

UNIVERSITY OF EDUCATION, WINNEBA

**Pre-service biology teachers' professional knowledge and Self-Efficacy beliefs
towards the use of activity-based teaching method**



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**PRE-SERVICE BIOLOGY TEACHERS' PROFESSIONAL KNOWLEDGE
AND SELF-EFFICACY BELIEFS TOWARDS THE USE OF ACTIVITY-
BASED TEACHING METHOD**



**A thesis in the Department of Science Education,
Faculty of Science Education, Submitted to the School of
Graduate Studies in Partial fulfilment of
the requirements for the award of the degree of
Master of Philosophy
(Science Education)
In the University of Education, Winneba**

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DECLARATION

STUDENT'S DECLARATION

I, IBRAHIM SEIDU BABA, declare that this thesis, with the exception of quotations and references contained in published books which have all been identified and duly acknowledged, is entirely my own original work, and it has been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE:

DATE:

SUPERVISOR'S DECLARATION

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

NAME OF SUPERVISOR: DR. ERNEST IMMAARE NGMAN-WARA

SIGNATURE:

DATE:

DEDICATION

This thesis is dedicated to my parents, Mr. Seidu Ibrahim and Mrs. Meimunatu Seidu, my siblings Mr. Abdul Rauf Seidu, Miss. Rabiatu Seidu and Mr. Lukman Seidu and the entire family especially Hassana Hussein.



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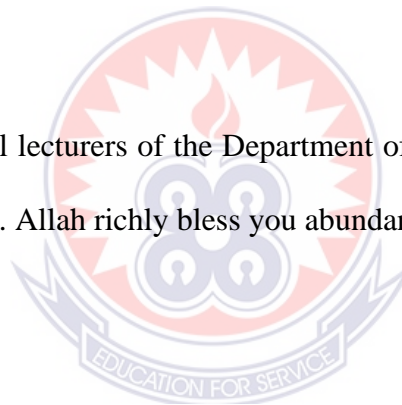


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ABSTRACT

Numerous studies have reported that the performance of students from Ghana and other countries in Africa in the field of biology and science at large have declined over the years. This development has become a major cause for concern to parents, guardians and stakeholders in academia. This performance largely depend on the quality of classroom teaching and interest of students toward science subjects which can be attributed to poor teaching method such as rote approach that make science to appear abstract. The purpose of this study therefore was to investigate pre-service biology teachers' professional knowledge and self-efficacy beliefs towards effective application of activity-based teaching method which has become a major concern for stakeholders in education. The research focused on fourth year pre-service biology teachers of the University of Education, Winneba pursuing Bsc. Biology Education. The pre-service biology teachers were required to respond to items of professional knowledge and self-efficacy instruments in ordered to determine their levels of professional knowledge and self-efficacy-beliefs. The data for the study were collected with the use of adapted Pre-service Teachers' sense of efficacy scale (TSES) originally developed by Tschannen-Moran and Hoy (2009). Professional knowledge was also explored using Pre-service Professional Knowledge test Instrument. Smart PLS 4.0.9.8 computer software was used to statistically to analyse the data for the study. Descriptive statistics were employed to describe and summarize the data. Participants for the study were 87 pre-service biology teachers. The outcome of the study suggested that the professional knowledge and self-efficacy beliefs of pre-service biology teachers towards teaching biology were high. The self-efficacy beliefs are gained from a high professional knowledge level of the pre-service biology teachers. However, results of some items showed average efficacy levels of some of the participant. This calls for courses design to tackle this finding. Also, from the findings, pre-service biology teachers can effectively implement activity-based teaching method during biology lessons as data collected and analysed indicated very strong correlation amongst the variables. From the data, it can be said that participants have strong capability to implement activity-based teaching method. This capability had been correlated to strong sense of self-efficacy beliefs. Albeit, the study suggested that observation of the pre-service biology teachers must be conducted in future research in order to have comprehensive information on the effects of professional Knowledge and self-efficacy beliefs towards the use of activity-based teaching method during biology lessons.

CHAPTER ONE

INTRODUCTION

1.0 Overview

Background to the study is discussed in this chapter, also, statement of the problem, as well as purpose of the study are also discussed. Objectives of the study, and research questions. The delimitation and limitation in the current study are also stated. The researcher has also illustrated the significance of the study, contextual definition of technical terms and organisation of the remainder of the study report into the subsequent chapters.

1.1 Background to the Study

Science teaching and learning in Ghana has undergone numerous reforms over the years. During the educational reforms of 2010, a number of curricula improvements were made in the Ghanaian biology syllabus for Senior High School (SHS). The objective backing the changes in the curriculum was to ensure that puddles of professionals are trained effectively for businesses in science discipline and academic research. It was also targeted that Ghanaian citizens can become scientific and technological literates through innovative science instructions to provide scientific explanations for natural phenomena and to engage in evidenced-based discussions and also help children understand generalisations or science principles that can be used to solve problems (Ministry of Environment, Science, Technology and Innovation, 2018). The teaching method recommended to be used was activity-based with the teacher as the facilitator. This is directly on the back of behaviourism. Behaviourists are of the belief that novices or learners do not just passively take information or knowledge but instead actively construct it. As people experience the world and

reflect upon those experiences, they build their own representations and incorporate new information into their pre-existing knowledge (schemas) Bandura (2006).

In most countries, second cycle pre-service teachers undergo perennial training programmes in order to acquire the knowledge (so-called professional knowledge) Großschedl (2018) which Ghana is not an exception. This knowledge is however acquired through a strong subject content knowledge with pedagogical knowledge and pedagogical content knowledge too included that are assumed to be relevant for their future teaching profession. These training programmes differ with characteristics, for example, with respect to their duration or the intensity with which particular contents are considered. These differences do concern not only training programmes between different countries, but also training programmes within a particular country (Tatto & Senk, 2011; Tatto et al., 2008). The Knowledge builds the confidence of the pre-service biology teacher which reflects on their self-efficacy beliefs that refers to an individual's belief in his or her capacity to execute behaviours necessary to produce specific performance attainments (Bandura, 1997).

The profile dimension described by the current Senior High School (SHS) biology syllabus underlying behaviour for teaching, learning and assessment in biology include Knowledge and Comprehension constituting 30%, Application of Knowledge 40%, Practical and Experimental Skills 30% (Ministry of Education, 2012). This indicates that to be able to successfully implement activity-based teaching method in instructions as required of competent biology teachers, much attention must be emphasized on pre-service teachers' professional knowledge due to the fact that its influence surpasses the rest of the profile dimensions. For effective teaching and learning of biology in SHSs, the pre-service teachers under training must have a clear

idea of the subject matter that will build their self-efficacy beliefs and practices strongly through professional training programmes.

Report of The Trends in International Mathematics and Science Studies (TIMSS) 2007 by Anamuah Mensah, Mireku and Ghartey (2008) indicated that Teacher training institutions (i.e. colleges of education and teaching universities) should provide opportunities for pre-service teachers to learn teaching strategies that take into consideration the diverse abilities, backgrounds, special needs and motivation of students. In view of the fact that majority of our schools and classrooms have multi-ability groups as well as diverse socio-economic status, this has the capacity to help the pre-service teachers to learn about ways in which instruction can be differentiated to bring improvement in learning. This will go a long way to improve the pre-service teachers' knowledge in their professional training.

Inquiry – based also known as activity-based method of science education has been promoted for over a decade and is endorsed by the next Generation science standards (Wilcox, Kruse & Clough, 2015). Students explore natural phenomena by raising questions, investigating alternative solutions, constructing theories and assessing their interpretation based on the evidence they have gathered in inquiry-based science education. In order to establish explanations about the natural world, scientific analysis necessitates the use of facts, reasoning, and imagination (Newman, Abell, Hubbard, McDonald, Otaala & Martini, 2004). Inquiry- based instructions necessitates knowledge of the essence of science, discipline specific content knowledge and pedagogical content knowledge on the part of teachers (Newman et al., 2004). Teachers must understand how scientific rules, concepts and mathematical expressions apply to the material they teach in order to use inquiry- techniques

(Newman et al., 2004). Unfortunately, the rate of teachers graduating with content – specific education is insufficient to reach the number of teaching vacancies (Hestes, Megowan-Romanowicz, Osborn Popp, Jackson & Jackson, 2005). Pre-service biology teachers must also be more sensitive to new demands with the rapid technical changes and science reforms in their passion for science. They must be role models (Ginns & waters, 2000).

Teachers are considered to be the cornerstones of education so they have crucial and shaping roles fostering the achievements of students (Demirtas, Comert & Ozer., 2011). Accordingly, the effect of teachers on students and learning is much greater than any other aspect i.e, curriculum, physical resources, educational technology, etc. (Sisman, 2004). Therefore, any nation should be able to produce quality teachers in order to enhance the standards of the education provided to students (Darling – Hammond & Bransford, 2005). But schools are still ill-equipped to sustain laboratory experiences and teachers lack the requisite science and math skills (Bradshaw, 2012; Hestenes et al., 2011; Jackson, 2010).

Pre-service teacher education in which pre-service teachers experience a ‘learning apprenticeship’ Pendergast, Garvis, and Keogh (2011) offers the first step in the teachers’ professional development and training them in skills (Wilke, 2004). In addition, pre-service teacher education has a reputation as an important medium for the growth of students in terms of cognitive, affective and psychomotor domains (Yong, et al., 2015).

A systematic study would constitute a necessary first step toward offering guidance to teacher educators (Pendergast, 2011), who are interested in fostering the Teacher self-efficacy (TSE) beliefs of pre-service teachers. Supporting the development of TSE

beliefs during initial teacher preparation is of particular importance because failures are especially detrimental to self-efficacy development if they occur earlier on Bandura (1997). Knowledge is undoubtedly known to be major source of pre – service teachers’ self-efficacy. The teacher’s efficacy beliefs are indicators of his or her instructional performance. Bandura (1977) defined self- efficacy in his social cognitivist theory as “beliefs in one’s capabilities to organise and execute the course of action required to manage prospective situations. In the context of biology teaching, self-efficacy consists of personal biology teaching efficacy and biology teaching outcome expectancy. Personal biology teaching efficacy refers to the belief that one is capable of effective biology instruction, while biology outcome expectancy refers to the teacher’s beliefs about students’ ability to learn biology. According to Schunk (2003), even though self-efficacy is crucial to teacher achievement, it is not the only important factor in that regard. He argued that another very inextricable influence on teacher achievement is knowledge of their profession. Pajares (1992) also asserted that knowledge and beliefs cannot be considered separately. In view of this one can deduce that pre-service biology teachers who have good professional knowledge and self-efficacy beliefs will also adopt positive attitudes and teach biology effectively through effective activity – based teaching method.

Researchers have identified a multitude of meaningful associations between teacher self-efficacy (TSE) and a range of sought after outcomes for in-service and pre-service teachers, as well as for students. For in-service teachers, for example, resilience (Beltman et al., 2011), instructional quality (Holzberger et al., 2013), occupational commitment (Klassen & Chiu, 2011; Chesnut & Burley, 2015), job satisfaction (Klassen & Chiu, 2010), teaching performance (Klassen & Tze, 2014), and burnout (Schwarzer & Hallum, 2008) have been documented to be linked to TSE.

For pre-service teachers, for example, burnout (Fives et al., 2007), occupational commitment (Klassen & Chiu, 2011; Chesnut & Burley, 2015), and commitment to finishing a teaching degree (Pfitzner-Eden, 2016) have been found to be associated with TSE. Moreover, TSE has been shown to be positively related to students' academic achievement (Caprara et al., 2006; Klassen & Tze, 2014). In contrast, studies focusing on factors that can predict TSE development are rare (e.g., Henson, 2002; Klassen et al., 2011). For years, reviewers (Henson, 2002; Klassen et al., 2011) have highlighted a lack of studies regarding the formation of TSE beliefs as one key problem hampering progress in this field of research. In light of the predictive power of TSE beliefs, systematically studying the formation of these beliefs seems warranted.

According to Bandura (1997), individuals form self-efficacy beliefs by interpreting information regarding their own capabilities. This information stems from the four sources: mastery experiences, vicarious experiences, verbal persuasion, and physiological and affective states. Mastery experiences provide information about one's successes, but also failures. Generally, successful experiences increase self-efficacy beliefs, while experiences of failure lower them. Vicarious experiences provide information about modelled attainments of others, which influence one's self-efficacy beliefs by demonstrating and transferring competencies (model learning) and by providing a point of reference for social comparison. Verbal persuasion by “significant others” Bandura (1997) can convince people of their capabilities, especially if this persuasion comes from a credible source. Physiological and affective states provide information about physiological and affective arousal during situations in which the capability in the domain in question is demonstrated. In stressful

situations people tend to read this somatic information as an indicator of dysfunction, thus impacting negatively on self-efficacy beliefs.

The rationale for teaching biology in Senior High Schools unequivocally clarifies the need to teach Biology ultimately to explain the living world in terms of scientific principles although appreciating that, organisms behave in ways which often seem beyond the capabilities of their component parts. It is also to guide and inculcate in the learner skills in observing and measuring, formulating hypothesis, predicating and designing, investigating, recording data and interpreting results, drawing conclusions and communicating them (Ministry of Education, 2018). The knowledge, skills and attitudes acquired through the study of biology is to provide the learner with the necessary basic tools for employment in laboratory, industry, agriculture, horticulture, forestry, health care, work with animals, marine and fresh water biology, information science, administration, finance, management and teaching. It further equips the learner for further studies and research in pure and applied science and technology that are vital areas for the advancement of society. Teaching elective biology with activity- based teaching method in totality guides the learner and makes them capable of critical thinking, making meaningful decisions and solving problems.

Teaching strategies refer to the methods, techniques, procedures and processes that a teacher uses during instruction. It is generally recognised that teaching strategies are multidimensional and their effectiveness depends on the context in which they are applied (Hattie, 2009; Marzano et al., 2001; Wayne & Young, 2003). An activity - based teaching method is required to enable biology students achieve the general aims of the biology syllabus (Ministry of Education, 2010).

Although it is undoubtedly clear that in-service biology teachers knowledge, self-efficacy beliefs and teaching strategies affect students' performance and interests in biology in the second cycle institutions, these qualities cannot be underestimated for the pre-service biology teachers as well. It has become very prudent to conduct further studies focusing on moving teaching and learning from the deductive acquisition of knowledge and rote memorization to a new position where students will be able to apply their knowledge, develop plans, generate new creative ideas and solutions to problems since no student or novice is a tabula rasa.

1.2 Statement of the Problem

It has been observed through numerous researches and reports that the performance of students from Ghana and other countries in Africa in the field of biology and science at large have declined over the years. Ghartey-Ampiah (2006). This development has become a major cause for concern to parents, guardians and stakeholders in academia. Mabula (2012) discovered in his research that students' performance in science subjects was affected by poor quality of classroom teaching and decline in interest in students toward science subjects which can be attributed to poor teaching method such as rote approach that make science to appear abstract.

Some earlier studies have suggested that teacher efficacy is linked to student achievement, student motivation (Midgley, Feldlaufer & Eccles, Lewandowski, 2005; Woolfolk Hoy, 2001), provides the foundation for teacher motivation (Adyin & Boz, 2010) and classroom management strategies (Ashton & Webb, 2005). Therefore it is important for colleges of educations and other teacher training institutions to be mindful of the importance of pre-service teachers' self-efficacy beliefs and attitude towards biology teaching during instructions.

According to Ngman-Wara (2016), it has also been observed that during teaching practice programmes, pre-service teachers usually exhibit low efficacy beliefs and negative attitudes towards the teaching of science. This is made clear when they make comments such as ‘I am afraid I would not be able to teach science effectively and ‘it is difficult to get materials to teach science’. This is because most of the students are admitted into the science colleges of education with poor grades (C4 to C6) obtained in the West African Senior Secondary Certificate Examination (Akyeampong, 2001). This fact is corroborated by the poor performance of the pre-service teachers in the end of semester examinations in science conducted by the Institute of Education, University of Cape Coast (Institute of Education, University of Cape Coast, [IEUCC]). The Chief (2007, 2008, 2009) reported that over 70% of the pre-service teachers obtained D+. Specifically, most students about 80% failed biology in the first semester of their 3-year examination from UCC 2018 first semester chief examiners report. In the light of this it is prudent for teacher education providers to scale down the level of science fear that many generalist teachers often have in effort to improve science teaching and students engagement in science, by increasing the self-efficacy of teachers (Bleicher, 2009; Bergman & Morpew, 2015).

Expectation of the pre-tertiary curriculum framework goal number five according to Ministry of Education (2018) is aimed at Ghana producing graduates who are problem solvers and have the ability to think creatively and have both confidence and competence to participate fully in the Ghanaian society as responsible local and global citizens. This aim is directly in line with the United Nations Sustainable Development Goals (UNSDGs), goal number four which is “Quality Education” .For this to be achieved, continuous professional development (CPD) must be encouraged for both in-service and pre-service biology teachers where professional knowledge becomes a

great concern. Pre-service teachers enter teacher education Institutions such University of Education, Winneba to study programmes with values, attitudes and beliefs based on their former education and their personal experiences. This situation is significant due to its impact on classroom practice in the future (Palmer, 2001). Many scholars agree that teachers' TSE beliefs are a major predictor of their decision and behaviours (Bandura, 1986). Activity based teaching is a strategy focused on the idea that learners ought to be included through activities. It is the procedure in which the learner is effectively included in taking interest rationally and physically. Activity-based learning is interpreted as meaningful school learning settings in which the learner creates mental ideas through dynamic contribution. This procedure may include the control of physical materials, the usage of games, or participating in experimentations with physical items.

According to Aydin and Boz (2010), teachers' self-efficacy beliefs help us to predict their motivation and choice and to ascertain their actions in class. It is therefore important to determine the pre-service teachers' self-efficacy beliefs towards biology teaching due to the fact that they will be teachers in the future. Any detection of low self-efficacy towards biology teaching can be addressed before they complete their programme. This phenomenon calls for comprehensive study of professional knowledge, self-efficacy beliefs in relation to the use of activity – based teaching method. Against this backdrop, this present study is designed to investigate the pre-service Biology teachers' professional knowledge and self-efficacy beliefs towards the use of activity-oriented teaching method.

1.3 Purpose of the Study

The purpose of this study is to investigate pre-service biology teachers' professional knowledge and self-efficacy beliefs towards effective application of activity-based teaching method.

1.4 Objectives of the Study

Specifically the study would seek to

1. Investigate the professional knowledge level of the pre-service biology teachers towards the use of activity-based teaching method.
2. Examine the level of self- efficacy beliefs of the pre-service biology teachers towards the use of activity-based teaching method.
3. Assess the extent to which pre-service biology teachers' professional knowledge and Self-efficacy beliefs influence their use of activity-based teaching method.
4. Establish relationship between pre-service biology teachers' professional knowledge and self-efficacy beliefs towards the use of activity – based teaching method.

1.5 Research Questions

The study will be guided by the following research questions.

1. What is the professional knowledge level of pre-service biology teachers towards the use of activity-based teaching method?
2. What is the level of self- efficacy beliefs of the pre-service biology teachers towards the use of activity-based teaching method?
3. To what extent do pre-service biology teachers' professional knowledge and Self-efficacy beliefs influence their use of activity-based teaching method?
4. What is the relationship between pre-service biology teachers' professional knowledge and self-efficacy beliefs towards the use of activity-based teaching method?

1.6 Significance of the Study

There are currently critical issues in biology education all over the world, prompting many researchers to contribute to this discourse. One of the main contributors to such challenges in Ghana is pre-service biology teachers' inadequate professional knowledge which affects how the teachers develop self-efficacy believes, in addition to self-confidence while instructing topics in biology (Adu-Gyamfi, 2014). Students perform excellently in biology when they are actively working, participating in discussions, and seeking information as this is essential for activity-based teaching method (Mims, 2003). Activity-based teaching methods aim to provide a “real-world” experience for learners. It makes learning become a study of nature that allows students to gain the knowledge and skills they need to succeed in school (Barron & Darling-Hammond, 2008).

Activity-based teaching method further helps students to think autonomously in a controlled environment in which the pre-service biology teachers can assist and direct struggling students (Schoffstall & Gaddis, 2007). Learning by doing is integral part of activity-based teaching method. With this method, students are not passive. It is an inquiry-based method of learning. According to research, it is essential for developing critical thinking skills and biological content (Apedoe, 2006). A paradigm shift in pedagogy is required to facilitate learning in which classroom theory is applied to real-world issues as this can enhance students' success in biology education. It is essential to adopt activity-based classroom practice where learners could be more engaged.

To contribute to this discourse, this study examines professional knowledge levels as well as self-efficacy beliefs of pre-service biology teachers towards the use of activity-based teaching method as a teacher factor in biology education, emphasizing their enormity and long-term consequences, and recommends activity-based teaching method as a teaching method to address the situation in the Ghanaian context against the traditional method of teaching biology which is still utilized as a part of a large portion of the educational establishments in Ghana. Keeping this perspective in view, this study has attempted to work on “finding how effective activity-based method of teaching biology students of senior high classes will affect their performance”. Even though there have been massive calls from education stakeholders on the need for teacher educators to implement strategies that will increase the pre-service teachers' self-efficacy through competent professional training, there are only few studies of self-efficacy and teaching strategies to match the new global paradigm shift in biology teacher education in Ghana.

However, early detection of professional knowledge level and self-efficacy beliefs towards activity-based teaching method will inform professional teacher training institutions to introduce science education courses that will target the professional knowledge and self-efficacy beliefs of pre-service biology teachers during syllabus and curriculum (policy) formulation in order to meet the required standard of biology teachers capable of improving the performance of biology in Ghana. In summary, findings from the study would inform pre-service biology teachers' professional knowledge and self-efficacy beliefs as very important part of their professional training and their influence on the use of activity-based teaching methods as preferred teaching method for biology. As a result, this study emphasises on shifting the teacher-centred paradigm to a learner-centred approach, participatory teaching method where students are involved in class activities and cooperative learning techniques (Rao & DiCarlo, 2000; Lombardi, 2007). Activity-based teaching method engages students in the classroom and promotes high retention, whereas passive students have low retention. Information from the findings and recommendations from this study would as well be used for future research.

1.7 Limitations of the Study

One major limitation of the study is the small sample size used in the study, which may affect the generalizability of the findings. Future research could expand the sample to validate the results across a broader population. Also observation was not conducted by researcher during the teaching practices of the pre-service biology teachers in order to ascertain their ability to effectively implement activity-based teaching practices. This impeded the willingness of some of the pre-service biology teachers to give the right information that is relevant to the study due to their inability to see the researcher in person and permissions to be observed during teaching

practices. However future research could conduct serious observation of participants. Absurdity in Internet and network connections and supply to some areas in the country where students are having their teaching practices will amount to a great challenge to the study. Also, the time of administering the questionnaire, when it coincides with lesson times or supervision. However, rescheduling will occasionally be arranged.

1.8 Delimitation of the Study

This study is conducted in the University of Education, Winneba (UEW). The targeted group for the study is the level 400 Bachelor of Science (Bsc.) Biology education students who are on their first semester mandatory internship teaching practices.

1.9 Definition of Terms

In this study, there had been the use of certain technical terms and abbreviations. These terms and abbreviations in question have been defined and broken down into comprehensive forms bellow.

- ✓ **Professional Knowledge (PK):** Professional Knowledge is known to be facts, information, and skills acquired through experience or education. It constitutes the theoretical or practical understanding of a subject.
- ✓ **Content Knowledge (CK):** content Knowledge is the knowledge of major ideas and theories of a particular domain.
- ✓ **Pedagogical Content Knowledge (PCK):** pedagogical Content Knowledge refers to the knowledge of instructional strategies which integrate the representation of subject matter and responses to specific

learning difficulties knowledge of instruction strategies for teaching and knowledge of students' conceptions and preconceptions.

- ✓ **Pedagogical Knowledge (PK):** Pedagogical knowledge is the knowledge of the broad principles and strategies of classroom management and organizations.
- ✓ **Pedagogical Paradigm Shift:** Pedagogical paradigm shift is the change of teaching method from the old traditional rote learning to the new scientific method of teaching.
- ✓ **Microteaching:** Microteaching is a technique used to prepare student teachers for the real classroom setting.

Meaning of Abbreviations

- ✓ **SHS:** This is the abbreviation of Senior High School.
- ✓ **TSE:** This is the abbreviation form of Teachers Self-Efficacy.
- ✓ **WAEC:** This is the abbreviation of the West African Examination Council.
- ✓ **CPD:** This refers to the Continuing Professional Development.
- ✓ **SDGs:** This is the abbreviation of the Sustainable Development Goals set by the United Nations
- ✓ **TEDS-M :** This is Teacher Education and Development Study in Mathematics
- ✓ **TIMSS :**Trends in International Mathematics and Science Studies
- ✓ **SCLT:** Social Cognitive Learning Theory
- ✓ **NTC:** National Teaching Council
- ✓ **NEP:** National Educational Policy

- ✓ **NTA:** National Testing Agency
- ✓ **TSES:** Teacher Sense of Efficacy Scale
- ✓ **UEW:** University of Education, Winneba
- ✓ **AAMUSTED:** Akenteng Appiah-Menka University of Skills Training and Entrepreneurial Development
- ✓ **CR:** Composite Reliability
- ✓ **AVE:** Average Variance Extract
- ✓ **HTMT:** Heterotrait-Monotrait
- ✓ **VIF:** Variance Inflation Factor



CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter outlines some theoretical and conceptual framework and review of the empirical literature to the study. Also, reviewed literature relevant to this study under themes developed from the objectives of the study is also discussed in this chapter.

2.2 Theoretical Framework

According to Ghaur and Granhang (cited in Mwikya, 2013), a theory is set of interrelated concepts, defining and propositions that present a systematic view of specifying relations among variables with purpose of explaining and predicting phenomenon. Theoretical framework is the structure that can hold the theory of research study (Abend, 2008). It defines the key concepts in research.

In this regard, this current study is pivoted on Bandura's (1977; 1997) social cognitive learning theory and his construct of self-efficacy due to its relevance to the study. This is a learning theory which has come out on the ideas that people learn by watching what others do, and that human thought processes are central to understanding personality. By the mid-1980s, Bandura's research had taken a more holistic bent and his analyses tended towards giving a more comprehensive overview of human cognition in the context of social learning. This theory was expanded from his social learning theory currently known as social cognitive theory Bandura (1999). This theory provides a framework for understanding, predicting and changing human behaviour (Green & Peil, 2009).

Moreover, SCLT places a heavy focus on cognitive concepts. It is also focused on how children and adults operate cognitively on their social experiences and how these

cognitions then influence behaviour and development. Individuals learn both behaviours and cognitive strategies by observing the behaviour of others and these acquisitions can be learned without being directly reinforced. This can be based on their studies and some basic assumptions of SCLT. It is obvious that that people can learn by observing others, Learning is an internal process that may or may not result in a behaviour change and Learning can occur without a change in behaviour (Observation without imitation). Regarding to behaviour, some other researchers such as Betz, (2007), supported Bandura's basic assumptions of SCLT and pointed that behaviour is directed toward particular goals, behaviour eventually becomes self-regulated and cognition plays a role in learning. Finally, some studies supported that reinforcement and punishment have indirect rather than direct effects on learning and behaviour (Green & Peil, 2009).

Self-efficacy in the Bandura theory introduced context of an explanatory model of human behaviour, in which self-efficacy causally influences expected outcomes of behaviour, but not vice versa (Bandura, 2004, 2006).

Self-efficacy beliefs however, exert their diverse effects through cognitive, motivational, emotional, and decisional processes. Efficacy beliefs affect whether individuals think optimistically or pessimistically, in self-enhancing or self-debilitating ways. They play a central role in the self-regulation of motivation through goal challenges and outcome expectations (Mark & Campbell, 2011). On this regard self-efficacy lies at the centre of SCLT and shows that beliefs about one's ability or capacity to execute a behaviour successfully. Moreover, it clarifies that people tend to engage in activities based on their sense of competence and or past success.

One of the primary features of Bandura's model is the specification of four sources of efficacy information, or learning experiences, leading to the development of self-efficacy expectations. It remains important as it is part of Bandura's social cognitive theory and is an integral part of SCLT (Betz, 2007). In other words, it can be stated that self-efficacy based on Bandura's psychological knowledge, experiences as well as suggestions can have perfectly direct effect on pre-service teachers' behaviour and cognition in the following ways: Activity choice, goal setting, effort, persistence learning and achievement.

In conclusion, people with high efficacy are more likely to view difficult tasks as something to be mastered rather than something to be avoided while the people with weak efficacy more likely to avoid challenging tasks and finally they focus on personal failings and negative outcomes (Mark & Campbell, 2011).

2.2 Pre-service Biology Teachers' Professional Knowledge towards the use of activity-based teaching method

Various theoretical works (Shulman, 2015; van Driel & Berry, 2010) and large-scale empirical studies (Kunter & Voss, 2011; Schmelzing et al., 2013) have highlighted the importance of pre-service teachers' professional knowledge which is teachers' knowledge derived from targeted processing of thematic expertise that enables its effective and flexible use in educational communication between students and teachers in a manner allowing the content to become clear for the students Shulman (1987) for the quality of classroom instruction and students' learning success. However, little is known about how pre-service teachers' professional knowledge develops during their education, and the factors that promote or hinder its development. To elucidate these issues, appropriate tests for assessing professional

knowledge were developed for measuring the professional knowledge of pre-service mathematics and science teachers (Großschedl, 2018). The objective was to determine reliable and valid test instruments for measuring pre-service biology, chemistry, mathematics and physics teachers' professional knowledge (Großschedl, Harms, Kleickmann, & Glowinski, 2015; Kleickmann et al., 2014). The subject-specificity of the test construction is based on both theoretical considerations and empirical findings on the effectiveness of subject-specific sequences of learning and teaching (Kunter, Baumert, et al., 2013; Seidel & Shavelson, 2007; Shulman, 2015).

In conceptualization of professional Knowledge based on Shulman's (1987) initial conception, current empirical educational research on the professional development of teachers mainly focuses on the core domains of professional knowledge: content knowledge (CK), pedagogical content knowledge (PCK), and pedagogical knowledge (PK). CK in biology constitutes (a) knowledge of the major ideas and theories of a particular domain (e.g., microbiology, genetics, ecology). Furthermore, it incorporates (b) knowledge of how validity or invalidity is established within the domain (i.e., knowledge of research methods) as well as (c) knowledge of the nature of science. Instruments have been developed and validated for testing the professional knowledge of people teaching (or aspiring to teach) mathematics. However, corresponding tests for teachers of the other main natural science subjects physics (Cauet, 2016; Riese & Reinhold, 2012), chemistry and particularly biology are still required due to its effect on pre-service biology teachers professional knowledge (Blömeke & König, 2010; Borowski et al., 2010; Jüttner & Neuhaus, 2013). In an attempt to address these gaps, several studies have presented the CK, PCK as well as PK in biology instrument (PK-IBI), an instrument specially designed to investigate knowledge of relevant biological topics for school teaching, comprehensively which had indicated a convincing

relationship between pre-service biology teachers' professional knowledge and students achievements with respect to effective classroom management and teaching method.

Although research has shown that CK is a central precondition for teaching (Ball, Lubienski, & Mewborn, 2001; Baumert et al., 2010; Friedrichsen et al., 2009; Grossman, Schoenfeld, & Lee, 2005), it also has been revealed that CK alone is not sufficient to improve either effective teaching or the learning progress of students (Abell, 2007; Baumert et al., 2010). PCK is the second type of content-related knowledge which seems to be at least as important for effective teaching as CK. Based on Shulman's (1987) initial definition, PCK forms an "amalgam of content and pedagogy" (p. 8) and is the type of knowledge which makes the subject matter comprehensible for students (Shulman, 1986). Even if Ball, Thames, and Phelps (2008) point out a lack of definition and empirical base after 20 years of research, it is widely accepted that PCK incorporates at least two facets of knowledge including knowledge of instructional strategies which integrate the representation of subject matter and responses to specific learning difficulties knowledge of instructional strategies for teaching and knowledge of students' conceptions and preconceptions (knowledge of students' understanding; Hill, Ball, & Schilling, 2008; Lee & Luft, 2008; Park & Oliver, 2008; Schmelzing et al., 2013; Van Driel, Verloop, & De Vos, 1998). In this study, PCK is described according to Tamir's (1988) conceptualization. In addition to the facets outlined above, Tamir (1988) further distinguishes between knowledge of the particular curriculum (curricular knowledge) and knowledge of evaluation in the respective subject matter (knowledge of assessment). In contrast to CK and PCK, PK transcends the subject matter (Shulman, 1986, 1987). Shulman (1987) defines PK as knowledge of the "broad principles and strategies of classroom

management and organization” (p. 8). Tamir (1988) extends this definition by integrating four facets which together constitute PK. These are concordant with the facets of PCK outlined above, albeit with a particular restriction: They are independent of the subject matter. In a sample of mathematics teachers, Voss, Seiz, Hoehne, Kunter, and Baumert (2014) have recently shown that PK of pre-service biology teacher is positively related to the quality of classroom instruction (activity-based method). While CK and PCK were considered in most large-scale studies from the very beginning, PK was sometimes entirely omitted (Baumert et al., 2010; Hill, Rowan, & Ball, 2005; Krauss et al., 2008; Schmidt et al., 2007), and was sometimes included later (Koñig, Bloñmeke, Paine, Schmidt, & Hsieh, 2011; Voss et al., 2014), and has only recently been equally considered (Buchholtz et al., 2014; Juñttner et al., 2013; Riese & Reinhold, 2012). In accordance with these recent studies, the current study investigates pre-service biology teachers’ Professional Knowledge towards activity-based teaching method.

Besides the domains of professional knowledge on a first dimension, Tamir (1988) distinguishes between knowledge and skills on a second dimension. Knowledge corresponds to declarative knowledge (knowing what), whereas skills refer to procedural knowledge (knowing how). Within the biology part of the KiL project, he analogously distinguished between knowledge (operationalized as “remember and retrieve”) and skills (operationalized as “apply and understand”). Both of them provide a description of what is to be done with or to a particular domain of professional knowledge (Krathwohl, 2002). A similar dimension was used by Bloñmeke et al. (2011) as well as Koñig et al. (2011) in TEDS-M. According to Krathwohl (2002), “remember and retrieve” conveys that participants retrieve relevant knowledge from long-term memory into working memory. In contrast,

“apply and understand” denotes that “the meaning of instructional messages, including oral, written, and graphic communication,” is determined. Moreover, a procedure is carried out or used in a given situation (Krathwohl, 2002, p. 215).

In the case of Ghana, due to the essence of biology knowledge to the country’s development, biology-specific access courses to the professional knowledge of pre-service biology teachers are crucially required. The fundamentally possible agreement across scholars on relevant PK facets, even across teacher training institutions courses do not affect the need to fill these facets with biology subject-specific content. The studies concerning the biology subject studied by pre-service biology teachers already are decidedly subject-specific, indicating the significance of PK's subject-specificity as well. Studies refer to most topics of school biology lessons, such as Ecology, Genetics (Kirschner et al., 2017), or Evolution, (Neubrand, et al., 2015) to capture corresponding specific aspects of pre-service biology teachers' PK. In a respective topic-specific manner, studies are reported, for example, by van Dijk and Kattmann (2010). Hence, a comprehensive, multidisciplinary and biology-specific courses are highly desirable, to acquire PK. Such courses could enable the development of effective interventions in pre-service biology teachers' education and training to boost their PK and, consequently, students' learning gains. Biology encompasses numerous traditional topics such as ecology, evolution, cell biology, genetics, microbiology, morphology, and physiology as well as other, interdisciplinary-oriented modern topics (e.g., biochemistry; Reece et al., 2016). The Ministers of Education (2018) defined three basic concepts of biology education structure and function, system, and development. These concepts form the basis for Ghanaian school curricula in biology and biology teacher education. Substantively, they reflect the variety of biological topics (Brechtner & Dreesmann, 2001). Topics on physiology and morphology, cell

biology, and genetics, for example, emphasize the concept of structure and function; topics on ecology emphasize thinking in networked systems; topics on evolution emphasize thinking in developmental processes or in the temporal dimensions (Ministry of Education, 2018).

Students with science background and values are admitted into teacher training institutions in Ghana with the intention to attain knowledge and skills in order to become professional teachers in future. These prospective teachers study Bachelor of Science degree in biology education. Through this process, they obtain the domains of professional knowledge from their institutions (Bayraktar, 2011). This knowledge encompasses five pre-service biology teachers' characteristics reflecting quality of teachers. These include (1) experience of teacher; (2) preparation programs and degrees for teachers, (3) teacher certification type; (4) specific courses completed, and (5) self-test scores of teachers (Rice, 2003). It examines empirical studies evaluating the pre-service biology teachers' characteristics over the effectiveness of teachers. There is a National central examination for professional teacher selection as part of the pre-service biology teachers' professional training process. It is known as Teachers' licensure examination by the National Teaching Counsel (NTC). It is a paper, pen and pencil type examination which is constructed by only multiple-choice and application questions. The percentages of questions according to subjects are organised by NTC.

Courses studied by pre-service biology teachers in the biology subject specific area and pedagogy positively contribute to outcomes of learning and teaching. Coursework taken for pedagogical purposes seem to add at all of the grade levels up to effectiveness of the pre-service biology teachers. High student achievement seems to

be related with the tests evaluating literacy levels or verbal abilities of pre-service biology teachers. It can be summarized being an expert in both subject area and pedagogy is crucial for achieving desired learning outcomes. Pre-service biology teachers who have a high professional knowledge, for instance, have been found to have the propensity to use the activity-oriented/student-centred teaching strategies (Aktağ, Walter, Cantrell, Young & Moore, 2003). On the other hand teachers who tend to have a low professional knowledge are rather prone to use teacher-centred technique/methods like lecturing, and /or reading from prepared notes or even directly from textbooks (Czerniak, Toprakçı, 2001; Toprakçı, 2003)

Friedrichsen et al. (2009) compared individuals with teaching experience who aspire to a secondary biology teaching certificate to those without teaching experience. They found no difference between the two groups with regard to PCK. However, only four participants attended the study; therefore, the results should only be generalized with caution. Brunner et al. (2006) and Krauss et al. (2008) found that the professional experience of secondary mathematics teachers (years of being a teacher) does not correlate with their scores on a CK and PCK test, respectively. In contrast, Clermont, Borko, and Krajcik (1994) showed that experienced teachers have a greater repertoire of PCK of instructional strategies for teaching than inexperienced ones. As outlined above, the empirical basis that refers to the relevance of teaching experience for professional knowledge development is mixed. Nevertheless, pre-service teachers and politicians strive for a more practice-oriented teacher education in biology. Currently, short periods of teaching experience are included in the first phase of teacher education in Germany, but the amount of lessons that pre-service biology teachers teach during these periods is very low (about 10 lessons).

Although there is some evidence that the domains of professional knowledge can actually be distinguished, the results can hardly be generalized to fit the population of pre-service biology teachers, which is in the focus of the current studies. Reasons for this include the differences between the studies such as (a) varying teacher populations (pre-service vs. in-service teachers), (b) a lack of a common theoretical basis (Bloëmeke, Felbrich, Müller, Kaiser, & Lehmann, 2008; Gramzow, Riese, & Reinhold, 2013), (c) the different operationalization of the domains of professional knowledge (academic research knowledge vs. profound mathematical understanding of the subject taught at school (Baumert et al., 2010), or (d) different teaching subjects across the projects such as biology, mathematics, physics. As it was discovered that there was lack of instruments to assess the professional knowledge of pre-service biology teachers regardless its relevance in biology teaching, instruments for CK, PCK, and PK were developed to bridge that research gap.

With regard to PCK, reciprocal effects between learning opportunities of two science subjects might also have an advantageous effect on PCK in biology. This seems reasonable, because pre-service teachers with two science subjects receive more learning opportunities for common contents (e.g., research methods or the nature of science). Since PCK is defined as an “amalgam of content and pedagogy” Shulman, (1987), it also seems plausible that content-related pedagogy is more easily transferrable to another science subject than to a non-science subject, which is conceptually more distal. With regard to PK, it could be hypothesized that pre-service teachers who are extremely science-oriented are less open minded toward general pedagogy and psychology than their fellows with a second subject that belongs to a non-science field.

2.3 Pedagogical Paradigm Shift in Biology Teaching

In this physical and humanistic world, changing is the only unchangeable and it takes place in all fields such as agriculture, medicine, industrial activities including teaching and learning process Jagannath Mohanty, (2007). The inborn trait of humans normally search new ideas and methods and derives ways and means of adopting them. The inventions make behavioural changes among human being and human beings behaviours leads to new inventions too Thiru, Moorthy and Arulsamy, (2014). It is however not apparent that every idea, innovation, invention and their corresponding adaptations can always birth a conducive environment to live in. it is therefore important to bear in mind that the conducive and novel technologies need to adopt and for that matter, must have the capability to channel a sustainable belief for humans. This is very essential for humanity, especially in the field of education aimed at enhancing teaching and learning processes more effectively in our schools with students or learners at the centre of the adaptation. The educational paradigm shift, adaptation and flexibility in our schools are always undoubtedly very important and cannot be underrated.

Teaching and learning takes place from ancient period and it is always transferring knowledge to the next generation (Thiru et al., 2014). In order to put the novice or learners in a comfortable position for them to fully participate and enjoy the learning betterment of traditional teaching process, the novel teaching techniques and methodology are preferred to adopt as paradigm shift. Many factors obviously lead to the planning and introduction of paradigm shift in teaching and learning across the world with Ghana not isolation. Such pragmatic step has confirmed the paradigm shift as necessary as a leading step in globalization, industrialization, population explosion, social changes and score of many others.

Deb Nandita (2013) in a study revealed that this age of globalization also has great impact on education. Teacher education is known to be the pillar behind all educational disciplines due to its capacity to deliver the education and training of the prospective teachers or pre-service teachers. With regards to arrival of globalization, there is a clear global paradigm shift in teacher training and education. A study was conducted to explore the role played by National Teaching Council (NTC) in bringing paradigm shift in teacher education in India National Curriculum Framework for Teacher Education (2009). The quality of pre-service biology teachers' education does not only depends on professionally sound and relevant curriculum, but also has a critical role to play on the way the implementation of the curriculum in Teacher Education and training Institutions. In turn, this depends on the proficiency of the faculty and its quality and the infrastructural and instructional facilities provided in the Institutions by policy makers. The NTC Act confers upon the Council to make every effort for improving the quality of teacher preparation in the country and also to ensure planned and coordinated development of teacher education.

The shift in paradigm just as constructivism is relatively a new paradigm which exerts major theoretical influence on the present Education system. Hence, there should be revitalization of whole Teacher Education programme including biology-specific programmes, which must give real thrust on constructivism. Gradually, thereafter NTC has adopted some strategies of constructivism in teacher education programmes to ensure quality in teacher education. The main paradigm changes in teacher education for which NTC has really taken several initiatives are: increase in duration of teacher education programmes, standard based curriculum, balance in theory and practice, shift from teacher to student- centred delivery system, quality assurance and shift in assessment procedures Deb Nandita (2013). A pool of studies have attempted

to make a systematic analysis of the recent steps of NTC in professional preparation of teachers and its effectiveness towards a paradigm shift in Teacher Education in India to suit international teacher professional standards (National Teaching Council, 2018).

The Policy emphasizes on work, skill and human oriented and shift from rote learning to critical and creative thinking. This has prompted couple of study in that field due to its importance in this globalisation era. Research shows that similar study was conducted by the National Educational Policy (NEP) in India. The aim was to shift the focus of students from “what to think” to “how to think.” The target of NEP (2020) is to keep students future-ready and to lay the foundations for new India and enable them for being vocal for local and feel proud for being Indian. New Education Policy 2020-A Paradigm Shift, NEP aimed to make India powerful, take it to greater heights, empower students and afford them opportunities to grow. The most vital changes come in teacher education. There is a great emphasis on Teachers education and improvement. Four year B. Ed program will be mandatory by 2030. Now the teacher will not be able to join the course accidentally but will join it with full planning and seriousness. NEP 2020 takes forward the education system towards International standards and it will have impact on the future of the Indian Education. Availability of teaching resources and textbooks in mother tongue teaching, availability of skilled teachers who understand thought behind NEP 2020 and removal of red tappism in the regulation and monitoring system, proper coordination between state run and private schools are some of the Challenges that Government may face in the long run.

The NEP deals with the school education and higher education. The policy aims to improve the quality of education by focusing on the following principles. (1)

Emphasis on conceptual understanding (2) Critical thinking and creativity (3) Unique capabilities (4) Respect for diversity and local context and local (5) Equity and inclusion (6) Continuous Review (7) Use of technology. Pedagogical structure-The positive changes in the structure of school education will bring a new era for the restructuring of education system. The new policy aims to divide school education into different stages on the basis of the need of the students where they have to expand their knowledge. (NEP, 2020) has been break-down of the existing 10+2 education pattern and instead of its introduced 5+3+3+4 structure of school education system that will focus on the 15 year of the schooling.

The aim of assessment would be to promote the students' learning that will be holistic 360-degree that reflects their progress of cognitive, affective and psychomotor domain. Report card would not to judge the students but provide the important information to the teachers and parents on how to support the each student. The Grade 3 examination, in particular, would test basic literacy, numeracy, and other foundational skills. The new Artificial Intelligence (AI) software would be developed to track the student's performance through their school year based on learning data for the students, parents and teachers. The NEP aim to abolish the coaching culture of education system and most importantly, Board exams will be redesigned to encourage holistic development; students will be able to choose many of the subjects in which they take Board exams, depending on their individualized interests. Board exams will also be made easier, flexible and best comprise of two attempts respectively. Through the testing Agency, students are allowed to select subject of their choice. Nonetheless, at higher education level, a recognized National Testing Agency (NTA) is mandated to offer a higher quality common aptitude test, to eradicate of taking coaching for these exams. However, some major changes in higher education are that the institute

are given grade autonomy instead of Affiliation to award degree. NEP also proposed the duration of undergraduate programme from 3-4 year span. By their fourth year, most of the students who want to go in entrepreneurship or research field are given another form of attention. Also, flexibility is given to students to Graduation entitled to get certificate diploma and degree after the study. Graduation is also held after 4 years with the final year being purely focused on research area and after that process, M. A will be one year. When it comes to Postgraduate education, the highlight is that M. Phil. programmes will be abolished under the reforms. The Government will setup world-class Multidisciplinary Education and Research Universities (MERUs) across India. These Universities will provide multidisciplinary education to students across country Deb Nandita (2013). Training for teacher is very important because teachers are of the builders of the nation. Quality pre-service and post-service is promoted in the multidiscipline institution. Virtual teaching, video lectures, tricks of skilled teaching can be delivered to every district, block in local language National Curriculum Framework for Teacher Education (2011).

2.4 Pre-service Biology Teachers' Self-efficacy Beliefs Toward the Use of Activity-based Method in Biology Teaching

Serious research in recent years has given great attention to the importance of self-efficacy concept in understanding teachers' and students' behaviours in the learning process (Savran, & Cakiroglu, 2003). This is evidenced by the plethora of researches conducted in order to measure teacher self-efficacy which affects the behaviours and attitudes of the teachers and the achievement of the students (Gibson & Dembo, 1984; Riggs & Enochs, 1990). A review of literature suggests that the self-efficacy perception of the teachers has been analysed in terms of students' achievement Tschannen-Moran, and Woolfolk-Hoy (2001), classroom management and time

management strategies (Gibson, & Dembo, 1984). Also, studies reported by Azar (2010) have established that self-efficacy of the pre-service biology teacher positively affects the achievements and attitude of the students. It has also been found to be directly related to the classroom behaviour of the pre-service biology teacher, involving openness to new ideas and the development of positive attitudes towards science teaching Woolfolk, and Hoy (2001). It is obviously clear that teachers who are more comfortable when teaching biology are more likely to devote more time to teaching it to make it more attractive, and are more likely to creatively teach it just as specifically required of pre-service biology teachers.

According to Ashton, Webb and Doda (1983) a teacher's sense of efficacy can be interpreted by the proposal of a blueprint which is made up of teaching efficacy, personal efficacy and personal teaching efficacy. Bandura (2012) pre-service biology teachers' belief about the general relationship between biology teaching and learning is teaching efficacy and this seems to be the same as Bandura's outcome expectancy. In a general thought, a pre-service teacher's own basic ideas about his or her own preparedness and effectiveness which is not specific to any particular situation is referred to as the teachers' personal efficacy. More so, personal teaching efficacy is conceived to be an amalgamation of a persons' teaching prowess and personal efficacy. It is considered to be important to keep teaching and personal efficacy as separate elements conceptually as suggested (Ashton et al. 1983). It is so because strategies for intervention to produce change may depend on the origin of a pre-service teacher's sense of efficacy.

Teachers who have a high efficacy, for instance, have been found to have the propensity to use the inquiry and student-centred teaching strategies (Cantrell, Young

& Moore, 2003). In another breath, it is worth to note that teachers who tend to have a low sense of efficacy are rather prone to use teacher-centred technique or method like lecturing, and or reading from prepared notes or even directly from textbooks (Czerniak, 1990). In the view of Gibson and Dembo (1984), teachers with higher stance on both teaching and personal teaching efficacy are known to be active and confident in their responses to students' needs and curiosities. Such calibre of pre-service biology teachers exhibit longevity, confidence and display maximum academic attributes in the biology classroom and show varieties of feedback.

According to the psychologist Bandura (1977) self-efficacy is the belief that one can achieve a particular goal within a specific time frame and under given conditions. It is trust in oneself in how he approaches objectives in his given job and how he solves the given set of problems (D'zurilla, 1971). It can be deduced from this theory that the issues can be solved resultantly if the individuals of that sector have a feeling of self-efficacy. Self-efficacy is essential part of Bandura's social learning theory, which emphasizes the role of socialization and behaviour modification in personality formation. According to Bandura (1977) The social cognitive theory proposes that people's actions and emotions, including their social behaviours and cognitive processes, are impacted by the behaviours they have witnessed, especially when faced with a problem that requires a solution. Since it is produced from external experiences and self-perception, self-efficacy is an essential component of social cognition theory (Anderson, 2007). It has a good effect on the outcomes of many situations. Self-efficacy is a representation of the individual's outlook on external social circumstances (Zhang, 2022). Bandura further hypothesized that pre-service biology teachers with higher levels of self-efficacy, thus, confidence in their capacity to perform well, are more likely to confidently embrace challenging activities, as the

prepared well-determined can easily overcome the hurdles. Self-efficacy which represents the pre-service biology teachers' confidence in their capability to teach biology successfully with the application of activity-based teaching method, can be investigated from the perspective of academic performance or educational objectives (Kuo, 2020). The concept of pre-service biology teachers' performance is significant in organizational theory and human resource management (Burke, 2023). Academic performance is important for students in realizing their optimum potential and for teachers to impart information and knowledge most efficiently and beneficially (Alam, 2022). In university faculties, self-efficacy can be defined as a professor's confidence in carrying out specific duties that fall under their core responsibilities of teaching and research (Morales, 2014).

In the quest to explore pre-service secondary science teachers' self-efficacy beliefs regarding biology teaching and to also compare pre-service secondary biology teachers' self-efficacy beliefs with regard to gender and educational level, data were collected by administering the science teaching self-efficacy beliefs questionnaire to 210 pre-service secondary science teachers. Results of the study showed that the pre-service secondary science teachers have very high level of secondary science teaching self-efficacy beliefs (Ngman-Wara, 2012). The pre-service secondary science teachers' self-efficacy beliefs and personal science teaching efficacy has always been known to be gender-related with the males having higher self-efficacy beliefs towards science teaching than their females counterparts and the latter having higher personal science teaching efficacy than their male colleagues. It is a bear fact that strongly efficacious pre-service biology teachers are very likely to confidently apply student-centred, inquiry or activity-oriented teaching strategy rather than the

traditional rote learning method during instructions which do very little to encourage students to be innovative and critical thinkers. It is not therefore surprising that self-efficacy and attitudes of pre-service teachers has been the focus of many studies (Enochs & Riggs, 1990; Morrel, & Carroll, 2003; Palmer, 2001). This points to the importance of pre-service biology teachers' self-efficacy in preparatory biology education programmes particularly in Ghana, where there is an immediate need for qualified biology teachers capable of innovative biology instruction as the Ghana government attempts to ensure that a pool of scientists are trained for business and academic research. It is also hoped that innovative biology instruction by pre-service biology teachers is capable of producing Ghanaians who are responsible local and global literates to provide scientific explanations to natural phenomena and to engage in evident - based discussions

Teachers' self-efficacy beliefs help us to predict their motivation and choice and to ascertain their actions in class (Aydin, & Boz, 2010). It is therefore important to determine pre-service teachers' self-efficacy beliefs related to biology teaching due to the fact that they will be teachers in the future (Cakiroglu, Cakiroglu, & Boone as cited in Aydin & Boz, 2010). Also, Aydin and Boz (2010) recommend that before planning suitable activities to enhance pre-service teachers, efficacy data should be gathered to determine whether their self-efficacy is high or low. It is however difficult to make changes in teachers' self-efficacy beliefs after the establishment of beliefs (Bandura, cited in Bursal, 2012). Therefore, an early detection of low self-efficacy in biology teaching is critically important in any education programme (Enochs, & Riggs, 1990). For this reason, investigations into pre-service biology teachers' self-efficacy beliefs have been highly provoked in Ghana and in other parts of the world.

Pre-service biology teachers' self-efficacy has been directly linked to teachers' classroom behaviour, their readiness to new paradigms and their approaches towards biology teaching. Riggs and Enochs (2002) suggest that teacher educators must be conscious of their students' beliefs and plan for experiences which will have positive impact on teacher personal biology teaching efficacy and outcome expectancy. In this vein, it is important to investigate pre-service biology teachers' self-efficacy beliefs especially in Ghana. This will provide a key platform to understanding how to increase their sense of efficacy in biology teacher education programmes. The results from study conducted by Fazal-ur-rehman (2023) showed that self-efficacy has a significant positive effect on the pre-service teachers' pedagogical knowledge, which depicts the same reconnection in the study conducted by Zakeri and Alavi (2011) while the same variables had a weak negative relationship in the study being conducted by Ramirez and Murdock (2017). Self-efficacy had a significant positive relationship with the pre-service biology teacher's knowledge which also confirms the findings of the studies being conducted by Depaepe and König (2018) and Abbitt (2011) while the same variables had an antagonistic relationship in the studies being conducted by Vaezi and Fallah (2011). Self-efficacy has shown a significant negative relationship with teacher's pedagogical knowledge confirming the results of Love, Findley, Ruble, and McGrew (2020) as well as Kirkiç and Çetinkaya, (2020).

Consistently for more than two decades, researchers have probed deeply into pre-service biology teachers' self-efficacy beliefs and made significant progress in understanding its nature, studied its relationship with other variables such as students' academic achievement as well as teaching methods and strategies and how they can be measured. Studies have equally been done on this construct involving pre-service biology teachers in teacher training institutions in Ghana. Therefore, this study was an

attempt to join the discourse. Also analysis of such beliefs may provide information that will direct training of biology teachers capable of innovative science instruction such as activity – based teaching method in Ghanaian schools in order to produce future students who are critical thinkers and are problem solving oriented as well.

2.5 Factors Affecting the Application of Activity-based Teaching of Biology

Activity-based teaching method is conducted through series of biology practical activities where learners are given maximum priority during the process. For quite a longer while now, these activities have been embraced and recommended for implementation in teaching biology by researchers and educators. The series of activities involve the learner entirely when well planned. Daba, Anbassa, Oda and Degefa (2016) are of the view that learners tend to be more successful when they practice the subject matter through series of practical activities. The Trends in International Mathematics and Science Study (TIMSS) 2007 study Sturman, Ruddock, Burge, Styles, Lin, and Vappula (2008) found out from a study in England that, learners are most likely to utilize more of their lesson time undertaking biology practical activities unlike learners in other countries and jurisdictions. Under the guise that an appreciable proportion of time in biology lessons is expected to be spent on practical work in England, it is equally important to be able to justify that amount of time by understanding the challenges and benefits methodology may come with.

Furthermore, pre-service teachers in England are often trained to use activity-based teaching approaches during classroom instruction due to its impact in teaching Chala (2019). Unambiguously, biology is fundamentally one of the disciplines of science implied in this regard. It is therefore imperative to know that observation of the surrounding and practical activities both outside and inside the biology classroom is

during instructions is very necessary so that there will be an understanding of the nature of biology and further motivate the learners. Moreover, Chala (2019) posits that in countries like Greece and Ireland, pre-service biology teachers occasionally use practical work, as a result of insufficient resources and their training orientations. It is however observed that even in countries where there are sufficient resources like Germany; the process seems to be more teacher-centred practical approach than any other approach. Such teacher-centred practical activities limit the interaction of learners with instructional resources. In Nigeria the objectives of studying biology in secondary schools revolves around hands-on activities and active learning (WAEC, 2014). Ackon (2014) from a study conducted in Ghana identified challenges including: time, attitude of the learner, resources and material as contributing to the minimum use of practical work in biology.

According to Azure (2015), a criticism often levelled against the teaching profession has been the too rapid induction of pre-service teachers to full-time teaching responsibilities with inadequate training and preparation in universities and colleges of education in Ghana. Student teaching practice is invariably too short, poorly supervised and generally a matter of survival rather than a genuine learning situation where different techniques can be tried out, repeated, and perfected (Anamuah-Mensah & Asabere-Ameyaw, 2009). Poor performance of students at both West Africa Senior School Certificate Examination (WASSCE) and JHS Basic Education Certificate Examination (BECE) is traceable to lack of proper and thorough grasp of concepts by students and pupils due to their teachers' poor teaching skills (Anamuah-Mensah et al., 2007). Some trainers and educators of prospective biology teachers in Ghana have observed that most Ghanaian pre-service biology teachers are inadequately prepared in biology content knowledge and pedagogy. Dey (2013) noted

that the greatest challenge confronting biology education in Ghana was the poor teaching methods of biology teachers, especially newly trained biology teachers and or pre-service teachers. Dey(2013) in a study appealed to management of teacher training institutions to examine the type of training being offered and review it to enable the products to perform satisfactorily. He noted that many pre-service biology teachers fail to acquire enough content and teaching skills to the detriment of their students' learning

Daba, (2016) found out that the pre-service biology teachers under study in Ethiopia were not equipped with the using of activity-based or laboratory practical method. The failure was orchestrated by the use of non-recommended teacher-centred method and others were the lack of equipment, absence of laboratories, and absence of a separate biology laboratory. Apparently, the failure to use the recommended activity-method ended up impacting negatively on the learner attainment, interest and attitude towards biology. From a similar viewpoint, Tiberghien, (2000) proposes and discusses a range of alternatives to practical work, including inquiry approaches, and more learner-to-learner interaction. Despite these controversies, many other studies continue to reiterate the position held by biology practical work. These activity-based methods are therefore not devoid of challenges (Ngesu, Gunga, Wachira, & Kaluku, 2014). Ameka and Nyakwara (2020) from their study reiterates challenges faced in practical activity-based biology teaching, however, their study focused on school administrative challenges.

Folorunso and Nwosu (2006) posit that engagement of learners when planning and executing improvisation of instructional material is an important aspect in biology instruction. During the teaching and learning of biology especially in second cycle

institutions, it is highly recommended that learners are fully involved in improvisation of biology materials when need be. The participation of learners in this vital instructional process tends to explore and expose them to broader knowledge and skills needed in the active learning process. The achievements of pre-service biology teachers perceive have often been found to be different from those identified by the learners. Some studies on practical work in secondary schools in Ethiopia have been conducted to identify factors hindering its proper implementation (Chala, 2019). Studies conducted in Ethiopia have shown that secondary students are never exposed to the practical experiences specified in the prescribed science curriculum. This is attributed to the teething challenges that limit this important undertaking. During every biology practical activity, it is pivotal to draw the attentions of learners to its purpose as well as the learning objectives in turn increase its effectiveness as a learning experience process and allow the students to benefit from it better. Also, if the goals and objectives are not exposed in terms of being able to apply scientific knowledge, skills and concepts involved are most likely to be a threat of students' simply acknowledging procedures during performing practical. Properly planned biology practical however, have been found to stimulate learners and engage them so as to learn at different levels. By so doing, the activities challenge them not only mentally but also physically in a manner that other science experiences may not. Score (2009).

Activity-based method of teaching biology can motivate learners by stimulating interest and enjoyment, be used to teach laboratory skills, enhance the learning of biology, give insights in to the subject area and develop expertise in using it and, develop scientific attitudes such as open mindedness and objectivity (Hodson, 1990; Imanda et al, 2020). Well planned activity-based method can stimulate and engage

students' learning at different levels, challenging them mentally and physically in ways that other science experiences cannot (Score, 2009). This conform to the study by Daba et al. (2016) which revealed that most of the learners under study reported that the activity-based they had been exposed to made them develop more interest to learn. However, these findings are in contrast to those by Negassa (2014) who found out that the learners under study were not interested in conducting practical activities.

Chala (2019) discovered that teaching biology with activity-based teaching methods have ability to provide good opportunities for students to apply their newly acquired knowledge and skills. As a result, learners are able to gain first-hand experience and interaction with the phenomena. The teaching of science in general with a sole aim of understanding on the part of the learners is grounded in the conceptual change theory. Biology for that matter being a science discipline too requires conforming to this. Achimugu (2014) observes that effective biology learning encompasses experimentation that involves hands-on and minds-on activities so that the learners can have a better understanding of the concepts and skills. This is because experimental methods enable students to verify theories, laws and principles surrounding science phenomena. Kulshretta (2013) from a study in India observes that some advantages of practical activities in science teaching include; skills development, planning, manipulation of equipment, observation, analysing, evaluating, experiential learning, testing out own ideas, testing out theories, developing of problem solving strategies and team work. Other importance as per Achimugu (2014) are: taking learning responsibility, nurturing self-learning, students work at their own pace and level, supporting differentiation by outcome, task and questioning. It is an indication that the benefits are varied from various researchers.

From the study of Imanda, Omwenga, Andima and Obuba (2020) they found out that when activity-based teaching method is planned and administered appropriately, it contributes positively to the learner attainment. Learners are expected to have a better performance when they undergo instruction via practical approaches that encompass process skills. This means that proper planning of activity-based teaching method affects the use of the method. This position is further supported by various other studies (Ndioho, 2007; Ekon & Eni, 2015; Ongowo & Indoshi, 2013). This benefit goes a long way in assisting learners beyond school life since biology as a subject deal directly with the learners' life, health and surrounding. Sadhana (2017) is of a similar standpoint that activity-based teaching method needs to be encouraged and practiced while rote learning should be discouraged. When learners are engaged in practical learning the outcomes from the process are more permanent, meaningful and concrete.

Ackon (2014) observes that science practical has a significant contribution to learner academic attainment. Learners who are taught through well planned practical approach have been observed to gain higher academic attainment as compared to those that are taught via the expository approaches. Similar observations have been observed from a study by Gituthu (2014) who observes that, learner or student-centred teaching approaches have a contribution towards learner achievement in biology examination. The study also found out that the declining pattern in learner performance in biology was an attribute of the negative attitude of teachers towards the learner-centred instructional approaches. Practical work is a learners-centred instructional approach which is powerful as part of heuristic teaching approach. Ngakhala, Toili and Tsingalia (2017) reiterate that the poor attainment by learners in biology practical examination might be as a result of poor teaching methodologies and

inadequate exposure of learners to the prescribed practical knowledge that is expected to mould them in the scientific way of life. Without an iota of doubt, it is therefore consistent from varieties of studies that activity-based teaching method should have impact on learner attainment provided it is well planned and implemented. It has therefore been found to be more effective in improving and enhancing appropriate teaching and learning especially when well planned in secondary biology. There is a need for a teacher to adequately plan for the various activities for there to be an increased level of value from the practical activities.

Nonetheless, activity-based teaching method/approach as envisaged in the literature has a myriad of challenges; equally there are benefits of applying it in the biology classroom. The most common benefits are expected to reflect other anecdotal evidence. Pre-service biology teachers under the study revealed that well planned practical activities, motivate and engage learners' learning at different levels. This ends up challenging and provoking their thinking in ways that other science experiences may not. Activity-based method of teaching biology leads the students to develop a bridge between what they can observe and handle (hands-on) and scientific knowledge (brains-on). This creates a link between biological knowledge and the real world. These findings corroborate those by Hunde and Tegegne (2010) who reported that science practical laboratories have a myriad of benefits ranging from making learning concrete to setting up a foundation for science education.

Hude (2010) discovered that when practical activity is of good quality the students can be engaged more, it can also make them develop the necessary skills, and enable them to have an understanding of scientific investigation process leading to better understanding of new concepts. Another benefit of experiencing biology practical

work is that it brings about to the acquisition of an understanding of hazard and risk in the learning environment. Safe teaching and learning environment birth atmosphere that minimizes infection and transmission of some communicable and contagious infections amongst stakeholders. Since biology as a subject features living organisms and their natural habitats, precaution is a necessity in dealing with it. This, if not mitigated may result in to a pandemic like the case of Covid-19 which has greatly impacted negatively on the education sector (Areba, 2020).

Studies by Hude (2010) further revealed that activity-based biology teaching tends to put biology into context. It allows the subject to be unique in the field of science as a natural science. This projects it as a constituent of natural creativity. The learners turn to be more creative during its study and through that they become problem solvers and critical thinkers in the mainstream field of science more specifically biology. Creativity is paramount when attempting to solve some of the pertinent problems that emerge in our daily life activities both locally and internationally. These problems are made up of issues pertaining to environmental pollution, human diseases, HIV/AIDS and terrorism etc. This concurs with the sentiments by Ameka and Nyakwara (2020) that discovered that no course in science including biology shall ever be complete without including a practical activity component. The practical activities need to be conducted by individuals either in biology laboratories or in classes during instructions. At school level, practical work is considered more important in biology because of the fact that we learn best by doing. Scientific practices and applications are thus rendered more meaningful. Sufficiently enough, there are glaring evidences that when learners observe a material and handle it, then there will be concrete and active learning unlike if they just hear about it or see it from far away.

As Gituthu (2014) contents, new concepts that are introduced during activity-based methods in biology teaching actually make the learning process to largely be inquiry-oriented. Science and for that matter biology is a practically oriented field in where learners are required to observe the real world through it. Practical activities being real create opportunity to imbue the practical phase to the theory. This boosts the learners' confidence in aspects of the theoretical content and phases that they go through during learning while under training in their various schools. By doing so, the learners are able to prove that biology as a science works since practical can be implemented at all group levels involving a few learners in each group (Kie, 2006). This encourages development of group involvements such as communication, cooperation and collaboration. It also tends to targets the affective domain of knowledge as per Bloom's taxonomy of objectives. Another phase of its' effect is that, practical activities promote understanding of biological concepts and principles. A practical activity is carried out by learners individually or in groups. Each learner or group of learners simultaneously perform an identical experiment. Learners can also perform different experiments in turns to give of them chance to perform all the experiments. This approach is normally applicable when resources or equipments are not sufficient. This approach is advocated for by various scholars (Imanda, et al, 2014). However, Etiubon and Udoh (2017) obtained contrasting findings.

2.6 Conceptual Framework

The conceptual framework for the study relates well with Bandura's Social cognitive theory and his construct of self-efficacy beliefs towards science teaching (Bandura 1997). It depicts the relationship between the pre-service biology teachers' professional knowledge and their self-efficacy beliefs and their combined influence or effect on the pre-service biology teachers' use of activity-based teaching method. The

pre-service biology teachers' professional knowledge is the precursor to their self-efficacy beliefs towards the use of activity-based teaching method in biology lessons. It is discovered that the higher professional knowledge of the pre-service biology teacher, the more likelihood that he or she will have a high self-efficacy beliefs towards the use of activity-based teaching method (Farooq & Shahzadi, 2006). Likewise pre-service biology teacher with low professional knowledge may have low self-efficacy beliefs towards the use of activity-based teaching method.

Pre-service biology teachers enter the University of Education, Winneba to pursue B.Sc. Biology Education programme in order to be trained to become competent biology teachers at the Senior High School (SHS) level, both nationally and internationally. The programme spans four years of full-time with study Objective of seeking to equip pre-service biology teachers with relevant teaching skills, enabling them to teach confidently at the SHS level. Pre-service biology teachers develop their professional knowledge in biology teaching when they become educated through a range of biology courses that promote the development of appropriate teaching aptitudes and skills, and the provision of pedagogical experiences on which the pre-service biology teachers can build a sound philosophy and approach Specific objectives

They turn to appreciate the beauty of biology in explaining nature opportunities to develop their unique pedagogical content knowledge (PCK) through curriculum and methodology study. This help them to organise their creative knowledge, practical skills and research abilities to design teaching and learning materials for use in teaching biology in the senior high schools. As part of the training, pre-service biology teachers take a course titled Pre-internship Seminar (EDP 361) in their sixth

semester that prepares them for the practicum in the seventh semester (Azure, 2015). During the Pre-internship seminar course, pre-service biology teachers hold microteaching sessions in which they present miniature lessons. During these sessions their peers act as their class students for the model lessons. They record their lessons with video-tapes for playback and reflection. They proceed for internship in basic and senior high schools for mentorship and supervision before graduating. Through this process, pre-service biology teachers gain professional knowledge. The training they acquire through the programme prepares them for engaging in learner-centred teaching approaches including activity-based teaching approach. This professional knowledge gained from the programmes would enhance the capability to use the approach, hence their high self-efficacy beliefs towards the use of activity-based teaching. The conceptual Framework that guided the study is presented in Fig. 2.1

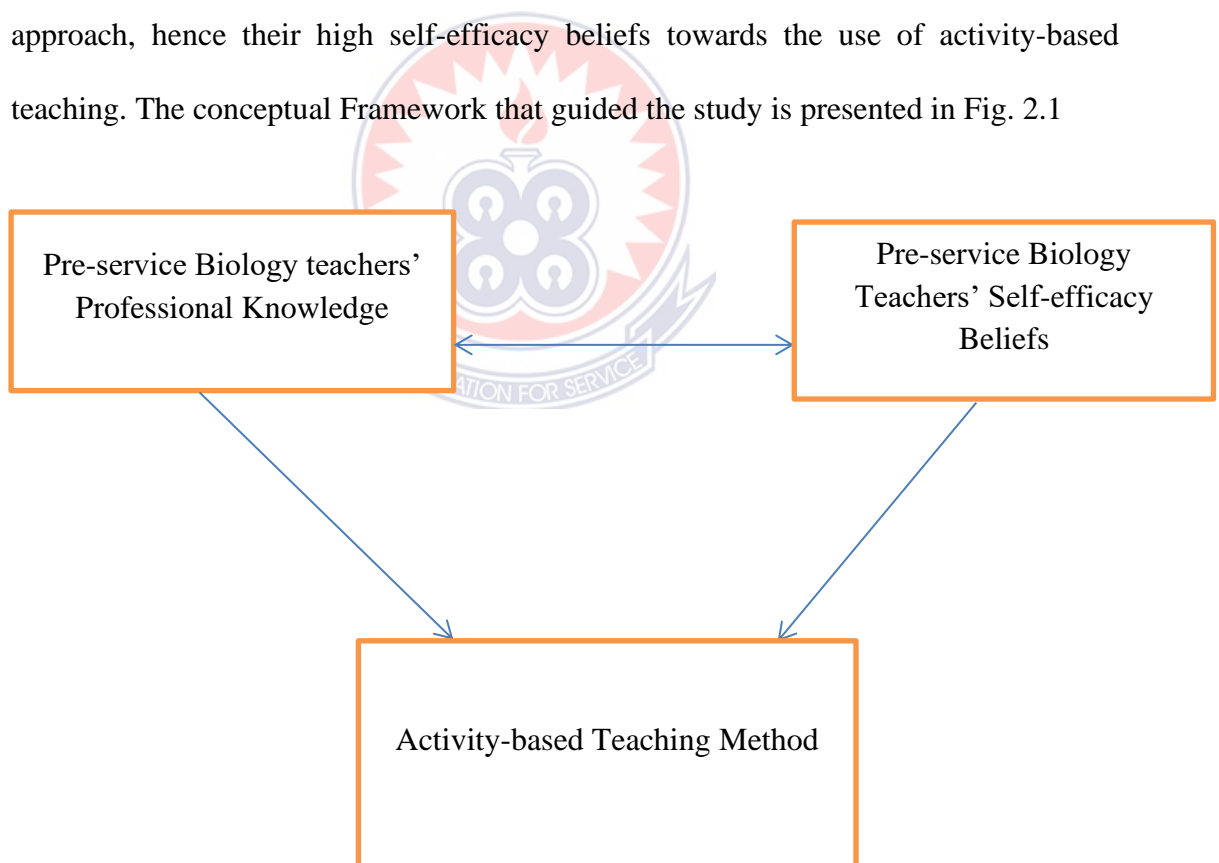


Figure 2.1: Conceptual Framework

The framework unveils the relationship among pre-service teachers' Professional knowledge, self-efficacy beliefs and activity-based teaching method in producing future prospective biology teachers who are critical thinkers and problem solving oriented. This will enable them become responsible Ghanaian local and global citizens. Pre-service biology teachers' self-efficacy has a significant positive effect on their professional knowledge and the teachers. This depicts the same reconnection in the study conducted by Zakeri and Alavi (2011). This significant positive relationship between the pre-service biology teachers' professional knowledge and their self-efficacy beliefs is also confirmed by the findings of the studies being conducted by Depaepe and König (2018) and Abbitt (2011). This implies that Pre-service biology teachers' professional knowledge and self-efficacy beliefs depend on each other. It further interprets that pre-service teachers with higher level of professional knowledge gain strong beliefs in their self-efficacy. Self-efficacy level of the pre-service biology teachers profoundly affects the teachers' performance which is influenced by their professional knowledge. Pre-service biology teachers with greater level of self-efficacy beliefs are more likely to feel motivated and develop wiliness to take on tasks and challenges, which can lead to improved performance in the implementation of activity-based teaching method and better results (Prifti, 2022). While those with lower level of self-efficacy beliefs on the contrary can lead to lower performance in activity-based teaching method, as they may become less motivated to take on tasks and challenges (Mamolo, 2022). In view of this it is therefore important for pre-service biology teachers to recognize the importance of their self-efficacy beliefs and to strive to increase it in order to step up their performance.

Pre-service biology teacher's capacity to instruct students and run their classroom with effective activity-based teaching method largely depends on the self-efficacy of the

biology. Pre-service biology teachers acquire the necessary professional knowledge, comprehend their learners, interact with them, work cooperatively with their peers, and create their own fair and uniform groups during biology lessons. The pre-service biology teachers must possess variety of pedagogical skills, including the ability to create engaging lessons, establish classroom rules, manage students' behaviour, and differentiate instruction (Park, 2017). Pre-service biology teachers must be knowledgeable about their subject area, have excellent communication and critical thinking skills, and be able to use technology to enhance instruction (Roberts, 2022).



CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter elaborates on the following aspects of the current study: Research design and procedure, the study area, Population and sampling procedure. It further presents on instrumentation of the study, validity and reliability of the instruments, data collection procedure and also captures the data analysis.

3.1 Study Area

The current study was done in the University of Education, Winneba located within the heart of Effutu municipality. Winneba is a town and the capital of Effutu Municipal assembly in the Central Region of Ghana. It has a population of about 55,331. Winneba, traditionally known as Simpa, is a historic fishing port, lying on the south coast, 140 kilometres (90 mi) east of Cape Coast. The University of Education, Winneba has its three campuses within Winneba (South Campus, Central Campus, and North Campus). The university has another satellite campus at Ajumako also in the Central Region of Ghana. The study was conducted at the South campus of the university. This is because the participants form part of the Faculty of Science Education which is situated on the campus (Fig. 2)

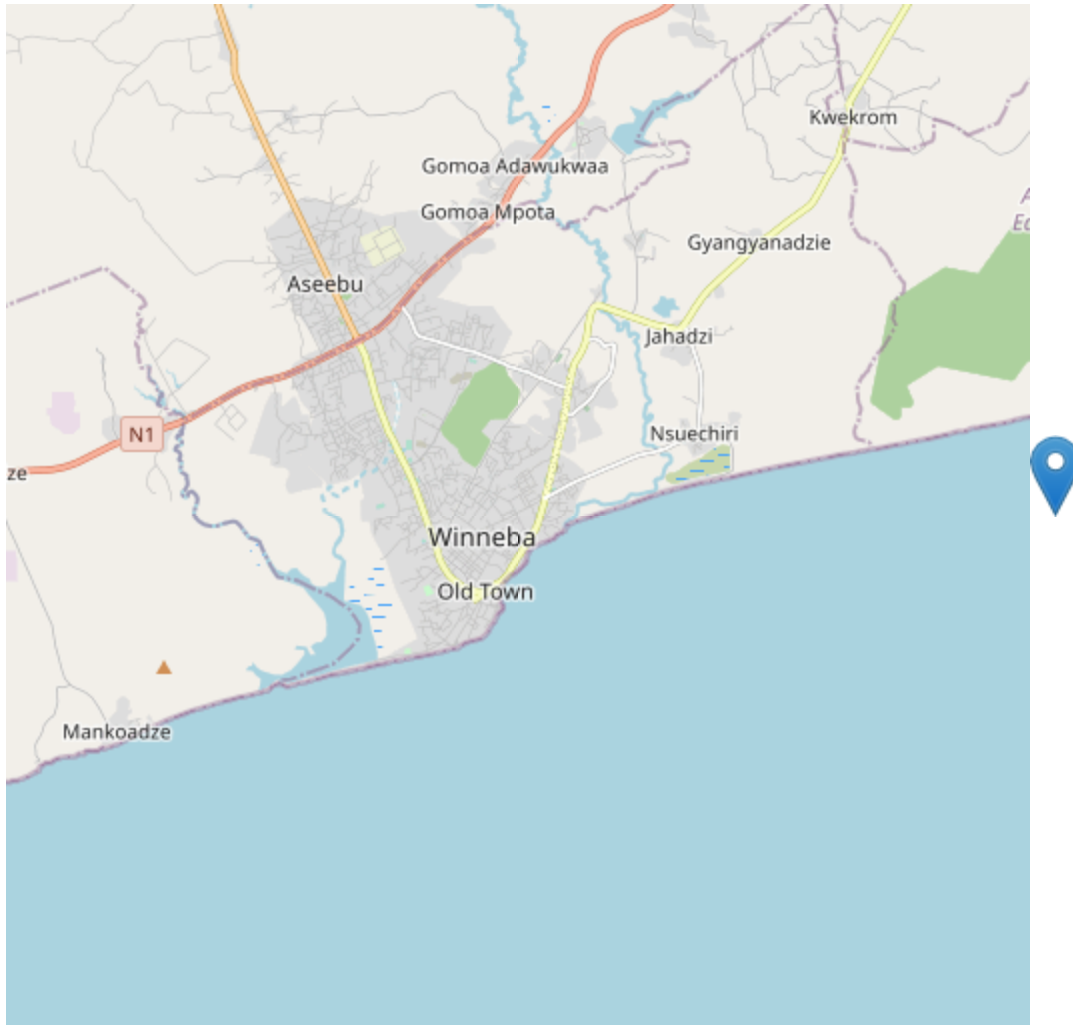


Figure 2: Map of Study Area

3.2 Research Design

The study used a descriptive survey research design. This type of research provides a numeric description of attitudes, opinions or trends of a population by studying a sample of that population. According to McNeill and Chapman (2005), it is a method of obtaining large amounts of data, usually in a statistical form, from a large number of people in a relatively short time using closed-ended questions. Mugenda and Mugenda (2003) point out that descriptive survey method is the process of collecting data from a sample group so as to determine the status of that group as per that time with respect to one or more variables. It is concerned with the present and attempts to

determine the status of the phenomena being investigated (Singh, 2006). It describes a given state of affairs which exists at a particular time and requires a direct contact with individual whose characteristic, behaviours and attitudes are relevant to the investigation. This is a good method to use to get data about what, why, how many. It deals with questions that seek to find out about the nature of the target population and is best utilized when control of dependent and independent variables is not easily achievable or desirable. It is instrumental when the sample has to be studied in its natural setting and occur in the current time or the recent past. This research design is appropriate in this current study because it allows the researcher to assess a wider variety of behaviours and other phenomena than can be studied in a typical naturalistic observation study (Marczyk *et al.*, 2005).

3.3 Population

A population is defined as all members of any well-defined class, people events, and objects on which the results of research can be applied or the findings can be generalised and clarified by the objectives of study (Ary, 2006). However, some researchers use the word 'universe' in place of 'population', but there is a minute difference between these two.

In the process of sampling, two types of population are considered. The first is the target population, which refers to the entire group of individuals or objects to which researchers are interested in generalizing the conclusion. The target population for this study was all pre-service teachers pursuing Bachelor of Science in Biology Education at the University of Education, Winneba.

The other type of population was the accessible population. This population is a subset of the target population and it is also referred to as the study population. The

accessible population for the current study is fourth year pre-service biology teachers studying Bachelor of Science in Biology Education at the University of Education, Winneba.

3.4 Sampling Technique

Census sampling technique was employed in this study. Sample in this regard is selected group of some elements from the population. It is from the study of this sample that something is known and said about the whole population. The assumption is that what is revealed about the sample will be true about the population as a whole. But it may not be true always as it depends on the way the sample is drawn. If the sample is a replica of the population, the foregoing assumption is true. But, if it is biased, such inferences about the population cannot be true. Census sampling was used because the study deliberately targeted the fourth year Bsc. Biology Education interns students whose sample size is not large but small.

The sample size for the study was 87 which comprised 49 females and 38 males. The pre-service biology teachers pursue four year Bachelor of Science degree in biology education programme made up of three years of taught courses in biological science, educational courses including curriculum and methodology in order to become future biology teachers in the second cycle institutions. The method courses for teaching biology include biology curriculum and curriculum material studies and assessment in biology. They also take a course titled Pre-internship Seminar that prepares them for the practicum. They proceed for internship in basic and senior high schools for mentorship and supervision as part of their training process. This makes them acquire creative knowledge, practical skills and research abilities to design teaching and learning materials for use in teaching biology in the senior high schools.

3.5 Instrumentation

The data for the study were collected with the use of adapted Pre-service Teachers' sense of efficacy scale (TSES) originally developed by Tschannen-Moran and Hoy (2009). Professional knowledge was also explored using Pre-service Professional Knowledge test Instrument.

3.6 Teacher Sense of Efficacy Scale [TSES]

Teacher Sense of Efficacy Scale (TSES), sometimes referred to as the Ohio State Teacher Efficacy Scales due its origin, was adapted and used in this study to measure the level of pre – service biology teachers' self-efficacy beliefs towards activity-oriented teaching method. The original instrument was developed by Tschannen-Moran and Woolfolk Hoy (2009) and is widely and commonly used by researchers worldwide to measure the self-efficacy beliefs of teachers in research. The TSES instrument emphasises the measurement of TSE in three classroom teaching domains: maintaining classroom discipline, involving students in teaching, and employing various instructional strategies (Perera et al., 2019). The domain specificity was intended to increase the predictability of the construct and increase the practical applicability of research findings to the specific contexts of teachers' work (Avanzi et al., 2013). However, individuals' perception of their capability varies across different domains and dimensions within each domain (Yang et al., 2022); hence, if TSE is measured in too narrow a domain, educators may be deterred from applying it in practice (Bandura, 2012). As noted by Bandura (2012), individuals tend to evaluate their self-efficacy towards specific tasks simultaneously with an assessment of their general ability. For example, teachers might hold a broader general view of their capability as a teacher in the school context, alongside their self-efficacy for specific tasks. These theoretical assumptions have been confirmed by variations in TSE for

subscales and the integrated information on the higher-order overall TSE (Perera et al., 2019).

Similar to the original instrument, the adapted TSES instrument consisted of 24 items in five-point Likert type scale ranging from one (nothing) to five (a great deal). The three subscales or domains: Efficacy in Student Engagement containing 12 items: Items 1, 2, 9, 12, 15, 17, 18, 19, 20, 21, 22, 23 Efficacy in Instructional Strategies containing 7 items: Items 3, 5, 6, 8, 11, 14, 24 with Efficacy in Classroom Management also containing 5 items: Items 4, 7, 10, 13, 16. The respondents were guided to response to each of the items by selecting one of the following options (1) Nothing, (2) Very little, (3) Some influence, (4) Quite a bit (5) A great deal depending on the extent to how they can apply the statements in each of the items of the instrument.

3.7 Pre-service Teachers' Professional Knowledge Instruments

In investigating the pre- service biology teachers' professional knowledge, fifty (50) test items were employed under the subdivisions of professional knowledge. With regard to Content-Related knowledge, two tests to ascertain pre-service biology teachers' content-related knowledge i.e., CK and PCK were developed. Pre-service teachers' CK was assessed through the use of 20 multiple-choice items which were to ascertain their knowledge of evolution (7 items), genetics as well as microbiology (7 items), and morphology (6 items). Pre-service teachers' PCK was achieved through the use of 20 items (open ended and multiple-choice items). The items focused on pre-service teachers' knowledge of students' understanding (5 items), their knowledge of instructional strategies for teaching (5 items), knowledge of assessment (5 items), and knowledge of the biology curriculum (5 items). Items were developed and judged

by experienced biologists and biology educators of different institutions and universities. Item development was as well supported by a 22-page manual which clarified the theoretical conceptualization of CK or PCK, gave item examples, and provided essential information about item formats and item construction (Raykov, 2014). Equally, the instrument before its adaption for the current study was as well carefully investigated and judged by experienced biologists and biology educators of different colleges of Education in Ghana, university as well as SHSs after the instrument was presented to them by researcher for their judgment. Item development was supported and guided by relevant syllabus of the University of Education, Winneba in order to strengthen its relevance. Beyond that, the manual referred to relevant contents of CK or PCK which could be used in item development.

The original instrument was developed and used in Germany where Contents were selected based on an in-depth analysis of the curricula of 16 representative universities and the national teacher education standards of Germany (Großschedl, Harms, Glowinski, & Waldmann, 2014; KMK, 2008). In this study, the instrument was adapted with the items being selected based on the UEW syllabus for Bsc. Biology Science Education. A coding schema was provided for each item by researcher which was in line with the developers of the original instrument In order to ensure face validity. Items were systematically judged and revised by the experienced educational researchers. The CK and PCK tests are a mixture of dichotomously (0 = wrong answer vs. 2 = correct answer) and polytomously scored items [0 = wrong answer; 1 = answer half correct (partial credit); 2 = correct answer]. In order to compute inter coder reliability with regard to the open-ended items, the researchers randomly selected about 15 % of the test booklets.

The Pedagogical Knowledge of Pre-service biology teachers was assessed using 10 multiple-choice items. These Items were originally developed by educational researchers in Germany to measure the pedagogical knowledge levels of pre-service biology teachers of selected 16 universities. The items were adapted for this study for similar purpose based on the curriculum for Bsc. Biology Science Education. The items focused on pre-service teachers' knowledge of students' understanding (5 items) as well as on their knowledge of instructional strategies for teaching (5 items). All items were dichotomous (0 = wrong answer vs. 2 = correct answer). Before administering, the instrument it was well scrutinised by the supervisor.

3.8 Pilot Testing of Instruments

Piloting is a small test administered before conducting an actual study. Its purpose is to reveal defects in the research instrument (Jack & Norman, 2006). It is a small scale-study conducted prior to conducting an actual experiment, designed to test and refine procedures." Fraenkel and Wallen (2004) indicated that it is highly recommended to conduct pilot test with an instrument so as to be able to revise the items based on the outcomes of the pilot test. This will enable the researcher to determine whether the items possess the required qualities of instrument. According to Fraenkel and Wallen (2003), schedule for pre-testing of instrument can reveal ambiguity, poorly worded questions that are not understood and unclear choices as emphasized. In the current study, 22 fourth year pre-service biology teachers of the University of Education, Winneba were used. They were actually not part of the main research. This was done fundamentally for the purpose of certainty, cost management as well as convenience. This was done in order to establish Cronbach reliability coefficients of the instruments and its subscales. The factor q coefficient for Pedagogical knowledge was .75, which indicates acceptable reliability.

3.9 Validity

Jack and Norman (2003) defined validity as the appropriateness, correctness, meaningfulness and usefulness of the specific inference's researchers make based on data they collect. Validity is the most excellent available approximation to the truth or falseness of a given conclusion, suggestion or inference (Cook & Campbell 1979). Simply put, it is the accuracy of the measurement.

In order to ascertain the validity of the instruments for the study, the instruments for both TSES and professional Knowledge were carefully developed in relation to the research objectives. During the instruments development, the researcher consulted experts and experienced biology educators from UEW, Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (AAMUSTED-M) as well as Second cycle institutions. The questionnaires were also given to colleagues of researcher to review and to comment on face validity after which it was given to the supervisor for assessment and corrections where necessary. Necessary corrections and modifications from supervisor's remarks were effected accordingly. The researcher ensured there was no ambiguity in the items of the instruments.

3.10 Reliability

Reliability is the degree to which a test is devoid of error of measurement. It is the consistency and the dependability of a test results. Jack and Norman (2003) stated that reliability gives consistence scores or answers provided by instrument. In reliability researchers try to figure out how consistent scores obtained are for each individual after it has been administered or used by different ratters.

In order to determine the reliability of the instruments for the study, the data obtained from the pilot testing of the TSES and PK instruments were analysed with the

modified and advanced version of SPSS which is SmartPLS 4.0.9.8 computer software for windows to determine the Cronbach Alpha reliability coefficient. They were 0.91 and 0.82 respectively indicating that the instruments had very strong internal consistencies. According to Frankel and Wallen (2003), the value of reliability coefficient should be 0.7 or preferably higher when tested. Therefore in comparison, the value 0.91 and 0.82 for the adapted instruments indicated clearly that there is higher internal consistency in the items. Albeit, the identified challenges was rectified before the actual administration of the instruments to collect data for the study.

3.11 Data Collection Procedure

The data for the study was collected or obtained through virtual means. The instruments were administered simultaneously online. The participants were contacted individually through their mobile phones and personal computers by the researcher. The researcher was also allowed to join an online class chat group of participants through a link by the administrators of the group. They were briefed and were guaranteed of confidentiality with end to end encryption. The participants virtually received the instruments with a unique link after they had agreed to respond. After completion, the responses were received and recorded accordingly for analysis by the SmartPLS version 4.0.9.8 computer software for windows.

3.12 Data Analysis

According to Frankel and Wallen (2003), data analysis is the process of making gathered data for a study simpler in order to make it comprehensive. The aim of data analysis is for highlighting useful information, suggesting conclusion and supporting decision making about the data (Ader, 2008).

The data for this study were analysed with the SmartPLS 4.0.9.8 software. Descriptive statistics were employed to describe and summarise the data. The variables for the study were defined, coded and inputted into the computer software. Unique numbers were assigned to each item on the questionnaire as special codes for the analysis.

The descriptive function of the computer software was used to organise the participants' background data into frequencies and percentages respectfully. It was also used to organise participants' responses to the items of the questionnaires into frequencies, percentages, mean scores and standard deviations. The results were then presented in frequency tables.

Model evaluation was conducted in order to determine the strength of items of the instrument on the pre-service biology teachers' professional knowledge and self-efficacy beliefs towards the use of activity-based teaching methods. Assessment of the measurement model was conducted employing the Partial Least Squares Structural Equation Modelling (PLS-SEM) approach and SmartPLS 4.0.9.8 software. This evaluation focused on ensuring the convergent and discriminant validity of the constructs, along with the reliability of the measurement. Evidence from the results showed that the factor analysis conducted on the test items yielded factor loadings that exceeded the threshold of 0.8, underscoring the robust representation of the variables by their respective latent construct. Conventionally, factor loadings exceeding 0.5 are indicative of a strong correlation between the items and the latent constructs, thereby establishing the solidity of the factor. In the context of Pre-service Teachers Sense of Efficacy, the test item PSTSE 6 emerged as the most strongly associated with the latent construct, as evidenced by its highest factor loading. This

was closely followed by PSTSE 5, thereby suggesting a significant contribution to the measurement of Pre-service Teachers Sense of Efficacy.

Table 1: Estimates from the Measurement Model

Variable	Items	Loadings	Cronbach's Alpha	CR	AVE	HTMT
Pre-service Teachers Sense of Efficacy	PSTSE 1	0.607	0.910	0.841	0.734	0.530
	PSTSE 2	0.660				
	PSTSE 3	0.559				
	PSTSE 4	0.525				
	PSTSE 5	0.806				
	PSTSE 6	0.864				
	PSTSE 7	0.632				
Professional Knowledge	PK 1	1.000	0.822			

Similar to Pre-service Teachers Sense of Efficacy, Professional Knowledge exhibits a robust relationship with its associated test items, with PK 1 demonstrating the strongest factor loading value of 1. The loading value of 1 indicates a perfect correlation between the test item and the latent construct. This was expected because the variable is an aggregate of the score of the questions answered by the respondents. This reinforces the validity of the factor model in capturing the significant variance within the variables. The construct, Pre-service Teachers Sense of Efficacy was

assessed for internal consistency using Cronbach's alpha coefficients and composite reliability (CR) values. The Cronbach's alpha coefficients for Pre-service Teachers Sense of Efficacy was found to be 0.910 with (CR) value being 0.841, indicating a high level of internal consistency among the items measuring these constructs. This suggests that the test items in the Pre-service Teachers Sense of Efficacy scale is well-correlated, providing a reliable measure of the constructs

The Average Variance Extracted (AVE) values for the constructs of Pre-service Teachers Sense of Efficacy were estimated to be 0.734. This demonstrates a robust convergent validity, indicating that the items in the Pre-service Teachers Sense of Efficacy scale are indeed capturing the same underlying construct.

The Heterotrait-Monotrait Ratio (HTMT) is 0.530. Generally, an HTMT value below 0.85 implies sufficient discriminant validity, meaning the constructs are unique and do not significantly overlap. An HTMT indicates strong discriminant validity, suggesting that the constructs model for the study are distinct and measure different phenomena, thereby strengthening the model's robustness and the reliability of the derived findings.

Table 2: Variance Inflation Factor (VIF) of Test Items

Variable	Test Items	VIF
Pre-service Biology Teachers Sense of Efficacy	PSTSE 1	1.378
	PSTSE 2	1.463
	PSTSE 3	1.349
	PSTSE 4	1.333
	PSTSE 5	2.291
	PSTSE 6	2.758
	PSTSE 7	1.454
Professional Knowledge	PK 1	1.000

The Variance Inflation Factor (VIF) of the test item was estimated to assess multicollinearity within the test items of the instruments. The results from the statistical analysis show that the Variance Inflation Factor (VIF) values for all test items fall within the acceptable range of 1 to 5. This suggests a moderate correlation among the test items, but not severe enough to require corrective measures. The moderate correlation also indicated that the test items did not significantly overlap in information, thus maintaining the uniqueness of the information each test item offered. The results therefore estimated that the relationship between Professional Knowledge and Pre-service Teachers Sense of Efficacy is strong due to the robustness of the test items and their measures. This indicated that Professional Knowledge significantly impacts Pre-service biology teachers' sense of efficacy with a significant influence. This means that the higher pre-service biology teachers increase in professional knowledge level, the more they develop confidence and competent that are essential attributes of self-efficacy in order to effectively apply activity-based teaching method during biology lessons.

3.13 Ethical considerations

Issues regarding ethical consideration are of great importance in any educational research. It involves voluntary participation, informed concern and absolute confidentiality between researchers and participants (Trochim, 2006). In view of this Gray (2019) insists on the need for researcher to obey the principle of ethics when conducting educational research. In this study the pre-service biology teachers were not forced into participating in the work but instead, the researcher deliberately took time to inform participants the procedures and the need to participate in the study. They were only engaged in the study upon their permission and consent. They were assured of confidentiality as well anonymity and that any information they provided

would not be made available to the public and that all information was end-to-end encrypted online. Clarification was made on items where necessary during the period participants were contacted.



CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter presents the results from the findings of the study. It begins with the presentation of demographic data of respondents, outcomes of the reliability test performed to gauge the internal consistency of the responses to the survey items with their corresponding interpretations. The chapter also presents the model estimation and analysis, which aims to investigate the correlation between professional knowledge and pre-service teachers' sense of efficacy towards activity-based teaching method. Additionally, the chapter draws comparisons and contrasts between the findings and the prevailing literature and theory on the subject. The presentations of the results were done according to the research questions. The discussion of results was done simultaneously with the presentation.

4.1 Demographic Data of the Respondents

The data on the demographic characteristics of the participants is provided in Table 3 and Table 4 below. Out of 100 participants, 87 accepted to respond to the questionnaires with 100% return rate. Amongst the 87 were 49 female constituting majority group (56.32%, n=49). 38 were male constituting the minority group (44.82%, n=38). The dominant age group ranged between 24 and 26 years (39.10%, n=34) and less dominant age group was 31 and above (5.75%, n=5).

Table 3: Demographic Data of participants

Variable	Category	Frequency(N)	Percentage (%)
Gender	Male	38	43.68
	Female	49	56.32
Total		87	100

Source: Field Data 2024

Table 4: Demographic Data for Participants

Variable	Category	Frequency (N)	Percentage (%)
Age	18-20	8	9.20
	21-23	21	24.14
	24-26	34	39.10
	27-30	19	21.84
	≥31	5	5.75
Total		87	100

Source: Field Data 2024

4.2 Research Question 1: What is the Professional Knowledge Level of Pre-service Biology Teachers?

Table 5 presents the results obtained by the participants in the professional knowledge test instrument. The instrument that was used to measure the professional knowledge of the pre-service biology teachers was an adapted instrument that comprised 50 items. In addition, Table 5 contains percentage frequencies of respondents. The scores obtained by the pre-service teachers were aggregated into mean scores, mode as well as percentages and frequencies. The possible minimum score of 0 indicated lowest knowledge level and 50 as the average or pass score and the maximum score was 100 which indicated highest knowledge level. The results of the respondents have been presented in Table 5.

Table 5: Descriptive Statistics of Pre-service Biology Teachers' Responds to Professional Knowledge Test

Score	Frequency (N)	Percentage (%)
46	1	1.1
48	2	2.3
54	2	2.3
58	1	1.1
60	1	1.1
62	3	3.4
64	2	2.3
66	3	3.4
70	5	5.7
72	4	4.6
74	3	3.4
76	4	4.6
78	5	5.7
80	6	6.9
82	9	10.3
84	14	16.1
86	11	12.6
88	6	6.9
90	3	3.4
92	2	2.3
Total	87	100

The scores obtained ranged between 46 and 92 with a mean score of 73.1. From Table 5, only 3 (3.4%) participants out of 87 obtained scores below the average (50) whilst 84 obtained above the average. This is an indication that most of the pre-service biology teachers had high level of professional knowledge.

The mean score 73.1 which is above the medium mark of 50 strongly represent a high professional knowledge. Also from Table 5, the mode (84) with a frequency of 14 indicates that many of the pre-service biology teachers have higher professional knowledge level.

4.3 Research Question 2: What is the Level of Self- efficacy Beliefs of the Pre-service Biology Teachers with Regard to Activity-oriented Teaching Method?

The objective of this question was to assess the levels of pre-service biology teachers' self-efficacy beliefs towards the use of activity- oriented teaching method during teaching and learning of biology. TSES instrument was employed to collect data from participants for the analysis. Descriptive statistics was used for the analysis of the sample responses on the subscales of the instrument. Descriptive statistics for each of the items of the subscale have been presented below. Table 6 presents the Mean Scores, Standard Deviation and Percentage Frequencies of Respondents' Score on Efficacy of Students Engagement Subscale of the TSES Instrument. Mean ratings of the TSES from 1.0 to 1.75 indicates low, 1.76 to 2.25 moderate, 2.26 to 3.25 high and 3.26 to 4.00 and above indicates highest. The results from respondents are presented in three parts with respect to the subscales or domains of the instrument. The first part represents the efficacy of students' engagement of the TSES instrument.

Table 6: Item Mean Scores, Standard Deviation and Percentage Frequencies of Respondents' Score on Efficacy of Students Engagement Subscale of the TSES Instrument

Item Number	Mean Score	SD	Agree %	Neutral %	Disagree %
1	4.02	0.94	80.2	10.1	9.7
2	3.61	1.32	73.2	15.2	11.6
9	3.84	0.99	71.4	16.7	11.9
12	4.32	2.10	88.1	9.5	2.4
15	3.83	1.14	59.5	26.2	14.13
17	2.90	1.36	71.6	21.4	16.7
18	4.44	0.89	78.7	13.9	7.4
19	4.13	0.90	84.7	9.6	5.7
20	4.57	0.90	94.9	2.6	2.5
21	3.89	1.33	84.7	8.2	7.1
22	3.75	1.14	68.7	10.3	21.0
23	4.13	0.90	79.4	12.9	7.7
Total Mean score, SD	47.43	13.91			

From the table, the means scores of items ranged between 2.90 and 4.57 the standard deviations also ranged between 0.89 and 2.10. Almost all the items had mean scores above the general mean of 3.0 of the scale with the exception of item 17 (M= 2.90, SD =1.36) that had mean scores less than the general mean of the scale. The total mean score and standard deviation of the subscales were 47.43 and 13.91 respectively. Generally the results indicate that the pre-service biology teachers are capable of exhibiting confidence during teaching due to high self-efficacy beliefs with regard to activity-based teaching method.

The results from Table 6 indicated that 80.2% of the respondents agreed that they can guide students to manipulate biology equipment which allows students to fully participate in the lesson (Item 1). In addition, 88.1% of the respondents can foster student creativity in biology which improves comprehension of the lesson (Item 12). In addition, greater percentage (71.4%) of the participants indicated that they can do much to help students' value cooperative/group which is very crucial in activity based teaching method (Item 9). This can better be realised when teachers are able to integrate students well based on their achievement levels. This was illustrated by most of the participants (94.9%) on how well they can integrate very capable students and low achievers to work together as a group to achieve a common goal (Item 20). Nonetheless, a little above average of the participants (59.9%) indicated that they can involve all students to actively participate in group work regardless of their biological concept level (Item 15) even though it is very imperative to activity- oriented teaching strategy. It is very important to note that large section (71.6%) of the participants expressed that they can do much to help students to relate their real life experiences with that of biology instructional objectives (Item 17). It was in deed not surprising when the results proved that 84.4% of the respondents showed positive responds

towards how well they can facilitate interactive learning amongst their students (Item 19) because of its direct relationship with the former. It was heart-warming that great percentage (84.7%) of the participants could go to the extent of assisting families in helping their children perform well in biology (Item 21). Many of the respondents agreed (79.4%) that they can do much to link their biology lessons to previous lessons (Item 23). This often becomes possible when the lesson is planned well. This reflected on the good percentage (68.7%) of respondents who indicated how much they can do to prepare biology lessons to properly suit the level of students (Item 22). This assertion was supported by majority of respondents (78.7%) who indicated that they can go to a larger extent to provide an alternative explanation or example when students are confused (Item 18). Since questions enable students to think critically, it was not surprising when great percentage of the participants (73.2) asserted that they can do much to help students think critically

Furthermore, the outcome from the Students engagement subscale was not really different from that of the instructional subscale see (Table 7). The Table presents Item Mean Scores, Standard Deviation and Percentage Frequencies of Respondents' Score on Efficacy in Instructional Strategies Subscale of the TSES Instrument. The trends were observed to be similar for the item mean scores of the subscale

Table 7: Item Mean Scores, Standard Deviation and Percentage Frequencies of Respondents' Score on Efficacy in Instructional Strategies Subscale of the TSES Instrument.

Item Number	Mean Score	SD	Agree %	Neutral %	Disagree %
3	3.81	0.95	91.2	5.4	3.4
5	4.34	1.89	90.5	7.1	2.4
6	2.65	0.93	68.4	19.7	11.9
8	4.48	0.92	83.6	9.2	7.5
11	3.91	1.30	80.8	12.9	6.3
14	4.22	1.18	76.2	14.3	9.5
24	3.74	1.21	78.6	10.9	10.5
Total Mean score, SD	27.15	8.38			

The mean scores of the items of subscale Efficacy in instructional strategies also ranged between 2.65 and 4.48 with subscale mean score of 27.15 and standard deviation of 8.38. With regards to the standard deviations of the items, the range was observed to be between 0.92 and 1.89. The results from this table also mean that the pre-service biology teachers demonstrate a high sense of efficacy beliefs since they demonstrate a strong ability in terms of instructional strategies during teaching and learning of biology.

Majority of the respondents (91.2%) indicated that they can improve students' curiosity during biology instructions to make the students perform better than usual (Item 3). Furthermore, 68.4% of the pre-service biology teachers indicated that improvisation techniques is key in activity-based teaching method and they can do much to guide students to apply improvisation techniques when necessary to meet biology practical objectives (Item 6). Some quite a good number of the respondents (90.5%) were also of the view that to make your expectations clear about student participation during biology lesson is very important (item 5) because it encourages effective lesson to a greater extent. They can collectively help in dealing with

disruptive students (Item 24) which was observed by appreciable percentage (78.6%) indicating their strong will in doing so. Similarly, clearly and comprehensive explanation to lessons cannot be over sighted as far as activity – based teaching method in biology is concerned in order to improve students’ understanding. On that note, most of the participants 76.2 % agreed to show positive responds on how much they can do to improve the understanding of a student who is missing biology concepts (Item 14). This can be articulated to the extent of crafting good question during instructions. Majority of the participants (80.8%) however indicated to a higher extent they can do to craft good questions for students during biology lessons (Item 11). Moreover, majority (83.6%) indicated positive responds on how well they can establish routines to keep biology instructional activities running smoothly which is related to asking and answering of questions during biology lessons (Item 8).

Also Table 8 presents the Efficacy in Classroom Management Subscale of the TSES instrument. From the results of the Table 8, similar trend can be observed. The mean scores of the items of the subscale ranged between 2.24 and 4.71 with subscale mean score of 18.43 and standard deviation of 5.4.

Table 8: Item Mean Scores, Standard Deviation and Percentage Frequencies of Respondents’ Score on Efficacy in Classroom Management Subscale of the TSES Instrument

Item Number	Mean Score	SD	Agree %	Neutral %	Disagree %
4	3.40	1.13	86.1	7.5	6.4
7	2.24	1.14	63.7	11.5	24.8
10	4.10	1.43	68.6	18.7	12.7
13	3.98	1.01	75.6	14.1	10.3
16	4.71	0.92	77.3	9.6	13.1
Total Mean score, SD	18.43	5.4			

The standard deviations of the items ranged from 0.92 and 1.43. These results can also be interpreted that the pre-service biology teachers have high sense of efficacy in classroom management.

The overall mean scores and standard deviation for the TSES scale was found to be 93.01 and 27.69 respectively. These scores generally mean that the participants exhibit very high efficacy beliefs with regard to the use of activity-based teaching method in the teaching and learning of biology. Participants' percentage scores for each item of the TSES scale are presented in Table 6, Table 7 and Table 8 with respect to its subscales. The results indicated very high self-efficiency with regards to classroom management. In view of that an appreciable percentage (68.6%) asserted that they can gauge student comprehension of what they have taught with regard to creativity.

It has been established that cooperative or group studies play key role in activity-based teaching method. Classroom management cannot be overlooked in line with this objective. This was indicated by (86.1%) of the pre-service teachers who believed this within the category of classroom management subscale on how much they can do to motivate students who show low interest in biology practical lessons (Item 4). Slightly contrary to that some 77.3% indicated their strong will to do well to establish a classroom management system with each group of students (Item 16) regardless their biological backgrounds. This will lead to achieving biology experiment expectations. It was not very surprising when 75.6% of the pre-service biology teachers indicated that they can go to a larger extent to meet their biology experiment expectations (Item 13). Alternatively, about 63.7% of the participants only revealed that they can do much to responds to difficult questions from students (Item 7).

4.4 Research Question 3: To What Extent do the Professional Knowledge and Self-Efficacy Beliefs of Pre-service Biology Teachers Influence Their Use of Activity-based Teaching Method?

In this study, the researcher sought to determine the extent to which pre-service biology teachers' professional knowledge and self-efficacy beliefs influence their use of activity-based teaching method during biology lessons. This evaluation focused on ensuring the convergent and discriminant validity of the constructs, along with the reliability of their measurement. Results from respondents proved that the factor analysis conducted on the test items yielded factor loadings that exceeded the threshold of 0.8, underscoring a robust representation of the variables by their respective latent construct. Conventionally, factor loadings exceeding 0.5 are indicative of a strong correlation between the test items and the latent constructs, thereby establishing the solidity of the factor. In the context of Pre-service Teachers Sense of Efficacy, the test item PSTSE 6 emerged as the most strongly associated with the latent construct, as evidenced by its highest factor loading. This was closely followed by PSTSE 5, thereby suggesting a significant contribution to the measurement of Pre-service biology teachers' Sense of Efficacy with direct relationship with the professional knowledge. These results indicated that the items in the instrument had statistically robust reliability to their measure, hence making their convergent and discriminant validity strong. This enables the strength of the test items to be very solid therefore supporting the association between the latent construct and their measure. This suggested a statistically significant influence of the professional knowledge level of the pre-service biology teachers with regards to the use of activity-based teaching method in biology.

Similarly, the Pre-service Teachers' Professional Knowledge and Sense of Efficacy exhibited a robust relationship with its associated test items, with PK 1 demonstrating the strongest factor loading value of 1. The factor loading value of 1 indicates a perfect correlation between the test item and the latent construct. This translates directly in the effectiveness of the pre-service biology teachers' ability to apply activity-based teaching method during biology lessons. This indicates a robust relationship amongst the variables for the study. The construct, Pre-service Teachers Sense of Efficacy was assessed for internal consistency using Cronbach's alpha coefficients and composite reliability (CR) values. The Cronbach's alpha coefficients for Pre-service biology Teachers Sense of Efficacy was found to be indicating a high level of internal consistency among the items measuring these constructs. This suggests that the test items in the Pre-service Teachers Sense of Efficacy scale is well-correlated, providing a reliable measure of the constructs. This further strengthens the extent to which pre-service biology teachers can use activity-based teaching methods. The Average Variance Extracted (AVE) values for the constructs of Pre-service Teachers' Sense of Efficacy were estimated to be 0.734. This demonstrates a robust convergent validity, indicating that the items in the Pre-service Teachers Sense of Efficacy scale are indeed capturing the same underlying construct. The strong correlation of the pre-service biology teachers' sense of efficacy and the measures also suggested a high level of internal consistency amongst the items measuring the corresponding contrasts. These results confirm the significant influence of the pre-service biology teachers' sense of efficacy toward the use of activity-based method. Pre-service biology teachers with high level of efficacy beliefs are more likely to exhibit confidence which teaching biology with activity-based teaching method.

The Heterotrait-Monotrait Ratio (HTMT) is 0.530. Generally, an HTMT value under 0.85 implies sufficient discriminant validity, meaning the constructs are unique and do not significantly overlap. This indicates strong discriminant validity, suggesting that the constructs model for the study are distinct and measure different phenomena, thereby strengthening the model's robustness and the reliability of the derived findings. The results from the statistical analysis show that the Variance Inflation Factor (VIF) values for all test items fell within the acceptable range of 1 to 5. This suggests acceptable correlation among the test items to require corrective measures. The moderate correlation also indicates that the test items do not significantly overlap in information, thus maintaining the uniqueness of the information each test item offers. The uniqueness of the test items as illustrated in Table 1 strengthens the items discriminant validity which validates the influence of pre-service biology teachers' professional knowledge and self-efficacy beliefs towards the use of activity-based method during biology lessons. It further strengthens the robustness of the test items indicating that pre-service biology teachers' sense of efficacy largely depends on their professional knowledge which enables them to gain enough confidence to apply activity-based teaching method.

4.5 Research Question 4: What is the relationship between pre-service biology teachers' professional knowledge and self-efficacy beliefs towards the use of activity-based teaching method?

This question sought to determine the extent to which professional knowledge and self-efficacy beliefs of the pre-service biology teachers influence their use of activity-based teaching method. To address this question, a null hypothesis was set as below.

Testing the Hypothesis with Respect to Research Question 4

H₀: There is no statistically significant contribution of professional knowledge level and TSE beliefs of pre-service teachers towards the use of activity-based teaching method.

H₁: There is statistically significant contribution of professional knowledge level and TSE beliefs of pre-service teachers towards the use of activity-based teaching method.

Results from the Pearson correlation on the effect pre-service biology teachers' knowledge and self-efficacy beliefs on the use of activity-based teaching method is represented in Table 9 with correlation significant at the 0.01 level.

Table 9: Results of correlation Analysis of pre-service biology teachers' professional knowledge and their self-efficacy beliefs towards activity-based teaching method

Variables		PK	SEB	P-Value
Professional Knowledge	(PK)	1.00	0.73	0.01
Self-efficacyBeliefs	(SEB)	0.73	1.00	

The results of the correlation revealed a strong positive correlation existed between the pre-service biology teachers professional knowledge and their self-efficacy beliefs towards the use of activity-based teaching method ($r=0.73$, $p<0.01$). This indicated that there was statistically significant relationship between the pre-service biology teachers' professional knowledge and their self-efficacy beliefs towards the use of activity-based teaching method. This suggests that whenever the pre-service biology teachers have high professional knowledge level, they develop strong beliefs in their capabilities towards the use of activity-based teaching method effectively. The teacher would exhibit confidence during biology instructions. This was supported by

Tschannen-Moran and Hoy (2001) that in order to effectively apply activity-based teaching method during instruction, one should support the development of self-efficacy beliefs of the pre-service biology teachers through effective professional training.

4.7.1 Discussion of Findings of the Study

This section entails discussion of the findings of the study. The findings are discussed under themes from the research questions.

4.7.2 Professional Knowledge Level of Pre-service Biology Teachers Towards Activity-Based Teaching Method

The training of pre-service biology teachers for second cycle institutions in Ghana continues to receive massive attention. This has become very imperative to education stakeholders within the domain of education. It had been discovered from previous researches Ngman – Wara (2016) that some pre-service biology teachers display low efficacy beliefs which mostly were discovered during their supervision when they make certain comments that supposed to mean so. Other studies also discovered similar findings (Berry, Daughtrey, & Wieder, 2010; Farooq & Shahzadi, 2006; Kelly, 2019).

From the analysed results, pre-service biology teachers showed a high professional knowledge level (See Table 5). The results from all the domains of professional knowledge indicated same. These results were similar to the results obtained by pre-service biology teachers' from Germany (Teacher Education and Development Study: Learning to Teach; (Buchholtz, Kaiser, & Blo'cke, 2014).

The pre-service biology teacher's professional knowledge level has a direct bearing on their performance; hence the many educational researches focused attention on it. A number of researches concluded that the pre-service biology teacher's professional knowledge level influence their propensity to apply effective teaching methods towards biology (Bloome & Delaney, 2012; Tatto & Senk, 2011; Wang & Lin, 2005). Furthermore, cross-sectional analyses with pre-service biology teachers indicate an increase in CK and PCK from the beginning to the end of higher education (Bloome et al., 2008; Kleickmann et al., 2013) considerably increase their professional knowledge between the early and later periods of their professional training. This is very crucial as far as biology teaching and learning is concerned. If the pre-service biology teachers' professional knowledge towards laboratory and hands-on activities are extended into their future biology lessons their students are likely to acquire essential process skills such as recording, communicating, predicting, inferring and interpretation of data. These skills are emphasised in the biology syllabus in Ghana (Curriculum Research Development Division, 2010, 2012).

Essential process skills such as recording, communicating measuring together with higher order skills like predicting, inferring, hypothesizing etc. are acquired through activity –based lessons (Mastropieri & Scruggs, 1994). The pre-service biology teachers with high level of professional knowledge will assist their students to conceptualise the biology topics that will be taught. This is because increased conceptualisation of biology topics among learners occurs through inquiry-based teaching that engages students in the investigative nature of biology (Yara, 2009). In addition, students engaged in activity-based lessons develop increased creativity, better attitudes towards biology, and have improved logic development, communication skills and reading-readiness (Haury & Rillero, 1994).

The high level of professional knowledge (Table 5) of the pre-service biology teachers could be attributed to the science method courses the pre-service teachers offered during their course of study and the demonstration lessons (pre-internship and internship courses) organised for them during their professional training. This is supported by Ginns and Watters (2005) assertion that the way people were taught biology during their earlier school days also influences the attitudes they develop towards biology and biology teaching. So biology tutors are encouraged to serve as role models, make biology teaching and learning fun and design enough demonstration lessons for pre-service teachers in order to leverage positive attitudes of the latter.

4.7.3 Pre-service Biology Teachers' Level of Self-efficacy Beliefs with Regards to Activity-based Teaching Method

The results from data analysed in this study proves very high levels of self-efficacy among the participants. This implies that the pre-service teachers have quite a strong conviction of their ability to execute activity - oriented teaching method effectively and will be able to guide targeted students to successfully achieve their learning goals in biology. Most of the respondents acknowledged that how well a teacher can integrate very capable students and low achievers to work together as a group to achieve a common goal is an integral part of activity-oriented teaching method and hence, they largely agreed to do much in that aspect (94.9%) that an additional effort by the biology teacher can transform a low achiever in class to high achiever. This means that teacher preparation institutions should endeavour to increase the self-efficacy of their pre-service teachers during their training. This when done will serve as the foundation for their attitudes and beliefs (Sarikaya, 2004) towards effective biology teaching (See Table 6).

The findings of this study also revealed further very strong science teaching self-efficacy beliefs of the pre-service biology teachers. It was clearly observed that the pre-service biology teachers have developed a strong zeal to take up the responsibility of their future students' learning achievements and goals. However, the relatively average level of how much the pre-service biology teachers can involve all students to actively participate in group work regardless of their biological concept level (59.9) raises questions on whether these pre-service teachers are adequately ready to take up the challenge of effective biology teaching in the second cycle institutions. About 63.7% of the pre-service teachers indicated that they can respond to difficult questions from their students during biology lessons and as high as 80.7% of the respondents claimed they have what it takes to craft good questions for students to answer during instructions. This is contrary to the finding of Wenner (1993) where only 2% of respondents in a similar study were positive of being able to answer student's questions.

Also, the pre-service teachers largely (88.1%) asserted that they would do much to foster student creativity in biology. They were ready to meet those skills by guiding students to apply improvisation techniques when necessary to meet biology practical objectives. Again, 71.4% would want to help their students' value cooperative/group learning whilst 77.3 % were poised to establish a classroom management system with each group of students to achieved learning goals for activity-based teaching method.

The very high self-efficacy levels of the pre-service biology teachers implies that they have quite a strong conviction of their ability to execute teaching skills effectively and will be able to lead their students to successfully achieve their learning goals as well as meeting the objectives of the SHS biology syllabus. The generally high level of

teaching self- efficacy of the pre-service biology teachers found in this study might be partly attributed to the many pedagogical content and practicum courses studied by the pre-service biology teachers during their professional training in their training institution (Czerniak & Chiarelott, 1990; Cantrell, Young & Moore, 2003). However, this must be encouraged and or improved in order to train adequate competent and committed teachers to address the high demands of teachers in the education sector due to the influence and effect of professional knowledge on the self-efficacy beliefs of pre-service biology teachers towards activity-based teaching method (Bandura, 2006; Pajares, 2005). This is because various studies suggest that teachers' efficacy may be significantly influenced by their teacher preparation programme Flores (2015) especially biology method courses (Bayraktar, 2011; Bursal, 2010; Bleicher & Lindgen, 2009). Also, teacher preparation institutions should endeavour to increase the self-efficacy of their pre-service biology teachers. This when done will serve as the foundation of their effective use of the activity-based teaching method (Sarıkaya, 2004) during biology teaching. Most studies had acknowledged that students who perform well in biology are highly related or influenced by the efforts of the biology teacher. This means that pre-service biology teachers with high level of efficacy-beliefs can transform even a low achiever in class to high achiever.

In this study, efficacy beliefs of teachers are their ability to teach biology concepts and skills in such a manner that learners achieve their learning objectives and goals. It involves judgement of the individual teacher's strengths in helping students to achieve relevant goals (Tschannen-moran & Hoy, 2009). The biology teacher's self-efficacy beliefs has critical role to play on the performance of students, hence a pool of educational researches focused attention on it. Although, there are several instruments to measure self –efficacy of pre-service biology teachers, the researcher adapted the

TSES scale for this study due to its, strong validity, reliability and relevance to the objective of the study. A number of researches concluded that the teacher's self-efficacy correlates with effective teaching and learning attitudes towards science (Anderson, Greene, & Loewen 1999; Ashton & Webb, 1986; Ross, 1992)

4.7.4 The Extent to Which the Professional Knowledge and Self-efficacy Beliefs of Pre-service Biology Teachers Influence Their Use of Activity-based Teaching Method

In order to determine the extent to which professional knowledge and self-efficacy beliefs influence the use of activity-based teaching method by pre-service biology teachers, the strength and robustness of the test items of the instruments towards the teaching method was conducted. The results of the study revealed that there is a strong positive correlation and robustness of relationship between the professional knowledge of the pre-service biology teachers and their self-efficacy beliefs toward activity – based teaching method. The results also unveiled a strong professional knowledge within all the domains leading to very high self-efficacy beliefs of the pre-service teachers which greatly influence their ability to effectively apply activity-based teaching method. In the context of Pre-service Teachers Sense of Efficacy, the test item PSTSE 6 emerged as the most strongly associated with the latent construct, as evidenced by its highest factor loading. This was closely followed by PSTSE 5 thereby suggesting a significant contribution to the measurement of Pre-service biology teachers Sense of Efficacy with direct relationship with the professional knowledge. This means that they are directly related. Increasing in professional knowledge will increase self-efficacy beliefs of the pre-service biology teachers which will affect their use of the activity-based teaching method. This is due to the strong relationship amongst the variables because the study has established that in

order to have confidence to effectively apply activity-based teaching method by the pre-service biology teachers, they must have a corresponding high professional level. This finding corresponds to a study by Shulman (2015). Many studies (Kunter & Voss, 2011; Schmelzing et al., 2013) have highlighted the extent of influence of teachers' professional knowledge and self-efficacy beliefs towards the quality of classroom instruction and students' learning success and have concluded that there is a great influence between the variables indicating that pre-service biology teachers with high level of professional knowledge have the propensity to effectively apply activity-based teaching method during biology lessons.

Furthermore, the Variance Inflation Factor (VIF) of the test items for the measurement was conducted to estimate the relationship amongst the variables by estimated multicollinearity within the test items. The results from the findings imply that the model is a suitable representation of the data for all the variables from the pre-service biology teachers. The results are interpreted as very strong relationships amongst the variables because in order to have a strong self-efficacy, pre-service teachers must have a very high professional knowledge level in order to have great confidence during biology instructions. A study to measure pre-service biology teachers' professional knowledge subject-specificity of test construction indicated the effectiveness and influence of the their professional knowledge and self-efficacy beliefs in relation to activity-based teaching method subject-specific sequences of learning and teaching (e.g., Kunter, Baumert, et al., 2013; Seidel & Shavelson, 2007).

Several researches have it that lower knowledge levels lead to lower self-efficacy beliefs as found in this study Wenner (1995) found negative relationship between knowledge level and self-efficacy beliefs towards teaching science in 1992 study

which is contrary to the follow up study in 1994 that disclosed a non-significant correlation between the two variables in his work. Research has it that only CK cannot be associated to Professional knowledge regardless its great influence on it. There is great need for biology teacher education programmes to provide more contents that encompass all the facets of the professional knowledge. This will provide an antidote to enhancing self-efficacy beliefs of pre-service biology teachers since they are prospective biology teachers.

4.7.5 Relationship Between Pre-service Biology Teachers' Professional Knowledge and Self-efficacy Beliefs Towards the Use of Activity-oriented Teaching Method

The results of the Pearson correlation showed a strong correlation or relation between pre-service biology teachers' professional Knowledge and use of activity-based teaching method. It further indicated that increasing professional knowledge of pre-service biology teachers increases their self-efficacy beliefs which increase their propensity to apply activity-based teaching method during biology lessons. This means that pre-service biology teachers with higher professional knowledge level had a high level of self-efficacy and will be able to apply the activity-based method effectively.

Research by Farooq (2005) concluded that lower knowledge levels leads to decreased efficacy beliefs related to diminution of locus of control. Victor (2020) also concluded at the same conclusion. Trochim (2006) on the other hand found negative relationship between knowledge level and efficacy beliefs toward teaching method. One widely accepted solutions to improve self-efficacy beliefs is that teacher education programmes need to contain relevant content of professional development for pre-

service biology teachers because they will become teachers in future due to its influence and effect on their teaching method. Koballa and Crawley (2003) stated a scenario whereby elementary school teachers judged their ability to teach science to be low (belief), resulting in a dislike for science teaching (attitude) that ultimately translated into teachers who avoid teaching science which biology is not an exception.



CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This section of the study discusses the summary of the study, findings from the study and also conclusion of the study. Recommendations based on the findings of the study are also discussed in this chapter as well as suggestion for further study.

5.1 Summary of the Study

The purpose of this study is to investigate pre-service biology teachers' professional knowledge and self-efficacy beliefs towards effective application of activity-based teaching method. The research design for the study was descriptive. The study was conducted in the University of Education, Winneba where pre-service teachers who are on their mandatory internship programme were contacted virtually to respond to questionnaire test instruments as part of the study to obtain data. Adapted Professional Knowledge instrument and TSES instrument were used to collect data for the study. Descriptive statistics were used to analyse the data.

5.2 Findings of the Study

1. Results from the analysed data indicated that pre-service biology teachers had higher levels of professional knowledge.
2. The study also unveiled that the pre-service biology teachers had strong sense of efficacy beliefs with very few of the items indicating above average level.
3. It was also revealed from the study that pre-service biology teachers' professional knowledge and self-efficacy beliefs influence their use of can activity-based teaching method during biology lessons.

4. The relationship between pre-service biology teachers; professional knowledge and self- efficacy beliefs towards activity – based teaching method showed strong positive correlations when the Pearson correlation was conducted.

This implies that most of the pre-service biology teachers were enthused about their abilities to apply activity-based teaching method effectively to teach biology in the second cycle institutions during their future professional service. However, the pre-service teachers' responses on some items of Efficacy of students' engagement subscale implied slightly above average level.

5.3 Conclusion

The findings from the study showed that the pre-service biology teachers had high level of professional knowledge. Therefore, there is a great need for teacher training institutions and biology tutors to integrate activity-based biology content in their method of biology courses to always upgrade pre-service biology teachers' professional knowledge since they will be biology tutors in future. This will enable them obtain more confidence in preparation to become competent teachers in future. The pre-service biology teachers develop their professional knowledge in biology teaching when they become educated through a range of biology courses that promote the development of appropriate teaching aptitudes and skills, and the provision of pedagogical experiences on which the pre-service biology teachers can build a sound philosophy and approach. Specific objectives in teacher training institutions such as UEW. They turn to appreciate the beauty of biology in explaining nature opportunities to develop their unique pedagogical content knowledge (PCK) through curriculum and methodology study. This help them to organise their creative

knowledge, practical skills and research abilities to design teaching and learning materials for use in teaching biology in the senior high schools.

The self-efficacy beliefs of pre-service biology teachers towards teaching biology were found to be high. These beliefs are gained from a high professional knowledge level of the pre-service biology teachers. The results obtained from the data suggested that across all the three subscales of the TSES scale, pre-service teachers exhibited strong sense of efficacy. However results of some items showed average efficacy levels of the participant. This calls for courses design to tackle this finding.

Also, from the findings, pre-service biology teachers can effectively implement activity-based teaching method during biology lessons as data collected and analysed indicated very strong correlation amongst the variables. From the data, it can be said that participants have strong capability to implement activity-oriented teaching method. This capability had been correlated to strong sense of self-efficacy beliefs.

Additionally, the results of the study revealed that there is a strong positive correlation between professional knowledge of participants and their self-efficacy beliefs toward activity – based teaching method. The results also unveiled that a strong professional knowledge within all the domains leads to very high self-efficacy beliefs of the pre-service biology teachers which greatly impact in their ability to effectively apply activity-based teaching method. The results further, unveiled the robustness of the relationship between the professional knowledge of the pre-service teachers and their self - efficacy beliefs towards activity-based teaching method which were very strong.

5.5 Recommendations

The recommendations from this study are made based on the research findings. They will have a great impact in programme designing for teacher training institutions and educational policy makers.

1. Based on the findings from the analysed data that indicated that the pre-service biology teachers had higher levels of professional knowledge which is very essential to professional quality and for that matter, teacher training institutions must endeavour to maintain or improve their training skills in order to keep or better the standard of quality biology teachers.
2. The study also unveiled that the pre-service biology teachers had strong sense of efficacy beliefs. Therefore, during their professional training process, biology- content courses must be designed in a manner to positively influence the self-efficacy beliefs of pre-service biology teachers.
3. Due to the strong relationship between pre-service biology teachers' professional knowledge and self- efficacy beliefs towards activity – based teaching method, teacher training institutions must expand and improve their requisite instructional materials that will be required by educators and learners during their professional training processes in order to produce more pre-service biology teachers with high level of professional knowledge and self-efficacy beliefs in order to address the rising demands of quality teachers in the country and international world at large.

5.6 Suggestions for Further Study

The data collected were narrowed to delve into the professional knowledge of pre-service biology teachers and self-efficacy beliefs towards activity-based teaching method but in this research, observation of the pre-service biology teachers was not

conducted in order to determine the extent to which they can apply activity-based teaching method effectively. Therefore, in future the researcher suggests that observation must be carried out in a similar study to have comprehensive information on the influence of professional knowledge and self-efficacy beliefs on pre-service biology teachers' use of activity-based method of teaching.



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APPENDICES

APPENDIX A

PROFESSIONAL KNOWLEDGE TEST INSTRUMENT

**UNIVERSITY OF EDUCATION, WINNEBA
DEPARTMENT OF SCIENCE EDUCATION
FACULTY OF SCIENCE EDUCATION**

INTRODUCTION: This study is designed to help the researcher to examine the professional knowledge of the pre-service biology teachers with regards to teaching biology using activity-oriented method. This exercise is strictly for academic purpose; hence your views on this subject matter will be helpful. Your anonymity and confidentiality are confidently assured, and no part of your views will be used for any other exercise apart from what is intended for. You are guaranteed that all reactions are entirely for scholarly purposes and will be dealt with privately. May I have your permission to start the interview?

DIRECTIONS: Please from the alternatives **A – D** choose the option that best answer the questions bellow correctly and provide short answers to complete the questions with gaps. All questions carry equal marks

Evolution

1. Paw of a mole and extremity of a mole cricket.
 - a. Homologous
 - b. Analogue
 - c. Homonogous
 - d. Amalogue
2. Pectoral fin of a whale and foreleg of a horse.
 - a. Homologous
 - b. Analogue
 - c. Amalogue
 - d. Homonogous
3. The Idea of the survival of the fittest is attributed to
 - a. Gregor Mendel
 - b. Charles Darwin
 - c. Jean Lamarck
 - d. Alfred Russel Wallace
4. The evidence that evolution has occurred in living organisms comes mostly from fossils records found in
 - a. molten magma in the earth's crust
 - b. igneous rocks
 - c. sedimentary rocks
 - d. metamorphic rocks

5. In terms of evolution, variation among individuals of the same species would
 - a. Lead to reproduction barriers
 - b. play a role in natural selection
 - c. play a role in specification
 - d. lead to disuse parts
6. All the following describe genetic factor of variation except
 - a. Diet
 - b. epistasis
 - c. co-dominance
 - d. mutation
7. The emergence of several new parts from a single ancestor type is called
 - a. Convergent evolution
 - b. somatic mutation
 - c. natural selection
 - d. divergent evolution

Genetics and Microbiology

8. Choose the odd one out
 - a. Height
 - b. skin colour
 - c. blood group
 - d. intelligence
9. Which of the following pairs has not been matched correctly?
 - a. artery, vein
 - b. ileum, duodenum
 - c. sperm, blood
 - d. pelvic, girdles
10. The moulds obtained nutrition from dead and decaying matter which are called
 - a. Saprophytes
 - b. parasites
 - c. commensals
 - d. none of these
11. The physical traits that appears in an individual as a result of its genetic makeup is called
 - a. allele
 - b. genotype
 - c. phenotype
 - d. hybrid
12. What is probability of woman with blood group AB married to a man of blood group O, producing a child of blood group A
 - a. 0%
 - b. 25%
 - c. 50%
 - d. 100%
13. Fungi are important in the production of all the following commercial products except
 - a. bread
 - b. beer
 - c. cheese
 - d. rubber
14. Which of the following is **MOST** likely to have a rigid cell wall?
 - a. bacterium
 - b. archean
 - c. fungus
 - d. protozoan

Morphology

15. The cell wall of green plant is made up of.
 - a. Chitin
 - b. Polypeptides
 - c. Cellulose
 - d. Adenosine triphosphate
16. A fruit is matured
 - a. ovule
 - b. ovary
 - c. stigma
 - d. ovulate cone
17. Pores on the leave surface that functions in gas exchange are called
 - a. guard cell
 - b. subsidiary cell
 - c. stomata
 - d. phloem cell

18. All the following are functions of the root system except
a. storage b. anchoring the plant c. water acquisition
d. photosynthesis
19. Chlorophyll is found in which cell tissue?
a. mitochondrion b. chromosome c. nucleus d. chloroplast
20. The leaf-like structure that protects the budding flower is called
a. petals b. anther c. sepal d. style

Students understanding

A man decides to divorce his married wife due to the fact that she has consistently been giving birth to only female children after several attempts to deliver a male child which is preferred by the man.

The description of this phenomenon can be used with the intention to address a particular student's misconception in the area of genetics. With this, this misconception should be altered by conceptual change into a correct conception.

21. What misconception is likely to be held by the man?
a. The woman is a female b. The woman is immature c. The sex chromosomes of the woman is XY D. Mothers determine sex of children
22. What is the right conception to use to alter that misconception?
a. Sex is determine spiritually b. Sex is determine by the mother
c. Sex is determine by the father d. Sex is determine by family records
23. The percentage of giving birth to male child is
a. 25% b. 50% c. 75% d. 100%
24. The person who determines the sex of a child is
a. mother b. child c. father d. midwife
25. The sex-chromosome of the wife of the man is
a. YY b. XY c. YX d. XX

Instructional Strategies for Teaching

A simple leaf is boiled to halt all metabolic activities within it in biology laboratory

26. What will be the nature of the leaf after boiling?
- Weak and tender
 - Hard and rigid
 - Turgid and wrinkled
 - Plasmolysed and wrinkled
27. A particular scientific method that is a requirement to be communicated and practiced with students.
- observation
 - experimentation
 - testing hypothesis
 - formulating hypothesis
28. The stage where students begin to ask direct questions such as 'how' and 'why' is
- Observation
 - Experimentation
 - formulation of hypothesis
 - testing hypothesis
29. It is good to put extensive biological drawings on the board before the class starts so that
- learners can draw
 - the instructor can take control of himself
 - learners attention will be gained
 - instruction time will not be wasted
30. In organizing a field trip, informing learners about the objectives and expectations of the trip is part of
- preparing
 - planning
 - follow – up
 - conducting

Assessment

31. What will you do as a biology teacher to assure the content validity of your test?
- construct a table of test specification and use it for item construction
 - give the response to two raters to rate and compare the results
 - seek expert advice on the validity of the entire test
 - score the responses to the test items objectively
32. Which part of a multiple-choice test item presents the task to be performed?
- Direction
 - premise
 - response
 - stem
33. Essays must be scored closely following a marking scheme in order to avoid the
- rater drift
 - carry over effect
 - halo effect
 - extraneous effect

34. The subjectivity of a test refers to the
- format of the test items
 - sampling of items
 - scoring the students response
 - use made of the test results
35. Which of the following item formats is the best to use to assess ‘synthesis’ type of learning behaviour?
- essay-type test item
 - Multiple-choice test item
 - Short-answer type test item
 - True or false type test items

Knowledge of biology curriculum

36. The ecosystem falls under which one of these sections of the SHS biology syllabus
- Cycles
 - Diversity of matter
 - energy
 - interaction of nature
37. Evaluation type carried out by a team outside planning and implementation group is called
- domestic
 - internal
 - external
 - norm-reference
38. The third step of the process model of curriculum development is?
- Outcome
 - content
 - evaluation
 - methodology
39. Which of the following subjects fall under liberal studies curriculum?
- Agric
 - Geography
 - Integrated science
 - chemistry
40. Which of the following is **NOT** a general objective under cycles in SHS one syllabus?
- There are repeated patterns
 - There are air movements around the earth
 - movement of nitrogen in the soil
 - the nature of matter and various forms

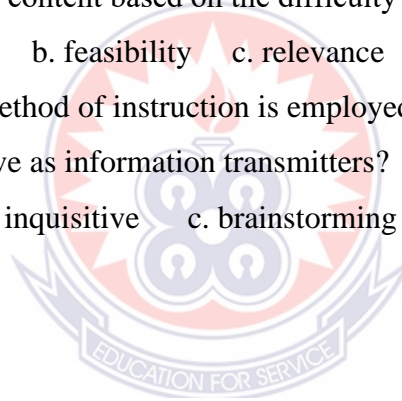
Students understanding

41. Which of the following test items is subjective in scoring?
- matching items
 - multiple choice
 - supply response
 - True – False
42. How many learning theories do we have?
- 3
 - 5
 - 11
 - none of the above
43. Which of the following skills refers to classroom showmanship
- practice answers to questions
 - present in an empty classroom
 - use gestures when presenting
 - mentally run through the points

44. In communication process, listening is
a. psychological b. physiological c. technical d. biological
45. Which of these tests can be used to assess originality?
a. essay b. objective test c. oral test d. performance test

Instructional Strategy for Teaching

46. The criterion of content which builds new knowledge on previous knowledge is called
a. sequence b. utility c. scope d. feasibility
47. The taxonomic principle applied in bloom's cognitive taxonomy is.....
a. internationalism b. classification c. complexity d. adaptation
48. Learning activities that help the trainee to acquire problem solving and thinking skills fall under
a. complexity domain b. cognitive domain
c. affective domain d. psychomotor domain
49. The criterion of content based on the difficulty level of subject matter is
a. significance b. feasibility c. relevance d. learnability
50. Which of the method of instruction is employed when teachers/training instructors serve as information transmitters?
a. expository b. inquisitive c. brainstorming d. deliberative



APPENDIX B

TEACHER SENSE OF EFFICACY SCALE

UNIVERSITY OF EDUCATION, WINNEBA

DEPARTMENT OF SCIENCE EDUCATION

FACULTY OF SCIENCE EDUCATION

INTRODUCTION: This study is designed to help the researcher to examine the levels of self- efficacy beliefs of pre-service biology teachers towards activity-oriented teaching method. This exercise is strictly for academic purpose; hence your views on this subject matter will be helpful. Your anonymity and confidentiality are assured, and no part of your views will be used for any other exercise apart from what is intended for. You are guaranteed that all reactions are entirely for scholarly purposes and will be dealt with privately.

DIRECTIONS: Please indicate your opinion about each of the statements below by choosing any of the options that best represent your opinion by placing a **tick (√)** in the spaces provided below the options. **1=Nothing, 2= Very Little, 3= Some Influence, 4= Quite a Bit 5= A Great Deal.** Your answers are confidential.

Please indicate your sex:

Pre-service Teachers' Sense of Efficacy Scale

S/N	Statement	Options				
		Nothing	Very Little	Some Influence	Quite a Bit	A Great Deal
1	How much can you do to guide students to manipulate biology equipment?					
2	How much can you do to help your students think critically?					
3	How much can you do to improve students' curiosity during instructions?					
4	How much can you do to motivate students who show low interest in biology practical lessons?					
5	To what extent can you make your expectations clear about student participation during biology lesson?					
6	How much can you guide students to apply improvisation techniques when necessary to meet biology practical objectives?					
7	How well can you respond to difficult questions from your students?					

		Nothing	Very Little	Some Influence	Quite a Bit	A Great Deal
8	How well can you establish routines to keep biology instructional activities running smoothly?					
9	How much can you do to help your students' value cooperative/group learning?					
10	How much can you gauge student comprehension of what you have taught?					
11	To what extent can you craft good questions for your students?					
12	How much can you do to foster student creativity in biology?					
13	To what extent can you meet your biology experiment expectations?					
14	How much can you do to improve the understanding of a student who is missing biology concepts?					
15	How much can you involve all students to actively participate in group work regardless of their biological concept level?					
16	How well can you establish a classroom management system with each group of students?					
17	How much can you help					

	students to relate their real life experiences with that of your biology instructional objectives?					
18	To what extent can you provide an alternative explanation or example when students are confused?					
19	How well can you facilitate interactive learning amongst your students?					
20	How well can you integrate very capable students and low achievers to work together as a group to achieve a common goal?					
21	How much can you assist families in helping their children perform well in biology?					
22	How much can you do to prepare your biology lessons to properly suit the level of your students?					
23	How much can you link your biology lessons to your previous lessons?					
24	How much can you do to control a student who is disruptive or noisy?					

Thank you