Teaching Science

Preparation of student teachers to teach science at the junior high school: A study of one teacher college of education in Ashanti Region, Ghana

Charlotte KUSI

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Department of Special Needs Education
UNIVERSITY OF OSLO

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Teaching science: Preparation of student teachers to teach science at junior high school

A study at one selected teacher college of education in Ghana

Abstract

The preparation of competent and enthusiastic science student teachers is important in the teaching of science and in the context of challenges facings science teacher education programme. Some of the challenges are difficulties of students to develop practical and conceptual understanding and how to transfer and relate scientific knowledge in life situations.

The aim of the study was to investigate and explore the teaching methods and specific focus on the practical method that tutors at the college of education use to prepare student teachers to teach science at the junior high school. Approaches for teaching science such as learner-centred approach has been emphasised on how best tutors can use practical methods to engage students' active learning for better understanding.

A qualitative approach with descriptive design was used to guide the study. The main source of data collection was semi- structured interviews supported by observation and documents. The data collected and analysed were mainly sample from three science tutors and four science student teachers from the selected college of education. The data gathered was categorised into four main themes: science curriculum, inadequate time for teaching, teaching methods- teaching practice and teaching learning materials and equipment.

The findings were organised thematically, analysed and interpreted descriptively in relation to the theoretical framework. Findings have shown that the themes were the bases for preparing student teachers to teach science. However there were still challenges with these themes which, serves as hindrance for preparation of student teachers to teach science. The science curriculum which served as the primary medium for students preparation was noted to be overloaded and hence hinders quality teaching of content for students understanding and competence. The study has indicated that the overloaded curriculum might have led to inadequate time for teaching and this might intend feed on the other themes. Therefore the study concluded that the curriculum should be revised to avoid overloaded contents which leaves no room for adequate teaching time and full right in the use of appropriate teaching method in preparing student teachers.

In addition, I argue that tutors should do advance preparation to become well versed and comfortable in the subject matter so that they can teach effectively to integrate the course

content. Also they should make extra time to do practical work and stop complaining of overloaded curriculum. This is because if a teacher have the required knowledge to teach he or she can teach effectively. Again, from my observation and experience in the curriculum, the required knowlege a student teacher will need to teach science is well structured in the currriculum plan and it is standardised.

I am incline to point that many tutors seem not to have strong foundation in the subject-matter (content) and the teachings skills and therefore could not teach content and practical work regularly as findings revealed. Tutors only put blame on curriculum and ignore their limitation.

I have recommended that learner -centred approach particularly practical methods which, seek to engage students at their own pace and help them to develop conceptual understanding should be encouraged. The learner-centred approaches are influenced by constructivism. Constructivism explains that every learner has prior knowledge which forms the foundation by which new learning experiences occur. This is because students' experiences are different from each other. A student may be challenged based on his or her individual zone of proximal development (ZPD) (Vygotsky, 1986). ZPD is the difference between what a learner can do without help and what he or she can do with help. I have recommended that the curriculum planners should include tutors who interact with student on daily base at the college level; and know their strength, weakness, potential and the interest. This may enable tutors to contribute to the planning of the curriculum and help to minimise the loaded curriculum and also make it to benefit the level of the students. This may in turn contribute to students rights in full participation and better understanding of concept.

Finally, I recommend that science tutors should learn to understand who their students are in order to adapt his or her teaching to the level and interest of students and how to assess the students acquired knowledge and skills. This may also help students to learn to apply the knowledge they have acquired when they become teachers.

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Dedication

This thesis is dedicated to all student teachers pursuing science programme at the colleges of education.

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Abbreviations and Meaning

DEG   Development of Education in Ghana

EFA   Education for All

EPS   Educational; Strategic Plan

GES   Ghana Education Service

JHS   Junior High School

MDG   Millennium Development Goal

PCK   Pedagogical Content Knowledge

SHS   Senior High School

UN   United Nation

UNESCO   United Nations Educational, Scientific and Cultural Organisation

ZPD   Zone of Proximal development

1   Contextual Background

1.1 Introduction

The preparation of science student teachers is crucial in the teachings of science and in the context of challenges facings science teacher education programme. The challenges would be discussed later in the study. The focus of this study was to investigate and explore the teaching methods and specifically the practical methods, which tutors at the college of education use to prepare student teachers to teach science at the junior high school.

This chapter presents the research topic *teaching science: preparation of student teachers at the college of education to teach science at junior high schools.* It introduces readers to the background of the study which describes issues surrounding the teaching of science. This leads to brief history on current education system of Ghana and the teacher college of education programme with focus on science education programme. This is followed by the purpose and justification of the study, statement of the problem, objectives for the study and research questions. In addition, the chapter presents significance and aims of the study indicating how science should be taught practically to involve and arouse the interest of students. Definitions and clarification of concepts is described for readers understanding. It further presents the limitation of the study and ends with the structure of the thesis.

1.2 Background to the Study

Teaching science student teachers at the college of education is a matter of concern. The way tutors prepare and teach them science has great influence on their development of knowledge and teaching skills (Freire, 2005). The focus of the study was to investigate how tutors use practical methods to teach students science at the teacher college of education. Education is human right for all and that access must be matched by quality teaching to improve the lives of people. It is UNESCO's great and affectionate mission to build peace, eradicate poverty and sustainable development (UNESCO, 2015). Therefore the right to have full access and quality to any form of education, in this context science teacher education must not be hindered. Science is considered as one of the pillars of development and connected between technology and socioeconomic development. Ekine and Abay (2013) pointed that a country's

ability to secure good health, fight against disease, protect the environment, produce food for its citizens and develop new industries and technologies is based among others on the scientific knowledge and skills of its people. In relation to this study, science is one of the programmes that contribute to development of individuals' and nations. Therefore, access to quality teaching methods to teach science is important to all students and may enhance students learning and understanding for development.

The subject *science* is the study of living organisms such as plants and animals including human beings and their environment. Therefore, to study and understand science as nature, one needs to go through processes. This makes science as the systematic study of nature through careful observation, experimentation and logical reasoning and conclusion. These make the teaching and learning of science practical, for example, teaching *fruits* as topic may provide opportunity for students to have concrete activities when a teacher brings fruits to the class. This may allow students to feel or touch of real objects of different types of fruits when samples of them are brought to classroom for studies. Teaching and learning about science is a way of developing an in-depth understanding of the nature of science (Hodson, 1998).

Despite the nature, benefit and interest science could be, studies have shown that there is persistent inappropriate teaching of science in schools and colleges across the world. Most especially in the developing countries, it is attracting various stakeholders in education (Schreiener, 2006) and hence the need to mitigate it. It has raised various concern in academic circle and while some studies shift the blame on students, others attention are being drawn to the role of teachers in the teaching of science (Cooper and McIntyre, 1996). In the same vein, several studies have shown that the science teacher is the most important factor for sustaining students' interest and improving student performance (Hattie, 2003; Wellington, 1998). The preparation of student teachers who are prospective teachers is crucial to science education.

Teaching of science has implication for students who are being prepared to become science teacher. The reason is that teachers are facilitators who teach, guide learners and their competency is determined by how they are taught to receive knowledge. Studies conducted by some researchers have indicated that poor teaching methods used to teach science influence students choice in the study of science (Schreiner and Sjøberg, 2004; Woolnough, 1994; 1990). This may lead to shortage of teachers as few students may offer science at the college. Schreiner (2006) argued that Europe would need science teachers.

Dillion and Osborne (2010) similarly indicated that many countries face shortage of science teachers, particularly those with a physical science background. They referred it to Moor et al. (2006 p. 106), that "44 percent of science teachers had a degree in biology; 25 percent had a degree in chemistry and 19 percent had a degree in physics". This was noted in a large scale survey of mathematics and science teaching in England. This shows that poor teaching is not only experienced in a particular continent and region of this world but a worldwide issue.

Similarly, UNESCO report (2015), recorded that there has been a declined interest and enrolment in engineering science which has led to shortage of engineers not only in Africa but also across nations. All these imply that when teaching methods of science is poorly delivered it may lead to low participation rate of students in science fields and hence could lead to shortage of science teachers.

Ghana educational development report (2008), on education emphasised that quality of education is essential to achieving the goal of the country and also reaching the target concern access to education. Science and technology is not responding adequately due to obsolete pedagogical strategies, inadequate funding and poor management (GEDR, 2008).

The point here is that when student teachers who will eventually become teachers at the junior high schools are not well prepared in the use of methods to teach science, they may invariably teach poorly. The fact is that teaching methods is critical in teaching and learning situation and sustain the interest of teachers, tutors and students in science. Tutors who involve students during teaching and learning step by step (Vygotsky, 1987) way and give them task to perform and share experience is a good example of students' involvement in lesson. This may help students to receive better understanding when teaching is effectively planned and taught.

Considering the challenges and the benefit of science, researchers have implemented developmental efforts such as revised curriculum, materials and inquiry- based instruction and even in-service and pre-service training that have been put in place to curb the problem but situation remains effortless (Abell and Driel, 2010). On this note, this study is purported to find out how tutors teach students and the methods they use to teach them science at college of education. Precisely, considering the experimental nature of science, the study investigates how practical methods are used to teach students to become competent.

1.3 Brief History and Current Education System of Ghana

Ghana, formerly known as the Gold Coast was a British Colony located on the West Coast of Africa. Ghana as one of the sub-Saharan African countries attained its independence on the 6th of March 1957. The nation shares borders with the following countries: Togo on the east, La Cote D'Ivoire on the west and Burkina Faso on the north. The Gulf of Guinea of the Atlantic Ocean is on the south (see appendix for Ghana Map). It has a total area of 238, 538 sq. km with a population of about 27.41 million people endowed with a relatively young and healthy population (World Bank, 2015; UN Report 2008). Administratively, Ghana is divided into 10 regions which is further divided into 138 distinctive metropolitan, municipal and district assemblies. The capital and largest city in Ghana is Accra in the Greater Accra Region.

Educationally, the nation is endowed with good education at all levels of education system. In the colonial era and between 1950's and 1960's Ghana's education system was the model within the Sub-Saharan African (Little, 2010). English is the sole official language from primary to university level of education. However, different local languages and dialects are spoken among different ethnic groups.

Education system in Ghana is grouped into three levels: *basic education* (kindergarten, primary school and junior high school), *secondary education* (senior high school, technical and vocational education) and *tertiary education* (universities, polytechnics and colleges). Education is compulsory between the ages of 4 and 15 (basic education). Science is taught at all the levels of education system in Ghana. This study concentrated on one of the tertiary education; teacher college of education science programme.

1.3.1 Teacher College of Education System

The former teacher education system programme, which was awarded a three-year certificate 'A', is upgraded to three-year Diploma in Basic Education. The current policy directives for the 3-year Diploma in Basic Education are mainly geared towards the education of a '*generalist' teacher* and *specialist teacher* who would be able to teach at primary and junior high school levels. Students are expected to take at least seven foundation subjects *English, Mathematics, Ghanaian Language and Culture, Integrated Science, Environmental and Social Studies, Pre-Vocational Skills and Religious and Moral Studies.* These foundation

courses are taught in primary and junior high school (Revised curriculum, 2014). Also they study education courses for professional development.

On the other hand, "specialist" training in *Mathematics, Science and Technical Skills* are offered by specific colleges of education for trainees at the junior high level. *French and Early childhood* are also options offered by specific colleges of education. This means that the teacher education programme though prepares student teachers for general teacher education and for special programme as indicated earlier, students taking these specialised courses are exempted from some of the foundation subjects.

Nevertheless, in the college of education programme, the need to give general education to teachers at the pre-service stage at the college of education cannot be over-emphasised. The reason is that student teachers could specialise either in primary education or secondary education as they climb the professional ladder. This study is basically on *science programme* which is one of the special programmes offered at the teacher college of education rather than general programme for general teacher education.

1.3.2 Science Programme

As mentioned earlier, this study is on one of the specialised programmes; *science*, specifically teaching of science. The science programme at the college of education consists of three main courses namely: biology, chemistry and physics. Each course is designed to have theoretical and practical component. The curriculum for science at the college of education in Ghana has general intended goals for teaching science which is referred below to key feature iii and goal v.

Key feature iii: It will "*establish a judicious balance between theoretical knowledge and teaching skills".*

Goal number v: It will *"produce teachers who are creative researchers*" in the classroom, i.e. solving problems through action research (Revised curriculum, 2014 p. 3).

The structured goal and key feature suggest there is an assumption and likelihood that challenges may arise. It further implies that a professional tutor should be creative to use the acquired teaching skills together with the knowledge of content to help meet the needs of individual learners (Freire 2005; Woolnough, 1994; Shulman, 1987; Vygotsky 1978).

Therefore, the study investigated and examined how tutors apply the structured goal and key feature in relation to methodology and contents in the teaching of science.

1.4 Purpose and Justification of the Study

The purpose of this study was to examine how tutors prepare student teachers to teach science at the junior high school. The intentions were to:

- find out the kind of teaching methods stated in the curriculum for tutors to apply in their teaching.

- obtain an understanding of the practical teaching methods used to teach science at the college of education.

- investigate how the teaching methods used by tutors improve student teachers' experiences; acquire knowledge, skills and competence.

This was done through interviews and observation of tutors on the use of teaching methods and the student teachers on the methods they receive from tutors.

Justification

I find it interesting in carrying out this study because according to (Schreiner, 2006), the methods most science teachers use to teach science is inappropriate. For instance, most lecturers, tutors at the colleges and teachers at the school levels often use lecture method instead of inquiry or exploratory method which engages learners with scientific phenomena (Minner, Levy and Century, 2010).

My personal experience shows that the methods most lecturers, tutors and teachers use to teach science leads to poor development and learning. My experience as a science student and science tutor reminds me of how some basic concepts of science were taught abstractly. Most science teachers simply teach scientific concepts without relating them to practical daily life activities. Some empirical example of basic concepts like *osmosis* and *diffusion* were taught abstractly without practical activities and daily life experiences. The abstract way of teaching does not make students think critically for understanding, and rather leads students to memorise (Freire, 2000) by producing the same content received from teachers without

reconstruction of new knowledge for understanding. This is what Freire refers to it as "banking," a concept used in education where students only receive, store and produce the deposits (Freire, 2000 p. 72).

Practical teaching influences the interest, participation and performance of most students not only in science but also in other courses as well. This is because it creates room for building and developing experiences since students are actively engaged in learning, unlike lecture or narrating teaching which makes teaching abstract, learners' are may be passive recipient and narrow minded.

My experience as a science tutor has made me aware and not only to attribute the blame on tutors and teachers teaching but also government inability to provide adequate text books, teaching learning materials and equipment for practical teaching.

Science is one of the important subjects among others in Ghanaian education system at all levels (from primary to college of education). It is one of the compulsory subjects that every student needs at least a pass grade from junior high school to enter senior high school, teacher education and university. As science is one of the compulsory and significant subject in Ghana education system, my study is intended to explore the teaching method that tutors at the college of education use to prepare students teachers to teach science at the junior high school**.**

1.5 Statement of the Problem

Numerous issues surround the teaching and learning of science in preparation of student teachers to teach science. Research findings in the past indicated that students, regardless of the country of origin, have difficulties learning science (Osborne and Dillon, 2008). Some of the issues identified include "misconceptions about science concepts that are resistance to change by traditional teaching methods" (Abell and Driel, 2010 p. 712). These contribute to students' failure to develop scientific thinking processes for example engaging in activity and solving problem. The issue is tutors have challenges in teaching science practically and relate teaching to real life situation for students to understand the fundamental concepts in science for transfer of learning. It has been argued that, the situation increases, and has been recorded that students have low appreciation and negative attitude towards science (Abell and Driel,

2010). This has led to poor performance of students in standardised test in many countries and eventually deciding not to pursue and enter the field of science profession.

Other studies have also shown that there is persistent inappropriate teaching of science in schools and colleges across the world. Study from Ghana Educational Strategic Plan (2003-2015) on policy target and strategies review on science and technology revealed that, science is poorly taught in Ghanaian schools and colleges (ESP, 2003).

In Ghana, students' choice of science programme at the teacher college of education is based on successful pass in the elective science programme at the senior high school. Therefore if students find difficulties in learning science as a result of for example poor teaching methods and practices used by teachers, then learning science to become teacher may not attract more students to study science.

This is because tutors' ways of facilitating teaching has influence on students thinking ability and also have great influence on students' acquisition of knowledge and teaching skills. This is to mention either some tutors use of teaching methods may arouse and sustain interest of students (Freire, 2005; Wellington 1998; Woolnough, 1994). Again, tutors teaching methods either motivate students to learn to teach the science or to demotivate them not to learn the science.

The problem seems to be that tutors have challenges in doing practical work with the students. Therefore the study intends to explore how tutors use teaching methods and specifically investigate if and how practical methods are used to prepare students so that in future, when I am back in Ghana I could contribute for making some changes.

1.6 Objectives for the study:

1a. To find out what is in the science curriculum and

b. To explore what the curriculum describes about science for example the teaching methods stated.

2. To find out what kind of teaching methods are used by tutors in teaching the student teachers science in order for them to teach science at the junior high school.

3. To investigate how student teachers experience the teaching methods they receive from science tutors.

4. To explore how relevant and useful are the teaching methods and the whole preparation students receive from the college to equip them to teach science.

1.7 Research questions

The following general and sub research questions guided the study.

The general research question was: *how do tutors prepare students teachers to teach science*?

Sub research questions

1. Which methods are stated in the curriculum that tutors use to teach student teachers courses within science: biology, chemistry and physics?

2. Are there any practical methods used to prepare student teachers to teach at the junior high school level? What are the practical methods?

3. How do tutors vary their teaching to meet the needs of all student teachers?

4. How do the student teachers feel prepared to teach the subject *science* at the junior high school?

1.8 Significance and Aims of the Study

A good background in science may pave way for many job opportunities in the modern technological world. Science in this technological world is playing an increasing role in all sphere of daily life such as in work situation, as citizens and as consumers (Schreiner & Sjøberg, 2004). Therefore, there is a need for effective use of teaching method to help attract and sustain students' interest in science because it has influence on students' progress in education.

It would be appropriate that the research is conducted to investigate whether quality teaching methods have been used or needed improvement in the teaching of science. When pertinent measures are put in place, it will not only help tutors and student teachers' competence but

also sustain the interest, increase participation and improve performance of learners. This study focuses on the teaching methods for science, especially how lecturers and tutors practical method to teach the content. It also looks at how teaching of science can be connected to daily life activities for transfer of knowledge.

In conclusion, I hope that the outcome of this study contributes to improving the practical teaching methods tutors use to teach students at the college of education. This will invariably help students to be prepared to teach science at the junior high school. Eventually, more students may be interested to be enrolled in the "specialised" science teacher education programme to become science teachers rather than the general teacher education. This study generally aims at finding and investigating the teaching methods tutors at the college of education use to teach student teachers science.

1.9 Definition and clarification of key concepts

The following concepts are defined in context and based on how they are used in the study.

Science is one of the special programmes offered at the college of education. It consists of three main courses namely: biology, chemistry and physics.

Student teachers: refers to students who are not yet teachers but are being educated to become teachers. Also, students may be used to mean student teachers based on the context. It could again be used interchangeably.

Learners: Are used to make reference to students at the junior high school.

Science tutors: are the lecturers who teach student teachers science at the college of education.

Participants: participants is used in this study to mean the same as informants

Preparation of students': means how student teachers are taught and educated to learn and teach science

Understanding: used in this thesis is the students' ability to use acquired information, build and transfer knowledge to solve problem.

Quality education is used as provision of content which is relevant in a curriculum designed for students to go through learner- centred approaches for active participation which include all learners and students for acquisition of knowledge and skills (UNICEF, 2000).

1.10 Limitation of the Study

This study could have been carried out in all the colleges that offer science as one of the special programmes in the Ashanti Region of Ghana. It could also have been extended to some junior high schools. The reason was to see the way student teachers in practice and the teachers at the field as professionals apply methods they have received from the college tutors to teach their learners. However, it was not feasible due to time and financial constraints. The study concentrated on only one selected teacher college of education in Kumasi District of the Region. Due to this, the study may not be applicable to all the colleges that offer science in Ghana, nevertheless, the findings can still give an indication of what is pertaining to other colleges offering science.

1.11 The Structure of the Thesis

This thesis consists of five chapters. The first chapter introduces the reader to the introduction of the study whilst the second chapter talks about the theoretical framework namely education as human right approach, approach for teaching science constructivism and critical pedagogy theory and other concepts. The third chapter describes the methodology of the study. It constitutes the research approach and design, methods and procedures for data collection selected for the study. The fourth chapter deals with the presentation and discussions of the research findings. Finally the fifth chapter presents the summary of key findings, conclusion and recommendation of the study.

2　　Theoretical Framework

2.1 Introduction

This chapter presents theoretical perspectives of the research and relevant concepts that emerged from the findings. They were employed to help in the analysis of the study: *teaching science: preparation of student teachers at college of education to teach science at junior high school*. The focus was to find and explore methods tutors use to teach science at the college of education. The study introduces the readers to four theoretical perspectives namely: education as human right, approaches for teaching science, constructivism and critical pedagogy. The reasons for employing these perspectives are that they complement each other and are helpful to understand this study. It is also used to answer research questions and the themes emerged in the study. They are presented to discuss the methods that science tutors use to teach science and to prepare science students at the college of education.

The human right framework focuses on how relevant quality and varied teaching methods be made available and accessible for student teachers` preparation in the teaching of science at the junior high school and how the framework influences students competence.

Approaches for teaching science demonstrate different and systematic ways of teaching science for active and effective students' participation and understanding. Constructivism and critical pedagogy theorists show how teaching and learning should be conducted by tutors and how knowledge acquired by students could be developed and applied respectively.

Constructivism is used to analysis how the student teachers perceive and build up experiences on the teaching methods tutors use to teach science at the college of education. Critical pedagogy explores and analysis how science tutors teach the content with competence in the teaching of science (Freire, 2005, 2000). This is because, "the knowledge base of teaching lies at the intersection of pedagogy and content" (Shulman, 1987 p. 15). Therefore science teachers should be competent in the subject matter and dynamic in the use of methods.

After presentation of the theoretical perspectives, relevant concepts emerged from the findings namely: curriculum,; practical activities, learner centred approach, project work, teaching practice and teaching learning materials and equipment are presented in this study.

First, I present the theoretical perspectives; human right framework that is education as human rights, approach for teaching science, constructivism, and critical pedagogy.

2.2 Education as a Right

Education in the world context is regarded as the fundamental human right as stated in the universal declaration of human rights since 1948. Human right approach can be described based on article 1 as the fundamental unity of all members of the human institution, as well as respect for their inherent dignity. It`s aim is to promote the awareness, respect and understanding (United Nation, 2015). The United Nation conference held by member states in Vienna on human rights (Babaci- Wilhite, 2014) came forth in the 1993. At the conference, various laws and declaration such as the convention on the right of the child and notable among them was the right to education was declared.

As enshrined in the Universal Declaration of Human Rights (1948), article 26 of the Human Rights Declaration (1948) states that everybody has the right to education without discrimination. Therefore education in the world context is regarded as the fundamental human right as stated in the universal declaration of human rights since 1948.

Since 1957, when Ghana had the independence, education has been considered as everyone's right for all citizens of Ghana. The right has been enshrined in the 1961 Education Act. The Act is the principal legislation that enforces the right to education for all in Ghana (GES, 2004 p. 2).

In relation to this study, declaration on science and the use of scientific knowledge adopted by world conference in 1999 makes science relevant for all people. In the preamble, all aspects of science should be at the service of humanity and should contribute to providing everyone with a deeper understanding of nature and society, a better quality of life and a sustainable and healthy environment for present and future generations in all nations (UNESCO, 1999).

Despite all these policies and legislations which is not only applicable to Ghana but in most parts of the world, UNESCO policy paper report (2014) showed that 58 million children of school going aged 6 to 11 are still out of school, showing little overall improvement since 2007. The paper also indicates critical gaps in the education of older children aged 12 to 15. Globally, 63 million adolescents were out of school in 2012. This is contrary to the

background that the Jomtien World Conference on Education for All (1990) set the goal for the education for all children of school–going age. Freire (2005; 1995) argues for inclusion and social justice in the sense that he believes that every learner can do something irrespective of social class; level of ability. He clarified that every on -going and professional teacher should be ready to tolerate every learner and live with their differences in the teaching processes. Donnelly (2003), similarly argued for social justice for all members to have opportunity and access to education.

In recent times, human rights is gaining attention in the research community especially in the field of education, special needs education and specifically teaching methods for science. The reason is that education is generally accepted as fundamental right that should be made accessible for all human being (Babaci- Wilhite, 2014; Donnelly, 2003). However, in the developing nations, it is a challenge as many people do not have full access to education and even when they have access, they do not get chance to actively participate due to closed lecture method receive. That is methods which do not allow students to bring out and share views in the teaching and learning process.

Some studies have shown that teaching methods most teachers use sometimes deny some students' active participation in most subject areas especially science and mathematics (Babaci –Wilhite and Geo –Jaja, 2011; Osborne, Simon and Collins 2003). Article 2 of human right declaration states: the right of education must be accorded "without distinction of any kind, such as race, colour, language, religion, sex, political or other opinion, national or social origin, property, birth or other status" (United Nations report). That is, the right of individual to education must be respected.

Babaci-Wilhite (2014) mentioned that within the human right declaration, governments are tasked with the responsibility of ensuring quality education of all citizens within their jurisdiction. This is a challenge to majority of governments in the developing nations of the world including Ghana. Babaci –Wilhite et al (2011) argued that there is a need for the right to education in relation to availability and accessibility. This can be linked to the fact that access to scientific knowledge for peaceful purposes from a very early age is part of the right to education belonging to all mankind without discrimination. It could be connected to the kind of teaching students receive whether it is based on the curriculum content and methods of teaching. Education is fundamental human rights in universal declaration and for this

reason different opportunity and accessibility to quality teaching and variety of teaching methods should be made available for students during teaching and learning activities.

The right-based approach is relevant to this study because in Ghana, education is recognised as everyone's right and it is guaranteed by the 1992 constitution of Ghana. Therefore, the study sought to investigate whether tutors and students have right to variety of teaching methods. It also investigates whether teachers provide opportunity and access to different teaching methods and practical ways of helping students' active participation for better understanding. The next is the convention on the right of the child.

2.2.1 Convention on the Rights of the Child

The United Nations adopted the convention on the right of the child and made signatory on 20 November 1989. It came into force on September 1990, after it was ratified by the required number of nations. Currently there are 196 countries and Ghana is in the membership. The convention considered children as human beings with a distinct set of rights to make them feel sense of belonging (UNESCO, 2014) and active rather than passive recipient. The rights set forth in the convention describe what a child needs to survive, grow, and live up to their potential in the world. In relation to this study, if everyone has the right to education without discrimination and every learner has the right to receive quality education; quality teaching methods, it may help them to understand and develop their potential.

Considering the right of the child to education and policy statements on science, teaching methods used by tutors should be participatory. This is to mention, learner centred approach-activity methods which would create room for learners' participation instead of making them passive recipients must be encouraged (Leach and Scott, 2010, Freire, 2005). Learners have experience before they enter school, they should be allowed to explore and bring out the best in them during teaching and learning process. They should practically receive quality teaching methods that will engage them to think critically and relate ideas in the learning process without discrimination. When students are involved in practical activities, it may enable them to have full participation, remember and understand concepts learnt and not only to memorise without understanding but with understanding. This connects the next presentation to the policy statements of Ghana.

2.2.2 Policy statements of Ghana

Policy statements can be described as declaration of plans and intentions of government or institution intended to safeguard its members in the states or nations (Collins Dictionary). Policies are mainly intended to set direction for members in a nation or an institution. Policy on the rights of the child took its mandate from the 1992 constitution of Ghana. Non-Governmental Organisation (NGO) Coalition on the rights of the child is established to ensure the promotion and protection of child rights. Since 1997, several important measures including child rights legislative reform and other related policies like child right regulations 2002, the children Act 1998 have been instituted to lead Ghana into conformity with international human rights standards on children.

However, there seems to be challenges as far as practical implementation of the policies are concerned. The education strategic plan (EPS, 2003-2015) on policy target and strategies review on science education reveals that science is poorly served in schools in Ghana. Many schools have inadequate laboratory equipment for practical work. Based on these challenges faced in science and general education as a whole, the Ministry of Education and its sub – sectors have adopted some policies, goals and strategies to curb the situation. This was to strengthen the goals by providing quality access, participation in education and in the teaching and learning processes.

2.3 Approaches for Teaching Science

Approaches for teaching science have been reconstructed and reframed from Woolnough (1994) studies on "students' choice of science programme". Woolnough discovered that students' choice of participating in science is influenced by the way teachers teach science. The reason is that teaching methods used by tutors at the college of education influence student teachers' preparation in the teaching of science. Thus either tutors teaching can influence students positively or negatively.

Approaches for teaching science could be explained as quality teaching procedures and measures put in place for effective teaching (Copper and McIntyre, 1996; Woolnough, 1994; Teaching could be described as passing an understandable information to students.

In this study, tutors and lecturers play key role in the teaching process since they are educators who teach and challenge their students (Freire, 2005). It suggests that tutors have influence on the student teachers with respect to the teaching methods they provide for them to be equipped to teach science at the junior high school. Therefore it is important for tutors to think about what to teach the student teachers and what science tutors and lecturers need to effectively teach them (Shulman, 1986).

Woolnough conducted comprehensive study on "students' choice of science". His study which identified four factors namely: *societal needs and demands*, *student potential input and personality*, *school factors* and *finally*, *external inputs* were noted as influence to students' choice of science.

In this study, *school factor* which was one of the aspects, Woolnough identified as influence to student's choice in science is discussed. Also Shulman pedagogical content knowledge is discussed. The reason is that it concentrates on the influence of the *teachers' quality teaching* and the *nature of the curriculum* as one of the important factors which is relevant to this study. Greater value was placed on the quality of teaching methods for science and teacher encouragement as critical determinants to attract more students' interest and participation in science professional careers (Woolnough, 1994).

This implies the characteristics of quality of tutors such as love and care to encourage students are determinants to students desiring to pursue science to a greater level. This may in turn motivate more students to become enthusiastic professional science teachers. In the present study, appropriate and quality use of teaching methods offered to student teachers may help determine how equipped and competent they are prepared to teach science at the junior high school.

Explicitly, Woolnough identified a well- qualified professional and enthusiastic graduate science teacher as a contributing factor to quality teaching of science. He emphasized that such graduate professional should be well versed in all aspects of the science as well as having specialization in a course. This means that a well-qualified professional teacher should not only be versatile in the content but also competent in methodology and unique mastery in any of the courses in science for example biology, chemistry or physics. In similar vein, Freire (2005) argues that professional teacher should not just bear the name but should be able to perform his or her duty by being proficient in content and methodology.

Furthermore, Woolnough (1994) clarified that good teaching is characterized by teachers who are enthusiastic about their subjects and well organised for interesting teaching. This suggests that it calls for a self –motivated science tutors to devote themselves to teach and prepare student teachers at the college of education to equip them with knowledge and skills to carry out their future profession.

In addition, Cooper and McIntyre (1996) found that quality teaching is effective teaching procedures and measures. Some common aspect of the measures and procedures perceived by teachers and learners were as follows:

- Clearly stated objectives for learning
- Preview and review of lessons
- Assisting students to contextualise content in relation to their own experience and knowledge
- Creating supportive social environment by the teacher to help students feel belonging, respected, showing care and love

When teaching, and learning of science is conducted in a systematic order and students are involved and valued in the teaching process, it encourages students to develop more interest in the content and methodology.

In short, the role of tutors is crucial in the lives of students during teaching and learning processes. The reason is that the prime and important duty of a tutor is to educate students not only academically but also play significant role in personal and social development (Woolfolk, Hughe, and Walkup, 2008). It is therefore important that tutors at the science department equip themselves with professional skills and knowledge competence to educate student teachers to be enthusiastic teachers who help meet the learning needs of learners.

Other studies have shown that building teachers' competence is a significant issue to implement in schools and improve practice (Buli-Holmberg, 2010; Skogen, 2014). The present study also acknowledges that teachers' teaching competence is vital at school and college level. Tutors' competence level has influence on students learning and confidence level. Holmberg and Tangen (2000) indicate significance of teachers participating in practice-oriented study programme as developing better applicable competence in schools and promoting implementation of the vision of inclusive education. Therefore it is important that

tutors understand the basic unit of knowledge acquired and build upon it in order to effectively teach and put into practice.

Another dimension, which is very relevant in this study, is Shulman's *pedagogical content knowledge* (PCK). He describes PCK as "that special amalgam of content and pedagogy that is uniquely the province of teachers, their special form of professional knowledge" (Wilson, 2004 p. 22). This is used as means of teaching science. Shulman PCK idea is relevant in this study because it demonstrates the blending of content and pedagogy for understanding how topics, issues are planned, organised, represented and adapted to the interest and potentials of all students during instruction (Wilson, 2004). Similarly, Cooper and McIntyre (1996) indicated that a teacher should teach with clear organised objective planned to help all students to achieve the goal.

Shulman (1987) maintained that the knowledge base of teaching lies between pedagogy and content. He used the concept "transformation" as aspect of larger process of knowledge and referred to as *pedagogical reasoning* which explained how teacher should acquire ideas and how to process the knowledge and decide on what and how to teach. He argued that to teach is first of all to understand and preferably comprehend critically different ideas to be taught. He emphasised teachers are expected to comprehend *what*, *when* and *how* to teach in different ways.

Furthermore, he noted understanding the subject matter is the most important thing a teacher should comprehend. That is the first stage of pedagogical reasoning is 'comprehension' and after which transforming the content to the students until new comprehension arrived (see Figure 1 in appendix). He then noted it as a complex process constituting four sub-steps representing the intersection of pedagogy and content.

In summary, "using approaches that integrate theory and practice is more effective than merely teaching theoretical constructs to [student] teachers without helping them translate those constructs into practice" (Timperley, 2008 p. 11). This is because the knowledge base of teaching is bringing together content and pedagogy for integration teaching for transfer of knowledge.

2.4 Constructivism Theory

Constructivism is a concept that came forth in the 1970s and 1980s, and it served to support the assertion that learners are not passive recipients of information, rather they make sense out of the information they obtain. In this respect, learners do their best to process knowledge by interpreting information not just receiving without building knowledge up on their own (Bruner and Piaget 1970). Therefore, constructivist believe that when learners make sense of the information they receive from teachers by building up knowledge, then their thinking changed from acquisition of information to construction of knowledge (Bruner and Piaget 1970. Similarly, constructivist theories basically create opportunities for students to make their own ideas clear. This can be done by discussions with others, undertaken critical inquiry or exploration, check for their strength by observation, experimentation (Hodson, 1998) and draw conclusion.

In building personal cognitive understanding, student's construct and reconstruct their social reality (Reusser and Pauli, 2015, Leach and Scott, 2010). For instance, interaction with peers and teachers at the school varies from each other. It is also important for tutors to know the differences and changes in behaviour of students to give task, based on the student's zone of proximal development. Vygotsky (1978) describes zone of proximal development as:

> *The distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers (Vygotsky1978p.86).*

This implies every learner has inborn potential which must be assisted or guided by capable person, teacher or more able peers. This is because every learner can explore his or her ideas to some level but when he or she receives support from a teacher or more able peer and experienced, the learner can improve beyond his or her original zone of development.

Vygotsky's view suggests that teachers teaching and learning in general should lead to development. It could be related to this study that, teaching of science should lead to development. Teachers can do that by providing opportunities for learners to be engaged in activity to help them acquire skills and knowledge cognitively. This is because a student's

cognitive development takes place through social interaction with his or her peers and teachers at school (Vygotsky, 1978).

Constructivism approaches to teaching science have been developed by several researchers (Woolnough, 1994; Osborne 1984) with a summary that a teacher identifies students' ideas and views to:

- create opportunity for student to explore their ideas and test their robustness in explaining phenomena, accounting for events and making prediction
- provide stimuli for students to develop, modify and where necessary change their ideas and views
- support their attempt to rethink and reconstruct ideas and views.

These suggest that they believe that learning is a process from acquisition of information and experience to construction of knowledge. Learners are not just passive recipients of information rather they are active processors of information. In other words, they can make meaning out of information

Furthermore, in constructivism ways to teaching science, a tutor can use variety of methods like posing a question, stating a problem, performing demonstration and engaging students in practical based activities in the laboratory or at the field. This may enable students to build up new experiences with the old experience and think critically to transfer experiences. In relation to this study, a skillful tutor can elicit students' response and interpretation using questioning, practical work, group discussion and writing activities. Other ways of supportive teaching like illustration of chart and diagram can be used in teaching (Hodson 1998; Woolnough 1994).

Though students attend science lesson with prior knowledge and experience because of everyday experience, it is not every lesson taught in science class that they are familiar with. In this sense, it is preferable for tutors to provide practical work experience for students to have a feel of phenomena to build up individual students' experience (Woolnough and Allsop, 1985). This is what White (1996) calls building up 'episodic knowledge' or 'recollection of events'. That is gathering pieces of ideas to make sense out of knowledge. It happens when educators try to help students by taking them through different ways of teaching and learning activities in a systematic way for sound understanding. Bruner refers to it as 'scaffolding' is

steps taken to assist students progressively towards sound understanding and eventually, greater independence in the learning process (Bruner, 1978).

In this study, it is important that college departments set positive and credible standards worthy of being emulated by prospective student teachers in the teaching of science. Departments where students had a reputation for failure tended to have fewer students enrolling with them (Woolnough 1994). Therefore teaching science should be done systematically for sound understanding.

In summary, constructivism or constructivists have taken the notion that learners construct their own understanding and build upon that. They maintain that teaching and learning depends on the way in which learners create new mental schemas (ideas) based on previous knowledge (Dillion and Osborne, 2010). This is in line with one of Cooper and McIntyre way of effective teaching that, an on- going teacher should preview and review lessons based on learners previous knowledge related to the study.

2.5 Critical Pedagogy

Freire (2005), in his book "teachers as cultural workers", stated that a professional teacher acknowledges that he or she does not possess all knowledge, he or she is aware that the students also possess knowledge that need to be guided (Freire, 2005 p. xxxiii). Knowing this, the teacher then recognises, appreciates and makes room for the learners' knowledge during classroom interactions (ibid). Therefore, students are to be treated with love and respect to come out with their views on a lesson.

Freire (2005) explained the professional qualities that a teacher in every society should attain to become efficient. He also elaborated on some virtues that a well-qualified professional must possess to help all learners. The virtues Freire referred to as qualities such as love, tolerance humility, flexibility and security. Love, tolerance and flexibility are used in this study to discuss the themes that emerged in the findings.

In his book "teachers as cultural workers" Freire (2005) mentioned that teachers are expected to discharge their duty with competence (p.xxxiii). This suggests that a well-qualified professional must be competent in their subject matter and methodology in teaching. Freire

explained professional as a teacher's ability to put theory into practice and not only bearing professional tags that has no relation on real classroom practices.

Furthermore, Freire (2005) on teachers' professional attitude further elaborated that love must be the foundation on which teachers perform their duties. Without love their work would lose its meaning. The love for teaching helps a teacher to treat all learners equally and takes care to make room for their weaknesses and strengths during teaching and learning processes. Love and tolerance will make the teacher appreciate the individual difference of the learner and design pedagogical plan that will benefit all learners without segregating and discriminating against anyone. However, he cautioned against ''coddling'' or pampering of students.

In summary, teachers serve as parents in the classroom but should not pamper their students. The reason is some learners take it as weaknesses on the part of the teachers. Nonetheless, they are not to be inflexible during classroom interactions but to be fair and firm, love, welcome and respect all learners. It in turn paves way for teachers to apply the appropriate teaching methods to benefit all learners in an inclusive classroom. Ensuring theory and practice are used practically to engage everyone in the classroom effectively.

2.6 The Curriculum

Curriculum as a concept has been defined in many ways. In this study, it is described as a broad plan of what to teach in educational institutions, for example the curriculum content consist of various topics to be learned. Curriculum is simply what is learned, how it is taught based on the method used to teach and how it is assessed and evaluated (UNESCO, 2014). It contains objectives, contents, method of teaching, assessment and evaluation. Objectives are the intentions of the study of the curriculum. It implies that, curriculum serves as a guide and provides what is to be taught and evaluated.

The curriculum for teacher college of education programmes in Ghana is aimed at achieving quality instruction necessary to meet 'society's teacher' demands and expectations (Revised Curriculum 2014) Therefore, the curriculum has been designed by planners to offer direction in educating students.

2.6.1 General objectives of the curriculum

The general objectives of the curriculum are the overall expected intentions of course of study. Cooper and McIntyre (1996) study on effective teaching reveals that there are aspects of teaching noted to be effective by teachers and students. Among those aspects are few examples such as

- Setting clear goals for student learning,
- Providing clear communication of lesson goals to students and
- Willingness to allow students to have input into goal setting in the teaching and learning environment.

The aspects recognise the importance of subject matter and pedagogical knowledge of the curriculum objectives that are made to meet students' needs and interest. In relation to this study the general intended objectives for the college of education programme are to educate teachers to have a clear grasp of intended outcomes of their teaching activities. When a science tutor has clear goals and objectives set for a lesson, it may help him or her to teach accordingly.

2.6.2 Content

The content is an aspect of curriculum that indicates what is taught. It is the intention of the teaching learning process of a course of study (Johnsen, 2014). That is, the intention of teaching learning process is achieved through content. The content should be opened to optimal integration with other learning activities and open to students' interest. In relation to this study, the quality of science teaching is determined by the content and how it is taught. Often, most teachers base their teaching on a prescribed set of educational outcomes or goals. But it could be flexible to meet the needs and interest of learner.

In many countries, teachers depend on the prescribed content. This is because the system has content-loaded examinations that students must pass and teacher's success is measured by students' performance on these examinations (Abell and Driel, 2010; UNESCO, 2004).

2.7 Methods of Teaching

Teaching methods which give priority to problem-solving, decision making, critical and reflective thinking is adapted. A student-centred and mentoring approach is used in some cases. In very few cases, the lecture method is used. Special emphasis is placed on practical and tutorial sessions. Methods of teaching is one of the aspects prescribed in the curriculum, it clearly shows variety of teaching methods which should be adopted and adapted based on the student's interests, and expectation. The use of variety of methods for teaching science will help involve and promote active participation of students to explore during teaching and learning activities (Hodson, 2009; Osborne, Simon and Collins, 2003; Woolnough, 1994).

2.8 Assessment

The role of assessment and evaluation is to monitor the direction of educational activities towards their intentions (aims, goals and objectives). According to Bashinski, M, S (2002) the adaptation of assessment practices is not limited only to the expansion of test-taking parameters. Johnsen (2001) has also criticized the traditional ways of assessing students whereby the achievements of students are measured and given marks in comparison with other students in class and in the nationwide

Many professionals have endorsed the uses of continuous assessment and cumulative record processes in inclusive educational system (Johnsen 2013, Wolf, P and et. al. 2006 Johnsen 2003). Using assessment tools such as observations, gathering in portfolios, logbook, checklists, etc. the continuous assessment process takes place through everyday teaching and assessing in a dialogue with individual pupils and the whole class. Assessment is done based on what has been learned.

2.9 Time for Instruction

Time for instruction or time allocated for each topic in the curriculum is the time schedule for teaching, how deep one should go into a topic and by the needs a specific group and individual's may have and of course on the methods applied. However, a curriculum could suggest guidelines 60 to 90 minutes a day for each course topic for science. Therefore time

available for the content to be taught is necessary for tutors teaching and students' active involvement in learning.

Inadequate time for instruction comes in when time schedule for lessons are less or are not sufficient for students to be actively engaged in activities. This may influence the preparation of student teachers. For the purpose of this study I briefly to see how it could influence the preparation of students at the college of education. In relation to this study, most students of all ages know how to construct knowledge when received adequate information ((Kirschner, Sweller and Clark (2006). Therefore adequate time for instruction is important as it may contribute to the full guidance and participation of students in the learning process.

2.10 Practical Activity Work

Practical work is an essential component of effective teaching of science in either classroom or on the field. The Consortium of Local Education Authorities for the provision of Science Services (CLEAPSS, 2008) noted *"appropriate practical work enhances pupils' experiences, understanding, skills and enjoyment of science" (p.109).* This implies that teaching and learning may be interesting and productive when tutors engage and involve students to take active participation of the learning processes. In the words of Millar (2004), practical work is any teaching and learning activity, which at some point involves students in observing or manipulating the objects and materials under study. Millar explained, he preferred to use the term *"practical work" to "laboratory work". (p. 2)* His reason was that location for activity is a key characteristic in laboratory work unlike using practical work where activities could be done in and outside school or college environment.

This study agrees to Millar's preference because practical activity has been taken as the main focus and the activities involved were not restricted to location. Rather it also looked at the broader perspective for example how activities, exercise demonstrations etcetera were done to engage students for them to explore and solve problem at their own pace.

Constructivism explains that learners learn best by active participation. The reason is that they learn to develop, build their experiences and knowledge systematically for better understanding. They do not just memorise facts but rather make sense out of information (Freire, 2000). Therefore, any form of practical work which involves series of activities, demonstration to involve students is ultimate for helping students to solve problem.

2.11 Learner Centred Approach

Learner centred approach is a learning that places student at the centre of learning process. In the learner centred learning, students are the active participants of their learning. Students are self-motivated as they actively participate and learn at their own pace. They learn with interest and this may help them to develop skills like how to learn and solve problems. It gives opportunity to develop individual's student potential as they interact with their peers and learning materials. Learning becomes flexible based on the needs of students (National Centre for Research on Teacher Learning, 1999).

Therefore, Learner centred approach is the one where complete learning experience is focused on the learners or students and it is basically activity based. In learner centred approach the course should be designed in a way in which students would be able to easily access the content of their choice, interest and work at their own pace. When content are designed to include students' interest and choice, learners would find the courses relevant to their challenges and learning needs. The relevance of learner centred approach is to enables students to retain information acquired during participation of activities with peer and hence improve retention of knowledge (Weimer, M. 2002). It gives students the opportunity to foster collaborative learning. This leads the presentation to project work.

2.12 Project work

Project work is an approach to teaching which gives methodology that involves students in learning experience Project work as a method for teaching allow natural integration of sound teaching practice as alternative means for assessment, cooperative learning and scaffolding (Stoller, 2002). It gives students the opportunity to develop their confidence level and independence to work together in the natural environment.

In project work, student work by collaborating on the problem or task that students themselves have experienced and select to perform. With project work as a method of teaching, different ways of teaching situations are created. This different ways of teachings enable individual students of mixed ability to get opportunity for individuals to exhibit their potential (Fried –Booth, 2003). It creates opportunity for students to identify problem and find solution to it.

2.13 Teaching Practice-Peer Teaching

Teaching practice is one of the preparatory activities that tutors take student teachers through in the teacher education programme. There are two forms of teaching practice namely; peer teaching which is done on campus and off campus teaching which is done out of the college campus.

Peer teaching is a complex process by which students learn from other students who are more experienced and knowledgeable about the subject material. Vasay (2010) describes it as a technique that helps students to perform better in understanding the different concepts, developing computational skills and their moral, social and emotional values particularly their ability to express their ideas.

The relevance of peer teaching is that many students feel more comfortable asking their colleagues questions, rather than their professors. It tends to make students feel relieved from difficult assignments as they receive the opportunity to share ideas and obtain views from other colleagues. Devoting adequate time for individualised teaching help student teachers to be equipped with skills and knowledge as peer teaching is also a way of learning for more valuable experiences. Teaching others ensures a high level of content mastery and learners needs into consideration. Vasay (2010) conducted a study of peer teaching in college mathematics, and found that it:

> *"greatly affects the intellectual and moral values of the students, such as the ability to express their ideas, mastery of different concepts, time management, sense of responsibility, sharing, self-discipline, and self-reliance self-confidence, resourcefulness, cooperation, obedience, etc." p.169-170).*

This implies that creating opportunity for student teachers to teach their colleagues prepare them to practice what they have learnt and give them confidence to express and share their ideas on topics and issues. It may further prepare students to be independent that is they learn to teach themselves whether under supervision or without it and make most of them become confident.

2.14 Teaching Learning Materials and Equipment

Teaching learning materials and equipment are educational resources that aid and support teaching and learning processes, for example textbooks, models for illustrations computers and chemical solutions. Spreen and Vally (2006) in a survey of schools in South Africa, found that 80 schools have no libraries and laboratories and 78 have no computers. Most of these schools are found in urban, peri-urban and mostly rural areas. Similarly, a study of four African countries namely, Uganda, Cameroon, Tanzania, and Ghana, by O'Connor, (2002) revealed that majority of the schools both primary and secondary, have no textbooks, laboratories, chemicals, tools and equipment, teaching aids, stores, and offices. There is no exemption in colleges of education. In this present study, similar situation of inadequate laboratory equipment and learning materials were experienced at the visited college of education as tutors hardly get required and enough teaching materials and equipment for learning activities.

2.15 Summary

This chapter has presented the theoretical framework namely: *education as human right, approaches for teaching science, constructivism and critical pedagogy theory.* Considering the right to education, it has been noted not only to provide access to students but also right to full participation. The rights should in include variety of methods, quality teaching to prepare student to be competent to meet the needs of all learners. Everyone has the right to education irrespective of race, gender, disability nationality or economic background (Donnelly, 2003).

The approaches for teaching science have been explored to demonstrate how teachers should vary their methods of teaching science to help student teachers to develop variety of skills and knowledge to teach their subject. The constructivism and critical pedagogy demonstrate how and why teachers should be competent in content and methodology to teach effectively so that students do not only acquire knowledge but also process information and build up their new knowledge. Since there are individual difference and learning capability, how individual learners learn varies from each other and that learners learn differently. These perspectives have been chosen because they complement each other and are useful for this study in analyzing and answering the research questions in connection with the themes.

3   Methodology

3.1 Introduction

This chapter presents the research approach and design which entails methods and procedures involved in the study. It provides description of the research site, the target population, sampling and sampling size, methods for data collection, pilot study, data analysis, reliability and validity and ethical consideration in research field and finally summary.

3.2 Research Approach and Design

Research approach is plan and the procedure for research. The design refers to the plan of how a researcher intends to carry out research process for the purpose of finding solutions to research problems and expanding knowledge and understanding (Creswell, 2009). This implies that, it is the framework for conducting research and various activities put in place right from the initial planning through data collection techniques to the appropriate ways of analysing data.

3.2.1 Qualitative Approach

The study adopted qualitative approach. It is an approach for exploring and understanding the meaning participant or participants may ascribe to a social or human problem. Yin (2003) describes qualitative research as an interpretive study of a specified issue in which the researcher makes sense of informants' views. It means that qualitative approach brings the researcher close to participants for interactions and makes sense of their views. It also provides flexibility for the researcher to explore topics and enable participants to share view freely (Creswell, 2012).

Creswell (2012) In view of the above, I used qualitative approach in order to obtain information and attempt to answer the intention of the study. The reason for this approach is that it is inductive and gives rise to application of concepts and emerges theories in relation to informants' construction of views. It is an approach in which individual views can be expressed in subjective way and linked to interpretivism. Its subjective way is not opened to

any form of generalisation. However, it has great strength of sensitivity to individual in terms of context. Thus researcher respects and understands individual's views, values and behaviour (Bryman, 2008).

In relation to this study, tutors were asked to share their views based on how they prepare the student teachers at the college of education to teach science in junior high school. Student teachers too were also asked to express their views on how tutors prepare them.

In short, qualitative approach is interactive and participants had the opportunity to express and ascertain their individual views regarding the preparation of student teachers to teach science (Bryman 2012; 2008). Qualitative approach helped me to delve deeper into how science tutors teach student teachers the subject science and provided me with in-depth information and understanding of how tutors use teaching methods to prepare student teachers at the junior high schools.

3.2.2 Descriptive Design

In this study, descriptive design within qualitative approach is used to obtain, organize and interpret data which is emphasised in Cohen, Manion & Morrison (2007 p. 78) that, "research design is governed by "fitness of purpose" which in turn determines the methodology and design of the research" (p.78). Descriptive design is the scientific way which involves observing and describing behaviour of individual without influencing the result. Looking at what has been said above; the purpose for research design is to guide a researcher to plan effectively.

Descriptive research design was used to obtain information regarding "what exist" with respect to how tutors use practical methods to teach students science at the college of education. Fraenkel & Wallen (2000) assert that the purpose of descriptive design is to observe, describe and document aspects of phenomenon as it naturally occurs. Therefore, I have adopted the descriptive design seeking to describe views held by participants, observation and information obtained from the study very well.

3.3 Research Site

Ghana is the country where the research was conducted. Specifically, I visited one selected college of education in Ashanti region and precisely one of the nearby science colleges of education. The reason was for accessibility, time, and the fact that the selected science college of education was located in the district within the region.

3.4. Sample and sampling procedure – selection of Participants

Sample is the segment of the population that is selected for investigation of a study. In other words, it is the subset of the larger population which serves as representative for a study (Bryman 2008; Cohen et al. 2007). Sample size is the number of informants or participants selected for a study.

An important aspect I considered as far as the sample and its size is concerned was sampling procedure to use for sampling this is because in qualitative studies, samples are typically small and based on information needs (Maxwell, 2005). The sample is small so that data obtained would be simpler interpreted and better understood. The assumption is that there is likelihood for the researcher to obtain detailed data and in-depth information from each participant to reasonable size. Therefore, the study made use of seven participants in two categories (see table 1)

Table 1 Categories and number of informants and participants

Category of Informants	Number
Science Tutors	3
Science Student Teachers	4
Total	**7**

3.4.1 Purposeful selection and Procedure

The study made use of purposeful sampling for selecting participants. Purposeful sampling involves intentional selection of particular group of people who are most likely to provide rich information to the research study (Cohen et al 2007; Gall. Gall and Borg, 2007). This implies that it is a way of selecting research participants based on the needs of the study so that participants who are able to give rich information that is suitable for detailed research are chosen (Patton, 1990). Therefore, I selected experienced participants in the study.

Precise sampling criterion was used to allow the researcher to select only participants who satisfied important criteria and were important to the study (Gall, Gall & Borg, 2007). The general criteria that I put in place were for the selections of the seven participants were:

- Three science tutors including one head of the department who are experienced and have been teaching science courses over the years.

- Four second year science student teachers who had the experience in the teaching and learning of science for at least one academic year.

This technique is a feature of qualitative research, often used in research studies where the researcher makes use of sampling on the basis of their judgment related to their interest or typicality (Cohen et al 2007 p. 114). In relation to this study, the reason for selecting a purposeful sample was that there are few colleges of education pursuing 'special' science programme. One among those colleges has been selected with the assumption that, rich information would be obtained for analysis. Moreover, the choice of purposive sampling was to select respondents who are experienced because, the more they are experienced, the more likely they could provide relevant answers. Therefore, science tutors who have been teaching the science programme and second year students who have had enough teaching on science course were selected as mentioned earlier. I selected experienced science tutors and second year students who have also studied science for at least more than one year and have experienced the teaching of science and were the relevant subject for this study.

I selected suitable participants by contacting my former colleague science tutors and searching more information from the website of the Ministry of Education to study the selected college. Information obtained and recommendation made by colleague science tutors made me to settle on the college mentioned for the study. I purposely chose participants, which in my opinion were relevant to the study. The idea of qualitative research is to purposefully select informants who are fitted to answer the research questions (Creswell, 1994).

The nature of the study involves a small sample from the population and it fits the characteristics that are appropriate for the study. Maxwell (2005) points out that in small and limited sites, consider purposeful selection rather than random. As a result, the choice of this sampling procedure is appropriate for the study.

3.5 Methods for data collection.

This part describes the instruments for collecting data and how it was conducted. I used interview as the main method for collecting data whilst observation and documents studies were supplementary or supporting methods for data collection. Strauss & Corbin (2008) observe that in qualitative research, one of the virtues is that sources of data are can be many. With that, the researcher employed three of the many alternatives and settled on interview, observation and document studies to gather data as stated already. Interview and observation allowed me to get closer to the informants to obtain first-hand information from them because they educate students and guide them to acquire knowledge and values during teaching. Furthermore, as activities are observed, it provides the researcher the real picture on the ground. Interviews and observation are fieldwork activities, which give direct information. The reason is supported by Patton (1990) saying that, "fieldwork is the central activity of qualitative enquiry" (p.46). It suggests that fieldwork activities for example interviews and observation enable the researcher to have direct contact with people under study in their natural environment. I had opportunity to interview and observed tutors and students during and after teaching.

Creswell states that in qualitative approach, the researcher is the primary instrument in the data collection (2014; 2012; 1994). With this line of thought, information I obtained from interviews, observations and document were vital to data collection. Semi structured

interviews and observation were employed for the study. This leads the presentation to the methods as sources of data collection such as interviews, observation and documents respectively.

3.5.1 Interviews

Interview has been defined as an interpersonal conversation between two partners that is, interviewer and interviewee on a research topic of "mutual interest" (Kvale and Brinkmann 2009 p.123). Information collected from the interviewees have been organised and interpreted by the researcher.

Creswell (1994) states that detailed descriptions of human experiences of the people being studied are examined. This enables the researcher to have a better understanding of the phenomenon under study. In view of this, qualitative research interview has been used as the main method. The interview lasted for 35 to 45 minutes for each tutor because the time varied from tutor to tutor based on how one explained his or her views on topics regarding the research interviews.

Before I conducted the interview, I clarified the purpose of the study for my participants. In the first place, I established informal conversations with them in Ghanaian and English language. It helped free them from shyness, tension and established a pleasant, conducive and relaxing atmosphere for free flow of interaction. Adequate preparation helped the participants to freely respond to the actual interview.

Probing questions were asked during the interview. I asked the participants to elaborate, gave enough information and clarified any vague responses (Creswell, 2012). During the individual and group interviews, recordings and field notes were made. Audio recording served as a supplement to the notes taken because I could not write everything during the interview. After the playback, I recaptured all that I missed. I made field notes to help me to recollect some expressions uttered by the informants.

3.5.2 Qualitative Semi –structured Interviews

I used qualitative semi-structured interview. The reason for choosing qualitative semi-structured interviews for collecting data was to obtain thorough information (Kvale 1996) as well as collecting rich and tangible data. This was explained as first-hand information from direct source (Gall, Gall, and Borg, 2008). The research questions helped me to find out various ways and different methods tutors prepare student teachers to teach science. (See pages 60-69)

Again, the method was chosen because semi-structured interview allows for flexibility and without compromising the participant's freedom to elaborate on topics of interest to him/her (Bryman, 2008). It enabled me to have an outline of topics to discuss and explore other topics brought up by science tutors and student teachers in area of their aspirations, worries and challenges. Semi-structured interview provided me the opportunity to regulate and re-organize the questions. It gave room for participants to expand their views in many aspects of the interview. It was expected to be time-consuming due to the open-endedness of the data (Kvale & Brinkmann, 2009). However, I spent much time with the participants and I received detailed information needed from them.

3.5.3 Observations

Observation is the act whereby a researcher gathers information 'live'. According to Cohen et al (2007) observational data are attractive as they afford the researcher the opportunity to gather 'live' data from 'live' situations. In direct observation, the researcher gets the chance to look at every activity that takes place in a situation rather than at second hand (Patton, 1990 p. 203). For instance, considering the research questions (see page) helped me to position myself well on how and what to observe as tutors teach different learners in the classroom in order to obtain practical information. The observation was semi structured type and constitute what I witness. The researcher will not be limited or restricted to specific observable characters, but rather observed all relevant features related to the study with reasonable time frame for about 30 to 35minutes in each of the three classes within the upper primary class.

During the visit to the college, I made it known to tutors and student teachers my presence and purpose so that they could do away with doubt and feel free in the course of the observation process. The weakness of the method is that teachers could pretend and alter their

behaviour during teaching process since they are aware there is an observer. Patton (1990 p.109) argues that "people may behave quite differently when they know they are being observed". As a result, data gathering using only this source could not provide detailed and enough information and would even distort the analysis of the findings in this study. I used other methods like interview as the main instrument to enforce both reliability and validity in the study. This leads to next method for data collection document.

3.5.4 Documents

The use of document such as curriculum was employed and collected from the Head of Science Department at the college of education in respect to the study. Hammersley and Atkinson (2007, p.122) assert that the use of documents provides an "insight of information about the setting being studied". I used this method of collecting data for broader information about the study. Bryman (2008, p.389) mentions, the use of official documents deriving from the state can be authentic and have meaning that is comprehensible to the researcher. In view of that, I obtained information and overall plan of the curriculum. It served as evidence to support some of the views raised regarding preparation and teaching methods used by tutors.

The document was useful because it was detailed, reliable and could not be altered unlike interview and observation. With the document the presence of a detective for example investigator cannot alter what is written or documented in the curriculum or policy plan. I could not in any way reconstruct whatever information written in the curriculum and the strategic policy plan document. However, despite inaccuracy the documents information might be, the information obtained has helped me to understand the study.

3.6 Pilot Study (pre-testing instrument)

Pilot study is a pretesting of research instrument, for example interview guide. This was done to try out all research techniques and methods, which were used in the research to see how well they would work in practice. It was done before the actual data collection so as to ensure that the interview guide was applicable and useful, and also to determine the approximate length of the interview. The reasons for conducting the pilot study were compelling to carry out a preliminary investigation' (Gall et al., 2007, p.648) in order to ensure the quality of research instrument. That is, the objective of piloting was to check whether there would be

problems in administering the methods for collecting data. In this study the questions were tried out in another college of education other than the actual college for the study to correct and rephrase some ambiguous questions for quality.

With this, questions which were too long and ambiguous were revised. The pilot study enabled me to familiarize myself with the interview guide and practiced my interview skills. I could test the data recording devices that I planned to use for the actual data collection. I used an audio recorder for the pilot study. This was to enable me not to miss words from participants.

3.7 Data Analysis

Qualitative data analysis approach was adopted for this study. I recorded things that were interviewed and observed on audio recorder and in a field notebook respectively. Thematic organisation and analysis was used, which aimed at identification of the themes emerged from the data that were relevant for the description of the study. Thematic analysis is a method of pattern recognition within the data, use of emerged themes as category for the analysis (Fereday, Muir-Cochrane, 2006, p. 3-4). It was recognized as suitable for the study because of its flexibility. The nature of its flexibility allowed me to apply emerged themes with different qualitative framework, including the constructionist perspective, and the range of research questions.

In analysing qualitative data, the initial task was to find concepts that helped "make sense" of what was going on (Hammersley & Atkinson, 1995 p.209). Themes and categories were evolved from data without presupposing in advance the important dimensions (Gall et al. 1996; Patton, 1990). This suggests that data analysis involves making sense out of the raw data that was obtained. Raw data does not make sense when it is not organised and analysed. I began by going through all the data collected and sorting out different themes from the interviews and observations that were transcribed and categorised all the data to written texts (Yin 2003). I reflected on how the themes emerged from the data related to the theories and concepts and also interpreted them based on participants' views.

3.8 Validity and Reliability

Validity refers to correctness, relevance and strength of collected information in relation to the purpose of the research. Reliability on the other hand is viewed as the consistency and trustworthiness of research information, and can be reproducible by other researchers (Kvale & Brinkmann (2009). This implies that reliability is mainly concerned with whether or not the instruments are really measuring the phenomena they are supposed to measure. One is also concerned with being able to apply the same instruments to measure the same phenomena from other places.

In this study, emphasis is rather placed on validity. The nature of my research is a qualitative study. This nature and purpose of qualitative research, is concerned with the variety of what is happening in the specific environment where the research is conducted. This will require an open-minded researcher to achieve validity.

Validity

The validity was to ensure whether my research truly and really studies and describes what really was said and observed. To ensure validity, I developed an interview guide in relation to the research questions and the objective for the study, but also use probe questions to elicit detailed views and gain better understanding of participants' views. Professional opinions were sought to check the relevance of the interview guide with respect to the objectives of the study. I presented views of informants based on their own description and avoided altering their views.

In research study process, especially in data collection, one of the key issues is clarity of the questions. Clarity of question was ensured through pre-testing. With this, the interview guide of the study was considered to enhance and improve both research methods and field work procedures. In connection to quality assurance, I used three steps to maintain validity:

(1) I read information on research to educate myself on research techniques.
(2) Restructuring interviews to ensure good set of questions and
(3) Pre-testing during data collection to minimize repeated mistakes.

Apart from these, I also considered the culture of the college and familiarized myself and understood the culture of the college before I conducted the interviews and observation in time frame. This is because every college has its values, believes and norm that governs the staff and the students. Being aware of and considering these factors will strengthen

Furthermore, during the process of data analysis and writing, I took extra care to ensure as much as possible that the findings were the result of the experiences and ideas of the informants, rather than my own preferences. In this respect, I re-read the transcripts over and over to ensure that the interpretations were accurate.

In short, getting variety of information and describing the phenomena as truthfully as possible with all possible variations, I used three methods and triangulated them at various stages of the study. Triangulation involves the use of two or more methods of data collection to study from more than one standpoint (Bryman, 2008). This implies that it is the use of two or more methods to study the same situation and see if these methods will give you the same findings. Triangulation helped increase the strength and correctness of data collected, since data obtained from interviews were supported or disproved by observation and documents or clarified and confirmed some information received. Also, some aspects of the curriculum document which were not clearly understood were clarified during the interviews. This is how validity was strengthened in this thesis.

3.9 Ethical Considerations

The study was guided by ethical principles that are utilized in research. Ethics according to Cavan is defined as "a matter of principled sensitivity to the right of others, and that "while truth is good, respect for human dignity is better (Cavan, 1977 p.810 cited in Cohen et al 2007 p.58). Based on this view, I preserved the dignity of my informants/participants to avoid any negative impact on them in the study. In this respect, measures were put in place to protect my participants from any situation that will identify them. Cohen et. al. (2007 p.58), argue that social researchers must consider the effects of their research on participants, and act in such a way as to preserve their dignity as human beings. I considered the effects my research might impact on the participants ensured to preserve their dignity as human beings. Therefore, I asked permission from the principal and I explained the purpose of activities like audio–recording, photo graphing and note taking to the informants to clear any doubt and

misunderstanding. Again, all participants were informed of their rights and participation as being voluntary and could be withdrawn at any time. Furthermore, I assured the participants that the information they provided for the study was for academic purposes and as such they were well protected.

Finally, I ensured that participants' identities were withheld and information they provided was kept confidential. Creswell (2012, p. 279) asserts that "an equally important aspect of ethical research practice resides in the writing and report phase of inquiry" (p. 279). Therefore, I ensured not to use unethical statements while reporting the study. As indicated earlier, participants remained anonymous and not identified in the final report.

3.10 Summary

This chapter has detailed description of the methodological approach to the study. It made use of qualitative research with descriptive design and described how the data obtained from the field was conducted. The chapter also dealt with the study population, sample size and the sampling techniques employed in the research. In addition, it discussed the methods used to collect data from participants. The procedures for analysing data have been presented and the criteria regarding issues of validity have been emphasised in this chapter. As stated earlier, using different methods enabled me to obtain more detailed information. Data was analysed using thematic analysis which was descriptive. It aimed at identifying themes which emerged from the data and were relevant for the study. Finally, the chapter considered ethical issues of the research.

4 Presentation and Discussion of Findings

4.1 Introduction

This chapter presents the findings emerged from the study, *teaching science: preparation of student teachers at the teacher college of education to teach science at the junior high school (JHS).* The chapter also discusses the findings in relation to theoretical framework. The focus of this study was to explore teaching methods and specifically how tutors use practical methods to teach student teachers and to equip them with skills and knowledge needed to teach science at the junior high school.

The findings of the study were obtained from:

- three science tutors and
- four second year science students at the selected college of education in one of the regions in Ghana.

The reason is that the participants have had experience pertaining to teaching and learning of science for more than a year. They were selected for **interview** and **observation** for the teaching of science. I also did **document studies**. The Findings are organised into four main themes namely:

1. Science curriculum
2. time instruction
3. 3A   Teaching methods used by tutors

   3B   Teaching practice done by students
4. Teaching learning materials and equipment

Each of the four themes has sub-theme (s) and are presented later.

The findings were basically from primary data sources such as interviews and classroom teaching observations and secondary data source of information. Secondary data source was a document for science curriculum designed by the Institute of Education, University of Cape Coast for all colleges of education in Ghana.

I have chosen to assign letters for the three tutors represented for each course in science: Tutor 'B' for the biology, Tutor C' for chemistry and Tutor 'P' for physics tutor

I assigned numerals for the four student teachers namely: student (i), student (ii), student (iii) and student (iv) respectively. Quotations from informants are written in *italics* without quotation marks.

As indicated earlier, the focus of this study is to explore teaching methods and specifically how science tutors use practical methods to teach student teachers science at the teacher college of education.

4.2 Presentation of science curriculum (document study, tutors, and students' views)

This theme was based on my study of the curriculum and the views obtained from tutors and student teachers on the science curriculum at teacher college of education.

First, the general science curriculum objectives are revealed and after which specific areas of the science curriculum are presented and discussed. The reason is that it may give a fair knowledge to readers on the science curriculum for college of education for better understanding.

The section contains the following emerged sub themes;

- curriculum objectives and key features,
- content,
- integration of course in science,
- assessment and evaluation.

The curriculum objectives and content are presented in this form:

A. document study

B. tutor's views

C. Student teachers views

I start with the findings from document study of the curriculum. The rest of the presentation is based on tutors' and students' views.

A. document study

The document study is my personal study and observation about the general objectives and contents of the curriculum. When studying the curriculum, I found the following **general objectives:**

1. Educate 'specialist' teachers capable of teaching specific subjects including science, mathematics at primary and junior secondary school levels

2. Educate teachers who have a clear grasp of intended outcomes of their teaching activities, who are skilled in monitoring, identifying and providing equal opportunity to all pupils.

The curriculum also had the following **key features** as goals:

1. Establish a balance between theoretical knowledge and teaching skills.

2. Educate teachers to be facilitators of learning but not instructors.

3. Educate teachers who are creative 'researchers' in and outside the classroom, i.e. solving problems (Revised Curriculum, 2014; Shulman, 1997).

I noted **specific objectives** for each of the three courses: biology chemistry and physics. There was one common relevant objective for all the three courses in science:

- Acquire skill, knowledge and understanding of concepts learned in science.

The next aspect of the curriculum is the **contents**.

I found that there was a systematic plan of different topics and sub-topics within each of the three courses in the curriculum. I also found that the curriculum planners have stated that, the curriculum in general is made to avoid overloading of contents. I noticed the science curriculum had many topics under each of the courses: physics chemistry and biology. There

were also detailed contents for every topic found in each of the courses. Biology aspect covers some topics for example, during the first semester at the teacher college: *The structure of the cell; Respiratory systems in humans; structure and functions of flowering plants; and Ecosystem* (Revised curriculum, 2014). I noted physics and chemistry have similar details just like the biology aspect.

Furthermore, the study revealed that the curriculum planners had made and described the science content as *theoretical and practical*. The theoretical aspect was based on some principles, laws and concepts of a study and these were most often demonstrated in the form of practical work. Finally, as I studied the curriculum, the planners have indicated in the curriculum that the knowledge base of a newly appointed teacher is crucial to their professional performance (Revised Curriculum, 2014; Shulman, 1987).

B. tutors view

All the three selected science tutors mentioned that there were clearly defined objectives for the college of education programmes. They indicated that, each course in science had its intended objectives. On the other hand, two out of three science tutors expressed concern that the curriculum for science should be reviewed. Tutor "P" mentioned, some of the topics in the science curriculum are too low and other topics were somehow little above student teachers' standard. Tutor "C" also revealed that *indeed the curriculum needs a thorough revision, some topics are not relevant and others too need to be replaced.* He gave a reason that clear objective would be achieved to make the science curriculum a holistic one.

Tutors "C" and "P" maintained that the curriculum should not be too low since some of them may go for further studies to upgrade themselves. Contrarily, tutor "B" said that as long as the student teachers were going to teach at the junior high school level, she felt the content taught at the college level to prepare them for teaching at junior high level is enough. She emphasised that the content was above the senior high school science programme, however, some of the topics needed more 'flesh' to be added. All tutors expressed concern to revise the curriculum.

C. Student teachers' views

Four science student teachers who were selected for this study mentioned that the curriculum objective is structured to enable students to acquire knowledge and skills for effective teaching. They also revealed that science tutors prepared them based on the science curriculum for college of education. Three of the students said that the science curriculum was loaded and the other pointed out that *I think the science curriculum has detailed content for me but it could still be improved* said student (i).

Among the three who said the curriculum was loaded, student (ii) and (iii) mentioned that curriculum for science was loaded and did not permit tutors to devote their time to teach them systematic and explained the topics clearly for understanding. Student (iii) added exceptional instance that, *we, student teachers do not learn purposely for our professional teaching, rather we learn for the sake of writing examinations and passing through. Student (i) added, since we are teachers to be, tutors do not usually teach us everything, rather they give us some topics to research and find answers on our own*

4.2.1 Discussions of the science curriculum objectives and contents (document study, tutors and student teachers' views)

The science curriculum revealed that courses have been systematically planned and this was consistent with the views of informants. This was clearly demonstrated in the objectives of contents in each of the courses namely; biology, chemistry and physics. This is in conformity to Woolnough (1994); his opinion on quality teaching demonstrates that a systematic plan of curriculum contributes to effective teaching and learning so that a professional teacher becomes competent in subject matter and use appropriate teaching methods. It suggests that a logical order of the science curriculum may promote quality teaching when tutors are proficient to teach content and methods in a systematic order for students to gain skills and knowledge.

On the other hand, science curriculum shows loading of contents which I noticed not helpful for tutors who are educators and student teachers who are educated to become teachers. The reason is that loading of curriculum content does not give tutors enough time to teach in a step by step way and clarify their lessons goals to their students (Vygotsky, 1986).

On the contrary, the science curriculum has aspects such as biology, chemistry and physics that suggest an overloaded curriculum. But considering the level of scientific knowledge a science teacher may need to teach effectively, then I suggest the curriculum is not overloaded. An on- going professional teacher should be well versed with content and pedagogical knowledge to teach with a clear set goal and logical order to impart knowledge (Copper and McIntyre, 1996, Shulman, 1986).

Copper and McIntyre (1996) argued that when clear goals are set for students learning, it contributes to effective teaching and hence overloading of content is avoided or come to minimal. It means that when tutors really have a fair and clear focus of what is to be taught, the issue of overloaded content could be overcome. This may help tutors to teach what is clearly defined in the content in order to help student in and outside of classroom. Woolnough (1994) suggested, in order to preserve good science teaching, tutors should teach what they are comfortable with and also to involve students in the teaching and learning environment. In relation to Tutor "B" view that the content is enough could imply she is comfortable teaching but probably felt not detailed enough and therefore suggested there should be detailed and relevant information. The other two tutors who maintained the curriculum is overloaded with too low or little above contents and some not relevant might probably just wanted to put blame on the curriculum planners or they do not have strong knowledge in the curriculum content. The issue of overloaded contents was not only mentioned by tutors but students also affirm it. It seems to suggest that, students are educated to be examination oriented but not professional literates as students indicated that tutors gave them topics and they learn on their own to write and pass examination but not to aim at professional competency. It could further imply that tutors do not have time to cover the course contents in the curriculum. This in turn may put much work load on student to finish the curriculum mechanically on their own to pass the examinations.

However, the intention could be to help them cover the content, to get in-depth understanding of the topics given to them, search and study on their own and taking responsibility for professional development. It is important to know how they are guided in teaching for them to build their experience, understanding and knowledge (Vygotsky 1986). This could help them to be competent as they prepare to be professional teachers.

Nevertheless, the knowledge base of newly appointed teachers is very crucial to their professional performance. As a result the curriculum does not seek to lower the knowledge

base of teachers in any way rather it seeks to integrate effectively teacher knowledge with professional performance in order to ensure improvement in teaching and learning (Revised Curriculum, 2014). Therefore, I maintain that the curriculum is not overloaded with as claimed by participants.

It is important that student teachers obtain very good knowledge in content and methodology to be competent in the teaching profession. This is in connection to Freire's assertion; a progressive professional teacher should be knowledgeable in content and methodology (Freire, 2005). The assumption is that tutors should provide the student teachers with broad knowledge and skills in order for them to teach the junior high school learners. Therefore a tutor given some topics for students to research for their answers is laudable as they may equip themselves with knowledge and skills for their profession not just for examination sake.

In conclusion, based on the document study, tutors and student teachers views on the science curriculum, the science curriculum should be revised for better improvement in such a way that, it can properly integrate courses taught in science as well as the methods of teaching science. This could help students to receive the required knowledge and skills to teach science at the junior high school. So that they will not just bear the "tag" professional teachers but they may demonstrate practically their teaching to reflect their profession. This leads to the next presentation to sub-theme integration of courses in science teaching.

4.2.2 Integration of courses in science teaching (tutors and students views)

Integration in this study refers to how the courses in science are described to be interconnected for transfer of knowledge and a more holistic understanding. I found, it was written in the science curriculum that, the curriculum consists of theoretical and practical content.

The findings from tutors revealed that there is no proper integration of science teaching. Tutor "P" and "C" shared similar views. As stated by tutor "P", *In Ghana, most tutors rarely integrate their teaching not even in the teaching of science.* He emphasised that *in practice there is no integration of the teaching of courses taught in science.* He gave a reason that; the courses are structured and described on the surface in the curriculum that, science consists of biology, chemistry and physics aspects.

He gave an example that, chemistry tutor goes to class and teaches his course in isolation without relating his teaching and some example to other aspects like physics or biology. He concluded different tutors teach the courses differently without relating for students to transfer knowledge. However, Tutor "C" added that integration is meant to fuse aspect of courses taught in science into whole but time does not permit tutors to relate teaching of course to each other for transfer of learning. On the other hand, tutor "B" mentioned *we do integration in our teaching but it is not regular* Her reason was the same as tutor "C"; limited time to relate teaching contents.

In different dimension, the study also revealed that the course "methods for teaching science" taught at the college as a methodology course is not detailed on science. Tutors mentioned that the methods are generally taught but not specifically linking to a practical science topics taught at the college. As a result tutor 'P' suggested that *I do not think methods of teaching science should be separated from the content.* He mentioned that practical methods for teaching the various courses in science should be incorporated in the content. Students gave no proper response to integration of course teaching. But one student (ii) briefly mentioned he applies knowledge in science in his daily life.

4.2 3 Discussion on integration of courses in science teaching

Most studies on student teachers' preparation for science teaching recognise the importance of subject –matter and pedagogical content knowledge for quality teaching of science (Abell and Driel, 2010; Abell, 2000) Therefore it is important for tutors not just to obtain the understanding of the subject- matter but also how to teach and help students to transfer knowledge effectively. Tutors should learn to practically engage students in the teaching and learning environment for students to explore their experiences. This coincides with Russell and Martin, (2007) that tutors should value authority of learning from experience.

Also, the curriculum revealed that courses taught in science are integrated such that theoretical and practical component of course blended for transfer of knowledge. However, responses given by tutors on the concept integration of science teaching revealed there is no integration of science teaching yet tutors have different views on integration.

It seems to suggest that tutors have not understood the concept integration well. It may also imply that tutors were just criticising the curriculum as they do not want to be blamed for

their professional duties and limitations. Perhaps how they teach courses in isolation expressed by tutor "P" illustrated that either science tutors have not clearly understood the demands of the curriculum or they lack competence in the course content and the methodology. Based on such premise, Shulman (1987) argued, it is not just sufficient for teacher to understand subject matter but to comprehend and teach subject matter in new ways. For example reorganising and dividing content, give and engage students into activities for understanding. Again, the issue of integration which tutors linked it to inadequate time as hindrance may imply the concept is once again wrongly understood and shifting blame on curriculum planners. This is because an on-going teacher should be able to organise his or her teaching lesson in a clear and systematic order to teach effectively within time framed (Hodson, 2009; Cooper and McIntyre, 1996; Woolnough, 1994). When teacher know what, when and how to teach, they can teach effectively.

As it is clearly stated in the science curriculum, it ensures to integrate effectively "teacher knowledge with professional performance'' (Revised curriculum, 2014 p.5) in order to ensure improvement in teaching and learning. This is in line with Freire (2005), assertion that, professional teacher should be competent in content and methodology to help students for insightful teaching in a learning environment. Science tutors should teach to integrate courses for transfer of experiences. The reason is that learners learn through social interaction and in their environment to (Vygotsky, 1978). This could help students to transfer knowledge in learning situation and relate content taught and experienced in a reflective way.

Furthermore, why tutors teach courses in isolation was concluded as curriculum problem. This is similarly connected to Tobias (1990) studies *on why so many college students turn away from science?* A students sum it up as "the absence of context" (p.59) and the kind of methods use led tutors to teach in isolation and hence not involving students in teaching and learning situation to transfer and relate ideas during learning processes.

The assumption is that, a good science tutor should have clear goals for students (Copper and McIntyre, 1996). When clear goals are set learning may be simpler and interesting for learners and hence teaching, learning process and assessment may not be seen as complex issue in education. This connects the presentation to assessment of courses in science.

4.2 4 Assessment of course in science (Tutors and students views)

In the context of this study, assessment is the process of obtaining information that is used for making decision on students' curricula and educational policy. My study on document from the curriculum revealed that assessment is based on 40% continuous assessment and 60% end-of-semester examination. It is part of the whole programme of learning. Tutors at the college organises internal examination in the form of quiz in every mid -semester for assessment of students which is 40% continuous assessment. Tutor "C" mentioned, continuous assessment is generated from two quizzes that the college organizes for the students in each semester. Furthermore, he emphasized that these organised quizzes done by the college are internal examination which form 40% assessment. The external examination which forms 60% assessment is standardized and organised for all teacher colleges of education by examination body from Institute of Education, University of Cape Coast.

However, when tutors were asked whether they give assignment to students and when and how they do that, all the tutors said, they give students assignments either individual or group and give marks to assessment. Tutor B responded that *I sometimes give them assignment after a topic has been extensively taught.* She mentioned, the assignment is to check how they present orally to their peers and how written text or assignment is done and it is assessed said tutor "C"

Similarly, students also mentioned that their assessment is internal and external examination. Student (i) indicated that the internal examination was based on written and observation during peer teaching practice. Student (ii) elaborated that, during the teaching practice a supervisor assesses how student teach the subject matter. Furthermore, student (iii) revealed, the external consist of written examination and observation teaching experience during off campus examination. Student (iv) concluded *assessment process helps me to know my strength and weakness.*

4.2.5 Discussion on Assessment of Courses in Science

The assessment structure put in place for teacher colleges of education is to evaluate students' internal and external assessment which forms 40% and 60% respectively. It is done to check students' progress and intended to help students to achieve internal continuous assessment to supplement the external marks that a student may obtained at the end of the external (Revised

Curriculum, 2014). However, it is important to note that assessment should not be aimed at students' scores. As indicated in the findings, the assessment is not merely to award marks but to check how students have acquired knowledge and how they demonstrate understanding and proficiency in theoretical content and in methodology (Abell, 2007; Freire, 2005, Loughran, Mulhall and Berry (2004). The assumption is that, it is meant to develop individual physical cognitive and psychosocial in a holistic manner.

In short, the planners hoped that students are assessed throughout the programme in each semester to evaluate how students are getting on with the programme.

4.3 Presentation of inadequate instructional time for teaching (Tutors and students views)

An indicator which was noted as hindrance to quality teaching of science was inadequate time for instruction. Findings of this study indicated that student teachers are taught based on time schedule for the lessons and the study has shown that time for teaching or instructional is not adequate. Below are the views from tutors and student's teachers on the preparation.

Tutors views

Overlapping responses from the tutors revealed that tutors teach student teachers based on time schedule for each course. Tutors said sometimes they cannot perform their duties in totality because the teaching time is limited for teaching and interaction of the courses in science. Tutors mentioned they do not have enough time to perform practical activities for some practical lessons. Notwithstanding, all tutors said students are to write practical examination for each of the courses physics, chemistry and biology in science. They mentioned the examination is paper written practical not real 'hands on' activities because of time issue. Tutors express concern for students to have solid foundation in the theory and the practical. As affirmed by tutor "P" and "C" *there are separate practical examination for each of the courses in science for students but there is no ample time for regular practical work.* They emphasised, during the regular classroom teaching and laboratory lessons the tutors manage to do hands on activities but adequate time has been a challenge. They claim non science subjects like education and general studies done by science students leaves no time for teaching science.

In addition, Tutor "B" and Tutor "C" emphasised that tutors do not necessarily plan for individual students in the class and cater for their differences because of time constrains. They mentioned the inadequate time for instruction could be due to the overloaded curriculum.

Student views

Similarly, all students expressed that time schedule for courses are not sufficient at all. Student (iii) emphasised that especially when the lesson consists of practical work. He explained the practical activity is interesting and engages students' active participation but time is not enough.

4.3.1 Discussion of inadequate instructional time for teaching (Tutors and students views)

Tutors are supposed to carry out practical activities in connection with the teaching of the content. This may help the students to get better understanding of the subject matter and equip them knowledge and skills to teach the junior high school learners. However, limited time for practical work remains a challenge as expressed by participants. It could imply that tutors have not been strategic enough to plan their learning objective clearly to work within a time frame, and attribute it to inadequate time which is caused by other general studies and education course done by science students. Copper and McIntyre (1996) pointed that effective teaching should be guided among many as indicated as clear objective for learning task. This may help teacher to carry out his or her teaching effectively with the learners.

Response from tutor "C" showed that students were normally grouped for activities and assignment. During the group activities, students learn from their colleagues as they collaborate and share ideas. This is what constructivism describe as learners learn as a result of social interaction and active participation (Vygotsky, 1978, Rogoff, 1990). However, tutor "C" referred that limited time schedule for teaching does not permit regular engagement in group activities in the classroom. Meanwhile, when students are grouped to perform a task they bring their individual views and this help other learners within a group to learn and acquire accepted ideas from the group members.

Woolnough (1994) asserted that a good teacher is sympathetic and willing to spend time with their students in and out of science lessons and go extra mile in school work. Therefore tutors

can organise extra practical work after regular college hours in order to help complete learning task better with the students.

In short, inadequate time for students to perform practical activity during examination has brought the implementation of uniform paper practical written examination. It also implies that student teachers are being prepared narrowly to focus on their academic examination but not professional preparation. A prospective professional teacher does not have access to the right and quality time of education. It is important for a learner to practice what he or she learns to become perfect. There is the also need to consider individual differences in teaching profession since there are different ability groups in every learning environment regardless of the limited time.

4.4 Presentation of teaching methods (tutors and student teachers' views)

Tutors and students mentioned that different teaching methods are used depending on the topic to be taught. Basically, there are two approaches: *learner centred and teacher centred approaches*. Some learner centred approaches like practical activity method revealed are presented first before project work as method. This is followed by teacher centred approach.

4.4.1 Learner centred approach: Practical activity method

Learner centred approach means putting students at the centre of their own learning and student get the opportunity to be actively engaged in a task at their own pace. There were two sub- themes found under this approach namely: Practical activity method and project work as methods of teaching.

Tutors views

All tutors 'B' "C" and "P" mentioned *they use activity method*. They added that project work is also used as method of teaching.

When I asked tutors how they use teaching methods to teach science? tutor 'B' cited an instance with the activity oriented method that, *if I want to teach a topic like flowers I can use real object for the learners to identify the various parts of the flower and after that student teachers should be able to draw and label the various parts of flower on their own*

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In an attempt to respond to how tutors use the teaching methods, tutor 'C' explained that, in the case of practical activity method a tutor could demonstrate to learners how particular teaching equipment for a particular task is done. He emphasised, teacher can involve students by engaging them in an activity for individual active participation. In this case the tutor has used another method in addition to what he was using to achieve a specific objective and skills that he wants learners to actually gain at the end of the lesson said tutor 'C'. He further mentioned he did laboratory work which happens to be practical activity method and he explained how he did it:

I did the pre-laboratory discussions with my students. Sometimes how certain solutions, standard solutions or reagents are prepared, I have to also brief them in the course of pre-laboratory discussions. Gave the instructions give them the reagents provide them the necessary teaching learning materials for them to carry on with the activity. said tutor 'C'

He clarified; whiles activity was carried out, he moved round to ensure whether students were focused on the task given them to carry out. When tutors were asked whether they offer practical activities, all the three science tutors responded in the affirmative because each of the courses within science has practical and theoretical component that needs to be taught. He emphasised taking students through activities may help them to understand theoretical concepts practically. This leads the presentation to student teachers' views on practical activity method**.**

Student teachers views

When student teachers were asked whether they do practical activity in science, Student (ii) responded that *sometimes we do it but it depends on the topics or practical topics we have for the semester.* He explained, this is because the practical topics for the semesters lead us to practical activities, for example if topics are not practically demanding, tutors try to use diagrammatical representation in order to help students to see how the thing looks like and also to understand topics clearly, said student (ii).

On the other hand, he mentioned the ones that were difficult and require practical activities, for example dissection of animals. *We did it and used a life rabbit where we exhibited and dissected it. We went through the process and everything was clear to understand* said students (ii) He emphasised that it depends on the practical work that will be done for a semester. All students affirmed that *we do not often do practical activities.* However, for

some topics like acids base and salts which demands practical activities for better understanding, *tutors send us to the laboratory and make sure practical work is carried out* said student (iii). He maintained that for practical topics like 'diffusion' which is not tedious because it is something that they already have experienced and exposed to at home; it was enough with simple examples said student (iii).

In different view, student (iv) mentioned that regardless of how familiar a topic could be, tutors did their possible best to perform some practical activities on the topic to be taught said students (iv). However, she pointed out that sometimes time constraints do not allow some tutors to do practical activities on some practical topics.

Student (iii) added that whenever time permits them to do practical work she observe carefully and have a feel of the actual concept learned and better understanding.

4.4.2 Discussions of learner centred: practical activity method (tutors and student teachers views)

The views from tutors and student teachers have shown that tutors do not only use a particular teaching method during teaching and learning process, but also, they use different methods depending on the topic to be taught. Freire (2005) mentioned the need for professional teacher to use variety of methods in their teaching and ability to combine content and methodology to help in the classroom situation is emphasised. This means that there is no one absolute method to rely on during teaching. Similarly, Copper and McIntyre (1996) on quality and effective teaching of science is seen in how teachers make use of different teaching methods and organise their teaching objectives clear and systematic to help students. In this study tutors and student teachers have shared views that there is no single method used to teach and the use of teaching method is dependent on the topic. However, science is practical in nature and as a result requires practical activities.

Wellingtons (1998) summarised on practical work and pointed that, practical work can improve learners' understanding and promote their conceptual development by visualising the principle and theories of science. This implies practical activities could illustrate, verify and affirm theoretical work as things could be clearly observed. He maintained that, it makes teaching and learning interesting and motivating hence helps learners to remember things learnt. This may help learners to learn best by doing and that they will always remember and

transfer learning (Hodson, 1998, Bruner and Wood, 1976). Therefore, tutors' only demonstrating for learners to observe is not enough for practical activity which will help students understanding but rather tutors allowing students themselves to also perform their own activities on a given task is the best way of engaging them for better understanding.

This study agrees with Wellington's summary, as findings have shown that practical work make teaching and learning of science more interesting, lovely, real and enthusiastic for student teachers. This is because students mentioned practical work give them the opportunity to feel and see things clearly as they get themselves involved during teaching activities. It in turn enables them to have better understanding because through that they acquire knowledge and build their experiences constructively (Vygotsky 1986). However, practical activities require ample time and the nature of the curriculum does not provide tutors enough time to conduct practical very often as findings revealed becomes a constraint. The study has shown that teaching science using a particular method for example lecture alone cannot arouse students' interest to make lesson interesting and understandable for individual students.

Consequently, using a single method may tend to exclude some students with different potential group for example intellectual developmental difficulty learners from teaching and learning process. This in turn may limit their rights to having quality teaching experience and hence hinder their potentials. The reason is that learners with intellectual developmental difficulties have challenges to understand abstract concepts, for instance those with severe learning disabilities do not have abstract thinking. They understand using concrete materials, samples of objects, and enjoy and love being in groups for activities. Therefore, they may be encouraged to be with other learners in group activities as these learners can be helped during practical and concrete activities. This may help them to gradually learn to fill the gap in their learning skills.

In short, the findings revealed and summarised that when topics to be taught demands practical activities, tutors do it, however time allotted for a lesson is not enough hence it is a challenge and hinder quality and effective practical activities during teaching and learning process.

4.4.3 Presentation of learner centred approach: Project work

Another learner centred approach which tutors at the college used was the project work as method of teaching students science Tutors views are presented first followed by student teachers views.

Tutors views

All the tutors revealed students in their final year offer project work before they finally graduate from the college. Overlapping statement from tutors indicated each student identifies a problem in a classroom, designs research problem and finally comes out with intervention(s).

In a different way, tutor "C" gave a singular clarification that with the project work, a tutor could mention a topic that might involve some process and allowed students to search for information with little direction from tutors. He gave an example that when he wanted to teach preparation of indicators, he gave students the summary of the processes involved in carrying out this particular project. He explained as the students undertook the project, sometime he observed or supervised them critically to ensure that they actually worked to achieve the intended objective for the study.

Tutor "C" drew attention to the fact that tutors prepare the students especially in their final year level to be able to design specific science equipment known as improvisation. Sometimes, too a tutor can assist students to prepare a solution or improvise a solution. For instance, acid and base and indicators too can be improvised. All tutors explained that the project work could be group based or individual based. Tutor "P" indicated that project work is a very essential method of teaching that engages students holistically and most often used when student teachers are in the final year. He however mentioned it could be used even in the first and second year but time limit could not allow that. He gave reason that for the final years they are sent out for internship- off campus teaching practice and they identify a situation or problem in a classroom and design solution to the problem.

Tutor "C" concluded that the project work as a method of teaching was intended to enable student teachers to find a better way of identifying a learning difficulty in a classroom, using

appropriate teaching method and also providing better assistance for learners with intellectual developmental difficulties. The next is student teachers views.

Student teachers views

Students revealed they do project work which may help them to critically think, explore and discover a lot of things themselves them in their profession. All the four students shared similar views that they identify problem and come out with solution. They indicated that with the project work they are tasked to identify a problem in a learning environment and find solution. One of the students mentioned that tutor "C" gave them task which was intended for project work after a visit to the dam.

4.4.4 Discussion of Learner centred: project work (tutors and students teachers)

Findings described under this heading project work, involve practical work, for example the issue of tutors moving round the classroom or project work room may look unethical to others. However, it is the duty of a progressive tutor to ensure that students are really performing the task as guided. Task given to students are project work, it is purely student centred being guided by a tutor. However, it is the duty of the tutor to come in when it becomes necessary to support them. There could be an assumption that the supervision done by tutors during project work as a method of teaching might in a way seems non –professional because the idea is to help students to acquire , process and build their own new knowledge(Vygotsky, 1978). The rational for tutors' supervision was to ensure that students take their responsibility and respective project work seriously to acquire knowledge of their own.

Constructivism, which has its foundation in the ideas of Jean Piaget, takes the point of view that individuals actively construct the knowledge they possess. This construction of knowledge is a life-long, process that requires significant mental engagement by the learners (Reusser and Paul, 2015) Therefore students could interact with the available tools and materials in their environment and use them to solve problem.

In this study, students could use the natural materials available or improvise materials and equipment within the local environment to solve problem. In this respect tutors were helping

students to take rights in participation of teaching and learning of science to explore in the learning environment and solve situations. Despite the limited time allotted for science courses, sometimes students gained the opportunity to participate in different teaching methods. Partly, their right to access and participation in teaching methods was hindered. Therefore, the issue of inadequate time remains a challenge as far as the right to full participation in preparation of students is concerned.

Contrarily to Wilhite and Jaja (2011) the teaching methods most teachers use sometimes deny some students active participation. This study has proven that, students' rights to access in science education and participation in different methods may equip student teachers to be independent as they identify, design plan, and find solution to a problem. This is in line with wellington (1998) assertion that any science practical work should aimed at problem solving.

4.4.5 Presentation of teacher centred approach: lecture and demonstration methods (Tutors and students views)

Teacher centred approach is the process of teaching instruction where by tutor controls what is taught and leads the students during instruction. Lecture and demonstration done by tutors were noted to be teacher centred approach. In this aspect the lecture and the demonstration methods are presented together since the demonstration method is used to clearly explain some theoretical concepts which tutors use lecture method to teach. The demonstration done by tutors is sometime used to supplement lecture method to enhance students' understanding. Tutors views are presented first followed by students' views.

Tutors views

Tutors mentioned that lecture method is most often used during teaching and it appeared to be the most dominated teaching method. However, all the three science tutors mentioned that a tutor or lecturer could not only use one particular method. One of the tutors explained that because sometimes the method that dominates may not be able to help all students to understand a concept being taught. Therefore tutors could use other methods for instance, teaching the topic *acid, base and salts* are purely taught using lecture method with little practical work on them said tutor "C". He argued different methods other than teacher centred may help students to understand how some chemical components were formed and in effect makes teaching become clear and understandable.

Considering the use of demonstration, tutor "B" mentioned tutors can teach to engage students' participation when they demonstrate a lesson to student and allow students to also demonstrate on their own. She indicated that depending on a topic to be taught a tutor could demonstrate it to the large class and could group learners to demonstrate. She said a tutor who would teach types of fruit would prefer to use real object for all students to understand.

On the other hand Tutor "P" added that sometimes tutors offer demonstration to the whole class where by individual student does not have access to demonstrate due to inadequate teaching equipment.

Coherently, Tutor "P" explained how he demonstrated on the topic "Heat" that is:

>*teaching heat can be done by first taking two similar containers, fetch quantity of water into one and the other be filled with alcohol. The liquids in two separate containers are of the same volume. Then I set a thermometer into each container, heat them at the same time and stop heating at the same time and after that students check the temperature in each of the liquids.*

Furthermore, he explained that the definition of heat was based on 1kilogram mass of substance by 1 calorie. He said that after the liquids had been heated, temperature was taken and recorded. The different temperatures were noted and students could see the temperature in the two different liquids which showed that two different liquids had different temperatures after heating them. He concluded that a lot of demonstrations have been done for the students to visualise real things and apply them in their daily activities.

Student teachers views

Overlapping statement from the four students revealed that most of the time, tutors used lecture method. Students mentioned in most cases demonstration done by only tutors occurred due to time constraints. However, sometimes students could easily practice demonstration done by tutors. In demonstration, I probed students to describe a method carried out on the topic *"diffusion".* Student (ii) described how he could use potassium permanganate or improvises using similar local substitute of potassium permanganate like "*Abidjan blue"* that is a blue which is in cube or block form. He explained that the *Abidjan blue* in a block form could be taken and put into water. It would change from block form as it was mixed with water. Student (ii) elaborated that diffusion occurred by moving the block which was of higher concentration to a liquid form which was of a lower concentration.

Student (i) also added diffusion could be demonstrated by using a scented material like a spray. She said it could be sprayed in one corner of the classroom whilst all students were also gathered in another corner. She said learners would later be asked about their experience in the classroom whether they smelt the scent of the spray or not after the spray had been poured. The above explanation could be demonstrated as diffusion said student (i).

4.4.6 Discussion of teacher centred- lecture and demonstration methods (tutors and student teachers view)

The study has identified that using lecture method alone may not help students active involvement. The reason was that it did not allow student to contribute and hence made tutors dominate the lesson taught.

Considering tutors views, tutor "C" indicated that teaching the topic "*acid, base and salts*" were purely lecture lesson with little student participation. He mentioned that due to limited time, practical work could not be carried out on the topic. Similarly, tutor "P" revealed that the lecture method was often used due to the limited time schedule and over loaded course content. He emphasised that most of the time tutors used the lecture method to cover the course outline. If tutors only used lecture method in teaching science most of the time, then they are not educating student teachers who are reflective. The reason is that the lecture method may restrict students' participation and they become narrow minded since they only receive and store without sharing and processing ideas obtained.

I argue that the narrowed approach like lecture method or demonstration only done by tutors inhibits student teachers potentials and efforts and hence fails to promote their full right in professional development and quality teaching in science. Teaching should aim at assisting students to reflect on the content practically. It is a view of knowledge which is socially constructed rather than certain (Reusser and Pauli, 2015; Liston, 1987).

Woolnough (1994) argues that teachers' knowledge is based on how they are prepared to acquire knowledge. It implies that teachers' competency is determined by how they are taught to receive knowledge. Therefore if the education given to student teachers does not introduce them to view knowledge as situation which is socially constructed rather than objective, (Liston, 1987) they may not be reflexive and practically reason.

However, tutors who use demonstration method done by tutors and students to support lecture delivery, has proven to be useful for students to experience teaching and learning in real terms. Though not all students have the chance to demonstrate individually, some of them get the opportunity to engage themselves in the activities as they visualise and manipulate objects of material under studying (Millar, 2004; 2006). When tutors demonstrate a concept to a class and students also get the opportunity to demonstrate, it stimulates their interest to learn and build up experiences. The assumption is that the use of real object for demonstration method which is done by tutors and students makes teaching and learning more practical, lively, clearly and understandable to all learners with different potential.

Tutors use demonstration method to clarify and substantiate other teaching methods like lecture method which may present some topics abstractly. Freire (2000) argued that when teachers usually narrate teaching, it leads students to memorise content being filled. This in turn can make students to be "containers" filled by teacher. Freire refers this as "banking" (p.72). Thus, a concept used in education where students only receive, store and produce the deposits without processing the knowledge gain. Social constructivism argues that learning is social process that occurs when individuals take active part of social activity. It points to suggest that learning must seek to allow learners participation to help them to acquire and build up knowledge of their own. In this study, the least chance students had the time to practice demonstration done by tutors and students themselves was noted helpful. However, the study has argued that demonstration done by tutors only without given opportunity for students to practice and interact with learning materials are discouraged. The demonstration method done by both tutors and students helped and made teaching and learning practical as learners were exposed to the real objects and experienced the concept they were taught. This may enable learners to relate and transfer knowledge to related concepts within the environment. To conclude, teaching is exchange of ideas therefore tutors should teach to involve all students. So that it may help learners to transfer learning an example is a student used *Abidjan blue* to demonstrated how diffusion could occur using improvised materials or similar material to improvised or explain a concept.

4.5 Presentation of teaching practice: Peer teaching and off campus teaching (tutors and student teachers' views)

This theme shows how tutors prepare student teachers to teach science at the junior high school. The aspect presents how tutors prepare them and when and how to practise peer teaching and off campus teaching practice as well as what goes into it.

Tutors views

All the three science tutors said, as part of the programme, students are mandated to take part in teaching practice

They explained that the teaching practice constitute peer teaching practice which is done on the campus and off campus teaching practice. Students practise teaching in the second year before they are finally posted to their station after the three-year programme.

All the tutors mentioned that, peer teaching help students to learn how to prepare a lesson and teach. Tutor "C" clarified that each science student teaches a topic in science to their peers. A supervisor who is a science tutor observes a science topic taught by a student and gives score and final comments. He cited an example that, a science tutor would be invited to observe, make input and discusses issues with the student who had finished teaching any science topic.

Tutor "P" also mentioned, *we also conduct this peer teaching with students to check whether they are really making appropriate use of the different teaching methods they receive from us in their teaching* said tutor "P".

Student teachers views

Similarly, student teachers revealed that, they practise peer teaching. Peer teaching is done on campus where student teachers teach their colleagues for them to be evaluated. The supervisor evaluated the students based on their strength and weakness in teaching.

 Student (i) said *I exhibit my talent and skill doing peer teaching.* Student (ii) explained that any time he was given the platform to teach a demonstrational lesson on a given topic, it prepared and gave him the confidence to teach the learners during peer teaching. He indicated *I see the relevance of the teaching methods my tutors have been using to stimulate me is helpful* Students (ii) emphasised that the tutors stimulate students to do things on their own

which makes them competent and confidence. All students have realised that peer teaching is good and helpful in their preparation.

4.5.1 Discussion of teaching practice- peer teaching and off campus teaching practice

The college`s organization of teaching practice is to equip student teachers not only with content knowledge but also methodology for teaching and learning moral values. This is in line with the study conducted by Vasay (2010) expressed that peer teaching is a technique that has great influence on students intellectual and moral values like ability to share views and express ideas within a group. Teaching practice may help student to gain confidence, mastery of different concepts and communicate effectively to others.

The aspect of the practice where supervisors provide feedback meant to help students to improve their teaching. The most important aspect of the feedback and comment is that it encourages student teachers to improve on their skills. Therefore supervisors first of all commend each student of his or her strengths and also the weaknesses.

In the nut shell, it was noted that students were assessed on how to use available resources to teach a lesson during peer teaching and off campus teaching practice. The evaluation marks for the practice are recorded on a well- designed assessment score sheet with the criteria of evaluation on it.

In summary, peer teaching is organised for student teachers to equip them with the necessary teaching methods, skills, knowledge and how they can combine content and methodology in the teaching and learning of science. This coincides with Shulman (1987 p. 15) that the "knowledge base of teaching lies at the intersection of pedagogy and content". This may enhance understanding and application of knowledge.

4.6 Presentation of teaching learning materials and equipment (tutors and student teachers view

Teaching learning materials used in this study is the learning aids like chart, models and pictures that tutors use to support teaching methods during teaching and learning process. Equipment are the instruments used to conduct practical activities during teaching and learning of science, for example specimens, beams, solutions of acid and base and computers. Participants revealed that teaching learning materials and equipment were inadequate.

4.6.1 Inadequate teaching learning materials and equipment

Inadequate teaching learning materials and equipment are poor and insufficient availability and use of teaching and learning aids and instrument to support teaching and learning. Findings revealed that there were insufficient teaching learning materials and equipment.

Tutors views

Tutors revealed that sometimes there was no equipment at all to carry out some practical activities. An empirical example is that, tutor "P" taught the topic *Sound* with the sub topic "longitudinal and transverse waves". He needed to demonstrate how longitudinal and transvers waves occur for students to get the deeper understanding. He emphasised that because of inadequate equipment for teaching and learning, he borrowed some equipment from Kwame Nkrumah University of Science and Technology (KNUST) for practical demonstration and for realistic teaching to help students visualize and understand concepts clearly. Also, he added when he taught calorimeter he talked about heating an object. He indicated, to carry out this activity there was a need to get stirrer, thermometer, metal, thermometry and at the end of the lesson students were grouped for activity work due to inadequate teaching and learning equipment. See figure 1 below showing virtually empty laboratory

In a different way, Tutor "C" mentioned that, tutors did their possible best to teach the student teachers how they could have improvised certain common teaching materials and equipment like "beaker" for measuring substances.

Contrarily, tutor "B" mentioned that it was not only inadequate teaching and learning materials that make them to group the students during teaching and learning process rather they group students for collaborative learning and it encourages individual students to participate actively in the teaching and learning processes.

Student teachers views

All the four students' shared similar view the college has laboratory but they are not well stock with needed materials and equipment for practical work. Student (i) revealed that at the science laboratory most of the materials and the equipment are outmoded and of no use at the laboratory. Student (ii) gave an instant that at the physics laboratory there is virtually nothing and the tutors most of the time borrow from the nearby university for practical activity.

4.6.2 Discussion of teaching learning materials and equipment (tutors and students teachers)

Many research studies on science and development of education in African and across world have revealed inadequate material and equipment as a challenge. The studies indicated that most schools and colleges particularly in Africa have inadequate materials and equipment (Geo-Jaja, 2013; Babaci-Wilhite and Geo –Jaja, 2011; Hodson, 2007; Addae- Mensah, 2000).

This current study has found similar prove from the findings from the participants views and picture illustrated laboratory without furnished laboratory materials and equipment for practical work. Addae Mensah (2000) noted that most urban schools and colleges are better resourced with respect to facilities and equipment for science. Surprisingly, findings in this present study proved otherwise since it was conducted in the second largest National City which is site of attraction. The millennium developmental goal 6 has failed to meet its target for ensuring quality education. This is because instruction materials and equipment is an aspect to support and enhance quality. Therefore if student do not have access and full right in using materials and equipment consistently for practical work then their rights in quality teaching and professional development in science education is hindered.

However, the efforts of tutors made to support students in teaching and learning process especially in the practical activity work shows example of being progressive enthusiastic professional tutors. Tutor "P"'s passion for using his own car as teaching equipment and also

going outside the college to KNUST to borrow practical equipment also showed a practical example of a well professional tutor. This is what Osborne (1990) describes as enthusiastic teacher who not only has a good spread of the subject matter, but also show subject loyalty by going extra mile using her own resources to help meet the learning needs of the students.

Alternatively, findings of inadequate teaching learning materials and equipment in a way contributed to group activities as students may not likely received individual material and equipment to work individually sometimes. However, grouping students during learning of science benefited most students as they had the opportunity to interact and shared views among themselves in the group. Wellington (1998) asserted teaching and learning of science should give students the opportunity to explore and solve problem. Student teachers were taught how to make some common aids and equipment. They were taught to help them to transfer the knowledge gain to prepare some of the teaching aids and equipment for use when there were no readily available materials to teach the learners at the junior high school level. Woolnough (1994) mentioned that a good teacher is willing and sympathetic to spend enough time with his or her students to help them for understanding.

4.7 General statements on the preparation for teaching science (Tutors and student teachers' views)

As mentioned earlier, apart from the four main themes which were identified as the means through which students are prepared to teach science, tutors and students revealed some general statements on the whole preparation.

Tutors views

When I asked the tutors how they prepare students to teach science in general, all tutors of agree that lecture method is mostly used however, they combine with any other methods like demonstration. Similarly, tutor "C" quoted that *I do not use single method to teach likewise other tutors.* However he added the lecture method is often used but most of the time combined with other methods said tutor "C". Tutor "P" indicated, *if I see that lecture method is not making my students to understand a topic then I realise the need to change the method and probably use demonstration to enhance understanding* said tutor "P". He added, he

discusses with the students and through the discussion they can come out with definition and illustration of equations are formed.

Furthermore, tutor 'B' also explained that though the teaching methods to be used have been stated raw in the curriculum, it is the responsibility of tutors to select and use appropriate method for a topic to be taught. She clarified that depending on a topic to be taught, for example if a topic requires demonstration method a tutor can demonstrate it to the large class and can group students to demonstrate.

Student teachers views

Students mentioned that they use lecture method but this is supplemented by other teaching methods. Students (i) mentioned that *the tutors prepare me by introducing the various methods of teaching science at junior high school which will help equip me with skills and knowledge to teach the learners.* Student (ii) also explained that *since I will be teaching at the junior high school; my tutors teach me how to use teaching learning material (TLM) in presentation.* He said that, tutors told them how to manage a class to bring about effective and co-operative teaching among students and the teachers. Student (iii) added that she was taught about how to get the attention of every learner in a class.

Furthermore, when student teachers were asked; do you feel prepared to teach science? Student (i) responded that, *as for me I am 85 percent prepared to teach the theoretical content in science. However, I am not fully prepared when it comes to practical.*

Interestingly, student (ii) added, *I am well prepared to teach science, because it is lovely carrying out activities in science, illustrating diagrammatical representations of some topic instead of doing experiment. Sometimes one must use drawing for illustration.* He emphasised he was not claiming to be 100 percent prepared in all but the fact is that he has the interest, confident and enthusiasm to teach science at the junior high school level said student (ii).

4.7.1 Discussions of general statements (tutors and student teachers' views)

The idea of tutors not using a single teaching method as revealed by tutors and students is a good example of a well-qualified professional teacher. This is in line with Woolnough (1994) assertion that good teaching is characterised by enthusiastic professional teacher who is able to use variety of teaching methods as well as relating his or her teaching to the learning context.

One reason tutors were not encouraged to use a particular method like lecture method for teaching could be the fact that every class represents different individuals with different learning ability level. In the case of learners with developmental difficulties, most of such learners have poor memory, and cannot recall what is taught (Kirk, Gallagher, Coleman and Anastasiow, 2012). As a result, using lecture method to dominate teaching may not benefit all students because they have different absorption rate. Therefore tutors could use practical method to engage all students in an activity for them to acquire experiences, skills and enjoy the lesson. There is an assumption that the way tutors teach have influence on students' preparation. For this premise, practical method that seeks to engage all learners in teaching science lessons is encouraged in this study. The reason has been proven to promote students critical thinking and reflections in solving problem (Russell and martin, 2007, Millar 2004). However time constraints could not permit regular practical ways of teaching science in this study. This had impeded student teachers learning and acquisition of knowledge and skills. Rogoff (1990) asserted that learning is seen as process of participation in socially organised practices through which skills are developed by the students as they engage in apprenticeship.

In different dimension, the use of different ways to preparing students is accorded in the right to quality education which is aimed at benefiting all students in the teaching and learning process. This could help student teachers to learn and understand that there are individual differences in every class and that they may know how to treat individual differences when they become teachers in the teaching classroom. It was noted to be interesting and worth wise for students to be educated on how to manage a class by taking care of every individual with their differences.

When students were asked how they feel regarding their preparation to teach, all students revealed that they feel well prepared to teach science. However, the degree of confidence in the preparation varied. The view of one student (ii) revealed that he feels prepared to teach

science and expressed how lovely it was to carry out activities in the science courses, for instance illustration of diagrammatical representations of some of the topic instead of doing experiment. The enthusiasm that student (ii) expressed confirms Woolnough assertion on quality of professional science teacher. There is an assumption that the use of illustrations and diagrammatical representations arouse and make students understand lessons better. The reason is that learners learn best through visual cues (Vygotsky, 1986).

On the other hand, student (i) feels prepared to teach science content. However, she was not completely sure to carry out some of the practical aspects of science. This seemed to suggest that there was indeed inadequate preparation on practical activities to equip students to be well versed in the content and practical. Again, could imply that tutors were not able to blend theoretical content and practical content properly in teaching. This contradict with Freire (2005; and Woolnough 1994) views on teaching. This is because a well- qualified professional should be versatile to combine theory and methods (Freire 2005, Woolnough 1994).

In constructionist theorist engaging students in the teaching and learning help students to explore and think critically to come out with new knowledge. Learners, have experience before entering classroom, therefore facilitators given individual learner the opportunity to ask, answer and discuss can arouse their interest and hence may sharpen their weakness and potential.

In conclusion, use of variety of means to prepare students which provide quality teaching and full rights in participating in the teaching and learning of science for all students is the one that this study encouraged. In connection to this study, findings have revealed that sometimes tutors group students into small groups during teaching and learning for student teachers to share ideas with their colleagues. Contrarily, thus when I asked tutors whether they differentiate lessons for learners with different ability group in a class, finding showed that there were no such practice. Tutors mentioned there was no time to plan individual lesson for students with special needs. However, tutor "P" mentioned that when he finds that some students have difficulties to understand concept or topic taught, he rather change teaching method and take his time in teaching. Otherwise after the lesson, he could ask other capable students to help those with difficulties. The assumption is that students learn best with their peers. This coincide with Vygotsky (1978) view that learners learn through social interaction

with experienced adult or more capable peers. This leads the presentation to observational data.

4.8 Presentation of observational data

My personal study on the curriculum is in conformity with participants views. As I observed from the curriculum, the planners have written that the curriculum have been made to avoid overloading. The description of the curriculum seems to contradict the scene. The reason is that findings from tutors and students have shown that the curriculum is overloaded and that not all topics are even taught by tutors. Students covered some of the topic themselves in order to complete the curriculum for each semester

A classroom observation affirmed how tutor "B" used different teaching methods to teach a topic called *ecological equipment*. Tutor "B" used for example question and answer to introduce the lesson. She gave a lecture on the topic *ecological equipment* and used demonstration methods in class. She showed some of the equipment like the thermometers, passed them round and asked students to discuss the difference between clinical thermometer and laboratory thermometer.

On the other hand tutor "C" taught lesson on a topic *acid base and salt* without practical activity for better understanding of the concepts. He did not perform any activity on the topic and attributed it to inadequate time. As I observed a lesson delivered by tutor "C" no practical activity in his lecture was done during the classroom observation.

4.8.1 Discussion of observation data

Observation from the curriculum objective and content revealed that science courses taught at the college ensures that student teachers are prepared to acquire knowledge, skills, understanding and application of the concepts. The content which is designed in theory and practical is not clearly defined and explained as to how they can be carried out.

Tutors use of different teaching methods is a good example of how graduate professional teachers do in performing their duties. This coincides with Meyers and Fouts (1992) assertion that professional teacher can be seen in the use of variety teaching methods to help bring the best in students. Also, the use varied methods may help every individual learner in teaching

and learning process to help achieve intended learning skills and objectives. In a common place of teaching, teachers should serve as modest to assist students in teaching and learning science Liston, 1987. Therefore it is important for tutors to do their best to carry out practical activities which aim at engaging student teachers full right in participation for individual person experience. Tutor "B" who could not carried out practical work on the acid base reaction might have no strong foundation in chemical reactions or there could be materials to teach it. Kaya and Began, (2011), identified that rate of reaction is abstract chemical topic which is relevant in other fundamental concepts.

However, the use of teaching learning materials and equipment helped, supported and clarified teaching concepts to students were not enough to be shared among individual. After tutors had finished demonstration on a topic, not all individual students got access to the equipment for one on one activity. Education is meant to help individual to be independent in thinking and solving problem. Therefore considering the practical nature of science, it is important that tutors create time and allow individual to perform demonstration done by students not tutors only for students to get the real exposure on whatever practical activities found in a lesson.

On the other hand, when there was somehow enough teaching learning materials (TLM) of real object like any type of fruit, time schedule for teaching may not allow each student in the class to feel touch and perform the intended goal in a lesson.

4.9 Summary

The chapter has presented and discussed the findings on how students are prepared at the college of education to teach science. The findings obtained for this study were organised into four main themes: *science curriculum*, *time for instruction*, *teaching methods and teaching practice* and finally *teaching learning materials and equipment*.

There were common general statements made by informants on the whole student teachers' preparation for teaching science. The four themes were identified as medium for preparation of students at the college of education to teach science at the junior high schools. However, there were some issues with the themes which hinder quality teaching.

5 Summary of Key Findings, Conclusion and Recommendation

The study intended to explore and investigate teaching methods with focus on practical teaching. Practical teaching is the one that engages students in learning environment and relate learning to life situations and experiences. This may help student teachers to develop conceptual understanding in the preparation of student teachers to teach science at the junior high school. The chapter provides the summary of key findings from the data collected and analysed. Conclusion is made and recommendation is presented on what needs to be done to promote quality teaching of science and suggests practical ways for future consideration and further studies.

5.1 Summary of key findings

The key findings were centred on four main themes:

1. Science curriculum
2. Inadequate time for instruction
3A   Teaching methods used by tutors
3B   Teaching practice: peer teaching and off campus teaching done by students
4   Teaching learning materials and equipment

1. The science curriculum consists of three main courses: biology, chemistry and physics. The study of the curriculum has revealed that curriculum planners have clear general and specific objectives and key features of the curriculum. There was one common objective which, runs through all the three courses: acquire skills, knowledge and understanding of concepts

This common objective runs through all the three courses taught in science. Also, I found that there was a systematic plan for different topics and sub-topics within each of the three courses in science curriculum. The curriculum planners have stated that, the curriculum in general is made to avoid overloading. However, Informants revealed that the content in each of the courses taught in science was overloaded. Therefore in this study, overloaded curriculum is one of the major findings which served as hindrance to quality preparation of student teachers at the college of education. If the curriculum is overloaded and too detailed it leaves no place for adjustments in accordance to students' interests, experiences and needs.

Tutors and students noted that the overloaded contents do not allow tutors to take their time and teach systematically. Tutors eventually mentioned that they do not often plan their lesson systematically and logically to teach. When curriculum is overloaded and lesson are not systematically planned, it may not give the students full rights to learning in science as tutor rush them through during teaching. The study revealed that the tutors` intention of rushing through curriculum was to manage and complete it without considering students interest, understanding and to meet the needs of students.

Based on tutors' and students' views, it could be mentioned that the reason why most tutors are constrained with time could probably be inferred from the overloaded curriculum. The study has found that the curriculum influences preparation of student teachers. A teacher may require in-depth relevant knowledge to teach effectively. Therefore I think the curriculum is not overloaded however, planners should revise it by working on any content which seems not to be very relevant to benefit students' academic and professional development.

2. Throughout the analysis of the study, an indicator which was also noted as hindrance to quality teaching of science is inadequate time for instruction. This could be due to the issue of overloaded curriculum as claimed by participants. From my experiences, it could be mentioned that the overloaded curriculum might have led to inadequate time schedule for teaching. Tutors could not have enough time to perform practical activities for some practical lessons for students to learn. This was due to inadequate time schedule for science which may be rooted from other education and professional courses on science teaching plan which makes curriculum seems overloaded to participants but they are relevant for teachers professional development.

3. With respect to teaching methods, teacher-centred approach which may not engage students in learning was found not to be encouraged because it does not seek students' interest and understanding. This approach may condition students to be just "containers" filled by tutors (Freire, 2000, 1995). The reason is that students only become recipient and of content stored and produced the deposits. Therefore, learner centred approach, which engages students contributed active students' participation and understanding. Particularly, practical work activities were explorative and encouraged students' active participation, interest and confidence in active learning. Therefore in this study, emphasis was placed on learner centred approach emphasising the practical activities.

Teaching practice: peer teaching and off campus teaching was also found to be one of the ways through which student teachers were educated to become teachers. It was noted to be helpful as it enabled students to master courage and build their confident level in teaching science. However time was somehow a challenge for students to fully demonstrate enough skills about what they have acquired during the teaching practice: both peer teaching and off campus teaching practice. Time scheduled for their practicing and regular lecture periods were inadequate.

4. Last but not the least, this study has also found that teaching learning materials and equipment were noted to have contributed to quality teaching in the preparation of students to teach science. However, inadequate teaching learning materials and equipment were noted to impede and influence quality teaching and better understanding of concepts.

5.2 Conclusion

Teaching methods for science is a subject of concern in many countries as some studies have revealed that most teachers teach poorly (Global Development, 2014). As a result there is emphasis on science education across the world.

In attempt to show the essence of practical work in the preparation of student teachers education to teach science, I argued that practical activity can improve students understanding and conceptual development in science. With practical method, teaching is done and related to life experiences for transfer of learning and understanding. Therefore, it is important for a tutor to understand and apply the content knowledge and find different procedures of teaching the subject matter. It may help student teachers to obtain different information and skills to process and apply the knowledge acquired in life situations and teaching learners at junior high school.

There is indication that practical activity welcomes students' participation which is a way of enhancing students' interest and understanding. On the other hand science could be seen as challenging when content and pedagogy are not open to learner centred activity. This agrees with Abell and Driel (2010) that, it is important for science teachers to understand what and how science could be interesting and challenging for students. This suggests how tutors could educate enthusiastic student teachers who are aware of how challenging science is and yet interested in studying and teaching science.

Finally, the study has identified that enthusiastic student teachers actively seek to find means to build and expand their knowledge for new skills, ideas and different ways to teach. Therefore to attain quality teaching of science, tutors may need to plan their lessons in a logical order to teach effectively. They should teach in a manner that would involve, engage and promote students experience and relate teaching to practical life situations for better understanding. I conclude that tutors should plan and create time to engage students in practical activity after theoretical content teaching in order to help enhance students' interest and understanding rather than shifting blame on curriculum developers.

5.3 Recommendations

Education is the fundamental right for everyone as enshrined in universal declaration of human right (1948). It is one of the keys to development in the lives of individuals and a nation. In this context science teacher education is one of the most important programmes for individuals and national advancement.

From my experiences in this study, I would like to suggest the following recommendation which may help improve tutors teaching, preparation and how best they can educate student teachers to become competent in the teaching profession.

I strongly recommend that some tutors who are technically qualified professional and are on the job should be included in the curriculum planning rather than only authorities who are not on the job to design the curriculum. When tutors who are technically qualified and teach the science course have the right to curriculum planning, they may help and consider including students interest in the curriculum planning. The reason is that they are facilitators for students, familiar with their strength, interest and differences and can contribute to make vital effort in planning the curriculum. Also the tutors may ensure that the curriculum is not overloaded since they know the challenges that arise from the prescribed curriculum.

Furthermore, I recommend that college authorities should recruit tutors who have broad knowledge and are experts in all the courses taught in science and have specialisation in their field. This would enable tutors to integrate teaching of the courses in science, for example by transferring the knowledge gained in biology and relate it to chemistry or physics to enhance students understanding. This coincides in Copper and McIntyre (1996) that science teachers should be expertise in the courses in science and have specialisation.

Therefore, science tutors should not have knowledge in only one of the courses but rather have fair knowledge in all the subjects (courses) for subject integration.

In addition to that, I suggest that what could be done for quality teaching in science is not only recruiting expert tutors in science but also recruiting enthusiastic and knowledgeable tutors who can go extra mile and do subject- integration for transfer of knowledge. Also, I recommend that the curriculum should be revised at least every two years to minimise overload of content which leaves no room for instructional time. This must be done by the curriculum planners in cooperation with the tutors who teach. The reason is that every successful teaching should follow a plan and systematic lesson delivery.

With respect to teaching methods, I recommend that tutors and teachers should put structures in place not only at the college of education but also at the junior high school (JHS). This may help enable tutors at the colleges and students teachers who would become teachers at the JHS to effectively carry out practical work. This would require that tutors at the college should be critical in their teaching; knowing how individual students learn and try to encourage and engage them in variety of teachings methods. This may help build the interest and potentials of students. Closely linked to this understanding, science tutors need to develop and use different teaching approaches such as learner centred approach which will create room for students' active participation and engagement in learning. This in turn may benefit all students to feel welcome and work within their own pace for better understanding. Therefore, I suggest tutors should provide students with supportive social environment that help students feel welcome, loved and accepted in a group (Freire, 2005).

Another important aspect of the preparation is the effort and the opportunity given to students to observe and practice teaching. Therefore I recommend that teaching practice, which consist of on campus and off campus should be practiced and in the first place be compulsory for the first-year students to go for at least two weeks observation during the second semester before they start on campus and off campus teaching practice. This may give them the opportunity to observe teachers on the job at the school level and learn to be equipped with teaching skills before they start the actual on campus and off campus teaching practice in the second year. This may also educate students not just desiring to learn and pass academic examination but also developing professional skills.

Furthermore, I recommend that government should provide enough teaching learning materials and equipment to help support teaching and improve students understanding. Also, tutors in their consented effort should do their best to teach students how to improvise teaching and learning materials in their teaching. This is because effective provision of science materials and equipment would render teaching and learning of science realistic and thereby meeting the Millennium Development Goal (MDG-UN Report 2010).

In conclusion, it is my hope that the colleges of education science tutors have mastery in the content area and methodology to demonstrate teaching practically and to integrate science courses in the teaching processes. Science tutors should integrate the teaching of science courses and relate them in real life situations in their environment for students to transfer knowledge. With this understanding, I finally recommend that tutors should explore ways that might facilitate students' learning, through use of practical works, model and developing most students' interest and confidence to learn and teach science.

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Appendices

Appendix A

Interview Guides

Interview guide for tutors

1. Please, can you tell me some of the teaching methods you use to prepare your students?
2. Could you please tell me how you use the methods to teach the courses within 'Science' (biology, chemistry and physics)?
3. Are there any practical activities you engage student in during the teaching learning processes? What are they and how do you engage student?
4. Do you do practical activities for your students to observe? Please explain your response for doing or not doing practical activities in the teaching learning process?
5. Do you assign group work? How do you as a tutor assign group work and activities to students?
6. Could you please tell me how and when you give individual or group assignments?
7. Could you please tell me your personal experience about your teaching?
8. How do you as a tutor vary your teaching?
9. Please, can you explain why you vary your teaching?
10. How do your students respond to your teaching?
11. Do you draw any teaching plan for teaching and do you follow? How do you do that?
12. Do you make the teaching plan to benefit individual students? How?
13. What do you think about the Science curriculum/syllabus?
14. How do you integrate the teaching of the courses in Science
15. Do you as a tutor think the curriculum should further be revised or not? Why?
16. Do you have any suggestions on how the curriculum should be? Give reasons for your response?
17. Do you prepare them for peer teaching? Why and how do you prepare them?
18. Do you observe your students in the classroom during the teaching practice activities? Why and how, can you explain?
19. Do you give students feedback? What kind of feedback do you give to the students after you have observed their teaching?

20. Please, do you motivate your students during teaching process? How do you motivate them?

21. Do you have any additional information or suggestion? Please just feel free and mention?

Interview guide for student teacher (s)

1. How do tutors prepare you as a student teacher to teach Science at the junior high school?

2. What can you say about the methods your Science tutors use to teach you?

3. Are the teaching methods used by tutors helpful to you as student teacher? How?

4. Do you understand the courses in Science the way they are taught to you? Can you tell me something about how you understand?

5. Do you feel you will be well prepared to teach Science at junior high school after completion of your teacher education? Please how do you feel, can you explain?

6. Please, can you tell me how relevant are the methods helpful to you as teacher student?

7. Do you do any practical activities with your Science tutors?

8. What do you think about the practical activity you do?

9. Do tutors attend to individual student needs during teaching? How, please explain.

10. How do you think individual student can get access to appropriate teaching methods?

11. Do you as a student have the right to ask questions during teaching and learning activities? When and how explain.

12. How do you feel when you ask your Science tutors a question in a class?

13. How is the reaction of your Science tutors when you ask questions related to the lesson during teaching learning process?

14. Are there any particular teaching methods often used by tutors to teach you Science?

15. Please, what are some of the methods used by tutors to teach you Science?

16. Do you feel prepared to teach Science at the junior high school level?

17. Do you have anything to say about the syllabus (content) for Science?

18. How is the teaching of Science related to the practical life

19. In your opinion, what do you suggest as the best and appropriate methods for teaching Science at the junior high school as you have received different methods from your tutors?

Please, is there anything you would like to add which will be relevant and useful in this study?

Appendix B Observation Guide

Categories	Description notes	Reflective notes
Tutors teaching methods and classroom and laboratory organisation		
Kind of methods tutors choose and use in teaching		
Tutors competence in teaching science courses		
Students involvement and engagement in science lessons		
Tutors use of teaching learning materials and equipment		
Challenges		

Appendix C

Map of Ghana

Appendix D

INFORMED CONSENT LETTER

Dear Tutor,

I am Charlotte Kusi, a Master's student in Special Needs Education at the University of Oslo, Norway. I am undertaking a research on the topic 'Teaching Science: How tutors prepare student teachers to teach science. The purpose of the study is to investigate how tutors prepare student teachers to teach science at the junior high school.

This study will make use of Interview, observation and document study for data collection. The interviews will be conducted to investigate how student teachers are prepared to teach science. About forty minutes time will be spent with each participant in an interview.

The observation will be carried out in the classroom and at the laboratory to support and supplement the conducted interviews. The duration for the classroom observation will be about forty five minutes to one hour time. The curriculum for science will also be studied before the interview and observation.

Your responses and the findings during observation will be treated with utmost confidentiality. Your identity will be anonymous in the study and information collected will only be shared through the thesis.

The interviews will be audio recorded and transcribed. The only purpose of the recording is to ensure precision. The recorded and transcribed data will be deleted immediately after the study has ended.

Providing responses are much appreciated. Your participation is voluntary and you are at liberty or have the right to choose whether or not to participate in this study. You are also free to decide to withdraw your participation in the study at any point in time without stating why and without any consequences.

Finally, your responses will contribute to finding out the different teaching methods used in teaching science and different possibilities towards preparing teachers to have required knowledge and skills to be able to teach science in inclusive classrooms to help achieve the goals of the Education for All programme.

Thank you for your co-operation and acceptance to take part in this study.

Charlotte Kusi, a Master's Student in Department of Special Needs Education, University of Oslo, Norway.

Name……………………………..

Sign……………   Date……………..
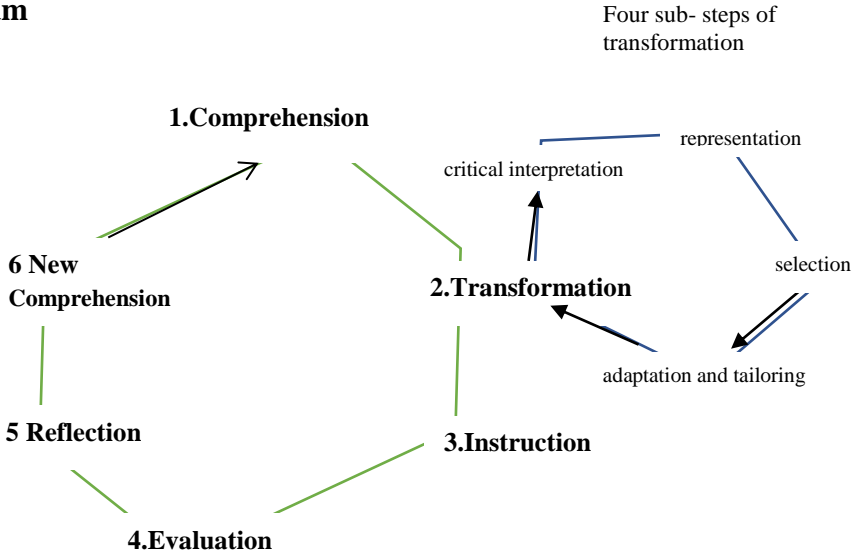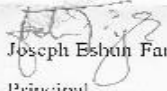
Appendix E

Diagram

Figure 1: Illustration of Shulman's Model of pedagogical reasoning (Shulman, 1987)

Appendix F: Two pictures showing science laboratory with inadequate teaching learning materials and equipment

Appendix G: Letter of Consent from Wesley College of Education

THE METHODIST CHURCH GHANA
WESLEY COLLEGE OF EDUCATION
P. O. BOX 1927, KUMASI, ASHANTI
GHANA, WEST AFRICA
GENERAL LINE: +233-322022264   PRINC. TEL/FAX: +233-322028541

| Our Ref: | Your Ref: | Date: | 9th December, 2015 |

TO WHOM IT MAY CONCERN

I write to confirm that Miss Charlotte Kusi has my consent to use pictures taken of the Science Laboratory on the campus of Wesley College of Education for the purpose of her thesis.

These pictures were taken during interviews and observations conducted by Miss Charlotte Kusi at the various classroom blocks and the laboratory in the College for her thesis which is entitled: Teaching Integrated Science: How Tutors Prepare Teacher Students to teach Integrated Science.

Thank you.

Yours faithfully,

Joseph Eshun Famiyeh

Principal

E-MAIL: info@wesco.edu.gh/wescoksi@gmail.com
WEBSITE: www.wesco.edu.gh