accomplishments, vicarious experience, verbal persuasion and emotional arousal.

Bandura (1997, 1999, 2009) further propounded that we gain information from personal involvement in an activity or action in the environment to gain socio-cognitive first-hand experiences. These enactive experiences enable people to become successful in mastering the social or material environment, overcome challenges and carry out further cognitive-enduring activities. He also noted that as the number of successful mastery experiences increase, the self-efficacy beliefs of the people also increase; whereas, repeated failures decrease one‟s self-efficacy beliefs. In confirmation to Bandura‟s assertion, Gür, Çakiroğlu, and Çapa-Aydin (2012, as citing Mulholland & Wallace, 2001) and Tschannen-Moran, Woolfolk Hoy and Hoy (1998) affirm that mastery experiences are the most powerful source of self-efficacy beliefs as this kind of experience depends on individual‟s own effort. Similar accession were made by Schunk and Pajares (2001) that as people "work on tasks, they learn which actions result in positive outcomes, and this information guides future actions" and that "anticipation of desirable outcomes motivates" people to persist on the task. That is "self-efficacy affects motivation and achievement in children and adolescents" (Schunk & Pajares, 2001).

Bandura again asserted that people can be influenced by vicarious experiences to modify their self-efficacy beliefs. This occurs when people observe others modelling behaviours or performing activities which serve to inform them that they can also do such tasks. However, if the observed behaviour is distasteful (produces adverse effects), it will deter the observer from performing it even though it was well observed or rehearsed; (Bandura 1977, 1986; Woolfolk Hoy, 2004)

Bandura (1977, 1986, 1997, 2009) further posited that information for self-efficacy beliefs development could be sourced from verbal/social persuasions a person receives in the form of exhortation, clarity of explanation, facilitator‟s instructions or encouragement from social groups. Moreover, this source of information could act as peer approval empowerment for a person‟s to perform actions with ease and without intimidation from the social environment. Verbal persuasion as a source of information for self-efficacy beliefs‟ development was confirmed by Mulholland and Wallace (2001, as cited in Gür, Çakiroğlu, & Çapa- Aydin, 2012) who carried out studies on factors that enhance self-efficacy of teacher induction and elementary science teaching. They confirmed that positive compliments tend to increase self-efficacy beliefs of teachers while self-efficacy beliefs were suppressed by negative comments. Also oral information was understood to potently influence students‟ performances, achievements, and ability to endure till they overcame difficulties and challenges associated with their activities/studies (Asabere-Ameyaw, 2008; Elliott et al., 2000; Passer & Smith, 2004).

The other potent source of self-efficacy beliefs originates from emotional arousal, that is stimulations which depended much on a person‟s physiological and affective conditions (stress modes). In line with this source, Bandura (1986) emphasized that if a people projected himself as incompetent and fearful then the person tends to exhibit those qualities in the circumstances that demanded a state of confidence and boldness. Emotional arousal therefore had the tendencies to promote or lower one‟s desire to initiate, sustain and perform an activity thus influences his/her achievements (Asabere-Ameyaw, 2008; Bandura, 1994, Passer & Smith 2004).

Teachers' Self-Efficacy Beliefs

Teacher‟s self-efficacy belief is the "belief in one‟s capabilities to organize and execute the courses of action required for managing prospective situations" (Bandura, 1986). On this basis Pajares (1996) and Tschannen-Moran, Woolfolk Hoy and Hoy (1998) said teacher self-efficacy can be the teacher‟s beliefs in his/her capability or competency to successfully organize and execute course of actions required to achieve specific teaching task in a particular context. It expresses competences towards specific areas of knowledge or skill; that is Self-efficacy belief is task/ability specific. Accordingly, Bandura (1994) states that "People with high assurance in their capabilities approach difficult tasks as challenges to be mastered rather than as threats to be avoided". Thus, teachers with high self-efficacy beliefs are likely to explore the environment, seek peer support, and create the right emotional settings that enable them to observe and rehearse the action(s) performed by models in order to continue to overcome their own challenges (Bandura, 1993, 1997, 2009; Pajares 1996).

In addition, Bandura (1997) and Elliott et al., (2000) assert that when teachers‟ believe they can succeed in teaching any subject or lesson, they are more likely to do so. Therefore, teachers‟ perceived self-efficacy beliefs play major roles in decision making, especially in teaching; decisions on selection of activities, classroom management, and effective lesson presentations, especially in the current dispensation of varying educational technologies (Bandura, 2001).

Again, Gür, Çakiroğlu, and Çapa- Aydin (2012) and Riggs and Enochs (1990) cited a number of researchers who emphasised that teachers with high self-efficacy beliefs are more likely to experiment and test new methods. These teachers were also likely to implement innovative curriculum content, and practise new teaching ideas; particularly concepts that are difficult to teach and involve risks. The researchers also found out that cyclically teachers with low levels of self-efficacy beliefs exert low levels of effort and achieve low performances target while those who have low performances because of exerting low efforts drift into lower levels of self-efficacy beliefs.

Teachers' Self-efficacy beliefs and Content knowledge (competency) acquisition

According to Bandura (2009), employees (including teachers) of high perceived efficacy have a preference for training that "enables them to restructure their roles innovatively by improving the customary practices and adding new elements and functions to them". He also noticed that, "Self-efficacious employees take greater initiative in their occupational self-development and generate ideas that help to improve work processes".

Also Bandura (1993) emphasises that teachers with high sense of self-efficacy beliefs set "challenging goals and maintain strong commitment" to achieve them. "They maintain a task-diagnostic focus that guides effective performance". They put in much effort to avoid failure, but if failure occurs, they tend to attribute the "failure to insufficient effort or deficient knowledge and skills that are acquirable" (p.144).

Again Bandura (2009) noted that perceived self-efficacy beliefs do not let people "only set the slate of options for consideration, but also regulates their implementation", by mobilizing effort and resources to accomplish "the decided course of action successfully and stick to it in the face of difficulties". He stressed that when people are "faced with obstacles, setbacks and failures, those who doubt their capabilities slacken their efforts, give up prematurely, or settle for poorer solutions". However, "those who have a strong belief in their capabilities redouble their effort to master the challenges".

There is therefore the likelihood that teachers may have high self-efficacy beliefs towards tasks but lack resources (content knowledge and skills) to execute their beliefs. Thus, to achieve these self-efficacy beliefs expectancies teachers will have to acquire the requisite knowledge and skills. Generally, it is noted that people do not easily perform well on any given task unless they have the needed content knowledge competencies regarding that specific task. This is because competency in content knowledge is task specific just as self-efficacy belief is task specific (Bandura 1977, 1986, 1993, 1994; Pajares, 1996). Content knowledge competency relates to a person‟s capabilities and abilities towards achieving sets of goals in specific situations using a set of cognitive processes relating to a subject matter content. Thus, Bourne and Russo (1998) and Rathus (1993) indicated that a person‟s competency could promote the person‟s self-efficacy beliefs and one‟s self-efficacy beliefs essential and potentially exposes one‟s competency traits. In a similar relation, Drits (2011) indicated that teachers with high content knowledge and pedagogical content knowledge have higher confidence in science teaching self-efficacy and were ready to teach using reform-based inquiry approaches.

IN-SET for Content Knowledge and Self-Efficacy Beliefs Development

In-service training is any form of staff development engagement that tends to promote the quantitative growth and qualitative development of knowledge and capacity of the participants. Jahangir, Saheen, and Kazmi (2012, as citing Kazmi, Pervez & Mumtaz, 2011) describes IN-SET as a catalyst that provokes significant changes in teachers knowledge, redefines their roles, broadens their vision and enhances their pedagogical attributes as teachers. Again, IN-SET is an instrument used by Institutions to meet the content knowledge and formal skills needs of their workforce (Jahangir, Saheen, & Kazmi, 2012); where, formal skills are the competencies possessed by people in knowledge organization, cognition gaining and drawing conclusions (Mathelitsch, 2013).

However, Satterfield (2007, as citing Sparks & Loucks-Horsley, 1989) identified that IN-SET can take the forms of self-directed learning, observation and assessment, participation in institutionalised level improvement process, and participation in small- peer group inquiry. Nonetheless, Ghana‟s Ministry of Education and Ghana Education Service (GES) often use the cascade IN-SET approach for training trainers of trainees, office staff, secondary school teachers and School-Based/Clustered-Based IN-SET (SBI/CBI) programmes for handling primary school teachers (Environmental Protection Agency, 2010; Ghana Education Service, 2012; Little, 2010; Ministry of Education, Youth and Sports [MOEYS], 2004). Thus, whatever form an IN-SET program is organised it should give teachers the ability to acquire adequate content matter knowledge and pedagogies to effect good classroom practices.

Generally, it is believed that the quality of science teachers (including those in JHS) cannot be ignored in the implementation of any innovative science curricular objectives. It is also believed that, strong science-based teachers have the capacity to interpret the curricular objectives and content, as well as understand and use materials effectively (Akale, 1990). Thus, it is noted that good curricula materials fail to produce the intended purposes because the uninformed science teachers were not convinced to take them seriously (Black, 1980). It is therefore important that science teachers (JHS) undergo IN-SET to gain adequate content knowledge competencies in the use of science curricula materials, especially those of basic electronics. This might also ensure that teachers use the materials for the benefit of pupils.

Furthermore, research indicates that effective science teachers possess the ability to master science subject content knowledge as well as exhibit the professional ability to transfer this knowledge to learners. Therefore, any IN-SET program for science teachers should have the tendency to increase these good qualities (Jahangir, Saheen, and Kazmi, 2012). According to Drits (2011), science teachers need to be engaged in IN-SET programmes which permits long-term peer-group collaboration and contextualisation of the content knowledge to practical classroom situations. This approach to science teachers‟ IN-SET has the tendency to improve on their content knowledge competency and self-efficacy beliefs (Bandura, 1999, 2009). In another study carried out by Swackhamer, Koellner, Basile and Kimbrough (2009), it was observed that a group of science teachers who undertook four or more content courses in IN-SET had achieved a threshold mean score representing high self-efficacy beliefs. However, a group of science teachers who had taken one to three content courses in the IN-SET did not achieve that score.

Therefore, as much as IN-SET workshops are useful, they should be made an effective tool in the hand of the user. Accordingly, Satterfield (2007, as citing Joyce & Showers, 2002) identified four specific component characteristics that bring about effective in-service workshops. They indicated that there should be:

- (a) an examination of the theoretical framework to promote direct instruction and dialogue that enables new concepts to be learned.
- (b) a sessions for modelling or demonstration for participants to develop new skills.
- (c) coaching and hands-on practices to ensure participants" can apply the new skills and concepts leant at IN-SET to real life situations; the classroom.
- (d) follow-ups and feedbacks from the IN-SET to enable the participant to conceptualise and contextualise their knowledge and skills within specific periods of time.

Teachers' Content knowledge Competency and its importance

The concept of competency has varied understanding depending on the field of knowledge, the groups of professionals" concerned, cultural settings, and the specific skills-tasks to be executed. According to Naumescu (2008, as citing Pellerey, 2001) competency is not only about mastery of knowledge, methods and the ability to use them but it involves the ability to combine different basis of the knowledge and skills to meet specific tasks. Naumesa further stated that competency in knowledge is a characteristic that can be acquired through self-experience, self-belief and educational training in a given field of study and in specific areas of situational challenges.

In addition, Ansah (2012) described competencies in vocational education training as sets of professional attitudes and behaviours that define the composite of a person"s knowledge, skills, values and personality needed to carry out a task in varying and complex situations. Whereas, Alorvor and el Sadat (2010) said a teacher"s competency is a characteristic of the teacher"s habit of the mind, which emphasises on critical thinking, experimentation and openness to change.

Also, UNESCO (2014) considers competencies in education as acceptable sets of characteristics or acquired learning outcomes which are essentially needed to produce an impact on quality education and bring about effective learning. It assigns educational competencies to forms such as core skills, content knowledge, cognitive skills and other several skills. It further acknowledges that acquisitions of competencies are the core values that attest to the effectiveness of an education system in the wake of quality education and effective learning. However, Alorvor and el Sadat (2010) elaborated about eight folds of criteria for appraising basic schools teachers" competencies in Ghana. These are the teachers" communication skills, lesson presentation, personality traits, and knowledge of subject matter. The other competencies are teachers" evaluation of learners" ability, punctuality and attendance, teachers" relationships and participation in coordination activities.

Studies have suggested that science teachers needed “threefold structures” of knowledge namely subject content knowledge, Pedagogical Knowledge and Pedagogical Content Knowledge (Alorvor & el Sadat, 2010; Elliott et al., 2000; Gilbert, 2010; Naumescu, 2008). Subject Content Knowledge (CK) comprises the basic theories, principles, facts, ideas, skills and concepts that make up the body of knowledge of the subject. Subject Content Knowledge Competency (CKC) is therefore, considered as the ability of a teacher to organise coherently these entities of concepts in the body of knowledge into meaningful and usable concepts that meet modern research findings (Elliott et al., 2000, as citing Boko & Putman, 1996).

According to Stronge (2007), there are bounds between good numbers of students who preferred some science subjects because science teachers exhibited high levels of good command of content knowledge during lesson delivery. It was also observed that Science teachers with good competency in science content knowledge were highly likely to transfer same enthusiasm to pupils. Again, studies carried out by Elliott et al., (2000) and Osbone and Dillon (2010) showed that science teachers who feel uncomfortable with a subject content knowledge tends to avoid teaching some details of the content or teach it hurriedly without attending to the emotions and attitudes of their students.

Also, Drits (2011) indicated that teachers‟ with sufficient subject content knowledge influence their classroom practices as they do easily endorse science reforms that seek to inculcate inquiry-based teaching approaches to engage students‟ with science and technology materials. Again, Drits (2011, as citing Keys & Bryan, 2001) iterates that "teachers who use an inquiry approach must have rich and deeply developed understandings of science content ... and ways to engage students in investigative practices". Drits (2011) further asserted that teachers exhibit higher confidence - abilities and willingness - to teach science using student-centred styles whenever their subject content knowledge commensurate with their pedagogical content knowledge. Additionally, Schunk and Pajares (2001) suggested that people, who generally perform well in a subject with mathematics background exhibit higher self-efficacy beliefs for learning new content knowledge than those who had general learning challenges.

The concept of pedagogical knowledge (PK) consists of the general learner–centred principles of instruction used in the teaching and learning of specific subject content (Gilbert, 2010). Thus PK relates to the basic principles and strategies expected to be possessed by teachers to enable them to retain a subject matter knowledge, package and deliver it to learners. It is also comprises all best methods of instruction used by instructors to introduce subject content knowledge, maintain learners‟ motivation and interest in lesson activities and the best approaches for evaluating learners‟

performance in the cognitive, affective and psychomotor domains (Boko & Putman 1996 cited in Elliott et al., 2000; Gilbert, 2010). However, the Pedagogical Content Knowledge (PCK) also called the subject teaching knowledge, describes the ways for representing and formulating specific subject content knowledge that makes the knowledge comprehensible to learners as well as convincing them to understand what makes learning of some portions of content knowledge difficult or easier (Elliott et al., 2000, as citing Shulman,1986; Stronge, 2007).

Teaching Basic Electronics at JHS

The Ministry of Education in Ghana seeks to use the curricula materials in basic electronics to inform pupils of the appropriate uses and safety measures against electronic hazards, especially e-waste and e-radiations. It is also to ensure that the pupils become selective consumers of electronic goods and services; especially ICT tools. It further seeks to develop pupils" interest to appreciate the values of learning basic electronics in order to protect, maintain and repair simple ICT devices in future (MoESS, 2007a; MOE, 2010a; 2012b).

Although, it is not expected that JHS pupils will become electronic scientists (technicians), it is expected that they should understand basic electronics in relation to socio-economic values of the 21st century education; career opportunities, industrial requirement and economic capacity development (MoESS, 2007a; MOE, 2010b; 2012b). In a wider focus, learning basic electronics at JHS is meant to lay foundations for future high thinking skilled and creative workforce for Ghana"s intended electronic and ICT driven industrialised economy (Ministry of Youth and Sports, 2010; MOE, 2008; MoESS, 2006; Ministry of Trade and Industry, 2011; NDPC, 2010; Republic of Ghana, 2003; UNCTAD, 2011).

In order to teach JHS basic electricity concepts JHS science teachers needed basic knowledge and skills on how and why the source of energy (cells) is interconnected to simple load (resistor) or load networks (resistors in series/parallel connections) via conductors (wires) and how to determine the numerical value of power dissipated by loads (MOE, 2012b; MOESS, 2007b, MOESS, 2008; Naeem, 2009).

However, for JHS science teachers to teach concepts of JHS basic electronics they need basic conceptual knowledge of semiconductors. They also need to identify, name and understand the functions of resistors, inductors, capacitors, diodes and transistors in a circuit and understand how each of these components behave in relation to other circuit components‟ in a combined circuit formation as well as the circuit‟s total output characteristic (Bishop, Anyanwu & Olopade, 1984; Close & Yarwood, 1982; MOE, 2012b; MOESS, 2007b, MOESS, 2008; Nelkon & Humphrey, 1981).

Additionally, JHS science teachers need subject matter content knowledge and practical skills on electronic circuit designs, and how to determine the numerical values of quantities associated with basic components via colour or symbolic codes. They also need knowledge on how individual circuit components behave in relation to other circuit components.

However, for JHS science teachers to teach concepts of induction using the coiled wire inductor they need to understand the relation between the geometrical features of an inductor and characteristics of the magnetism produced. Some geometrical features associated with coiled wire inductors used in JHS basic electronics are the diameter of wire (insulated), number of turns of coil, closeness of coil turns, radius of coils, and coil wounding direction. The coil wounding direction determines the direction of current flow and polarity of ends of the coil. Again, the JHS science teachers need to know that light emitting diodes (LED) are used as rectifiers for very small currents and also serve as indicator of current flow through specific loops of electronic circuits (Bishop, Anyanwu & Olopade, 1984; Close & Yarwood, 1982; MOE, 2012b; MOESS, 2007b, MOESS, 2008; Nelkon & Humphrey, 1981).

Electronics and Nature of electronic system circuits

Electronics is a branch in physics and engineering that involves the study and usage of electric charges flowing through useful devices. Electronic components are used in broad products that include radios, television sets, computers, medical instruments, entertainment gadgets, and many more. People rely much on these electronic products for communication, information processing, medicine and research, automation, industrial use and for transportation and exploration (Bandura, 2009, Held, 2001; Synder, 2003). Scientists and engineers continue to search for ways to use microelectronic circuits to make smaller, faster and more complex devices.

Electronic systems make use of electric currents and voltages to carry electric / electronic signals in devices. Electronics serve as the foundation for strengthening the military prowess of defence and security, control engineering and phototronics. Other likely areas of application of electronics systems are photonics, robotics, mechatronics and most automation engineering as well as the basis for the hardware and software information technologies (Hongshen, 2005; Kanatzidis, & Poeppelmeier, 2007; Nelkon & Humphrey, 1981).

An electric signal is an electric current or voltage modified in some way to represent information in an electronic circuit/device. Many electrical appliance and digital or analogue electronic gadgets have electronic circuit network systems made from discrete circuit components such as diodes, capacitors, inductors, resistors and transistors to generate and make use of electric signals. However, many logically controlled multifunction and computerised electronic circuit systems are built from simple discrete components to complex miniature logic gates. Some of the common logic gates used in basic electronics are the AND, NOT, OR, NOR, and NAND gates. For example the microprocessor chips used in computerised devices look compact and simple yet they are made from several hundreds to thousands of fused micro-components of simple discrete electronic components built as integrated circuits in chips. Considering the analysis of electronic systems in this text it would be realized that JHS basic electronics forms a foundational knowledge to enable pupils to appreciate the concepts of advanced electronics as future career (Bishop, Anyanwu & Olopade, 1984; Close & Yarwood, 1982; MOE, 2012b; Nelkon & Humphrey, 1981).

Measurement of Self-Efficacy Beliefs – Instruments

Several instruments have been developed for the measurements of self-efficacy beliefs depending on Bandura"s notion that self-efficacy belief is a situation specific construct and a determinant of intention; perceived capability (Riggs & Enochs, 1990). In addition, many of the self-efficacy instruments" items constructed were based on Bandura (2006) suggestions that self-efficacy beliefs" construct items should be phrased – "*can do* rather than *will do*". However, there is no one specific instrument for measuring self-efficacy beliefs as people"s behaviours based on self-efficacy beliefs can be measured on different dimensions such as levels, generality, and strengths (Bandura, 1977; Pruski, Blanco, Riggs, Grimes, Fordtran, Barbola, & Lichtenstein, 2013).

Also, Bandura (2006) appealed that self-efficacy assessment instruments should ask the subjects" to affirm their capability and strength of self-efficacy beliefs. This appeal was in support of his stipulation that people differ in task-specific self-efficacy and also develop self-efficacy to different levels even within their given pursuits

(Bandura, 2006). Therefore, as much as possible, there should be no all-purpose measure of perceived self-efficacy. Thus, a one-measure fits-all approach usually has limited explanatory and predictive value because some of the items in an all-purpose test may have little or no relevance to the purpose of the specific target-domain measured (Bandura, 2006).

Also, Tschannen-Moran and Woolfolk (2001) indicated that some researchers too, disagree about the nature of domain specificity and subcomponents of domains to be measured by any single self-efficacy belief scale or instrument. This had come about because choices of subcomponents do, in most occasions, reflect themes of the researchers" interest. Again, any combination of constructs used in instruments only measured specific portions of individuals" self-efficacy beliefs linked to the researchers" interest. The ranges of choices come about because there are several micro-domains of the socio-cognitive domains of self-efficacy beliefs which sublet themselves differently to different instruments at different levels and strengths. These domain diversities, therefore, had led to the construction of different instruments for measuring different domain frameworks of self-efficacy beliefs (Silverman & Davis, 2009).

Furthermore, Pruski et al. (2013) agrees with other researchers (Bandura, 1977, 1997; Riggs & Enochs, 1990) that, in the academic settings self-efficacy instruments should usually ask participants to rate their confidence level of self-efficacies in solving specific problems, perform particular task or engage in some specific self-regulatory skills. However, to measure the cumulative strength of self-efficacy beliefs of participant(s) the summation of confidence ratings for the whole instrument(s) can be used (Lian, 2003).

However, instruments such as “Bandura‟s Teacher Self-Efficacy Scale” (with 30 items and 7 subscales pinned on five points rating), and “Gibson and Dembo‟s Teacher Efficacy Scale” (TES; with16 items and 2 subscales) have been used over several years to measuring self-efficacy beliefs of teachers (Pruski et al., 2013). Based upon the items of TES, an in-service elementary school science teachers five-point Likert-type scale called “Science Teaching Efficacy Belief Instrument-A” (STEBI-A) was developed by Riggs and Enochs (1990). The STEBI-A had 25 items categorized into two subscales: Personal Science Teaching Efficacy Beliefs (PSTE) and Science Teaching Outcome Expectancy (STOE). The scale for rating the items ranged from „„Strongly Agree‟‟‟(5) to „„Strongly Disagree‟‟‟(1); with negatively worded statement items scored in the opposite direction; „„Strongly Agree‟‟‟(1) to „„Strongly Disagree‟‟‟ (5) (Riggs & Enochs, 1990).

On the contrary, Roberts and Henson (Pruski et al., 2013) raised reliability concerns about Riggs and Enochs‟ STEBI-A scale and the Teaching efficacy scales from Gibson and Dembo. They therefore, developed the Self-Efficacy Teaching and Knowledge Instrument for Science Teachers (SETAKIST) and the SETAKIST-Revised to include items on teachers‟ pedagogical content knowledge. The SETAKIST had two subscales, with sixteen items rated on a five-point Likert scale (Pruski et al., 2013, as citing Roberts & Henson, 2000).

In related literature, a five-point Likert-type scale was assigned a score of 3.0 by researchers to reflect a neutral response. However, scores of one standard deviation above or below this mark represent high or low levels of efficacy respectively (Riggs & Enochs, 1990; Swackhamer, Koellner, Basile & Kimbrough, 2009). Conversely, Robert and Henson (2000, as cited in Pruski et al., 2013) gave a score ranging from 0 to 4 to rate responses to items; with 0 representing “very low self-efficacy” and 4 representing "high self-efficacy". Nonetheless, all these benchmarks‟ ranges were consistently reliable and valid for the numerous studies on self-efficacy beliefs (Bleicher, 2004). Therefore, Swackhamer et al. (2009) used a neutral score of 3.0 with a standard deviation of 0.56 as the threshold for showing high levels of efficacy (3.56) and low levels of efficacy (2.44).

Reliability Test for Likert Scale Type Self-Efficacy Beliefs Items

Cronbach‟s alpha coefficient of reliability, commonly called alpha (α), is a test of reliability technique that requires only a single test administration of several Likert-type items that are summed to make a composite score or summated scale to obtain a unique estimate of the reliability for a given test. Cronbach‟s alpha is based on the mean correlation of each item in the scale for all possible combinations of items when split into two half-tests to obtain internal consistency of items in the scale. Alpha has ranges of values between 0 and 1 (Gliem & Gliem, 2003; Leech, Barrett & Morgan, 2005).

According to George and Mallery (2003, as cited in Gliem & Gliem, 2003) and Leech, Barrett and Morgan (2005) whenever alpha was greater than 0.7 the items in the scale were acceptable and whenever alpha was less than 0.7 the items in the scale were questionable. However, some authors accept scales with few items that produced lower alphas in the range of 0.60 to 0.69 as reliable (Leech, Barrett & Morgan, 2005). Nonetheless, an alpha of less than 0.5191 suggests that the items in the scale do not measure a common construct (Griffith, 2015) whiles an alpha greater than 0.90, probably indicates that the items are repetitious or more than needed for a reliable scale (Leech, Barrett & Morgan, 2005).

CHAPTER THREE

METHODOLOGY

Overview

This chapter describes the methodology used for the study. The methodology is described under the following subtopics: research design, population, sample and sampling procedure, instrumentation, data collection procedures and methods of data analysis

Design of the Study Area

The geographical area for this study is Kassena Nankana Municipal (KNM) with Navrongo town as its administrative capital. The KNM is a political administration that shares boundaries with the Kassena Nankana West District to the geographical north, Bolgatanga Municipal to the east, the West Mamprusi and Builsa South Districts to the geographical south and the Builsa North District to the west (See map in Appendix K, courtesy: Ghana Statistical Service, 2014). There are 38 Public and 3 Private JHS in the Municipal with about 53 science teachers in these schools for the 2014/2015 academic year, which was the period of this study.

The researcher chose the KNM area because he had orally interacted with some JHS science teachers as well as observed some lesson plans on basic electronics when he visited these JHS. The prior visits further gave the researcher the opportunity to acquaint with some challenges that the JHS science teachers were encountering in teaching basic electronics. The interactions also revealed that, some of the JHS science teachers lack sufficient content knowledge competencies and confidence to teach some topics of JHS basic electronics in Kassena Nankana municipality.

The Research Design

The design for this study was an action research. This design was meant to determine the JHS science teachers" Self-efficacy beliefs (SEB) and content knowledge competency (CKC) in teaching basic electronics, without necessarily determining the cause-effect relationship (Creswell, 2003; Ellis & Levy, 2009). The design followed the outline shown in Fig. 3.1.

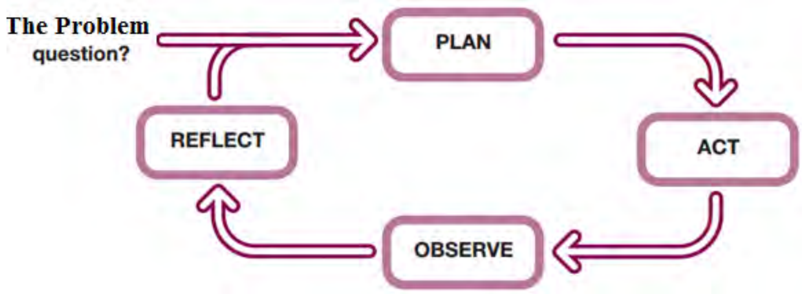

Figure 3.1: Action Research Design for the Study (Courtesy: Hall & Keynes, 2005)

The research data were collected in two phases. The plan was to collect an initial data from JHS science teachers using pre-workshop questionnaires administered to them at their respective schools. This initial information was to enable the Researcher assess the pre-workshop status of JHS science teachers CKC and SEB in line with their assertion that JHS basic electronics was a challenge to teach. It also guided the Researcher in the selection and preparation of content topics on JHS basic electronics and other resources needed for the IN-SET workshop.

In order to act on the plan, an IN-SET workshop was organised to find out whether teachers" CKC and SEB status could be changed through the values of participation, self-determination and empowerment in knowledge acquisition. Again, to observe whether there was any impact of the action, second data was collected from JHS science teachers using post-workshop questionnaire administered to them after an IN-SET workshop organised for them at Navrongo Senior High School. The pre- and post-workshop questionnaires were the main instruments used for collecting the respective data before and after the IN-SET workshop for this study**.** The two sets of data were then statistically analysed to reflect and respond to the research questions from which conclusions were drawn for recommendations to be made.

Population

The target population was 74 integrated science teachers; comprising 11 females and 63 males, in the 22 public JHS of the Kassena Nankana West District (KNWD) and the 41 JHS in the Kassena Nankana Municipal (KNM) of Upper East Region (UER) in Ghana. However, the accessible population for the study was all JHS science teachers teaching in JHS in the Kassena Nankana Municipal (KNM). It was presumed that all these science teachers possessed common pedagogical knowledge and skills needed in good classroom management and understanding of the school atmosphere. Also, it was presumed that the JHS science teachers had received logistical resources, were supervised and had undergone good mentoring from KNM education directorate. Therefore, they possessed common pedagogical characteristics to be sampled for the study (Crossman, 2013; Dampson & Danso-Mensah, 2014). However, the JHS science teachers in the KNWD were used for pilot testing of the data collection instrument.

Sampling Technique

A sample is a finite part of a statistical population whose properties are studied to gain representative information about the whole population. Samples are selected because of cost effectiveness in the use of resources, time and funding (Crossman, 2013; Dampson & Danso-Mensah, 2014; Tannenbaum, 2007).

Forty six (comprising 7 females and 39 males) JHS science teachers were purposively sampled from each of the forty one (41) JHS in the KNM to serve as participants for the study. This method of sampling was used because the accessible population of

JHS science teachers was not too large and to ensure that at least one science teacher from each JHS had an opportunity to benefit from the Workshop (Dampson & Danso-Mensah, 2014; Tannenbaum, 2007).

Instrumentation

The study made use of two sets of questionnaires as instruments for the data collection. These were pre-workshop (Appendix A) and post-workshop (Appendix B) questionnaires which were used to gather large data from participants on a wide scope of content and objectives in the JHS basic electronics (Agyedu, Donkor & Obeng, 1999; Tannenbaum, 2007). The pre-workshop questionnaire was meant to gather data to assess JHS science teachers‟ initial levels of self-efficacy beliefs (SEB) and initial content knowledge competency (CKC) in JHS basic electronics. The post-workshop questionnaire was used to gather data on JHS science teachers after the IN-SET workshop. The items on SEB in both questionnaires were similar but items on CKC differed slightly in the two sets of questionnaire, however both questionnaires were meant to measure similar constructs.

The sets of pre-workshop and post-workshop questionnaire instruments used for data collection for the study were developed by the Researcher in collaboration with the supervisors of the study. The items on self-efficacy beliefs of the questionnaires were adapted from similar instruments such as Barros, Laburú, and da Silva‟s (2010) instrument for measuring self-efficacy beliefs of secondary school physics teachers in Brazil; Bandura‟s (2006) instruments for teacher self-efficacy scale; and the Fencl and Scheel‟s (2004) instrument on Sources of Self-Efficacy Science Courses–Physics (SOSESC-P).

The pre-workshop questionnaires items were grouped into three sections: A, B, and C. Section A had 11 items that requested the personal information of participants, their school activities and sources of content knowledge on basic electronics. Section B was a Likert-type scale with fourteen (14) items. Each item consisted of a statement and five options of choice on the teachers‟ self-efficacy beliefs (SEB) towards basic electronics. This section asked JHS science teachers to rate their self-efficacy beliefs in basic electronics using Likert-type scale items with responses ranging from Strongly Disagree (1), Disagree (2), Uncertain (3), Agree (4) and Strongly Agree (5) attached to stems of statements. Some of the items were deliberately negatively worded just to avoid the monotony of positive items (Riggs & Enochs, 1990). The construct of Section B were meant to measure JHS science teachers‟ SEB towards basic electronics in terms of perceived difficulty of basic electronics, perceived competence in teaching topics in basic electronics and perceived time they can devote to study JHS basic electronics.

Section C‟ of the pre-workshop questionnaire had six (6) items which comprised of 37 sub-items. It sought for information on the science teachers‟ content knowledge competency on basic electronics. It was also meant to measure JHS science teachers‟ ability to correctly identify real basic electronics components, the pictures and circuit symbols of discrete basic electronic components used in JHS. Also they were to name terminal codes of bipolar transistors and symbols of scientific units as attached to circuit symbols used in JHS. Science teachers‟ ability to state the functions of each electronic component used in JHS basic electronics was also assessed.

Also, the post-workshop questionnaire had three sections of A, B and C. Section A comprised of three (3) items that sought for basic personal information of JHS science teachers and their impression of the IN-SET workshop they attended for this research work. Section B comprised of fourteen (14) Likert-type scale items that measured teachers‟ SEB after the IN-SET workshop.

There were six (6) items with 36 sub-items in Section C that were meant to measure JHS science teachers‟ content knowledge (competencies) after the IN-SET workshop meant for this research work. The structures of items on both SEB and CKC in the post-workshop questionnaire were similar to corresponding items in the pre-workshop questionnaire for the study.

Workshop Manual

An IN-SET workshop manual (see Appendix C) was prepared by the Researcher as an intervention resource material to assist JHS science teachers to acquire content knowledge in basic electronics. It was also anticipated that the workshop activities would improve JHS science teachers‟ SEB after the IN-SET workshop. The workshop manual had hands-on activities patterned to promote exploration of basic electronics components kit (MOE, 2012b) which were given to JHS science teachers at the workshop. The worksheets in the manual therefore served as a guide to improve upon JHS science teachers‟ content knowledge competency through practical activities that might orient them to do, see, write and explain simple observation on basic electronics circuits (MOE, 2012b). The performance approach adopted in the workshop manual expected JHS science teachers to construct electronic circuits, observe outputs of light emitting diodes (LED), and record observations into the workshop manual. From circuit observations, JHS science teachers were to respond to some questions on each hands-on activity.

The basic electronics kit that each JHS science teacher used along with the workshop manuals had the following basic electronics components: two capacitors (100ɥF-16V, 1000ɥF-16V), five fixed resistors (3.3kΩ, 10kΩ, 100kΩ, 470Ω, 560Ω), and one metre of single core insulated copper wire (SWG 32 diameter width) to construct inductors. The other components in the kit were one general purpose diodes (1N5392), four

LEDs (white, red, yellow and multiple colour flashers), one NPN transistor (BC548 code) and breadboards as platform for circuits‟ construction.

Pilot testing of the questionnaire

A pilot was run on the pre-workshop questionnaire on about twenty and one (comprising 4 females and 17 males) integrated science teachers in their respective JHS in Kassena Nankana West District (KNWD) in December, 2014. The three sections of the questionnaire were coded and scored separately. The total summated scores for the self-efficacy beliefs (SEB) and content knowledge competency (CKC) were determined separately for each JHS science teacher. The piloted pre-workshop questionnaire data was analysed (Appendix F) and a Cronbach‟s alpha coefficient (α) of reliability of 0.627 was obtained for the self- efficacy belief (SEB) items while the items of the content knowledge competence (CKC) had an α = 0.954. The reliability statistics of the pilot tested items were used to refine the items of the pre-workshop questionnaire used for the study.

Data Collection Procedure

The pre-workshop questionnaire was administered to each science teachers in their respective JHS in KNM within a period of two weeks in December 2014. Each JHS science teacher responded to items 1 to 11 of Section A, items 1 to 14 of Section B and items 1 to 6 of Section C.

The items 1 to 4 of section C of the pre-workshop questionnaire were responded by JHS science teachers through question and answer interactions with the Researcher (using materials shown in Appendix A). In order to answer item 1 of section C, the Researcher gave JHS science teachers a set of real circuit components such as resistor, capacitor, transistor, coiled wire inductor, light emitting diodes (LEDs) and P-N junction diodes. The JHS science teachers were asked to identify the components as the Researcher mentioned the names of the components. JHS science teachers were also asked to state the functions of the basic electronic components identified as responses to item 4 of Section C. JHS science teachers were further asked to identify electronic circuit symbols of components mentioned by the researcher in response to item 2 of Section C. Again, in response to item 3 of Section C, JHS science teachers were asked to identify pictures of electronic circuits components mentioned by the Researcher. Each correct response to the sub-items scored the JHS science teacher 1 mark and 0 mark for each wrong response.

The post-workshop questionnaire was administered to obtain post-workshop data from JHS science teachers after they had attended an IN-SET workshop on JHS basic electronics. The IN-SET workshop was organised at the physics laboratory of Navrongo Senior High School after the Director of Education of the Kassena Nankana Municipal had given his consent to the Researcher to engage the JHS science teachers for the study. The Researcher also sought permission from the Headmistress of Navrongo Senior High School to organise the IN-SET workshop in that School (Appendix E). These administrative consents facilitated JHS science teachers in the KNM to attend the workshop for the research work. At the end of the IN-SET workshop JHS science teachers responded to the post-workshop questionnaires. The scores obtained from responses of JHS science teachers to items of the post-workshop questionnaire were used to assess their post-workshop self-efficacy beliefs and content knowledge competency in JHS basic electronics.

The IN-SET workshop

The in-service training workshop programme for the study engaged JHS science teachers for two days: 29th -30th January 2015 (Appendix D). The IN-SET workshop was designed such that JHS science teachers were to learn the content knowledge of

JHS basic electronics as well as the pedagogical skills of teaching through hands-on activities, Facilitator‟s lecture and demonstration, peer collaboration and self-learning strategies.

The IN-SET workshop activities began about 9.00 a.m. and ended about 2.30 p.m. for the first day. In order to facilitate socio-cognitive performance experience each teacher was given a workshop manual and a kit on JHS basic electronics components (MOE, 2012b) for the workshop. Also to foster socio-cognitive vicarious experience JHS science teachers were put into ten groups with at least four teachers in a group. As much as possible each JHS science teacher interacted often with their own kits guided by worksheets‟ instructions in their workshop manuals. However, they collaborated with other members of the group for direct and indirect assistance to read and interpret observations on their electronic circuits.

At the beginning of the workshop, the facilitator (Researcher) assisted JHS science teachers to identify and state the functions of basic electronics components through power point presentations, use of model electronic circuits and discrete components in their kits. The model electronic circuits used in the workshop were obtained from motherboards of radio sets and compact florescent lamps. The facilitator further helped JHS science teachers to identify important physical or structural features on discrete electronic components whiles emphasizing on correct positioning of components in electronic circuits in order to produce desirable observations or outcomes. Safety precautions were also emphasised in order to conserve the components; avoid damage and injury. The facilitator also guided JHS science teachers to read examples of simple electronic circuit diagrams. JHS science teachers were also guided to construct and manipulate some pure resistive and pure capacitive electronic circuits whiles probing them to observe and interpret observations on the circuits.

Again, JHS science teachers constructed simple circuits to test for continuity, polarity and functions of each discrete electronics circuit component in the kits. The JHS science teachers constructed electronic circuits intended for the content for JHS Years 1 and 2 (MOE, 2012b). During the workshop, members of the groups collaborated among themselves in each of the hands-on exercises whiles at times the facilitator helped them to evaluate and discuss their observations. In each hands-on activity JHS science teachers observed circuit they built, recorded observations and made inferences to answer question items that followed each hands-on activity. Any circuit constructed was disassembled after records of observations made in order to construct other circuits on the breadboards. The second day of the workshop enabled JHS science teachers to complete the activities in the workshop manual. The workshop started about 9.00 a.m. and ended about 3.30 p.m. on the second day.

Validity of the Instrument

Validity is the "extent to which differences found with a measuring instrument reflect true differences among those being tested" (Kothari, 2004) and thus indicates the extent to which the instrument measures what it is intended to measure. Supervisors of the study and some experts in teaching and learning of basic electronics from the Department of Physics at the Education of University of Education, Winneba, approved the content and face-validity of the two sets of questionnaire instruments and the IN-SET workshop manual for the study. Their comments and suggestions were used to refine some of the questionnaire items and the workshop manual"s exercises used for the study.

Reliability of the Instrument

According to Ellis and Levy (2009) reliability relates to the consistency with which a measuring instrument yields certain results such that the measurement errors are not so high as to discredit the findings of the study. Gliem and Gliem (2003), Leech, Barrett and Morgan (2005) and Griffith (2015) asserted that whenever Cronbach‟s alpha coefficient of reliability (alpha, α) on internal consistency of Likert-type scale was greater than 0.7 the items in the scale were acceptable.

Already, the pilot tested pre-workshop items that were tested had reliable alpha (α). Nonetheless, the pre-workshop questionnaire items (of which many were used in the post-workshop questionnaire) were analysed and the self- efficacy belief items had α = 0.83 while the content knowledge competency (CKC) items had α = 0.91.

Data Analysis

All responses to items of the pre-workshop and post-workshop questionnaires were coded, scored, analysed and presented as descriptive data in tables using the Microsoft office excel programme and the statistical package for social science (SPSS) software. The total expected mean scores of JHS science teachers on the SEB were five (5) for both questionnaires. Also the expected scores on CKC for JHS science teachers were 37 (100%) marks for items of the pre-workshop questionnaire and 36 (100%) marks for items of the post workshop questionnaire. The descriptive data were used to explain the research questions and determine the significant differences in the hypotheses (Crossman, 2013; Jahangir, Saheen, & Kazmi, 2012; Tannenbaum, 2007).

The responses to items 1-11 of Section A of the per-workshop questionnaires were coded, categorized and presented as frequencies and percentages frequencies of responses in tables. The items of Section B used the Likert-type scale responses to which were intended to measure JHS science teachers‟ SEB. They item responses were scored as Strongly Disagree – 1; Disagree – 2; Uncertain – 3; Agree – 4; Strongly Agree – 5. However, the negatively worded item statements 1, 11, 12, 13, and 14 of the Section B were reversed coded and scored as: Strongly Disagree – 5; Disagree – 4; Uncertain – 3; Agree – 2; Strongly Agree – 1 (Pruski et al., 2013; Riggs & Enochs, 1990). The specific responses to the items were combined so that teachers with the most favourable beliefs will have the highest scores while teachers with the least favourable beliefs will have the lowest scores (Gliem & Gliem, 2003). Again, Gliem and Gliem (2003, as citing Nunnally & Bernstein, 1994) agreed that the averages of all individuals‟ summated scores serve as measures of the SEB scores. The average scores were used in order to minimise the errors of measurement.

In order to assess the achievement or level of CKC of JHS science teachers, a numerical data was used for the analysis. A score of 1 mark was given for each correct response to items 1 to 6 of Section C, whiles a score of zero (0) was given to incorrect item responses. The total score for the Section C was 37 marks. Therefore, the total percentage scores for JHS science teacher on Section C were used as measures of their pre-workshop content knowledge competency (PRE-CKC) in JHS basic electronics.

Also, the data obtained from the item responses of JHS science teachers on SEB and CKC of the post-workshop questionnaires were coded, scored, analysed and presented as frequency and percentage frequencies of responses in tables. The responses to items of the post-workshop questionnaires was analysed the same way as the responses to items of the pre-workshop questionnaires; using the Statistical Package for Social Science (SPSS) version 20.0 and Microsoft office excel 2010 programme.

Ethical Issues

The Researcher met the science teachers in their various JHS to obtain the content and needs-satisfaction leveling for the workshop. They were encouraged to voluntarily attend the workshop for the study when they were given official permission.

The KNM Director of Education gave the science teachers official permission to attend the IN-SET workshop. The Headmistress of Navrongo Senior High School also gave permission for the teachers to attend the workshop in the school.

CHAPTER FOUR

RESULTS, FINDINGS AND DISCUSSION

Overview

This chapter is made up of the analysed data of the research study. The descriptive and inferential statistics of the pre-workshop and post-workshop data are presented such that they can be used to answer the research questions and relate them to the research objectives set for the study. First, there is a presentation and explanation of the demographic data of the teachers. Second, there is the presentation and discussions of the data on teachers‟ self-efficacy beliefs (SEB) and teachers‟ content knowledge competencies (CKC). Each data was then considered in relation to the research questions. Finally, the findings of the study are discussed in relation to the findings from previous studies.

Demographic Data of JHS Science Teachers in the Study

The demographic data of JHS science teachers comprises the following: gender, age, academic and professional qualifications, the programmes studied by JHS science teachers at the Senior High Schools (SHS), Colleges of Education and the University. The data also includes the years of teaching experience and the number of classes JHS science teachers teach at their current schools as at the time of the study. Furthermore, information on the subjects JHS science teachers had expressed greater pleasure in teaching and the current science syllabuses they use in JHS as well as the IN-SET workshops they attended on any of the Science syllabuses are presented. Again, the demographic data presents information on JHS science teachers‟ opinions on the level of knowledge in JHS basic electronics they had acquired from several sources including IN-SET workshops they attended and this IN-SET workshop for the study.

Gender and age of science teachers

The data on the forty six (46) JHS science teachers who attended took part in this study in KNM and their age ranges are presented in Table 4.1.

Table 4.1: Gender and Age of Participants in the Study

Bio-data	Group	Frequency	Percent
Gender	Male	39	85
	Female	7	15
Age (years)	Under 26	4	8.7
	26-45	41	89.1
	46-60	1	2.2

Table 4.1 shows that seven (7) female teachers, (representing 15% of the science teachers) as against 39 male teachers (85% of science teachers) attended the workshop This is an indication that more males than females teach integrated science at JHS of KNM at the time of the study. Table 4.1 further shows that 9 % representing four (4) science teachers have ages below 25 years, 89.1% representing forty one (41) have ages between 26 years and 45 years while 2% (1) of teachers are above 46 years. The results suggest that majority of science teachers who benefitted from this IN-SET workshop for the research study still have over fifteen years of continuous service in teaching. Therefore, they could probably lend their knowledge in basic electronics to the benefit of their pupils.

Academic and professional qualification of the JHS science teachers

The academic qualification (certification) and professional qualification (nature of certification) of JHS science teachers are presented in Table 4.2.

Table 4.2: Highest Educational Qualification Attained by JHS Science Teachers

Qualification (academic & professional)	Frequency	Percent
Teacher Cert. A	2	4.3
Diploma/UTDBE	23	50.0
Post Diploma/ Degree	18	39.1
HND	2	4.4
WASSCE	1	2.2
Total	46	100

Table 4.2 shows that among the participating JHS science teachers 4.3% (2) were holders of Teacher Certificate „A", 50% representing twenty three (23) teachers had Diploma in Basic Education/Untrained Teachers Diploma in Basic Education (UTDBE) certificates and 4.4% (2) had Higher National Diploma certificates. Also 39.1% comprising eighteen (18) of the teachers held Post-Diploma/First Degree certificates while one teacher (2.2%) was a West African Senior School Certificate Examination (WASSCE) holder.

Programmes studied by JHS science teachers in SHS, Colleges of Education, Polytechnics or University

The programmes JHS science teacher studied at the Senior High Schools/Senior Secondary Schools SHS/SSS, College of Education and University/ Polytechnic were General science, Agric science, and non-science programmes (General arts, Business, Social studies, Mathematic or Technical skills). The number counts of teachers (frequencies) who read the various programmes is presented in Table 4.3.

Table 4.3: Programmes JHS Science Teachers Studied at SHS/SSS, College, and University

Institution	SHS/SSS		College of Education		University	
Programme	Frequency	Percent	Frequency	Percent	Frequency	Percent
General science	12	26.1	25	54.3	7	15.2
Agric science	22	47.8	-	-	-	-
Non-science programme	12	26.1	20	43.5	11	23.9
Total	46	100.0	45	97.8*	18	39.1**

* 2.2% (1) is a pupil- teacher; **60.9% (28) are non-university graduate JHS science teachers

Table 4.3 shows that 26% representing twelve (12) JHS science teachers studied General science programme at the SHS/SSS, 47.8% (22) studied General Agricultural science while 26.1% (12) studied non-science programmes (General arts/ Business/Technical Skills). Also Table 4.3 shows that about 54.3 % comprising twenty five (25) of JHS science teachers studied integrated science at the College of Education, while 43.5% (20) had studied non-science programmes. However, 2% representing one (1) science teachers was a pupil-teacher (WASSCE certificate holder).

Table 4.3 further indicates that 15.2% representing seven (7) science teachers were post-diploma/first degree certificates holders in Basic Science Education (or Agriculture Science Education). Also 23.9% comprising eleven (11) science teachers were post-diploma/first degree certificate holders in non-science programmes. This implies that about 60.9% (28) JHS science teachers were non-university graduates.

Number of classes JHS science teachers handle and years of teaching experience in integrated science

JHS science teachers were asked to indicate the number of classes they currently teach and how many year they have been teaching integrated science JHS as at the time of the study. The results are presented in Table 4.4.

Table 4.4: Number of Classes JHS Science Teachers Handle and Years of teaching Science

Item statement	Response Options	Frequency	Percent
Number of Classes science teachers handle	One class	15	32.6
	Two classes	9	19.6
	Three classes	22	47.8
Number of years of teaching integrated science	0-1 years	14	30.4
	2-5 years	28	60.9
	≥6 years	4	8.7

Valid Sample, N =46

Table 4.4 results shows that about 33% (15) of the JHS science teachers taught only one class (JHS 1, 2, or 3) at their schools and 20% (9) taught two classes (JHS 1 & 2, 1 & 3, or 2 & 3) while about 48% (22) of them taught all three classes (JHS 1, 2 & 3) in their schools.

Table 4.4 also indicates that 30% (14) of JHS science teachers had one year of integrated science teaching experience in JHS. However, about 61% (28) of science teachers had between two to five years of science teaching experience in JHS. Probably one could say that many of these JHS science teachers might had encountered topics on basic electronics in the science syllabuses (MOE, 2012b; MOESS, 2007a). Also, about 9% (4) of science teachers have had over six years of integrated science teaching experience in JHS.

Subjects JHS science teachers had greater pleasure, science syllabuses they currently in use at JHS and workshops they attended on syllabuses

The study also sought for information on the subjects JHS science teachers had greater pleasure to teach at JHS and the science syllabuses they currently use for teaching in JHS well as the IN-SET workshops they had attended to sharpen their skills and knowledge to use the JHS science syllabuses. The results are presented in Table 4.5.

Table 4.5: Subjects JHS Science Teachers have Greater Pleasure, Syllabus Used in Class and Workshops Attended on Syllabus

Item statement	Response Options	Frequency	Percent
I obtain greater pleasure in teaching......	Integrated science	41	89.1
	Mathematics	5	10.9
Which syllabus do you use for your science lesson?	2007 syllabus	37	80.4
	2012 syllabus	9	19.6
I attended an in-service training on the use of the...	2007 syllabus	3	6.5
	2012 syllabus	9	19.6
	None	34	73.9

Sample size, N = 46

Table 4.5 results indicate that about 89%, representing 41 JHS science teachers, said they had greater pleasure in teaching integrated science as against 11% in mathematics. The results suggest that a greater number of JHS science teachers had greater pleasure in the teaching of integrated science in KNM. Thus, as a pre-workshop data it could suggest majority of the JHS science teachers would probably appreciate any intervention to develop their capacity to teach science (possibly basic electronics) when they are offered the opportunity.

Table 4.5 also indicates that 80% representing thirty seven (37) JHS science teachers were using the MOESS (2007a) integrated science syllabus. However, about 20% comprising nine JHS science teachers were using the current integrated science syllabus (MOE, 2012b). It could further be observed from Table 4.5 that about 74% of the JHS science teachers did not attend an IN-SET programme that supports them to teach MOESS (2007a) and MOE (2012b) JHS science syllabuses. However, about

20% of JHS science teachers had attended workshops on the use of the MOESS (2007) science syllabus and 6.5% of JHS science teachers had attended workshops on the use of the MOE (2012b) JHS integrated science syllabus. Therefore, the IN-SET workshop meant for this research study was likely to give majority of JHS science teachers in JHS of KNM the opportunity to experience on how to teach content of the JHS science syllabus and specifically content topics on JHS basic electronics.

Teachers experience of learning basic electronics at workshops and other sources of knowledge in basic electronics

The study further sought to find out whether JHS science teachers had learnt some content topics of JHS basic electronics in other IN-SET workshops, schools, and the IN-SET workshop for this study. The results of JHS science teachers" responses are presented in Table 4.6

Table 4.6: JHS Science Teachers' Experience of Basic Electronics at Workshops and other Sources of Knowledge in Basic Electronics

Item statement	Response Options	Frequency	Percent
I learnt how to teach basic electronics in **previous** IN-SET workshops	Not at all	36	78.2
	Fairly	9	19.6
	Good	1	2.2
I learnt some content knowledge on JHS basic electronics at the...	SHS/College	26	56.5
	University	2	4.4
	None	18	39.1
I have learnt how to teach JHS basic electronics in this study"s IN-SET workshop	Fair	3	6.5
	Good	24	52.2
	Great deal	19	41.3

The results in Table 4.6 points out that 78.2% representing thirty six(36) science teachers did not learn any content knowledge on basic electronics in previous workshops, 9.6% of teachers did not learn adequate content knowledge in basic electronics while 2.2% of teachers had learnt deep content knowledge on basic electronics in previous workshops attended. The results suggest that many of JHS science teachers did not acquire adequate content knowledge on basic electronics in previous in-service trainings. Therefore, the workshop for the study, probably, could be a good intervention for learning JHS basic electronics.

Furthermore, Table 4.6 results indicates that 56.5%, representing 26 science teachers, learnt some content knowledge of basic electronics in SHS and College of Education while 4.4% acquired the knowledge at the University. The remaining 39.1% of science teachers did not acquire content knowledge on basic electronics at formal institutions.

Now after the in-service workshop for the study, JHS science teachers were asked to indicate their levels of satisfaction with the workshop in relation to learning JHS basic electronics. Table 4.6 indicates that 41% representing nineteen (19) JHS science teachers were of the view that they benefited greatly from the workshop, 52% had a high level of satisfaction while 7% of JHS science teachers were not adequately satisfied with the support the IN-SET workshop offered. None of the participants were completely dissatisfied with the IN-SET workshop intervention.

Analysis of Data in Response to Research Questions

The data was analysed to respond to the research questions on the study. The research questions sought to determine the differences between JHS science teachers"pre-workshop and post-workshop self-efficacy beliefs and content knowledge competencies and whether there exist any relationship between these variables.

Research question 1:

What are the differences in JHS Science Teachers' Self-Efficacy Beliefs towards Basic Electronics before and after an IN-SET workshop?

Section B of both pre-workshop and post-workshop questionnaires had 14 items which were meant to measure the JHS science teachers‟ self-efficacy beliefs towards basic electronics. The items numbered 1, 11, 12, 13 and 14 of Section B were reversed coded because they were negatively worded statements while the other nine (9) items were positive statements. As a five-option Likert-type scale the responses for the positively worded items were rated and scored as follows: "Strongly Disagree – 1; Disagree – 2; Uncertain – 3; Agree – 4; Strongly Agree – 5". The reversed coded items were rated and scored as: Strongly Disagree – 5; Disagree – 4; Uncertain – 3; Agree – 2; Strongly Agree – 1 (Riggs & Enochs, 1990). As five-points Likert-type scale coding, some researchers assign a score of 3.0 to reflect a neutral response and scores of 0.56 to 1.0 standard deviations above and below this mark to represent high and low levels of efficacy respectively (Bleicher, 2004; Palmer, 2006 as cited in Swackhamer et al., 2009; Riggs & Enochs, 1990).

Therefore, the data of the study were analysed such any decimal mean score was converted to nearest whole number before it was rated. Thus, a mean score of 3.0 was rated as moderate level of self-efficacy beliefs and a score of 0.56 standard deviations below and above the score of 3 were rated as low self-efficacy beliefs and high self-efficacy beliefs respectively. The rated data on JHS science teachers‟ perceived SEB on the difficulty of JHS basic electronics was presented in Table 4.7, Table 4.8 presents data on JHS science teachers‟ perceived SEB on time devotion to study basic electronics and Table 4.9 presents data on JHS science teachers‟ perceived SEB on their competency to teach basic electronics in JHS.

Table 4.7: JHS Science Teachers SEB on Perceived Difficulty of JHS Basic Electronics

Item No.	Self-efficacy beliefs item statement	Pre-Workshop	Post-Workshop	Mean diff	t-test value	Sig.
		MS (SD)	MS (SD)			
1(9)** (RC)*	I believe the practical activities of basic electronics are difficult to teach in JHS.	2.72 (1.46)	3.78 (0.76)	-1.065	-4.69	0.000
2(3)	I believe I can teach JHS basic electronics when I seriously study on it	4.48 (0.91)	4.33 (0.60)	0.152	0.98	0.332
3(1)	I have self-motivation that I can teach the contents of basic electronics in JHS.	4.04 (1.15)	4.15 (0.52)	-0.109	-0.64	0.528
5(6)	I believe I have adequate content knowledge to teach basic electronics in JHS.	3.39 (1.29)	4.02 (0.54)	-0.913	-3.93	0.000
10(12)	I can confidently say that basic electronics in JHS science syllabus is easy to teach.	3.02 (1.33)	3.63 (0.80)	-0.609	-2.81	0.007
11(13) (RC)*.	I cannot teach basic electronics in any of my science lessons in JHS.	3.93 (1.42)	4.02 (0.54)	-0.087	-0.44	0.660
12(14) (RC)*.	I can teach only some portions of basic electronics in my science lessons in JHS.	3.61 (1.27)	3.63 (0.77)	-0.022	-0.10	0.919
13(4) (RC)*.	I believe that JHS basic electronics should be taught by special science teachers.	3.07 (1.67)	4.30 (0.59)	-1.239	-5.27	0.000
14(2) (RC)*.	I need more content knowledge so I can identify discrete basic electronics‟ components used in JHS.	1.50 (0.89)	4.26 (0.65)	-2.761	-17.70	0.000
	Overall mean score	3.30	4.05	0.75	7.70	0.00

**Pre-workshop (Post-workshop) items; (RC)*- Reversed Coded item responses; SD – Standard Deviation in parenthesis; MS – Mean Score.

Analysis of Table 4.7 indicates that before JHS science teachers attended the IN-SET workshop they had moderate self-efficacy beliefs (MS = 2.72 ≈ 3.0) that practical activities in basic electronics were difficult to teach in JHS. However, after attending the IN-SET workshop JHS science teachers attained high self-efficacy beliefs (MS = 3.78) that practical activities of basic electronics were not difficult to teach in JHS.

This implies that, JHS science teachers had high self-efficacy beliefs, both before (MS = 4.46) and after (MS = 4.33) attending the IN-SET workshop, that they could teach JHS basic electronics when they seriously study on its content. Again JHS science teachers had expressed high self-efficacy beliefs, both before (MS = 4.04) and after (MS = 4.15) the IN-SET workshop, that they had self-motivation that they could teach the contents of basic electronics in JHS. Also, these JHS science teachers had indicated high self-efficacy beliefs, both before (MS = 3.9) and after (MS = 4.02) the IN-SET workshop, that they had adequate content knowledge to teach basic electronics in JHS.

In addition, before the IN-SET workshop JHS science teachers expressed moderate self-efficacy beliefs (MS = 3.02) that basic electronics in JHS science syllabus (2012) was easy to teach. However, after the workshop they had shown high self-efficacy beliefs (MS = 3.63) that basic electronics was easy to teach in JHS. Interestingly, the JHS science teachers had high levels of self-efficacy beliefs both before (MS = 3.93) and after (MS = 4.02) the IN-SET workshop against (reversed coded interpretation) the statement that they could not teach basic electronics in any of their science lessons in JHS. Again these teachers had high SEB, both before (MS = 3.61), and after (MS = 3.63) the IN-SET workshop against the statement that they could teach only some portions of basic electronics in their science lessons in JHS.

Also, before the IN-SET workshop JHS science teachers had a moderate mean self-efficacy (MS = 3.07) that JHS basic electronics should not be taught by JHS science teachers, but these self-efficacy beliefs were raised (MS = 4.30) against this premise, after the IN-SET workshop. Again, before JHS science teachers attended the IN-SET workshop they had expressed low self-efficacy beliefs (MS = 1.50) indicating that they needed more content knowledge in order to identify discrete basic electronics components used in JHS. Nonetheless, they developed high self efficacy beliefs (MS = 4.26) after the IN-SET workshop indicating that they believed that they had sufficient content knowledge to identify discrete basic electronics‟ components used in JHS.

Thus, in summary Table 4.7 shows an overall self-efficacy beliefs of JHS science teachers on the perceived difficulty of JHS basic electronics before attending the IN-SET workshop as moderate (MS = 3.3). However, JHS science teachers‟ uncertainty in self-efficacy beliefs on the perceived difficultness of basic electronics content knowledge diminished after the IN-SET workshop resulting in the development of an overall post-workshop high self-efficacy beliefs (MS = 4.05). Again, Table 4.7 shows that in both the overall item responses and that of all the individual item responses, there are significant differences between JHS science teachers‟ self-efficacy beliefs after and before the IN-SET.

The study also sought to find out whether JHS science teachers had the belief that devoting more time to the JHS study of basic electronics could minimize some of the challenges they would encounter when delivering lessons on it. The results are presented in Table 4.8.

Table 4.8: JHS Science Teachers SEB on Perceived Time Devotion towards Basic Electronics

Item No.	SEB item statement	PRE MS (SD)	POST MS (SD)	Mean difference	t-value	Sig.
*4 (5)	I can devote adequate time to study JHS basic electronics before my science lessons	4.20 (1.167)	4.30 (0.695)	0.174	0.88	0.38

* Pre-workshop (Post-workshop) items; MS=Mean score; SD - Standard Deviation in parenthesis

Table 4.8 indicates that JHS science teachers had high self-efficacy beliefs, both before (MS = 4.2) and after (MS = 4.30) the IN-SET workshop that they could devote adequate time to study basic electronics before attending their science lessons in JHS. However, there is significant differences between the item responses score, hence JHS science teachers"self-efficacy beliefs after and before the IN-SET.

In addition, JHS science teachers" self-efficacy beliefs in their „perceived competency" to teach classroom activities on basic electronics were also determined. Some of the intended competencies in content knowledge and skills were assessed and the responses presented in Table 4.9.

Table 4.9: JHS Science Teachers' Self-efficacy Beliefs on their 'Perceived Competency to Handle JHS Classroom activities

Item No.	Self-efficacy beliefs item statement	Pre-Workshop MS (SD)	Post-Workshop MS (SD)	Mean Diff	t-test value	Sig.
*6(7)	I can confidently carry out hands-on activities on JHS basic electronics with my pupils in JHS.	3.1 (1.36)	3.9 (0.78)	-0.804	-3.75	0.001
*7(8)	I can confidently solve pupils" difficulties in learning basic electronics in JHS.	3.4 (1.24)	3.9 (0.57)	-0.522	-2.93	0.005
*8(10)	I can confidently draw basic electronics circuits as required by the JHS science syllabus.	3.6 (1.24)	4.0 (0.58)	-0.457	-2.42	0.019
*9(11)	I can confidently answer evaluation questions on JHS basic electronics.	3.7 (1.06)	4.1 (0.65)	-0.391	-2.49	0.016
	Overall mean score	3.4 (1.06)	4.0 (0.50)	0.60	3.56	0.000

*Pre-workshop (Post-workshop) items; MS– Mean Score; SD –Standard Deviation in parenthesis

Table 4.9 shows that before JHS science teachers attended the IN-SET workshop, they had shown moderate self-efficacy beliefs (MS = 3.1) as against the high self-efficacy beliefs (MS = 3.9) expressed after the workshop, that, they could carry out hands-on activities on JHS basic electronics with their pupils. Also, as to whether they were confident that they could solve JHS pupils" difficulties in learning basic electronics, JHS science teachers had shown that they possessed moderate self-efficacy beliefs (MS = 3.4) as against high self-efficacy beliefs (MS =3.9) before and after the IN-SET workshop respectively.

Nonetheless, JHS science teachers had shown that they had possessed high self-efficacy beliefs both before (MS = 3.6) and after (MS = 4.02) the workshop on the premises that they could confidently draw basic electronics circuits as required by the current JHS science syllabus (MOE, 2012b). Also, science teachers had shown high self-efficacy beliefs, both before (MS = 3.7) and after (MS = 4.1) the IN-SET workshop that they could confidently answer evaluation questions on JHS basic electronics. In generally, Table 4.9 indicates that on the premises of JHS science teachers" perceived competencies to confidently to handle classroom activities with pupils, JHS science teachers" had expressed moderate self-efficacy beliefs (MS = 3.4) before the IN-SET workshop and high self-efficacy beliefs (MS = 4.0) after the IN-SET workshop. Again, Table 4.9 indicates that there are significant differences between JHS science teachers" self-efficacy beliefs after and before the IN-SET workshop in all the item responses.

In order to ascertain the impact of the IN-SET workshop for the study, on science teachers" self-efficacy beliefs towards teaching JHS basic electronics, t-test analyses for paired (dependent) samples were determined on the mean scores. The t-test was to establish the significant difference between the pre- and post-workshop mean scores. The t-test results are presented in Table 4.10

Table 4.10: Overall JHS Science Teachers' Self-Efficacy Beliefs and t-test Analysis of Paired Samples

Category	Pre-Workshop MS (SD)	Post-Workshop MS (SD)	T-test results t-test	df	p-value
Overall Self-efficacy beliefs mean Score	3.4(0.70)	4.0(0.43)	6.018	45	0.000

N = 46, MS =Mean Score; SD= Standard Deviation in parenthesis

The results in Table 4.10 indicates that generally, JHS science teachers in JHS Kassena Nankana Municipal had expressed moderate self-efficacy beliefs (MS = 3.4) towards teaching JHS basic electronics before they attended the IN-SET workshop. However, after the IN-SET workshop JHS science teachers had shown high self-efficacy beliefs (MS = 4.0) towards teaching basic electronics. It is further indicated in Table 10 that there is significant difference between JHS science teachers‟ self-efficacy beliefs after and before the IN-SET workshop. Hence the IN-SET workshop has had positive impact on JHS science teachers‟ self-efficacy beliefs towards teaching basic electronics in JHS of KNM.

Research hypothesis 1:

H_1: There is no significant change in the JHS science teachers' self-efficacy beliefs towards basic electronics after an IN-SET programme

Again, Table 10, which presents a t-tests analysis of paired samples scores shows that statistically, there was significant difference [t(45) = 6.018, p= 0.000] between the JHS science teachers‟ self-efficacy beliefs overall mean scores before (M= 3.4) the IN-SET workshop and after the IN-SET workshop (M = 4.0).

Therefore, the null hypothesis that, "there is no significant change in the JHS science teachers‟ self-efficacy beliefs in basic electronics after an IN-SET programme" was rejected. Hence, it can be concluded statistically, that there is significant changes in the JHS science teachers" self-efficacy beliefs towards teaching JHS basic electronics after they attended an in-service workshop on the JHS basic electronics.

Research question 2:

What are the differences in JHS Science Teachers' Level of Content Knowledge (Competencies) in Basic Electronics before and after an IN-SET workshop?

Items of section C of both pre- and post-workshop questionnaires were to measure teachers" content knowledge competencies (CKC). The items determined JHS science teachers" ability to identify, name, and state the functions of basic electronic components used in JHS. Teachers were also asked to identify transistor terminal codes and state the meaning of symbols used in basic electronic circuit diagrams. However, item 1 of Section C of the pre-workshop questionnaire requested JHS science teachers to identify real basic electronic components mounted on a breadboard. There was no item in post-workshop questionnaire corresponding to item 1 of the pre-workshop questionnaire. This is because JHS science teachers had interacted so much with the real components in the IN-SET workshop hands-on activities and that they had become well versed on identifying the real components of basic electronics. Thus, Table 4.11 displays the results of item responses of JHS teachers who correctly identified each of the real basic electronic components before they attended the IN-SET workshop.

Table 4.11: Results of JHS Science Teachers' Correctly Identifying Real Basic Electronic Components

*Item 1Components"	Percent (Frequency)
Resistor	33 (15)
Capacitor	37 (17)
Inductor	13 (6)
Transistor	30 (14)
LED	52 (24)
PNJ diode	11 (5)
Overall Mean	29.8 (≈14)

N= 46; *Pre-workshop item; Item response Frequency in parenthesis.

Table 14.11 shows that apart from the light emitting diode (LED) which 52% (24) of JHS science teachers were able to identify, less than 40% of JHS science teachers were able to identify the resistor, capacitor, and transistor. The least identified components were the inductor (13%) and the P-N junction diode (11%). On the average about 29.8% of JHS science teachers were able to correctly identify all real basic electronic components before attending the IN-SET workshop.

Also, item 2 of Section C of Pre-workshop questionnaire and item 4 of Section C of Post-workshop questionnaire requested science teachers to identify circuit symbols of JHS basic electronic components" presented on a paper. The item response frequency of JHS science teachers who correctly identified the circuit symbols are shown in Table 4.12.

Table 4.12: Results of JHS Science Teachers Correctly Identifying Circuit Symbols

Items 2(4) Components	PRE-CKC Percent score (Frequency)	POST-CKC Percent score (Frequency)	Percentage Difference	t-test	Sig.
Resistor	59.0 (27)	100 (46)	41.0	5.627	0.00
Inductor	17.0 (8)	80.4 (37)	62.6	8.762	0.00
P-N J Diode	24.0 (11)	95.7 (44)	71.9	10.688	0.00
Capacitor	28.0 (13)	87.0 (40)	59.0	7.997	0.00
LED	35.0 (16)	93.5 (43)	58.5	7.364	0.00
Transistor	28.0 (13)	91.3 (42)	63.3	7.477	0.00
"Mean	31.9 (14.7)	91.3 (42)	59.4	13.10	0.00

N=46 Items; 2(4) = Pre-workshop (Post-workshop) items; Item response Frequency in parenthesis

Table 4.12 indicates that before the IN-SET workshop, except for the circuit symbol of the resistor that 59 % representing twenty seven (27) JHS science teachers were able to identify correctly, less than 40% of JHS science teachers were able to identify the other circuit symbols such as the inductor (17%), P-N J Diode (24%), capacitor (28%), transistor (28%) and light emitting diode (LED) (35%). However, after the IN-SET workshop all JHS science teachers (100%) correctly identified the circuit symbol of the resistor whiles over 80% science of teachers identified the circuit symbols of the inductor (80%), P-N J diode (96%). capacitor (87%), LED (93%) and transistor(91%). However, on the average, not as many JHS science teachers who were able to correctly identify the six JHS basic electronic circuit symbols shown to them after attending the IN-SET workshop (91%) were able to do so before attending the IN-SET workshop (32%).

In addition, Items 3 and 1 of Section C of pre- and post-workshop questionnaires respectively requested JHS science teachers to identify pictures of JHS basic electronic components presented on paper. The frequency counts of JHS science teachers" who correctly identified these pictures are presented in Table 4.13.

Table 4.13: Results of JHS Science Teachers' Correctly Identifying Pictures of Basic Electronics Components

Items 3 (1) Components	PRE-CKC Percent score (Frequency)	POST-CKC Percent score (Frequency)	Percentage Difference	t-test	Sig.
Resistor	33 (15)	100 (46)	67.0	9.64	0.000
Capacitor	43 (20)	100 (46)	57.0	7.65	0.000
Inductor	17 (8)	97.8 (45)	80.8	12.04	0.000
Transistor	24 (11)	100 (46)	76.0	11.96	0.000
LED	41 (19)	80.4 (37)	39.4	4.09	0.000
P-N J diode	7 (3)	97.8 (45)	90.8	21.74	0.000
Teachers" Mean	27.5 (12.7)	96.0 (44.2)	68.5	15.45	0.000

Items 3(1) = Pre-workshop (Post-workshop) items; Item response Frequency in parenthesis

Table 4.13 shows that before attending the IN-SET workshop, about 33% representing fifteen (15) JHS science teachers correctly identified the picture of the resistor, about 43% identified the picture of the capacitor and 24% identified the transistor. However, all JHS science teachers (100%) identified the pictures of the resistor, capacitor and inductor after the IN-SET workshop. Also, before the IN-SET workshop about 17% of JHS science teachers correctly identified the picture of the inductor, 41% identified the picture of LED and 7% identified the picture of the P-N J diode. Nonetheless, after the IN-SET more than 80% of JHS science teachers correctly identified the picture of the inductor (98%), the LED (80%) and PNJ diode (98%). On the average, as many as 27.5% of JHS science teachers correctly identified all six pictures of basic electronic components before attending the IN-SET workshop, but an average of 96% of JHS science teachers correctly identified all these pictures after the IN-SET workshop.

Again, items 4 and 5 of Section C of the pre- and post-workshop questionnaires respectively requested JHS science teachers to state the functions of basic electronic circuit components either in isolation or in relation to their position in an electronic circuit. Although, item 4 requested JHS science teachers to state the function of the basic electronic components, item 5 asked teachers to write names of basic electronic components to match with options of statements of functions of basic electronic components. The frequency of JHS science teachers" correct responses are shown in Table 4.14.

Table 4.14: Results of JHS Science Teachers' Correctly Stating/Relating Basic Electronics Components to their Functions

Items 4(5) Components	PRE-CKC Percent score (Frequency)	POST-CKC Percent score (Frequency)	Percentage Difference	t-test	Sig.
Resistor	46 (21)	89.1 (41)	43.1	5.056	0.00
Capacitor	35 (16)	100 (46)	65.0	9.186	0.00
Inductor	9 (4)	95.7 (44)	86.7	17.321	0.00
Transistor	22 (10)	93.5 (43)	71.5	10.688	0.00
LED	50 (23)	93.5 (43)	43.5	5.056	0.00
P-NJ Diode	7 (3)	76.1 (35)	69.1	9.238	0.00
Teachers" Mean	28.2(12.8)	91.0 (42)		13.892	0.00

Items 4(5) = Pre-workshop (Post-workshop) items; Item response Frequency in parenthesis

The pre-workshop data of Table 4.14 indicates that over 40% of JHS science teachers could correctly state the functions of the resistor (46%) and LED (50%). However, less than 40% were able to state the functions of the capacitor (35%), the inductor (9%), the transistor (22%) and the P-N J diode (7%) before attending the IN-SET workshop. Nonetheless, after the IN-SET aside the PNJ diode with 76%, over 80% of JHS science teachers correctly related basic electronics components to their function statements; the resistor (89%), capacitor (100%), inductor (96%), transistor (93%) and LED (93%). In summary, about an average of 28.2% JHS science teachers correctly stated the functions of six (6) basic electronics components before attending an IN-SET workshop. However, an average of 91.0% of JHS science teachers did relate correctly the basic electronic components to their functions after the IN-SET workshop.

Furthermore, items 5 and 2 of Section C of the pre- and post-workshop questionnaires respectively requested JHS science teachers to relate scientific units Ω, V and F (with prefixes k - kilo and µ - micro and measures of 3.3, 9, 100 and 470) to corresponding basic electronic components. The frequency of correct interrelations by JHS science teachers are presented in Table 4.15.

Table 4.15: Results of JHS Science Teachers' Correctly Relating Scientific Units to Basic Electronic Components

Items 5(2) Components (unit)	PRE-CKC Percent score (Frequency)	POST-CKC Percent score (Frequency)	Percentage Difference	t-test	Sig.
Cell (9 V)	74 (34)	93.5 (43)	19.5	2.446	0.00
Capacitor (100 µF)	20 (9)	91.3 (42)	71.3	8.941	0.00
Resistor (3.3 kΩ)	46 (21)	95.7 (44)	49.7	5.778	0.00
Resistor (100 kΩ)	59 (27)	91.3 (42)	32.3	2.87	0.00
Resistor (470 Ω)	43 (20)	91.3 (42)	48.3	7.05	0.00
Teachers'' Mean	48.4 (22.2)	92.6 (42.6)	44.2	6.867	0.00

Items 5(2) = Pre-workshop (Post-workshop) items; Item response Frequency in parenthesis

Table 4.15 shows that apart from 20% of JHS science teachers who were able to relate the 100 µF to the capacitor before attending the IN-SET workshop, over 40% of them were able to relate the unit symbols to the respective basic electronic components; 9V to cell (74%), 3.3 kΩ to resistor (46%), 100 kΩ to resistor (59%) and 470 Ω to resistor (43%). However, after the IN-SET workshop over 90% of JHS science teachers were able to relate the units to the respective basic electronic components; 9V to cell (94%), 100 µF to capacitor (91%), 3.3 kΩ to resistor (96%), 100 kΩ to resistor (91%) and 470 Ω to resistor (91%). In conclusion, an average of 47.8% of JHS science teachers before the IN-SET workshop as against 91.7% of after the IN-SET workshop correctly related scientific units of quantities to their basic electronic components.

JHS science teachers are expected to introduce bipolar (PNP/NPN) transistor to pupils in JHS year two (MOE, 2012b). This transistor has three unique terminal pins with specific names such as base, emitter and collector. JHS science teachers‟ knowledge of these names is essential in lesson delivery. Therefore, items 6 and item 3 of the Pre- and post-workshop questionnaires respectively requested JHS science teachers to name the terminal pins of the bipolar transistor. The items of the questionnaire also asked the science teachers to name the symbols of scientific units related to basic electronics components. The frequency counts of teachers who correctly named the terminals/symbols are presented in Table 4.16.

Table 4.16: Results of JHS Science Teachers' Correctly Naming Symbols of Terminal /Scientific Unit of Basic Electronic Components

Items 6(3) Components	PRE-CKC Percent score (Frequency)	POST-CKC Percent score (Frequency)	Percentage Difference	t-test	Sig.
b - Base	37(17)	100(46)	63.0	8.760	0.00
c - Collector	35(16)	100(46)	65.0	9.186	0.00
e - Emitter	37(17)	100(46)	63.7	8.762	0.00
T - Transistor	35(16)	78.3(36)	43.3	5.056	0.00
µF- Microfarad	13(6)	67.4(31)	54.4	6.752	0.00
V - Volt (V)	28(13)	56.5(26)	28.5	2.784	0.00
kΩ – Kilo-ohm	28(13)	95.7(44)	67.7	9.644	0.00
Ω - Ohm	46(21)	97.8(45)	51.8	7.006	0.00
Teachers‟ Mean	32.4(14.9)	87.0(40)	54.6	10.739	0.00

Items 6(3) = Pre-workshop (Post-workshop) items; Item response Frequency in parenthesis

Table 4.16 indicates that before the IN-SET workshop 37% representing seventeen (17) of JHS science teachers, 35% and 37% of JHS science teachers correctly named the three terminal pins **b**, **c** and **e** of the transistor respectively, whereas after the IN-

SET workshop all the teachers (100%; 46) correctly named all the three terminals. Again, before the IN-SET workshop about 35% representing sixteen (16) of JHS science teachers named correctly „T" (attached to the transistor circuit symbol) as transistor, 13% named the „uF" as microfarad and 28% named „V" as volt. However, after the workshop 78%, 67% and 54% of JHS science teachers named the correspondent „T", uF and „V" symbols correctly. Also, before the IN-SET workshop about 28% and 46% of JHS science teachers correctly named the respective kΩ (kilo-ohm) and Ω (ohm) symbols whereas 96% and 98% respectively did after the IN-SET workshop. Table 4.16 further indicated that, before the IN-SET workshop on average about 32.4% (15) of the teachers were able to correctly name all the terminal pins of the transistor and all symbols of scientific units used in JHS basic electronics components and circuit diagram whereas on the average about 87% (40) of science teachers named all the symbols in the circuit after the IN-SET workshop.

There was an item in Section C of the post-workshop questionnaire which requested JHS science teachers to state the functions of some supplementary components associated with basic electronics circuits used in the hands-on activities during the IN-SET workshop. The results of JHS Science teachers" response are presented in Table 4.17.

Table 4.17: Results of JHS Science Teachers' correctly Relating Auxiliary Electronic Circuit Components to their functions

*Item 6 Components	Percent score (Frequency)
Conductor	65.2 (30)
Cell	82.6 (38)
Breadboard	93.5 (43)
Circuit diagram	84.8 (39)
Crocodile clips	78.3 (36)
Teachers" Mean	81.0 (37.2)

N = 46; *Post-workshop item; Item response Frequency in parenthesis

Table 4.17 showed that 65% representing thirty (30) science teachers correctly related the electric wire to its functions, 93% relates the breadboard as prototype circuit board for constructing circuits on it, 85% correctly related the functions of circuit diagram, and 78% of JHS science teachers related the crocodile clip to its function. In summary, about 81% of JHS science teachers were able to correctly relate all these auxiliary components to their functions.

Therefore, considering the impact of the IN-SET workshop on the individual participated JHS science teachers, Fig. 4.1 shows a scatter plot of science teachers" content knowledge competency (CKC) scores before and after attending an IN-SET workshop on JHS basic electronics.

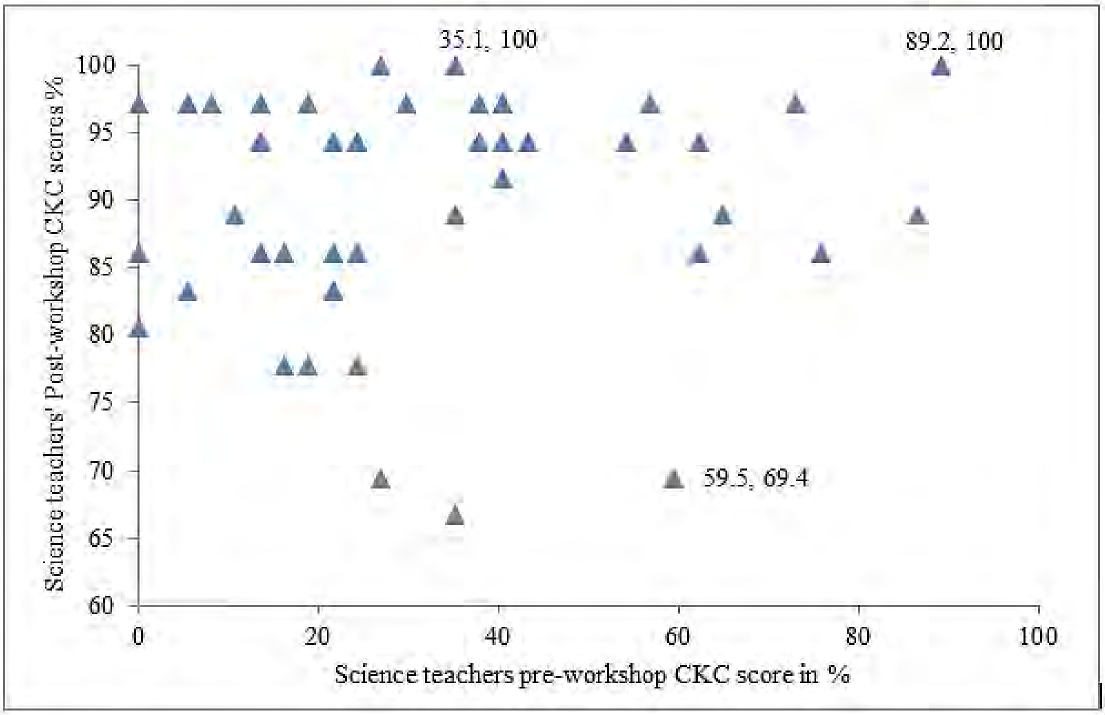

Figure 4.1: Scatter Plots Comparison of Individual (marker, ▲) JHS Science Teachers' Pre-workshop CKC Score (horizontal axis) to the Post-workshop CKC (vertical axis)

The marker, ▲ on the Graph represents an individual JHS science teacher with the pre-workshop CKC score analysed from the horizontal axis and the post-workshop CKC scores on the vertical axis. For example on the graph JHS science teacher ▲

(59.5, 69.4) had a CKC score of 59.5% before attending the IN-SET workshop and had 69.4% score marks after attending the IN-SET workshop. The markers on the graph are 42 because these pairs of scores: (13.5%, 94.4%); (21.6%, 83.3%); (24.3%, 94.4 %) and (40.5%, 97.2%) were each scored by two teachers (see Appendix I).

The scatter graph of Figure 4.1 shows that before the IN-SET workshop as many as 78.3% JHS science teachers had CKC assessment scores clustered between 0% and 50% marks. However, JHS science teachers improved on their CKC after attending the IN-SET workshop on content knowledge and skills in teaching basic electronics in JHS. Consequently, as many as 89.0% of JHS science teachers had CKC assessment score between 80% and 100% marks as shown in Fig. 4.1 Scatter Plots.

Again, the holistic impact of the IN-SET workshop for the study on JHS science teachers CKC on JHS basic electronics could be analysed from Table 4.18.

Table 4.18: JHS Science Teachers Overall Mean Percentage Scores in Content Knowledge Competencies assessments before and after IN-SET Workshop on JHS basic electronic

JHS science Teachers' CKC	N	Mean Percent Score (S D)
Before IN-SET workshop	46	32.8(22.86)
After IN-SET workshop	46	89.9(8.49)
Difference of mean %		57.1%

It is shown in Table 4.18 that before JHS science teachers attended the IN-SET workshop on JHS basic electronics they had an overall mean percent score of 32.8% (SD = 22.86) on content knowledge competency (PRE-CKC). However, after the IN-SET workshop JHS science teachers obtained an overall mean percent score of 89.9% (SD = 8.49) on the content knowledge competence (POST-CKC). Therefore, there is a difference of 57.1% scores in content knowledge competency between the two overall mean percent scores; which is in favour of the of JHS science teachers post-workshop overall mean scores.

Also graphically as shown in Figure 4.2, the proportion of space occupied by PRE-CKC is nearly one-third of the proportion of space occupied by POST-CKC. Therefore, by face value comparison, the IN-SET workshop for the study had greatly assisted JHS science teachers to acquire some content knowledge in JHS basic electronics.

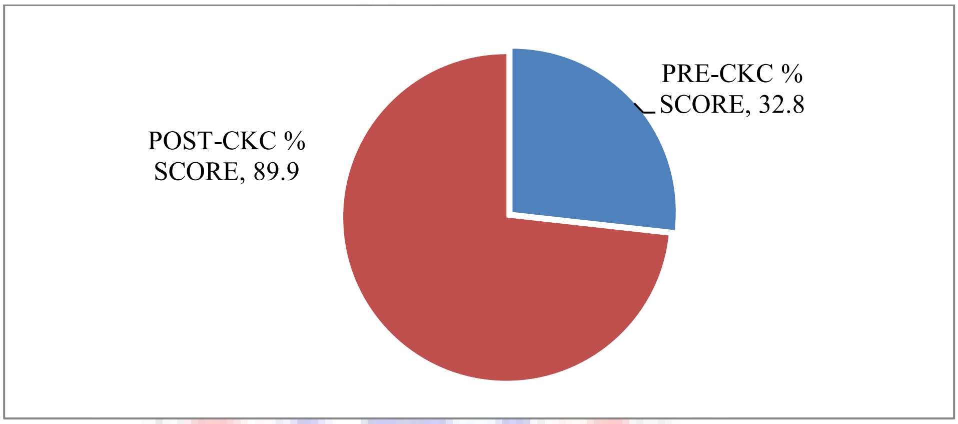

Figure 4.2: Comparison between JHS Science Teachers' Mean Content Knowledge Competency in JHS Basic Electronics before (PRE-CKC) and after (POST-CKC) an IN-SET workshop

However, to determine how significant the difference in overall mean scores were, the set of data was subjected to t-test for paired (dependent) samples analysis and the results presented in Table 14.19. The t-test value was then used to answer the Research hypothesis 2.

Research hypothesis 2:

H_2: There is no significant difference in the JHS science teachers' content knowledge competency in basic electronics before and after an IN-SET workshop.

Table 4.19: Results of t-test analysis on paired samples of JHS Science Teachers Content Knowledge Competency Scores before and after attending workshop

Science Teachers' CKC	Overall MS (SD)	t-test	df	P
Before IN-SET workshop	32.8 (22.86)	16.547	45	0.000
After IN-SET workshop	89.9 (8.49)			

N = 46; MS = mean Score, SD = Standard deviation

The t-test shows that statistically there was significant difference (t(45) = 16.477, p = 0.000) between JHS science teachers" content knowledge competency mean scores before (MS = 32.8%; SD = 22.86) and after (MS =89.9%; SD = 8.49) the IN-SET workshop. Therefore, the null hypothesis was rejected. Hence, there is significant change in JHS science teachers" content knowledge competency in JHS basic electronics after attending the in-service training workshop. Again, it implied that the IN-SET workshop conditions influenced the change in science teachers" content knowledge competencies; since it was the main intervention used by the Researcher in the study.

Research question 3:

What is the relationship between JHS science teachers' self-efficacy beliefs and content knowledge competencies in basic electronics after an IN-SET workshop?

Research hypothesis 3

H_3: There is no significant relation between JHS science teachers' self-efficacy beliefs and content knowledge competencies in basic electronics after attending an IN-SET workshop.

Table 4.20: Summary of Mean Scores of JHS Science Teachers' Self-Efficacy Beliefs and Content Knowledge Competencies Before and After an IN-SET Workshop on JHS Basic Electronics

JHS science Teachers'	Pre-workshop Mean score (SD)	Status at Pre-workshop	Post-workshop Mean score (SD)	Status at Post -workshop
CKC % mean score	32.4(22.86)	Low	89.9(8.49)	High
SEB mean score	3.41(0.70)	Moderate	4.03(0.42)	High

N= 46; MS=Mean Score; SD = Standard Deviation in Parenthesis

Table 4.20 results show cumulatively that, before attending the IN-SET workshop, JHS science teachers had low CKC corresponding with moderate self-efficacy beliefs whereas after the IN-SET workshop they had high CKC corresponding with high self-efficacy beliefs towards JHS basic electronics. These results may suggest a linear regression relationship or correlation between the pre-workshop and post-workshop SEB and CKC mean scores.

However, the contribution of each respective paired (CKC and SEB) mean scores of each JHS science teacher to the relation is shown in a scatter plot graph in Figure 4.4; with the determined linear relation equation. The marker ▲ represents a JHS science teacher whose content knowledge competency (CKC) score is determined on the vertical axis and the self-efficacy beliefs (SEB) mean score value is on the horizontal axis of the scatter plot graph. Thus, an example of JHS science teacher ▲ (3.86, 66.7) had a CKC score of 66.7% marks when the SEB mean score was 3.86.

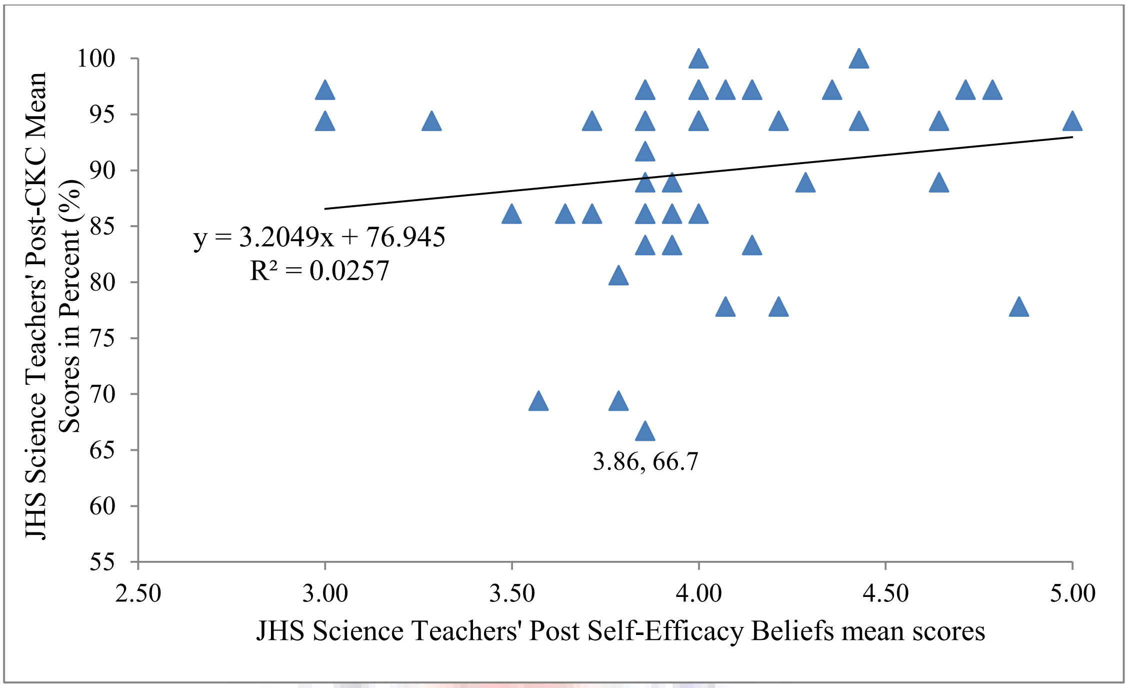

Figure 4.3: Comparison between Individual Science Teachers' Post-CKC and Post-SEB Means Scores

The scatter plot graph of Figure 4.3 shows that the scores obtained by JHS science teachers in the two variables does not show a pattern of high or low CKC score necessarily corresponding with a high or low SEB score. Thus, the graph shows a linear relation between the two variables with a coefficient of determination (R^2 = 0.0257) that depicts a weak correlation (Cohen, 1988, as cited in Pallant, 2005). Also, the R^2 indicates that JHS science teachers῾῾ self-efficacy beliefs contributes approximately 2.6% (effect size) of influence to bring about a change in JHS science teacher῾s level of content knowledge competency in basic electronics, which is however not significant at $p<0.05$ (as shown in Table 4.21).

Also, to respond to the study῾s Null Hypothesis 3, JHS science teachers῾῾ post-workshop self-efficacy beliefs and content knowledge competency mean scores were subjected to correlation analysis to determine the statistical relation between them. The analysis results are presented in Table 4.21.

Table 4.21: Correlation Statistics of JHS Science Teachers' Post-Workshops' CKC and SEB in Basic Electronics

Correlation Between	N	Pearson Cor., r	Sig. (2-tailed)
Post-workshop CKC % mean scores and Post-workshop SEB mean scores	46	0.160	0.287

Table 4.21 shows a Pearson product-moment correlation, r = 0.16 (p = 0.287) which shows that the correlation between JHS science teachers‟ self-efficacy beliefs and their content knowledge competency was not statistically significant at a confidence interval of 95 % of normal distribution of scores ($p < 0.05$). Therefore, the IN-SET workshop intervention could not show a comprehensive predictable dependence between JHS science teachers‟ self-efficacy beliefs and content knowledge competencies (at critical significance of $\alpha = 0.05$).

The null hypothesis therefore, cannot be rejected. Hence it stands that there is no significant correlation between JHS science teachers‟ aggregate content knowledge competency in JHS basic electronics and their aggregate self-efficacy beliefs towards teaching basic electronic after this IN-SET workshop ($p<0.05$). Therefore, if there were any major variations in the content knowledge of JHS science teachers in basic electronic, it was greatly influenced by other external factors likely to be produced by the conditions of learning set by the IN-SET workshop for the study.

Discussions of Results

The general objectives of organising the IN-SET workshop for this research study was to use it as a tool for developing JHS science teachers‟ professional content knowledge and skills in teaching basic electronics in the Kassena Nankana Municipality (KNM). It was also to enable JHS science teachers‟ change their existing beliefs about teaching basic electronics, where these seemed necessary (Gilbert, 2010). As noted, several factors influence JHS science teachers‟ ability to acquire content knowledge competencies (CKC) and development of self-efficacy beliefs (SEB) towards a given task area. This study therefore gathered data on JHS science teachers‟ demography, previous school science and basic electronics teaching experiences to ascertain whether these factors could be an influence on JHS science teachers‟ pre-workshop SEB and CKC. The knowledge of any initial influences of these factors on JHS science teachers was to serve as a guide in determining whether or not the IN-SET workshop had made an impact, when any changed behaviour (SEB and/or CKC) of JHS science teachers is observed after the IN-SET workshop for the study.

Gender and age of science teachers in JHS of Kassena Nankana Municipal

It was observed in the data analyses that more males (85%) than females (15%) science teachers teach integrated science in JHS of KNM. Also majority (97.8%) of these JHS science teachers in KNM were above 25 years (MS = 30.5) of age with most (78%) of them in the age bracket of 20-35 years. However, studies had shown that self-efficacy beliefs are independent of gender (Bussey & Bandura, 1999 as cited in Schunk & Pajares, 2001) though learners‟ perception of success in the acquisition of content knowledge in science relates to male domains (Schunk & Pajares, 2001).

Academic and professional qualification of JHS science teachers in KNM

In terms of minimum professional qualification (certification), the study shows that almost all (93.3%) JHS science teachers held Teacher‟s Certificate „A‟ or Diploma in Basic Education certificate. Also many of these JHS science teachers read science related programs at SHS (74%), as a Basic Science Education programme at the Colleges of Education (54.3%) and as a Post-diploma/First Degree programme in Basic Science Education at the University (15%). Cambell (1996, as cited in Anwar, 2009) suggested that teachers who were older in age, had good teaching (performance) experience and higher education background had higher self-efficacy beliefs. Also Bleicher (2004) had study results that suggest that there were significant differences between the higher personal science teaching self-efficacy learners who had positive previous school science experience to those who had negative previous school science experience.

Thus, from the data of this study and by implication, one could deduce that about 46% of JHS science teachers in KNM teach integrated science without adequate pedagogical content knowledge background in science education curriculum. According to Dillon and Manning (2010**),** pedagogy is not just teaching but representations of the general philosophy and value system teachers acquire professionally as a guide to make the choices they do in what and how to teach a subject. Thus, the inadequate professional background of many of JHS science teachers (46%) in KNM could contribute to teachers exhibiting moderate self-efficacy beliefs towards basic electronics before attending the IN-SET workshop.

Science teaching experience of KNM JHS science teachers

The results of the study also showed that many JHS science teachers (69.6%) had taught integrated science for over two years in JHS. Again, majority (67.4%) of them handled science lessons in two/three classes at their schools whilst about 89% of JHS science teachers had expressed greater pleasure in teaching integrated science. On the other hand, studies had shown that years of teaching experience were insignificant predictors of teachers" self-efficacy beliefs except that there was corresponding satisfaction in years of mastery performances (Bandura 1977, 1986, 1993, 1997; Gür, Çakiroğlu & Çapa, 2012; Kahyaoglu, 2011; Riggs & Enochs, 1990; Gür, Çakiroğlu & Çapa, 2012). Thus, the high self-efficacy beliefs towards teaching basic electronics as exhibited by some individual JHS science teachers in KNM before attending the IN-

SET workshop, could probably result from the positive effects of apparent mastery experiences of teaching integrated science over the years in JHS since many of them (69.6%) have been teaching integrated science for over two years in JHS.

According to Bandura (2009) when people have higher perceived efficacy to accomplish "educational requirements and occupational roles" they widen the career options they seriously want to pursue, they develop greater interest and better prepare themselves educationally for the different occupational careers, as well as develop greater staying power in challenging career pursuits. Therefore, there is the possibility that the few (11%) JHS science teachers who had no greater pleasure and interest in teaching science might have certain dispositions that might have far-reaching negative implications on their performances and that of pupils‟ achievements in science, especially in basic electronics. These „beliefs-attitudes‟ were liable to impose unfavourable responses when a consistent and persistent attitude towards science was required by JHS science teachers (Gilbert, 2010). Also in the light of teaching basic electronics, pupils‟ achievement was likely to be negatively affected, because teachers‟ displeasure for a subject was synonym to expressing low self-efficacy beliefs towards the subject. Thus, JHS science teachers who expressed lack of interest and greater pleasure in teaching JHS science were likely to contribute greatly to the moderate self-efficacy beliefs (MS = 3.4) expressed by JHS science teachers in KNM towards basic electronics before they attended the IN-SET workshop.

The use of reviewed curriculum material and teacher orientation

Ghana Education Service under the Ministry of Education produced a revised JHS integrated science syllabus (MOE, 2012b) for implementation in 2013/2014 academic year. Nonetheless, the research study found out that majority (80.4%) of JHS science teachers were still using (in December 2014) the former JHS integrated science syllabus (MOESS, 2007a) in JHS in KNM. One of the interesting reasons some JHS science teachers assigned for this occurrence was that they were unaware of the changed JHS integrated science syllabus. Hence, a greater number (80%) of JHS science teachers were likely unaware of the reviewed content topics of basic electronics in the current approved syllabus (MOE, 2012b). Thus, it could be inferred that as majority (80%) of the JHS science teachers lacked adequate knowledge of the content topics of basic electronics in the current science syllabus (MOE, 2012b), it could be another liable factor contributing to their general moderate self-efficacy beliefs (MS=3.4) and low content knowledge competency shown in the pre-workshop data. This is because basic electronics" content topics in the former syllabus (MOESS, 2007) are more challenging to teach than the current syllabus topics (MOE, 2012b). For example, teachers taught concepts of transistors at JHS Year 1, oscillators and multi-vibrators at JHS Year 2, and phase shift oscillator at JHS Year 3 (MOESS, 2007). However, in the current syllabus teachers teach uses of basic electronics components, guided by many circuits and simplified teacher – pupils" activities provided by the syllabus (MOE, 2012b).

The research study also found out that very few (26.1%) JHS science teachers in KNM had IN-SET workshops on the use of the MOESS (2007) and MOE (2012b) versions of JHS science syllabuses. Therefore, majority (73.9%) of JHS science teachers alleged they did not attend any IN-SET on the use of the former and current syllabuses. This probably might mean that many of them lacked the policy awareness of the syllabuses and may deliver science lessons (if they did) on some irrelevant materials, especially in JHS basic electronics (Anwar, 2009; Bleicher, 2004). As noted by Jahangir, Saheen and Kazmi (2012) in-service teachers" training is a mechanism to promote major changes in teachers; to redefine their responsibilities in the face of curriculum innovation; widen their view on new national education policy re-orientations and improve certain attributes of efficiency in these (science) teachers for the welfare of their pupils. Therefore, the lack of in-service training for JHS science teachers in KNM on the syllabuses could be one of the likely factors contributing to the moderate self-efficacy beliefs and low content knowledge competencies in basic electronics in the pre-workshop data of the study.

However, the research study had results that showed that most of KNM JHS science teachers (69%) had different levels of previous school (SHS, Colleges of Education, University) experiences with content topics of JHS basic electronics though these content knowledge may not be sufficient for effective lesson delivery. Also, few (21.8%) JHS science teachers through some IN-SET programmes were supported to have some content knowledge experience in JHS basic electronics. However, lack of adequate exposure of a greater number of JHS science teachers (78%) to content topics in JHS basic electronics during previous schooling periods could probably impede the development self-efficacy beliefs and content knowledge competency towards basic electronics before attending the IN-SET workshop.

JHS Science Teachers' Self-Efficacy Beliefs towards Basic Electronics Before and After Attending an IN-SET workshop

The results from the self-efficacy beliefs data showed that before the JHS science teachers‟ attended the IN-SET, they had a general state of moderate self-efficacy beliefs (M = 3.4, SD = 0.70); general doubtfulness in their competencies that they can teach basic electronics in JHS. However, they were able to change this general state of beliefs after attending the IN-SET workshop to a state of high self-efficacy beliefs (M = 4.0, SD = 0.42) towards teaching basic electronics (Table 4.10). Deductively, it could be said the collective moderately self-efficacious science teachers had now developed high confidence that they can teach JHS basic electronics since they were now trained and had acquired some basic skills and knowledge on basic electronics from the IN-SET workshop. Therefore, they possessed the ability or competence to initiate teaching basic electronics, cope with the challenges in basic electronics, determine how much effort they will expend to teach basic electronics, and how long the desire to teach effective lessons in basic electronics will be sustained in the face of obstacles and aversive experiences (Bandura, 1977, 1986, 1997; Pajares 1996).

On individual JHS science teacher basis, the lowest entry point into the IN-SET workshop was a JHS science teacher with low self-efficacy beliefs (MS = 1.8) and a highest entry point of JHS science teachers‟ with a state of high self- efficacy beliefs (MS = 4.8). However, the IN-SET workshop had supported JHS science teachers to develop appreciable levels of self-efficacy beliefs such that the lowest quitting self-efficacious state of teachers after the IN-SET workshop was moderate state self-efficacy beliefs (MS = 3.0) and a highest level of self-efficacious science teachers‟ state of very high self-efficacy beliefs (MS = 5.0). Hence, the individual science teachers had their personal perceived self-efficacy beliefs towards teaching basic electronics raised after the IN-SET workshop on the JHS basic electronics (see Appendix G). By implication, the IN-SET workshop had probably informed individual science teachers that hands-on activities on basic electronics help to learn the actions/tasks that result in positive CKC and SEB outcomes. It was likely that this information / knowledge would guide their future actions (Schunk & Pajares, 2001) in teaching basic electronics.

Statistically it was also shown that there was significant differences between the pre-workshop entry point of moderate self-efficacy beliefs of the JHS science teachers and the post-workshop exit point of science teachers‟ high self-efficacy beliefs (t(45)

= 6.127, p = 0.000). These results are in consonance with related literature from Bandura and Schunk (1981) who indicated that when learners acquire skills they build self-efficacy faster. They further iterate that the more self-instructional materials learners are made to master the stronger their sense of self-efficacy in a task. They also concluded in their research that there was moderate correlation between instructional performance and strength of self- efficacy.

JHS Science Teachers' Level of Content Knowledge Competencies in Basic Electronics Before and After Attending an IN-SET Workshop

The data collected from JHS science teachers before they attended the planned IN-SET workshop for this research study showed that the lowest content knowledge competency (CKC) achieved by JHS science teachers was 0.0% while some JHS science teachers scored as high as 89.2% (see Appendix H). Again, the pre-workshop data produced an impression that about more (78%) JHS science teachers had CKC scores below 50% and that the performance of JHS science teachers yielded an impression of an overall CKC mean score of 32.4% (SD = 22.86). Nonetheless, during the IN-SET workshop, JHS science teachers carried out several learning orientation strategies that supported them to acquire adequate content knowledge in JHS basic electronics. Consequently, the post-workshop data (see Appendix H) seems to suggest that, a lowest CKC score of 64.1% and a highest CKC score of 100% were the ranges of scores obtained by JHS science teachers after the workshop. It is of more interest to state that the collective performance achievement of the post-workshop JHS science teachers produced an overall CKC mean score of 89.9% (SD = 8.49) marks.

The difference in CKC scores of JHS science teachers" performance before and after the in-service training on basic electronics predicts a great probability of improvement in JHS science teachers‟ content knowledge competency after the IN-SET workshop. Statistically it was shown that there was significant difference between the pre- and post-workshop CKC levels of JHS science teachers (t(45) = 16.477, p = 0.0000).

Therefore, it can be inferred that, the JHS science teachers‟ post-workshop high self-efficacy beliefs and high content knowledge competencies resulted from the well-designed hands-on activities and learning-friendly socio-material resourced environment provided by the IN-SET workshop. These activities served as examples of appropriate teaching methods for delivering content knowledge topics in JHS basic electronics to diverse group of teachers and this can be contextualized in the normal classroom (Swackhamer et al., 2009). Again, it was anticipated that the approaches used in the IN-SET workshop was another way of making JHS science teachers have preference to concentrate on sub-task of a full problem; especially physics oriented activities such as JHS basic electronics (Palmer, 2007).

The researcher is therefore of the conviction that, the IN-SET workshop offered JHS science teachers of KNM the opportunities to work on individual specific electronics circuit sub-tasks in detail to give them better intuition and appreciation of JHS basic electronic. Also, every effort was employed to ensure that JHS science teachers‟ motivation to learn what they believed to be difficult but achievable will yield a fruitful ending. The activities carried out were designed to spur JHS science teachers to acquire transferrable knowledge and skills which could easily be contextualise as well as guide them to translate challenging topics of basic electronics into actual classroom work after the IN-SET workshop (Mathelitsch, 2013).

Additionally, Bandura (1993) is of the view that, teachers with high sense of self-efficacy beliefs set "challenging goals and maintain strong commitment" to achieve them. "They maintain a task-diagnostic focus that guides effective performance". They put in much effort to avoid failure, but if failure occurs, they tend to attribute the "failure to insufficient effort or deficient knowledge and skills that are acquirable". JHS science teachers exhibited strong urge qualities that signified a strong drive to develop one‟s effectiveness as they engaged seriously on every practical exercise in the workshop. These attitudes could possibly become strong strata on which it is hoped JHS science teachers would encourage themselves to contextualise and promote continuous feedback, as observed throughout the IN-SET workshop session between themselves as peers and the facilitator of the IN-SET workshop.

Studies had also shown that competency in content knowledge is task specific just as self-efficacy belief is task specific (Pajares, 1996) and one‟s competency is cyclically linked to one‟s self-efficacy beliefs just as one‟s self-efficacy beliefs are demonstrated in one‟s competency traits (Bourne & Russo, 1998; Rathus, 1993). It is therefore anticipated that the enthusiasm and collaborative behaviours JHS science teacher-participants exhibited in all the IN-SET workshop‟s activities were likely some of the factors that promoted the high results achieved in self-efficacy beliefs and content knowledge competency after the IN-SET workshop.

Relationship between JHS science teachers' self-efficacy beliefs and content knowledge competencies in basic electronics after an IN-SET programme

In this research study, it was observed that statistically, there was no correlation between the JHS science teachers‟ post-workshop self-efficacy beliefs and post-workshop content knowledge competencies ($r = 0.0160$, $p = 0.287$). Although informal observation of the individual science teachers‟ post-workshop self-efficacy beliefs and content knowledge competency results (Appendices G and H) may depict some correlation in the discrete states, on the contrary, the correlation between aggregate scores results were less observable. Nonetheless, a study in Sri Lanka showed that there was a more positive relationship between some individual science teacher‟s self-efficacy beliefs and their content knowledge competency experience. It was also observed that these teachers had distinctly different levels of self-efficacy beliefs for specific content tasks that correlate slightly (Anwar, 2009, as citing Gorrell & Dhamadasa, 1994). Nevertheless, the negligible correlation observed in this research study for JHS science teachers in KNM can probably be associated, among other factors, to the nature of the subject content topics (JHS basic electronics) and the environment (equipped physics laboratory; peer-teaching-workshop as against life-classroom demonstrations (Anwar, 2009).

Also the observable low correlation of the study can relate to Bandura (1977) findings that:

> *Similar relationships between level of self-efficacy and performance are obtained when the data are considered separately… Correlation coefficients based on aggregate measures do not fully reveal the degree of correspondence between self-efficacy and performance on the specific behavioral tasks from which the aggregate scores are obtained. A subject can display an equivalent number of efficacy expectations and successful performances, but they might not correspond entirely to the same tasks. The most precise index of the relationship is provided by a microanalysis of the congruence between self-efficacy and performance at the level of individual tasks"* (p.206).

It is important to note that some research studies concluded that beliefs are the best indicators of the decisions we make daily in our lives and the motors of behaviours which have a long-term stabilities (Gilbert, 2010; Pajares, 1992 as cited in Anwar, 2009). Thus, the enthusiastic active participation of JHS science teachers and the post-workshop performance achievements attained by these JHS science teachers can affirm the suggestion that perceived self-efficacy beliefs are exhibited as probable competencies in knowledge, endurance in actions and sustainable thoughts in aversive challenges to attain specific goals (Bandura, 1977, 1986, 1993 & 1994). The goal achieved is to be able to teach basic electronics at JHS in Kassena Nankana Municipality.

Again, the researcher findings agree with some researchers (Bandura, 1997; Bleicher**,** 2004) that (JHS science) teachers believed they can produce desired goal expectations (acquire content knowledge and increase self-efficacy beliefs in basic electronics) as dominant determinant by attending the IN-SET workshops. These beliefs could have given them the motivations and efforts that sustained them in all the activities carried out in the IN-SET workshop in the face of individual personal challenges.

Also, the significant change in JHS science teachers‟ self-efficacy beliefs towards teaching basic electronics and the level of improvement in the content knowledge competencies may affirm the assertion that people with high self-efficacy beliefs (expectations) have the motivation to learn, acquire knowledge and practice new methods and skills (Pajares, 1996; Schunk, 1995 as cited in Schunk & Pajares, 2001). In addition, beliefs (self-efficacy) lead people to acquire specific experiences, associate attitudes, intentions and behaviours that follow closely, often without conscious thought (Gilbert, 2010). It could therefore be deduced that the development of JHS science teachers‟ self-efficacy beliefs and content knowledge competencies occurred concurrently with one of the variables hidden behind the shadow of the other variable but actively nurturing the overt variable.

Therefore, it is anticipated that the JHS science teachers‟ who left the IN-SET workshop with high self-efficacy beliefs will strongly uphold these beliefs in high motivation to display favourable attitudes. These favourable attitudes should redefine their persistent disposition to teach JHS basic electronics in response to consistent needs of pupils in the light of their high levels of content knowledge competencies that are continually acquirable.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

Overview

This chapter summarises the study on JHS science teachers" self-efficacy beliefs and content knowledge competency towards the teaching of basic electronics. The findings were presented in line with each research question. The conclusions of the findings are made and recommendations presented based on the study.

Summary of the Research Study

The general reason for organising the IN-SET workshop for the research study was to serve as an intervention to determine its effect on JHS science teachers" self-efficacy beliefs towards basic electronics and their content knowledge and skills in JHS basic electronics. The study was to find out whether IN-SET can change JHS science teachers" existing self-efficacy beliefs towards basic electronics and possibly acquire content knowledge competencies in areas they deemed necessary (Gilbert, 2010).

This study was carried out in the Kassena Nankana Municipal (KNM) of Upper East Region. The study used pre-workshop and post-workshop questionnaires as instruments to collect data on forty six (46) JHS science teachers. The data collected by the pre-workshop questionnaire included the demographic data, previous school science and basic electronics teaching experiences to ascertain the influence of these factors on teachers" pre-workshop self-efficacy beliefs and pre-workshop content knowledge competencies. The knowledge of the influences of these initial factors on teachers" pre-workshop SEB and content knowledge competency (CKC) did guide in the selection of materials for the IN-SET workshop and construction of the items of the post-workshop questionnaire. The data for determination of the level of influence of the IN-SET workshop on JHS science teachers‟ SEB and CKC was collected using the post-workshop questionnaire. Inferential t-test analysis on paired samples were carried out to determine the level of statistical differences between post and pre-workshop SEB as well as the post and pre-workshop CKC results. Also, Pearson product-moment correlation, r was determined to obtain the level of correlation between JHS science teachers‟ post-workshop SEB and post-workshop CKC.

In order to obtain information on JHS science teachers‟ SEB they were asked to rate themselves on question items that define their self-efficacy beliefs on practical activities in basic electronics, their confidence to study/teach basic electronics. Information was also sought on JHS science teachers‟ self-motivation to teach and whether or not they possessed adequate content knowledge as well as their knowledge of the content topics of JHS basic electronics in JHS science syllabus. Again they were asked rate their SEB on whether or not JHS basic electronics should be taught by JHS science teachers and can they teach basic electronics in any science lessons. In addition, SEB information on whether or not JHS science teachers were going to teach only some portions of content topics of JHS basic electronics in their science lessons and do they need more content knowledge to identify basic electronics components.

The items on content knowledge competencies were to determine JHS science teachers‟ competencies to identify and name real basic electronics components (resistor, capacitor, inductor, PN junction diode, transistors and light emitting diode), their pictures and circuit symbols. They were also expected to state the functions of these basic electronics components as well as identify and name transistor‟s terminals (b, c, e) and state the meanings of the symbols (μF, kΩ, Ω, V, T) used a circuit diagrams.

Summary of Findings

The study came out with some findings from the analysed information on JHS science teachers sampled for the study.

Main findings

1. Generally, JHS science teachers in Kassena Nankana Municipal had moderate self-efficacy beliefs towards teaching JHS basic electronics before they had opportunity to attend the IN-SET workshop meant for the study. However, after the IN-SET workshop they had developed overall high self-efficacy beliefs (confidence) towards teaching basic electronics in JHS. There was significant difference between JHS science teachers self-efficacy beliefs after and before they attended the IN-SET workshop [t(45) = 6.018, p= 0.000].
2. Again on the average the overall teachers‟ pre-workshop content knowledge competency (32.8%, SD = 22.86) needed an improvement (Alorvor & el Sadat, 2010). However, the post-workshop content knowledge competency (89.9%, SD = 8.49) was excellent (Alorvor & el Sadat, 2010). The analysis of the results statistically showed that there was significant difference (t(45) = 16.477, p = 0.000) between the teachers pre- and post-workshop content knowledge competency results.
3. It was also observed that statistically, there was no correlation between JHS science teachers‟ post-workshop self-efficacy beliefs and post-workshop content knowledge competencies (r = 0.16, p = 0.287).

Findings which were likely to influence the pre-workshop results

1. The study showed that many JHS science teachers (68%) were teaching about two/three classes in the schools and that most of them (70%) had taught integrated science for over two year at JHS. Therefore, they were likely to have delivered lessons (over two years) on content topics of JHS basic electronics which took effect in the year 2007. These JHS science teachers could also have had some mastery experiences that can credibly be expressed as self-efficacy beliefs and content knowledge competencies towards teaching basic electronics in the pre-workshop data (Anwar, 2009 as citing Cambell, 1996; Bandura, 2009).
2. It was observed that more than one half (60.9%) of JHS science teachers were non-university graduates. However, many JHS science teachers (93%) are professionally trained pedagogically to handle classroom administration and lesson delivery but only some of them (54.3%) had pedagogical content knowledge training in basic science education. Therefore, these JHS science teachers (46%) who had inadequate professional training in basic science education (curriculum) could be expected to had influenced the moderate self-efficacy beliefs and low content knowledge competency teachers exhibited towards teaching basic electronics in the pre-workshop data (Anwar, 2009; Bandura, 2009; Bleicher, 2004).
3. The study found out that many JHS science teachers (80%) were using the MOESS (2007a) JHS science syllabus instead of the approved MOE (2012b) science syllabus. Again, many of these JHS science teachers (74%) said they did not attend in-service training on how to teach content topics of both the MOESS (2007b) and MOE (2012) syllabuses. Therefore, the IN-SET workshop mean for the study could have offered these JHS science teachers (74%) the opportunity to

have had first-hand experiences on how to teach content topics of basic electronics in the syllabuses.

4. Also majority of JHS science teachers (98%) confirmed that they did not learn adequate content knowledge on JHS basic electronics in previous workshops organised by the KNM. However, some of them (60.9%) claimed they had acquired some content knowledge of basic electronics as previous school experiences in Senior High Schools, Colleges of Education or the Universities. nonetheless, these amount of content knowledge they possessed was inadequate to enable them teach effective JHS basic electronics lessons.
5. The constructs on the SEB indicated that before the IN-SET workshop JHS science teachers had moderate self-efficacy beliefs indicating their uncertainty as to whether or not JHS basic electronics was difficult to teach. Again, JHS science teachers had moderate SEB, which meant they were uncertain as to whether or not they could handle classroom activities with pupils; carrying out hands-on activities; solving pupils‟ difficulties in learning basic electronics; drawing basic electronic circuits and answering evaluation questions on JHS basic electronics. However, they indicated high self-efficacy beliefs towards devoting adequate time to study basic electronics before attending lessons.
6. Furthermore, before the IN-SET workshop JHS science teachers‟ strength in content knowledge competency were shown in identifying only the real LED (53%), identifying the circuit symbol of the resistor (59%), and identifying the cell‟s (V) and resistor‟s (Ω/kΩ) scientific units of measure. On the average less than one half of teachers did correctly identify all real basic electronics component (29.8%), their circuit symbols (14.7%) and pictures (27.5%) used in the study. Also, averagely less than one half of JHS science teachers (47.8%) did correctly

relate the three major scientific units (kΩ, µF, V) of measure to their respective basic electronics components. Again, few (32.4%) JHS science teachers were able to name the symbols (a, b, c, „µF‟ „V‟ „T‟ kΩ) used in circuits diagrams and not many (28.2%) were able to state the functions of the six (6) JHS basic electronics components used in the study.

Findings which were likely to produce the post-workshop results

1. Majority of JHS science teachers (89.1%) in KNM were within the ages of 26 years to 45 years (Mean =35.5), thus many of them (98%) had over fifteen years of continue teaching service. this duration of continual service might have informed them of the adverse effect of teaching without adequate content knowledge in JHS basic electronics they perceived to be difficulty. This could motivate them to appreciate in-service training that would develop their efficacies to restructure their classroom roles, practices and generate ideas that can improve their teaching skills in JHS basic electronics (Bandura, 2009). These efficacies might have led to the overt behavioural traits shown as high post-workshop SEB and CKC.
2. In addition, many of the science teachers (89%) had expressed greater pleasure and interest in teaching integrated science. This interest could favour JHS science teachers‟ desire to develop high SEB and CKC in basic electronics. (Bandura, 1977, 1997, 2009; Gilbert, 2010). Thus, majority JHS science teachers (93%) benefited greatly with high levels of satisfaction in the support the IN-SET workshop for the study had offered them; with none of them dissatisfied.

Conclusion

The findings of the study had shown that the IN-SET workshop had positive impact on JHS science teachers in JHS of Kassena Nankana Municipality. The IN-SET workshop enabled them to develop high self-efficacy beliefs and high level of content knowledge competencies towards teaching the scope of content topics in basic electronics sampled for the study. However, there was no correlation between both JHS science teachers" post-workshop self-efficacy beliefs and content knowledge competencies.

Recommendations

Based on the findings JHS Science teachers should be given regular in-service workshops on specific content knowledge topics in science, especially basic electronics to develop their self-efficacy beliefs and content knowledge competencies. JHS science teachers" ability to handle specific content topics could lead to effective teaching in those specific task areas, especially in basic electronics.

In order to satisfy the other contextual factors that affect the development of SEB and CKC, JHS science teachers should use adequate teaching-learning material as required by current (existing) syllabuses used at JHS.

Suggestion for Further Studies

The study was limited to science teachers in JHS of Kassena Nankana Municipality. A study could be extended to public JHS in other areas of Ghana with similar education service conditions to help confirm the results of this study. Again, the study was limited to basic content knowledge (factual knowledge) of selected content areas of JHS basic electronics. A study could be conducted on other knowledge areas on JHS science teachers" self-efficacy beliefs and content knowledge in basic electronics.

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APPENDIX A

THE PRE-WORKSHOP QUESTIONNAIRE

University of Education of Winneba, Faculty of Science Education

Department of Science Education, Winneba.

Determination of JHS Science Teachers Self-Efficacy Beliefs and Content Knowledge Competency in Basic Electronics

I am a student studying Master of Philosophy in Science Education at the University of Education, Winneba. I am seeking your opinion to this questionnaire meant for Academic purpose only. I promise you anonymity to any *information provided for this study. Please, do not write your name on this paper.* School: ………………

SECTION A: Basic Personal Information on Teachers

Please tick in the bracket appropriate to your response.

1. Gender: Male [ ] Female [ ]
2. Age: Under 26 [ ] 26 – 45 [ ] 46 – 60 [ ]
3. Highest educational qualification attained (tick only one).

   Teacher Cert. A [ ] Diploma cert. / UTDBE [ ] HND [ ]

   First Degree/ Post Diploma [ ] Other specify ....
4. What programme did you study at: (tick where appropriate)

Programme Studied	SSS / SHS / Technical Inst.	College of Educ. / Polytechnic	University
General Science			
Agric science			
General Arts / Visual Arts / /Business/Mathematics			
Other (specify)	....	....	....

5. Which **class(es)** do you currently teach integrated science at the JHS

   JHS 1 [ ] JHS 2 [ ] JHS 3 [ ]

6. How many years have you been teaching integrated science at the JHS?

   0 – 1 yrs [ ] 2–5 yrs [ ] 6–10 yrs [ ] >11yrs[ ]

7. Which one of these subjects do you obtain greater pleasure in teaching?

   Integrated Science [ ] Mathematics [ ] BDT (Pre-tech/voc) [ ]

8. Which Integrated Science Syllabus do you use for your science lessons?

   The 2012 Syllabus [ ] 2007 syllabus [ ]

9. I attended in-service training(s) on the use of the integrated Science Syllabuses

   for .... 2007 [ ] 2012 [ ]

10. I learnt how to teach JHS basic electronics in previous IN-SET workshop(s).

    Not at all [ ] Fairly [ ] Good [ ] Great Deal [ ]

11. I learnt some content knowledge on JHS basic electronics in...

    SHS [ ] College of Education [ ] University [ ] None [ ]

SECTION B:

Personal Self -Efficacy Beliefs towards Teaching JHS Basic Electronics

Tick in the column using the Likert scale to indicate your level of agreement with the statements in the Table below. The SD = Strongly Disagree; DA = Disagree; UD = Undecided; AG = Agree; SA = Strongly Agree.

No.	Item	SD	DA	UD	AG	SA
1	I believe the practical activities of basic electronics are difficult to teach in JHS.					
2	I believe I can teach JHS basic electronics when I seriously study on it.					
3	I have self-motivation that I can teach the contents of basic electronics in JHS.					
4	I can devote adequate time to study JHS basic electronics before my science lessons.					
5	I believe I have adequate content knowledge to					

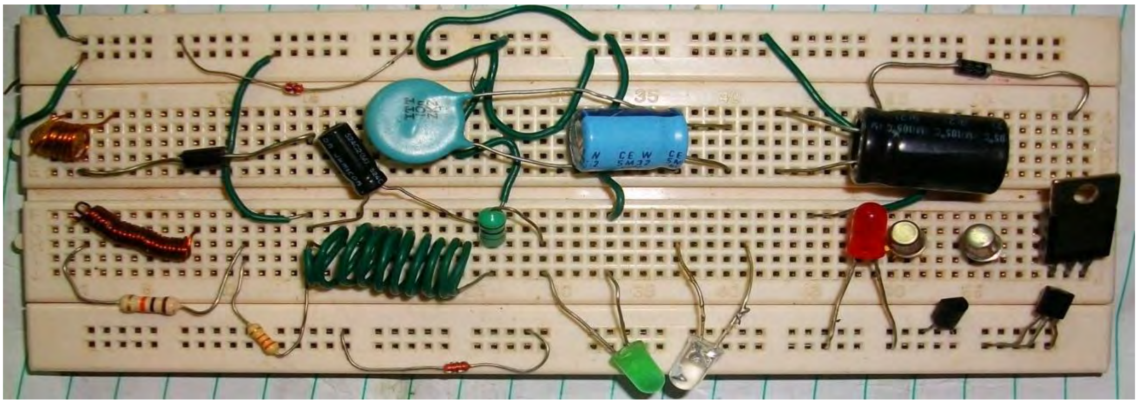
	teach basic electronics in JHS.					
6	I can confidently carry out hands-on activities on JHS basic electronics with my pupils in JHS.					
7	I can confidently solve pupils" difficulties in learning basic electronics in JHS.					
8	I can confidently draw basic electronics circuits as required by the JHS science syllabus.					
9	I can confidently answer evaluation questions on JHS basic electronics.					
10	I can confidently say that basic electronics in JHS science syllabus is easy to teach.					
11	I cannot teach basic electronics in any of my science lessons in JHS.					
12	I can teach only some portions of basic electronics in my science lessons in JHS.					
13	I believe that JHS basic electronics should not be taught by JHS science teachers.					
14	I need more content knowledge so I can identify discrete basic electronics" components used in JHS.					

SECTION C: Content Knowledge Competency in JHS Basic Electronics

Researcher ticks the box item1 to item 4 for the component which the science teacher identifies / states the functions the correctly.

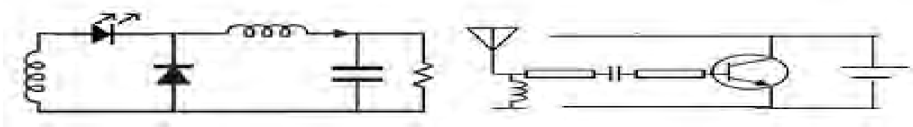
1. Identify the following real discrete basic electronics" components mounted on the breadboard which I will mention to you.

Resistor	Capacitor	Inductor	Transistor	LED	PNJ -diode
I	ii	Iii	Iv	V	vi



Photograph of specimen of real basic electronic components used for the study

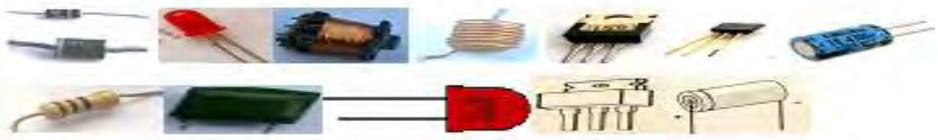
2. Identify the circuit symbols of basic electronics components whose names I mention to you.



Resistor	Capacitor	Inductor	Transistor	LED	PNJ –diode
i	ii	iii	Iv	v	vi

3. Identify the pictures of the basic electronics components shown on the paper as I mention the name.

Resistor	Capacitor	Inductor	Transistor	LED	PNJ –diode
i	ii	iii	Iv	v	vi



4. Briefly state the functions of the basic electronics components whose name I mention to you.

Resistor	Capacitor	Inductor	Transistor	LED	PNJ –diode
i	ii	iii	Iv	v	vi

5. Write in the corresponding boxes of the Table below all the values of the electronic circuit components.

Capacitor(s)	Resistor(s)	Cell(s)
I	i	I
Ii	ii	Ii
Ii	ii	Ii

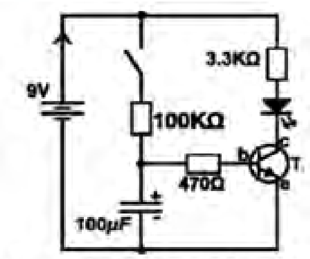


Figure 1 : Electronic Circuit

6. What do the following symbols on the circuit diagram shown in figure 1 represent?

b →	**c →**	**e →**	**T_1 →**
µF →	**V →**	**kΩ →**	**Ω →**

APPENDIX B

POST-WORKSHOP QUESTIONNAIRE

Determination of JHS science teachers' self-efficacy beliefs and content knowledge competence in basic electronics

I am seeking your opinion to this questionnaire meant for Academic purpose only. I promise you anonymity (*privacy)* to any *information provided for this study.*

Section A: Teacher's Personal Data

Please tick in the bracket appropriate to your option.

1. Gender: Male [ ] Female [ ]
2. Age: Under 25 [ ] 26 – 45 [ ] 46 – 60 [ ]
3. I learnt how to teach JHS basic electronics in this study IN-SET workshop.

   Not at all [ ] Fair [ ] Good [ ] Great Deal [ ]

Section B: Teacher's Personal Self-Efficacy Beliefs

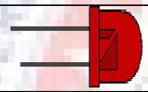
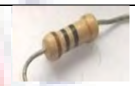
Please, *tick in the columns* using the Likert scale to indicate the level of agreement with the statements in the Table below. The SD = Strongly Disagree; DA = Disagree; UD = Undecided; AG = Agree; SA = Strongly Agree.

No.	Item Statement	SD	DA	UC	AG	SA
1.	I have self-motivation that I can teach the contents of basic electronics in JHS.					
2.	I need more content knowledge so I can identify discrete basic electronics" components used in JHS.					
3.	I believe I can teach JHS basic electronics when I study more on it.					
4.	I believe that JHS basic electronics should not be taught by JHS science teachers.					
5.	I can devote adequate time to study basic electronics before my science lessons in JHS.					
6.	I believe I have adequate content knowledge to teach basic electronics in JHS.					
7.	I can confidently carry out hands-on activities on basic electronics with pupils in JHS.					

8.	I can confidently solve pupils" difficulties in learning basic electronics in JHS.					
9.	I believe the practical activities of basic electronics are difficult to teach in JHS.					
10.	I can confidently draw basic electronics circuits as required by the JHS science syllabus.					
11.	I can confidently answer evaluation questions on JHS basic electronics.					
12.	I can confidently say that basic electronics in JHS science syllabus is easy to teach.					
13.	I cannot teach basic electronics in any of my science lessons in JHS.					
14.	I can teach some portions of basic electronics in my science lessons in JHS.					

SECTION C: Content knowledge competency in the JHS basic electronics

1. Please write the names of the following basic electronic components by them.

					
i.	ii.	iii.	iv.	v.	vi.

2. Write the type of electronic circuit component each of the items in the table represent as shown in figure 1.

s/n	Item value	Name of component
i	9V	
Ii	100 kΩ	
Iii	470Ω	
Iv	100 µF	
V	3.3 k Ω	

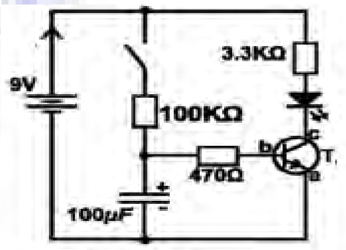
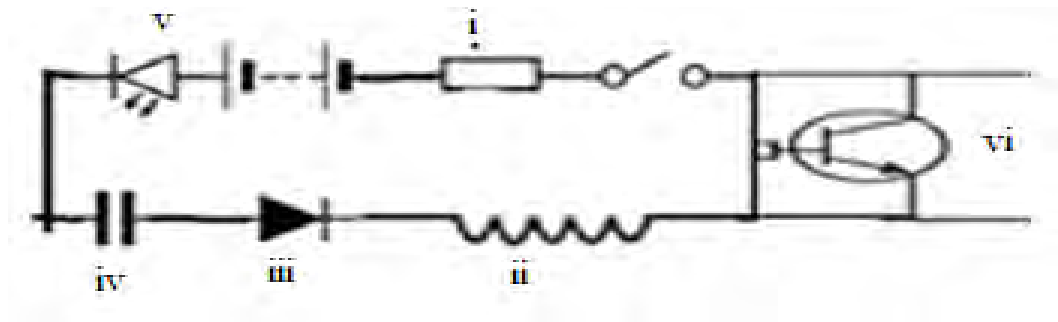


Figure 1

3. What is the meaning of each of the symbols in the circuit shown?

i). **b** →	ii). **c** →	iii). **e** →	iv). **T** →
v). **µF** →	vi). **V** →	vii). **kΩ** →	viii). **Ω** →

4. Write in the table below the names of all the components in the circuit below.



Name of the component labelled	
i.	ii.
iii.	iv.
v.	vi.

5. Indicate in the Table below the JHS basic electronics components against the row of statements that represent their functions.

S/N	Functions	Component
5.i	It stores temporary electric energy (charges) in its plates.	
5.ii	It produces temporary magnet fields when electric current pass through it.	
5.iii	It is an indicator that current is flowing in the electronic circuit.	
5.iv	It allows current flow in only one direction in a circuit;	
5.v	It amplifies, switches on and oscillates circuit signals.	
5.vi	It is a small device that regulates current flow in circuit components.	

6. Indicate in the Table below the JHS basic electronics components against the row of statements that represent their functions

S/N	Functions	Component
6.i	It links circuit components together to form a loop.	
6.ii	It produces voltage / power across circuit components	
6.iii	It is a platform for mounting components in circuits" construction.	
6.iv	It is drawn to guide students to construct real electronic circuits.	
i.	It has clamp for holding the circuit components to wires.	

APPENDIX C

IN-SET WORKSHOP MANUAL FOR JHS SCIENCE TEACHERS

Venue: Navrongo Senior High School, Physic Laboratory

Thursday 29th – Friday 30th JANUARY 2015

Teacher activity 1.0: JHS 1 - Basic electronics

Each exercise has its objective to be achieved according to the JHS Syllabus

Exercise 1.1: To explain the terms in JHS basic electronics

i. What is electronics?

....

....

ii. Mention the importance of the ff. in the electronic circuit

a. Connecting wires (conductors) ....

b. The switch ....

c. The (dry) cell ....

iii. Examine various types of components given to you in the kit

a. By what feature(s) would you identify the negative and positive terminals on a LED?

....

b. By what feature would you identify the negative and positive terminals on the general purpose silicon P-N junction Semiconductor diodes?

....

c. How many Colour code bands has a normal fixed carbon-ceramic resistor?

....

d. By what feature would you identify the positive and negative terminals on the Capacitors? ....

iv. Draw the circuit symbols of these basic electronic circuit components.

a. Resistor .... e. LED ....

b. Capacitor .... f. Transistor ....

c. Inductor .... g. The cell ....

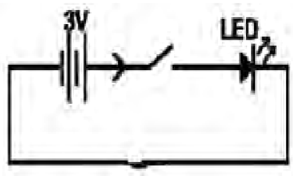
d. Diode ....

v. Identify the Positive (P) region and Negative (N) region of the general purpose P-N junction diode provided. What feature of the diode guided you?...

vi. Use pictures/video clips to enable the teachers to observe various electronic components.

Exercise 1.2: To demonstrate the behaviour of LED in a d.c. electronic circuit

i. Connect a simple electronic circuit comprising a 3V battery made of two dry cells in series with a switch and an **LED** as shown.

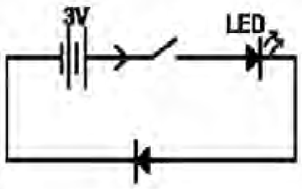


ii. Close the switch and observe. Write down what happens to the LED. ……………………………..

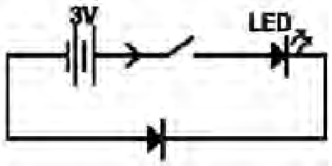
iii. Open the switch and observe. Write down what happens to the LED. ……………………………......................................……………………………

iv. Therefore, what is the **main purpose** of the LED in the JHS basic electronic circuit? ....

Exercise 1.3: To demonstrate the behaviour of PNJ diode



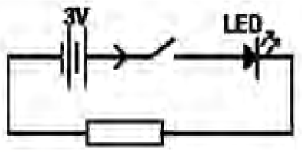
i. Connect a 3V battery, a switch, P-N junction diode and an LED in series as shown in the diagram.
ii. Close the switch and write down what happens to the LED in the forward bias of the PNJ diode ....
iii. Hence explain the term Forward bias of a PNJ diode ....



iv. **Reverse** the P-N junction diode terminals connection as shown in the diagram. Close the switch and write down what you observe happens to the LED in the reverse bias of the PNJ diode ....
v. Hence explain the term **Reverse Bias** of a PNJ diode**.**

....

Exercise 1.4: To demonstrate the behavior of resistor

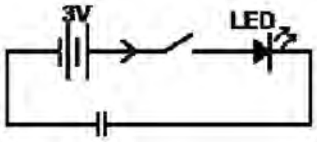


i. Connect a 330Ω **resistor** in place of the P-N junction diode in the series circuit as shown in this circuit. Close the switch and observe.
ii. Write down the level of brightness to the LED. ....
iii. Replace the 330Ω resistor with a **higher resistance** of 3,300Ω (3.3k Ω). Write down current level of brightness of the LED? ....
iv. Explain why there is a change in the brightness.

....

v. Therefore, what is the function of the resistor in the electronic circuit? ....

Exercise 1.5: To demonstrate the behaviour of capacitor



i. Replace the 3.3kΩ resistor with the 1000 u̧F **capacitor**.

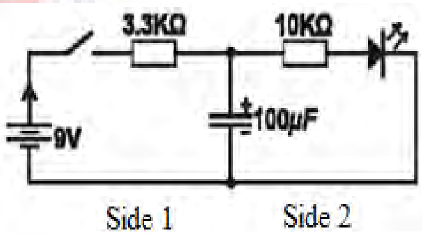
ii. Close the switch while observing the LED. Write down what you observed about the LED..

iii. Remove the capacitor, touch the terminals of the capacitor to each other and separate them. Why do you have to touch the terminals together? ....

iv. Replace it in the circuit. Close the switch again and write down what you observe again about the LED……..

v. Hence what is the function of the capacitor in this circuit? ....

Exercise 1.6: To demonstrate the charging and discharging action of an electrolytic capacitor



i. Connect the circuit according to the schematic diagram shown.

ii. How many loops are in this circuit? ....

iii. Close the switch while observing the LED. What happens to the LED? ....

iv. Open the switch while observing the LED. Write down what you observe about the LED. ....

v. Where does the LED gets its" energy when the *side 1* part of the circuit is opened? ....

vi. Which loop of the circuit is for charging the capacitor? ....

vii. Which loop of the circuit is for discharging the capacitor? ....

viii. What is the purpose of each of the two resistors in the two loops of the circuit?

....

ix. Therefore, explain how the capacitor is charged and discharged in this circuit.

....

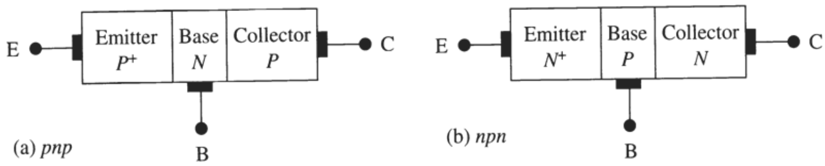
....

Activity 2.0: JHS 2 - Basics Electronics

Exercise 2.1: To describe the composition and types of Bipolar Junction transistors (NPN; PNP).

Describe the physical characteristics of transistors.

a. Using the configuration symbols below, how many P-N junctions make up a PNP or NPN transistor? ....



b. Pick up the transistor in your kit bag. Can you identify the Emitter lead (e), Base lead (b) and Collector (c) lead by just observing it? Yes [ ] / No [ ]

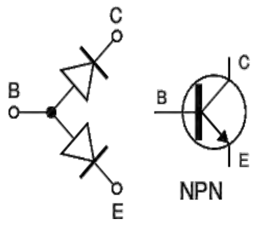
c. How would you identify this transistor as PNP or NPN? By

[α] Using the..found on the transistor.

[β] Using the B.C.E. tester ports of a ....-meter.

[ɣ] Using simple tester made up of .... resistor and LED.

Identifying the BCE of transistors guided by the schematic or circuit symbols



a. Using the digital multimeter

<u>Procedure:</u> Set the *digital multimeter* to diode test mode.

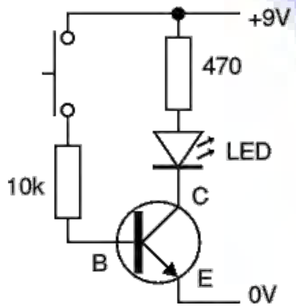
However, when you are using an *analogue multimeter* set it to a low resistance range mode. Test each pair of leads both ways (six tests in total) for conduction.

<u>Observation</u>:

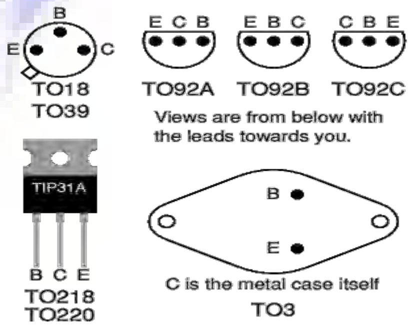
The base-emitter (BE) junction should behave like a diode and conduct one way only. Again, the base-collector (BC) junction should behave like a diode and conduct one way only. Also, the collector-emitter (CE) should not conduct either way.

b. Using the LED brightness method of a *Simple tester* (battery, resistor and LED)

<u>For NPN transistor</u>:



Connect the transistor into the circuit shown. The transistor (conduction) serves as a switch. If the transistor is good and the connection secure the LED should produce light when the switch is pressed and the light goes off when the switch is released.

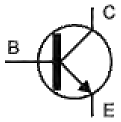


<u>For PNP transistor</u>:

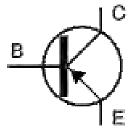
Use the same circuit above but reverse the terminals of the LED and that of the supply voltage.

c. Using the structural orientation or features

d. Identify the circuit symbols below as NPN transistor and PNP transistor.



a................................



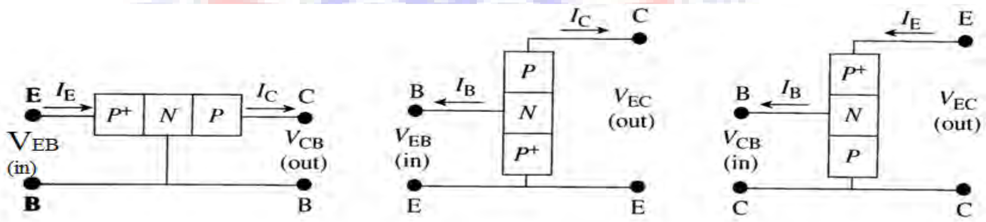
b ....

e. Complete the statement about how you identify the two types of transistor circuit symbols.

<u>NPN transistor</u>: the current flows from the .... to the .....and back into the transistor through the .....

<u>PNP transistor:</u> the current flows from the ...... to the ..... and back into the transistor through the ......

f. Use the circuit connection below. State the three configurations (type of connection) of a transistor in an electronic circuit.



i. ....

ii. ....

iii. ....

APPENDIX D

IN-SERVICE WORKSHOP PROGRAMME OF ACTIVITY

Thursday 29th January, 2015

S/N	Day 1: Activities	Time	Duration
i.	Arrival and registration of teacher attendants.	8.30 am	
ii.	Welcome address and introduction of workshop rules and modalities.	9.00 am	
iii.	Distribution of workshop material to teachers: electronic kits, work-manual and hand-notes	9.15 am	
iv.	Introduction to the content of JHS basic electronics.	9.30 am	
v.	Power point presentation on basic electronic components and circuit (s).	10.00 am	
vi.	Video on basic electronic components and circuit.	11.00 am	
vii.	Physical examination and identification of basic components.	11.30 am	
viii.	Lunch	12.00 am	
ix.	Hands on activities on JHS 1 electronics	12.30 pm	
x.	Closing prayer and departure	2.30 pm	

Friday 30th January, 2015

S/N	Day 2: Activities	Time	Duration
i.	Arrival and registration of teacher - attendants. Distribution of the workshop manual	8.30 am	
ii.	Hands-on activities – 1	9.00 am	
iii.	Snacks	10.20 am	
iv.	Hands-on activities – 2	11.00 am	
v.	Lunch	12.30 pm	
vi.	Post-workshop Questionnaire administration	1.00 pm	
vii.	Remarks from workshop Prefect/ secretary	1.50 pm	
viii.	Closing ceremony: KNMED Training Officer	2.00 pm	
ix.	Closing prayer by participant	2.20 pm	

APPENDIX E

LETTERS OF CORRESPONDENCE IN THE RESEARCH

A. Letter from University of Education, Winneba.

B. Letter to Ghana Education Service, Navrongo

C/o Navrongo Senior High School
P. O. Box 33,
Navrongo.
01st January, 2015

The Municipal Director,
Ghana Education Service,
P. O. Box 56,
Navrongo.

Dear Sir,

APPLICATION FOR PERMISSION TO ORGANISE IN-SERVICE WORKSHOP.

I would be very grateful if you could permit me to organise an in-service and educational training (IN-SET) for the science teachers in the Kassena Nankana East Municipality.
I am pursuing a Master of Philosophy in Science Education at the University of Education, Winneba. As part of the course, I am expected to organise an IN-SET workshop on the JHS basic electronics for forty (40) Junior High School (JHS) integrated science teachers.
This workshop will enable the teachers to:
Identify the types and kinds of the basic electronic components to use at the JHS.
Improvise some basic electronic components from used electronic gadgets.
Test for good and usable electronic circuit components from improvised source.
Carry out all the practical activities (hands-on activities) in basic electronic at the JHS.
I have already acquired the basic electronics resource materials for this IN-SET for forty teachers.
I am therefore, seeking your permission to bring these teachers together for the workshop on:

Date: 29th -30th January 2015
Venue: the Physics Laboratory, Navrongo Senior High School, Navrongo.
Time: 8.30 am to 2.30 pm daily.

I count on your consideration and approval for me to impart these skills and content knowledge to the teacher in the Directorate.
I count on your approval.
Yours" faithfully,

Oscar Kubirizegah Abagali
(Mobile no. 0207572368)

C. Letter to Navrongo SHS, Navrongo

C/o Navrongo Senior High School
P. O. Box 33,
Navrongo.
01st January, 2015.

The Headmistress,
Navrongo Senior High School,
P. O. Box 33,
Navrongo.

Dear Madam,

APPLICATION FOR PERMISSION TO ORGANISE IN-SERVICE WORKSHOP.

I would be very grateful if you could permit me to organise an in-service and educational training (IN-SET) for the science teachers in the Kassena Nankana East Municipality at the Physic laboratory in your science department.
I am pursuing a Master of Philosophy in Science Education at the University of Education, Winneba. As part of the course, I am expected to organise an IN-SET workshop on the JHS basic electronics for forty (40) Junior High School (JHS) integrated science teachers.

This workshop will enable the teachers to:
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Yours" faithfully,

Oscar Kubirizegah Abagali
(Mobile no. 0207572368)

D. Letter from Ghana Education Service, Navrongo

APPENDIX F

THE TESTS RESULTS OF THE QUESTIONNAIRES

A. **Pilot-Test Questionnaires Reliability Results**

The Self-Efficacy Beliefs (SEB) and Content Knowledge Competence (CKC) analysis

The pilot sampled – N = 21**:**

	Reliability Statistics		Scale Statistics		
Pilot Test	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Mean	Std. Dev.	N of Items
SEB items	0.627	0.669	46.33	6.537	14
CKC items	0.954	0.962	17.24	11.502	35

B. **Pre-workshop Questionnaires Reliability Test Results**

SEB = Self-Efficacy Beliefs; CKC = Content Knowledge Competence

The sampled - N = 46.

Pre – Workshop Questionnaire

	Reliability Statistics		Scale Statistics			
Characteristic	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Mean	Variance	Std. Dev.	N Items
SEB items	0.826	0.831	47.67	95.736	9.784	14
CKC:	0.910	0.924	12.00	71.556	8.459	35

APPENDIX G

JHS Science Teachers' Self-Efficacy Beliefs Mean Scores

Frequency and Percentage Frequency Counts of JHS Science Teachers' Pre-workshop and Post-workshop Mean Scores in Self-Efficacy Beliefs (SEB) Towards Teaching Basic Electronics

PRE-WORKSHOP SEB SCORES			POST-WORKSHOP SEB SCORES		
Teacher SEB Mean scores	Frequency counts of teachers	Percent frequency of teachers	Teacher SEB Mean scores	Frequency counts of teachers	Percent frequency of teachers
1.8	1	2.2	3.0	2	4.3
1.9	1	2.2	3.3	1	2.2
2.4	1	2.2	3.5	1	2.2
2.5	3	6.5	3.6	1	2.2
2.6	1	2.2	3.6	1	2.2
2.7	2	4.3	3.7	2	4.3
2.8	2	4.3	3.8	2	4.3
2.9	2	4.3	3.9	9	19.6
3.1	2	4.3	3.9	3	6.5
3.2	2	4.3	4.0	6	13.0
3.3	2	4.3	4.1	2	4.3
3.4	7	15.2	4.1	3	6.5
3.5	1	2.2	4.2	2	4.3
3.6	4	8.7	4.3	1	2.2
3.7	1	2.2	4.4	1	2.2
3.9	4	8.7	4.4	3	6.5
4.0	1	2.2	4.6	2	4.3
4.1	3	6.5	4.7	1	2.2
4.2	1	2.2	4.8	1	2.2
4.3	1	2.2	4.9	1	2.2
4.4	1	2.2	5.0	1	2.2
4.6	1	2.2	Total	46	100.0
4.7	1	2.2			
4.8	1	2.2			
Total	46	100.0			

APPENDIX H

JHS Science Teachers' Content Knowledge Competencies Mean Scores

Frequency and Percentage Frequency Counts of JHS science Teachers‟ Pre-workshop and Post-workshop Content Knowledge Competency (CKC) in basic Electronics

PRE-workshop Teachers' CKC % mean score			Post-workshop Teachers' CKC % mean score		
Teachers‟ CKC Mean scores (%)	Frequency counts of teachers	Percent frequency of teachers	Teachers‟ CKC Mean scores (%)	Frequency counts of teachers	Percent frequency of teachers
0.0	3	6.5	66.7	1	2.2
5.4	2	4.3	69.4	2	4.3
8.1	1	2.2	77.8	3	6.5
10.8	1	2.2	80.6	1	2.2
13.5	4	8.7	83.3	3	6.5
16.2	2	4.3	86.1	7	15.2
18.9	2	4.3	88.9	4	8.7
21.6	4	8.7	91.7	1	2.2
24.3	4	8.7	94.4	10	21.7
27.0	2	4.3	97.2	11	23.9
29.7	1	2.2	100.0	3	6.5
35.1	3	6.5	Total	46	100.0
37.8	2	4.3			
40.5	4	8.7			
43.2	1	2.2			
54.1	1	2.2			
56.8	1	2.2			
59.5	1	2.2			
62.2	2	4.3			
64.9	1	2.2			
73.0	1	2.2			
75.7	1	2.2			
86.5	1	2.2			
89.2	1	2.2			
Total	46	100.0			

APPENDIX I

Individual JHS Science Teachers' SEB and CKC Mean Scores

Teacher (TR) ID	Pre-CKC % mean	Post-CKC % mean	Pre- SEB Mean score	Post-SEB Mean score
TR 1	21.6	94.4	4.0	3.29
TR 2	64.9	88.9	4.6	4.64
TR 3	5.4	97.2	3.4	3.86
TR 4	0.0	97.2	1.8	4.14
TR 5	40.5	97.2	3.2	4.14
TR 6	24.3	94.4	2.8	4.00
TR 7	62.2	86.1	3.7	3.86
TR 8	0.0	80.6	3.5	3.79
TR 9	21.6	83.3	3.3	3.93
TR 10	62.2	94.4	4.7	4.43
TR 11	29.7	97.2	3.4	4.07
TR 12	75.7	86.1	4.2	3.64
TR 13	24.3	77.8	2.7	4.86
TR 14	43.2	94.4	3.9	3.71
TR 15	13.5	97.2	1.9	3.00
TR 16	73.0	97.2	4.3	4.79
TR 17	27.0	69.4	3.4	3.57
TR 18	35.1	66.7	3.4	3.86
TR 19	59.5	69.4	2.9	3.79
TR 20	35.1	100.0	3.9	4.43
TR 21	37.8	97.2	2.8	4.36
TR 22	24.3	86.1	2.9	3.71
TR 23	54.1	94.4	4.1	3.86
TR 24	8.1	97.2	3.4	3.86
TR 25	40.5	97.2	4.1	4.00
TR 26	86.5	88.9	3.6	3.93
TR 27	27.0	100.0	2.7	4.00
TR 28	13.5	94.4	3.4	4.64
TR 29	24.3	94.4	3.1	4.21
TR 30	21.6	83.3	3.6	4.14
TR 31	18.9	97.2	3.9	4.00
TR 32	16.2	77.8	3.2	4.07
TR 33	37.8	94.4	2.5	4.00
TR 34	56.8	97.2	4.1	4.71
TR 35	40.5	94.4	3.4	3.00
TR 36	13.5	94.4	4.8	5.00
TR 37	35.1	88.9	3.6	4.29
TR 38	16.2	86.1	3.9	4.00
TR 39	21.6	86.1	2.5	3.50
TR 40	0.0	86.1	2.4	3.86
TR 41	5.4	83.3	3.6	3.86
TR 42	40.5	91.7	2.6	3.86
TR 43	89.2	100.0	3.3	4.43
TR 44	18.9	77.8	3.1	4.21
TR 45	10.8	88.9	2.5	3.86
TR 46	13.5	86.1	4.4	3.93
Total score	1491.9	4133.3	156.6	185.07
Trs. MS (SD)*	32.4 (22.86)	89.9 (8.49)	3.4 (0.70)	4.02 (0.4246)

*MS = means core; SD = standard deviation

APPENDIX J

JHS that Science Teachers were Participants for the Study

S/N	NAME OF SCHOOL	NO. OF TEACHERS	GENDER	Remarks
1.	Abatey JHS	3	F(2) / 1M(1)	
2.	Abempimgo JHS	1	Male (M)	
3.	Adabayeri JHS	1	Male	
4.	Adda JHS	1	Male	
5.	Akurugu-Daboo JHS	1	Female (F)	
6.	Asobayeri JHS	1	Male	
7.	Awe JHS	1	Male	
8.	Azaasi JHS	1	Male	
9.	Badunu JHS	1	Male	
10.	Basina JHS	1	Female	
11.	Biu JHS	1	Male	
12.	Bonia JHS	2	Males	
13.	Bosco"s Practice JHS	2	Females	
14.	Doba JHS	1	Male	
15.	Gaani JHS	1	Male	
16.	Gayingo JHS	1	Male	
17.	Gia JHS	1	Male	
18.	Gingirigo JHS	1	Male	
19.	Kologo JHS	1	Male	
20.	Kwarania JHS	1	Male	
21.	Kwogwania JHS	1	Male	
22.	Manyoro A. JHS	1	Male	
23.	Namolo JHS	1	Female	
24.	Nangalikinai JHS	2	Males	
25.	Natugnia JHS	1	Male	
26.	Navro-Pungu JHS	1	Male	
27.	Nayagnia JHS	2	Males	
28.	Nyangua JHS	1	Male	
29.	O. L. L. Girls JHS	1	Male	
30.	Presby JHS	1	Male	
31.	Punyoro JHS	1	Male	
32.	Saabisi JHS	1	Male	
33.	St. Mary JHS	1	Male	
34.	Tono JHS	1	Male	
35.	Vunania JHS	3	Males	
36.	Wisdom Gate JHS	1	Male	
37.	Yua R/C JHS	1	Male	
38.	Naaga JHS	1	Male	
39.	Tampola JHS	0	Male	Pre-workshop Only
40.	Manyoro B JHS	0	Male	Pre-workshop Only
41.	Balobia JHS	0	Male	Pre-workshop Only
	Total no. of teachers	46	F(7)/M(39)	

APPENDIX K

Map of Kassena Nankana East Municipal, Upper East Region

Courtesy: Ghana Statistical Service (2014).