UNIVERSITY OF EDUCATION, WINNEBA

INVESTIGATING PRESERVICE TEACHERS' SCIENCE CONTENT KNOWLEDGE, ATTITUDE AND EFFICACY BELIEFS TOWARD SCIENCE TEACHING IN SELECTED COLLEGES OF EDUCATION

ISHMAEL EDEM MACLAN KOFI DORWU

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

AUGUST, 2015

DECLARATION

Student's Declaration

1, ISHMAEL EDEM MACLAN KOGI DORWU, declare that this dissertation, with the exception of quotations and references contained in published works which have all to the best of my knowledge, been identified and acknowledged, is entirely my own work, and it has not been submitted either in part or whole, to any institution anywhere for any academic purposes.

……………………………………………. ……………………..

ISHAEL EDEM MACLAN KOFI DORWU Date

Supervisor's Declaration

We hereby declare that the preparation and presentation of this dissertation, was supervised in accordance with the guidelines set for dissertations laid down by the University of Education, Winneba.

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DR. ERNEST NGMAN-WARA Date
(Principal Supervisor)

ACKNOWLEDGEMENT

The preparation of this work could have been successful without the divine guidance of God Almighty. All praise and adoration belongs to Him. I wish to express my heart field gratitude to my supervisor Dr. Ernest I.N.D. Ngman-wara for his invaluable support and guidance which saw me through this saw. I also wish to thank all the lecturers of the Science Department, University of Education, and Winneba who in diverse ways contributed to the success of this work. In addition, am very grateful to my wife who stood by me through all the difficulties to ensure that this work is completed. I also want to say thank you to all others who helped me in many different ways during this work, not forgetting my colleagues Charles Ladzekpo, Lawson Nyavor and C.C. Gato. May God bless you all and replenish your efforts bountifully.

DEDICATION

Dedicated to the memory of my father, the late L.A. M Hodanu.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The study focused on finding out the science teaching efficacy beliefs, science content knowledge and attitudes of preservice teachers in Colleges of Education in Ghana. A survey was used to gather data from a sample of 100 preservice teachers in two colleges of education in Ghana. A questionnaire consisting of a science teaching efficacy belief instrument (STEBI-B) science teaching attitude scale and a test were used to collect quantitative data respectively. The data were analysed using descriptive statistics functions of SPSS. The main finding were that generally the preservice teachers had strong efficacy beliefs, positive attitudes towards science teaching but had low science content knowledge on some selected topics from the basic school integrated science syllabus. The study found that weak science backgrounds of the preservice teachers contributed to their low science content knowledge. A number of recommendations were made including revision of the programmes of the college of educations to boost the content knowledge levels of the preservice teachers,

CHAPTER ONE

INTRODUCTION

Overview

This chapter contains a brief discussion of the background to the study. The study has been undertaken to ascertain the science teaching self-efficacy, attitudes and science content knowledge levels of preservice science teachers in the Science and Mathematics Colleges of Education in Ghana. These colleges have their prime responsibility of producing quality science and mathematics teachers for the basic schools in the country.

Background to the Study

The subject content knowledge of basic school teachers as the basis for science teaching has become a major concern in pre-service teacher education in Ghana and some other countries around the world. The argument that science teachers at the basic school level in Ghana need to acquire more knowledge in the subject content has been on going over the years. It was observed by the researcher during teaching practice monitoring that only a few of teacher-trainees could teach science at the basic level with very little or no difficulty during their teaching practice programme. Various reports on education over the years and the Anamuah-Mensah's Committee Report (2002) revealed a declining trend in education. With the importance the nation attaches to science education, it was indicated in the 1987 education reform report that the Teacher's Certificate 'A', programme could no longer produce teachers that would be competent enough to teach science at the basic schools in the country. This was necessitated by the numerous curriculum changes that took place over the years resulting in deepening of the content levels of the subjects in the basic schools. This and many other considerations culminated in the 2004 New Educational Reform

Implementation Committee Report resulting in the upgrading of the thirty eight teacher training colleges into diploma awarding institutions now called Colleges of Education and the subsequent designation of 15 Colleges of Education as Science and Mathematics Colleges.

Professional Teaching Standards mandate teachers to demonstrate excellence in their knowledge of the subject content and pedagogical content knowledge. As indicated by Darling (2000), the teachers' content knowledge is a key factor to students' academic success in today's classroom. In line with this, one only qualifies as certified science teacher at the basic schools in Ghana if that individual passes all the science courses in the three year initial teacher training programme run by the state. However, the question of whether mere completion of the teacher training programme adequately equips the preservice science teacher with enough content knowledge to teach the basic science competently remains unanswered. It is none the less, desired that highly qualified teachers should be teaching science in the nation's schools as the nation prepares for science and technological take off especially in the wake of the nation's oil find and extraction.

There are many different views being held by stakeholders such as educational researchers, educators, parents etc. about what actually makes a good science teacher: science content knowledge or professional competencies. Professional competencies in teaching refer to the pedagogical content knowledge and skills required for the successful practice of teaching (Watts, 1982).Many a time on various educational platforms in Ghana stakeholders express doubts about the science content knowledge of the basic school science teachers due to the fact that students' performance in science at this level has been poor. However there are little or no studies on the preservice science teachers' content knowledge in Ghana. It is therefore desirable to find out the level of science content knowledge of the preservice teachers preparing for teaching practice. This will ensure that preservice teachers will be adequately equipped with enough content knowledge in order to teach the basic science efficiently.

What may be the strongest findings of the effect of teacher content knowledge are studies that show that student achievement is higher when teachers have strong knowledge of the discipline they teach (Fertler, 1999; Golder & Brewer, 1999; Hill, Rowan, & Ball, 2005; Monk, 1994).When teachers are comfortable with the content they are teaching they become more confident with designing effective lessons and teaching the content. If teachers dislike teaching a topic, they may take it upon themselves to eliminate the topic altogether from the curriculum or be selective in what and how they teach (Furner & Robison, 2004,). Teachers teach what they are most comfortable with.

Other factors that influence elementary science instructions are attitudes and beliefs toward teaching. Many studies have documented that teachers' attitude toward science teaching is a strong indicator of both quality and quantity of science taught to the children (Schoeneberger & Russell, 1986: Wallace & Louden, 1992) as positive attitude towards science teaching results in effectiveness and quality time spent on teaching.In a study by Koballa and Crawley (1985), it was found that teachers who have low beliefs in their ability to teach science also developed negative attitudes towards science. These teachers eventually avoided teaching science. Teachers' efficacy beliefs are indicators of the teachers' instructional performance. Bandura (1977) defined self- efficacy in his social cognitivist theory as "beliefs in one's capabilities to organize and execute the course of action required to manage prospective situations" (Bandura, 1986 p.3). Bandura (1997) also proposed that efficacy beliefs were strong indicators of behaviour. 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. Pajares, (1992).Asserted that knowledge and beliefs cannot be considered separately. In view of this one can deduce that preservice science teachers who have good content knowledge and self-efficacy beliefs will also adopt positive attitudes and teach science effectively.

Some earlier studies have suggested that teacher efficacy is linked to student achievement student motivation (Midgley, Feldlaufer & Eccles, 1989) and classroom management strategies (Ashton & Webb, 1986). It is therefore important for colleges of educations to be mindful of teacher efficacy-beliefs during instructions and integrate them into their courses of study.

According to the above studies, it appears that factors such as science content knowledge levels of teachers, attitude towards science teaching and their various efficacy beliefs are crucial in predicting teacher performance. It is therefore clear that a teacher's strong subject matter knowledge develops a strong self-efficacy, which leads to the development of positive attitudes towards the teaching of science.

Statement of the problem

From a global perspective, science educators continue to convey the need for reforms in science education in an effort to promote a more critical scientific literacy (Bybee, 1997; Hodson, 1998). Such a critical scientific literacy has been described as multi-dimensional and considered in terms of three major elements: learning science, learning about science and doing science. For a teacher to be able to achieve these objectives, it is important to build a strong subject content knowledge as well as pedagogical content knowledge to be competent enough to deliver. However, as a tutor in a college of education, the researcher has observed that students are admitted into the colleges with varied backgrounds. Many of the student-teachers demonstrate weak science content knowledge in class. This fact is also corroborated by the poor performance of students in the end of semester examinations in science.

The Chief Examiner's Report (Institute of Education , University of Cape Coast, IEUCC, 2007; 2008; 2009) showed that students have a great deal of difficulty in learning the subject. It was observed that students found it difficult to write and balance simple chemical equations, draw organic structures, perform simple practical experiments and solve problems involving the mole concept. Questions that demanded comprehensive explanations were poorly answered. This became clear from the answers some students provided. These actually resulted in over 70% of the students scoring below grade C^+ in their end of semester examinations. It is also a fact that most students admitted into the colleges of education to pursue elective science programme came with grades D^+, D or E obtained in the West African Senior Secondary Certificate Examination. Also, there were some significant number of students admitted to read elective science in the Colleges of Education were non-science students in the senior high schools. These clearly indicate that the students have poor science backgrounds. It could be said that is it is the low knowledge levels of these preservice teachers which negatively affect their science achievement in college and subsequently culminating in the poor performance of their students in the Basic Education Examination result as indicated by the Chief Examiner's Report (West African Examination Council, WAEC, 2007; 2008; 2009). According to Stevens and Wenner (1996) there is positive relationship between strong science content knowledge and positive attitudes and high self-efficacy towards science teaching and vice versa. In line with this the colleges of education have instituted a number of curriculum changes to upgrade the content knowledge levels. Also there was a remedial programme put in place in some few years ago to upgrade the content knowledge levels of prospective applicants to colleges of educations who had low grades in science, mathematics and English which has been stopped. It has also been observed by the researcher that during teaching practice programmes, the preservice teachers usually exhibit low efficacy beliefs and negative attitudes towards the teaching of science. This is made clear when they make comments such as 'am afraid I would not be able to teach science effectively and it is difficult to get materials to teach science.

The study therefore intends to find out the content knowledge levels, attitudes toward science and efficacy beliefs of these students as they prepare to start their one year teaching practice.

Purpose of the study

The purpose of this study was to examine the science content knowledge of preservice science teachers, their attitudes toward science and science teaching and their efficacy beliefs toward the teaching of science.

Objectives of the study

In order to achieve the desired goals of this study the following objectives were useful:

1. Ascertain the science teaching efficacy beliefs of the final year preservice science teachers of selected colleges of education

2. Ascertain the level of science content knowledge among the final year preservice science teachers of selected colleges of education.
3. Ascertain the preservice teachers' attitude towards science and teaching of science in selected Colleges of Education.

Research Questions

This study was guided by the following research questions:

1. What are the science teaching efficacy-beliefs of the preservice teachers toward science teaching in selected colleges of education?
2. What is the science content knowledge level of the preservice science teachers in selected colleges of education?
3. What is the attitude of the preservice science teachers towards science teaching in selected Colleges of Education?

Significance of the Study

This study among other things will document the level of science content knowledge of prospective science teachers in the college of education. This will enable the Department of Science in the Colleges of Education to adopt the right strategies to help the students in their areas of weaknesses. The findings will also help science curriculum planners of colleges of education in deciding on what content areas to be included in the curriculum. The findings of this study will enable the curriculum planners to try to align the topics in the basic school's curriculum with those in the curriculum of the colleges of education. This will enable the trainees to develop better content knowledge and practical experience in the teaching of those topics before they start their teaching practice.

The outcome of the study could also be of immense use for researchers who may want to undertake further research in this direction. In addition, since science content knowledge, efficacy beliefs and attitude towards science are crucial factors in teacher performance, the findings of this study will be of immense use to the colleges of education in order to plan actions to that effect.

Finally, the findings of this study will help researchers, teachers and teacher educators to understand the preservice science teachers' self-efficacy beliefs regarding science teaching and attitude toward science teaching so as to organize programmes that will enhance them.

Delimitation

This study was delimited to two science Colleges of Education out of the fifteen due to the fact that the colleges are spread all over the country. Therefore financial and time constraints made it difficult to access all the colleges.

Limitations

This study could not compare the self-efficacy beliefs attitudes and knowledge levels of male and female preservice teachers because of the very low numbers of female students in the elective science classes of the selected science colleges.

Also because the preservice teachers were preparing for their out segment programme some of them felt reluctant to fill and submit the questionnaire and returned them unfilled.

CHAPTER TWO

REVIEW OF LITERATURE

Overview

This chapter deals with the theoretical framework and development of teachers' efficacy beliefs and the contribution of attitude and knowledge toward science teaching. The following review of related literature is sub-titled as the construct and assessment of teacher's efficacy beliefs, knowledge of scientific concepts and their own attitudes towards science instruction as perceived by teachers generally at the elementary level.

Theoretical framework

In social learning, self-efficacy belief is a notable psychological construct theory developed by Bandura (1977, 1981). Self-efficacy beliefs are defined as "judgments of how well one can execute courses of action required to deal with prospective situations" (Bandura, 1982, p. 122). According to him behavior is based on two factors; firstly, an individual develops a generalized expectancy about action – outcome contingencies based on one's life experiences, or outcome expectancy, and secondly, the individual develops specific beliefs about his /her own ability to cope, or self-efficacy.

In Bandura's view, behavior may be predicted by probing into self-efficacy using both types of expectancy determinants (Bandura, 1982), in his own hypothesis, Bandura asserts that people having both high outcome expectancy and personal efficacy will behave in an assured, decided manner and persist on task. On the contrary, people with both low and high outcome personal efficacies temporarily intensify their efforts but in the long run become frustrated.

Bandura (1997) identified four sources of efficacy expectations; i.e. mastery experience, psychological and emotional states, vicarious experiences and social persuasions. The most potent source of efficacy information among these is the mastery experiences. The notion of having executed a satisfactory performance rather generates efficacy beliefs, which tends to add to the expectation of a future proficiency in performance rather than generates efficacy beliefs, which tends to add to the expectation of a future proficiency in performance. Efficacy beliefs also tend to be lowered when there is the perception of failure in one's performance. This contributes to the expectation that performance in future will also be inept (Tschannen-Moran, Hoy & Hoy, 1998).

Vicarious experience apart from mastery experiences involve the modeling of deserved performance which influences efficacy beliefs. Self-efficacy is usually increased if one compares well and decreased if one compares less favorably with people in similar situation. According to Schunk (2003), whereas high self- efficacy belief is an important ingredient for achievement, it is not the sole factor for achievement. He indicated that one major factor for achievement is knowledge. High efficacy will not produce desirable performance when the needed knowledge is absent (Schunk, 2003).

Knowledge and beliefs cannot be delinked (Pajares, 1992). In line with this notion it can be deduced that preservice teachers who have high efficacy beliefs and knowledge of science would be able to execute very good instructions. Teachers with stronger science content knowledge engage their students more in inquiry learning as compared with teachers with weak content knowledge (Alonzo, 2002). In the words of Henze, vanDriel and Verloop, 2008 teachers' content knowledge has a direct and indirect influence on class room practices. Ginns and Watters 1990), stated that teachers' beliefs and attitudes towards teaching science rooted on their experiences in science classes during high school. However it was found out that there is a positive correlation between strong science content knowledge levels and positive attitude toward science teaching and negative relationship between weak science content levels and a low efficacy towards science teaching (Stevens &Wenner, 1996).

Preservice Teachers' Self-Efficacy Beliefs

Many researchers have delved as a focus of study into self-efficacy and outcome expectancy in relation to teaching. Examples of such researchers are Ashton & Webb, 198b; Enochs & Riggs, 1990; Gibson &Dembo, 1984; Guskey, 1988; Wood folk & Hoy, 1990). According to Tschannen – Moran et' al (1998), two types of research can be made. Rotter's social learning theory of internal versus external control (Rotter, 1996) is the first type. Some teachers consider themselves to have the capability to give effective tuition to difficult and unmotivated learners. These teachers are considered to have internal control. On the other hand, other teachers whose belief is that students' learning is affected more strongly by the environment than the teacher's own teaching acumen are considered to have external control (Berman, McLaughlin, Bass, Pauly &Zellman; 1977), studied teacher efficacy and developed two items which have the basis of control orientation.

The environmental influence, particularly that of the home environment plays a key role in a student's motivation and performance. Basically, this also in turn affects a teacher's performance. By this assertion, those teachers who subscribe to this statement will realize that environmental factors can largely influence their efforts overwhelmingly in schools. In what is known as General Teaching Efficacy (GTE), teachers' beliefs about the power of external factors (of the environment) on students' vis-à-vis that of the teacher and the school. These environmental factors like conflicts /violence at home, substance abuse either at home or in the community and which the child may be directly exposed to may have far-reaching negative consequences on the child. Apart from these, other factors are the value placed on education at home, social and economic realities in the locality with regards to class, race, gender and the psychological, emotional and cognitive needs of particular child may all a tremendous impact on a student's motivation, and eventually, his performance (i.e., learning) in school.

There are also another group of teachers who strongly agrees with the fact as stated that: "If one really tries hard one can get through to even the most difficult and unmotivated students". These teachers refuse to be intimidated by any negative factors which make learning difficult for students. This caliber of teachers makes a strong point for themselves about their own dexterity in teaching (i.e. Efficacy) which thereby reflects their self-confidence generated by the adequacy of training they have had, their own ingenuity and resourcefulness in developing strategies to solve students' learning problems. This is practically know as Personal Teaching Efficacy (PTE). This approach is more specific in comparison with the General Teaching Efficacy (GTE).

In the Rand/Rotter Tradition there are other measures of efficacy such as: The Teachers locus of Control (TLC) (Rose & Medway, 1981), the responsibility for student Achievement (RSA) Guskey, 1981) and the Webb Efficacy Scale (WES) (Ashton, Olejnik, Crocker and McAuliff, (1982). The measure of TLC consists of 28 forced-choice items that give indications of instances of success among respondent students which comprise of 14 items as well as student failure which also has another set of 14 items. These two forced-choice options allow for the interplay of two elements, which are, either the internal element – the teacher, or the external element – the student. These provided an explanation for the student outcome. In the same vein, the Responsibility for student Achievement (RSA) measure also consists of 30 items which also espouses to possible explanations (internal vrs. external) which could be indicative of student success or failure as the case might be.

Bandura's social cognitive theory and this position on the construct of self-efficacy theory (Bandura, 1977) also provide the basis for another line of research on teacher efficacy. Out of this tradition emerged a number of measures which include the Teacher Efficacy Scale (Gibson &Dembo, 1984). The Science Teaching Efficacy Belief Instrument (Riggs & Enocks, 1990), (Ashton, Buhr & Crocker, 1984), and the Teacher Self Efficacy Scale (Bandura, Undated).

The first group of researchers to expand the Rand Methodology by using two original items in addition to conducting interviews and classroom observations to study efficacy were Ashton and Webb (1986). They postulated that, responses to the first Rand item i.e. (When it comes right down to it, a teacher really cannot do much because most of the students' motivation and performance depends on his/her home environment".), indication of beliefs about outcome expectations. However, responses to the second Rand Item (i.e., "If I really try hard, I can get through to even the most difficult or unmotivated student") also reflect efficacy expectation. A teacher's efficacy is therefore determined when these two items are combined.

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 and personal efficacy and personal teaching efficacy. A teachers' belief about the general relationship between teaching and learning is Teaching Efficacy and this seems to be the same as Bandura's outcome expectancy. In a general sense, a teacher own general ideas about his own effectiveness which is not specific to any particular situation is referred to as personal efficacy. Personal teaching efficacy is considered to be a combination of one's teaching proves and personal efficacy. It is considered to be important to keep teaching and personal efficacy as separate elements conceptually as suggested by Ashton et al. (1983). This is because strategies for intervention of produce change may depend on the origin of a teacher's sense of efficacy. Personal Teaching Efficacy is postulated by Ashton et al. (1983) as an accurate indicator of a teachers' behavior. Teachers who have a high efficacy, for instance, have been found to have the propensity to use the inquiry and student centered teaching strategies. On the other hand teachers who tend to have a low sense of efficacy are rather prone to use teacher centered technique/methods like lecturing, and /or reading from prepared notes or even directly from textbooks (Czerniak, 1990).

A variation in teacher's self-efficacy becomes prominent depending on the subject(s) they may be teaching as propounded by Ashton and Webb (1986). An instance of this is that a teacher may have low self-efficacy in a specific subject area, like, science but high in another, such as the language arts. This may result in spending more time in teaching the language arts, and naturally, the teacher may exhibit more personal interest in participating in professional development activities which are related to this discipline. Consequently, this may result in lesser or no time at all allocated for science instruction which is inimical to using didactic methods of teaching and also the avoidance of professional development activities which are relevant to the teaching / learning of science.

Gibson and Dembo (1984) using the factor analysis in a research study, identified two types of teacher-efficacy dimension and also developed an expanded 30-item Teacher Efficacy scale (TES) to assess these two dimensions of efficacy Personal Teaching Efficacy (PTE) is the first type and it includes teacher belief on their knowledge of the use of suitable techniques in teaching, the ability to motivate students to learn and achieve more and to do better than usual and increase retention of other skills (which is equivalent to self-efficacy). The second type is known as General Teaching Efficacy) which hinges on the belief that the teachers influence on learners is also controlled by other external factors, such as, the home and family background (and which equates with Bandura's outcome expectancy factor). With the inclusion of the Rand items in the factor analysis with the Gibson and Dembo measure, the Rand 1 item loaded on the PTE factor (Coladara, 1992; Ohmart, 1992; Woolfolk& Hoy, 1990).

From indication, several items under the two factors loaded on both factors consequent upon which some researchers have utilized an abridged version of this instrument which facilitated the use of only 16 of the items which loaded compatibly on one factor or the other. Hoy and Woodfolk (1993) used even still a further shorter version with only ten items consisting of 5 personal and 5 general teaching efficacy items. The reliabilities they found for each sub-tests were within the range for the longer versions (a = .77 for PTE; a=,72 for GTE).

In the view of Gibson and Dembo, (1984) a comparison of teachers who had a low expectation of their own abilities to influence their students' learning and teachers who have higher scores on both teaching and personal teaching efficacy would be active and confident in their responses to students' needs. These teachers persist longer and provide greater academic leverage in the classroom and show varieties of feedback. Teachers who attain low scores on both general teaching and personal efficacy relates to the amount of personal effort made by the teacher in class and their persistence (Gibson & Dembo, 1984). Teachers who attain a high sense of efficacy in both PTE and GTE factors were likely to criticize a learner with an incorrect response and are more likely to persist with a situation of failure. High efficacy teachers were more likely to break up their classes into smaller groups for instruction instead of the whole class.

Studies have shown that there is a veritable relationship between efficacy and learner's achievement that emerged from the instruments of Gibson and Dembo, (1984) and Ross, 1992; and Watson, 1994).

Apart from students' achievement, students' inclination towards school activities, lessons of instruction and even their relationship with the teacher personally, is also largely determined by teacher efficacy. The stronger the general teaching efficacy of the teacher, the greater the students interest in school the higher their perception that their lessons of instruction are important. Students under the tutelage of teachers who have a stronger sense of personal efficacy also tend to give a more positive evaluation rating of the teaching (Wood folk, Rosoff, & Hoy, 1990).

Studies have shown that, there is a link between personal Teaching Efficacy (PTE) and instructional experimentation which involves a teachers desire to use a number of materials and techniques/ methods and the need to discover better ways of tuition and the implementation of progressive and innovative methods. The level of organization, planning and a sense of equity displayed by a teacher as well as clarity and enthusiasm in teaching was also related to personal teaching efficacy. This in the view of Tschannen-Mmoran, Hoy & Hoy, 1998), is the fact that General Teaching Efficacy (GTE) was related to clarity and enthusiasm in teaching.

In conclusion, one can state that researchers who used Gibson and Dembo's instruments must have discovered that teacher efficacy is replicated in the teacher's own classroom behavior which is skin to his receptiveness to trying out new concepts and his/her attitude to teaching. It is clear from the positions of other scholars that teacher efficacy impacts directly on student achievement, attitude and effective growth. In the same vein, the schools physical structural set-up and organizational atmosphere also significantly influence a teacher's sense of efficacy.

Some other instruments were also evolved in appraisal of the teacher's efficacy and related constructs. This conforms to Bandura's (1997) idea that self-efficacy was most appropriately measured in specific contexts. As such, Riggs & Enocks (1990) developed an subject matter instrument which was science Teaching Efficacy Belief Instrument (STEBI) to measure efficacy for teaching science. STEBI is noted to have two variations, which are the science Teaching Efficacy Belief Instrument form A (which is indicated as (STEBI – A) for in-service elementary (basis) school teachers and the form B which is also shown as (STEBI-B) for pre-service elementary (basic) school teachers. These instruments were based on the Gibson and Dembo instrument – TES and which consisted of two largely uncorrected subscales: Personal Science Teaching Efficacy (PSTE) and Science Teaching Outcome Expectancy (STOE). In most applications, STEBI consists of 25 items with a 5 – point Likert-type scale.

According to Riggs and Jerunalladas 1993, Teachers who have a high sense of personal science teaching achievement as measured by the use of the STEBI spend more time teaching science and developing scientific concept among pupils. Diametrically opposed efficacy (PSTE) who rather tend to spend less time in teaching science and may not on their own volition chose to teach science. (Riggs 1995) Such teachers are most likely prefer to use the text-based method and could make fewer positive changes in their beliefs about how children learn science. Higher PSTE Scores that are observable among pre-service teachers are related to their inclined preference to teach science (Lucas, Guinns, Tullip &Watters, 1993) and to a more humanistic orientation toward control in the classroom (Enocks, Scharman & Riggs, 1995).

The quality of science teaching is related to scores obtained on the second factor of the STEBI. In this light teachers who obtained low scores in the science Teaching Outcome Expectancy (STOE) were classified to be less effective in the teaching of science. They rated themselves to be average performers and consequently by observation noted as poor performers (Enocks, Schaman & Riggs, 1995. Having obtained low scores on the STOE for the use of text-based method the use of activity-based procedures makes co-operative learning less tedious (Riggs 1995).

Further studies were carried out on the use of the Dembo and Gibson Instrument (TES) by Emmar and Hickson (1990). They used the same instrument which yielded the 36 – items measure with three efficacy subscales. Namely, efficacy for classroom management and discipline, external influence and lastly, personal teaching efficacy. Teachers who have a high sense of achievement at the pre-service level have the tendency to rely on external assistance to help them deal with students disciplinary problems. Similarly, studies have shown that Coladarci and Breton (1995) used a 30 item instrument which was modified by Gibson and Dembo which applied only to special education needs assessment.

With regards to the perception of weaknesses in TES, many are the researchers who recently developed their own instruments in the study of teacher efficacy. Among those who sought to develop teacher efficacy instruments are Tschannen-Moran and Woodfolk Hoy (2001) whose Teachers' sense of Efficacy Scale (TSES) was noted to have relativity with the tasks confronting teachers in school. They argued that TSES could be used to assess the three domains of efficacy or to obtain a rather generalized efficacy score, TSES uses a 9 – point Likert scale which involves three strong factors: Efficacy for Instrumental Strategies, Efficacy for classroom Management and finally, Efficacy for Student Engagement.

Sample items used in this regard included "To what extent can you influence self-discipline among your students?" and "How much /what can you do to reconstruct student's' misconceptions?" Because it was a new instrument it needed extra testing and validation across different samples in order to position it for future research.

Furthermore, Roberts and Henson (2000) developed a subject matter specific instrument which was Self-Efficacy Teaching and Knowledge Instrument for Science Teachers (SETAKIST). The researchers essentially largely retained the personal teaching efficacy items, with the exception of rewording to reflect science content and elimination of past tense verb uses. Because science education is explicitly involved with the pedagogical conversion of science information into a format meaningful for students, Roberts and Henson (2000) developed a knowledge efficacy construct, which is intended to roughly approximate efficacy for science pedagogical content knowledge. The SETAKIST requires additional validity evidence regarding the knowledge efficacy construct, given its attempt to assess an efficacy dimension formerly ignored in teacher efficacy research. However, the concept of assessing efficacy for pedagogical content knowledge is intriguing and worth further investigation.

Teacher efficacy can be influenced by unique features of inherent cultures. Based on this idea, some researchers modified teacher-efficacy instruments in their countries. For example, Çakıroglu, Çapa, and Sarıkaya (2004) developed a Turkish version of the Teachers' Sense of Efficacy Scale (TSES). TSES administered 628 preservice teachers from six different universities located in four major cities in Turkey. They found that Turkish version of the Teachers' Sense of Efficacy Scale (TTSES) appears to be a valid and reliable instrument for Turkish prospective teachers. They suggested that TTSES could be a valuable tool for teacher educators working in practical and research settings to assess the efficacy beliefs of prospective teachers. In a similar study, Diken and Ozokcu (2004) examined the Turkish version of Teacher Efficacy Scale (TTES), and investigated factors influencing Turkish teachers' sense of efficacy. Data were collected from TTES and a questionnaire on 82 special education (SE) and 38 regular education (RE) teachers. Consistent with previous teacher efficacy research results (Ashton & Webb, 1986; Gibson & Dembo, 1984; Woolfolk & Hoy, 1990: Guskey & Passaro, 1994), TTES had two reliable sub factors. They also reported that SE teachers showed higher levels of sense of efficacy and the years of experience with students with mental retardation positively correlated with SE teachers' efficacy scores. In another study, Bikmaz (2002) investigated the validity and reliability of elementary science teaching self-efficacy belief instrument version of pre-service elementary teachers developed by Riggs and Enochs (1990) in Turkey conditions. Both original and Turkish forms were administered to 24 preservice science teachers in METU in a period of one week and item equivalency was found as .68. Afterwards, Turkish form was administered to 279 students from three different universities of Turkey who attended elementary school teacher education program. Factor analysis results revealed that the Turkish version had two factors like the original scale, but Turkish version of this scale consisted of 21 items. This study concluded that Turkish version of STEBI-B appears to be a reliable instrument for Turkish prospective teachers. On the other hand, Lin and Gorrell (2000) used a modified version of Gibson and Dembo teacher efficacy scale on a Taiwanese preservice teacher sample. They found a different factor structure compared to the original scale. They concluded that the concept of teacher efficacy may be related to cultural factors and this should be kept in mind when applied to teachers in different countries.

Some researches on self-efficacy were about comparison of teacher efficacy beliefs on different countries. Çakıroglu and Çakıroglu (2003) compared pre-service elementary teachers' sense of efficacy beliefs in a Turkish university, and in a major Midwest university in USA. The data were collected by Science Teaching Efficacy Belief Instrument (STEBI-B) (Enochs and Riggs, 1990). Students were also asked to indicate how many science courses they had completed to college and high school. In Turkish sample, there were 100 pre-service elementary teachers and in American sample there were 75 pre-service elementary teachers. The pre-service teachers indicated generally positive self-efficacy beliefs regarding science teaching in both countries. Data of this study also suggested that, in both countries, science courses completed in high school and college did not appear to have influence on subjects' self-efficacy beliefs regarding science teaching. The results also indicated that preservice elementary teachers in USA had significantly higher personal science teaching efficacy scores than preservice elementary teachers in Turkey. On the other hand, science teacher outcome expectancy scores of the preservice teachers from the two countries were not significantly different. Similarly, Gorrell et al. (1993) compared American, Swedish, and Sri Lankan preservice teachers with using a modified form of Gibson and Dembo (1984) scale and they found that American preservice teachers had more positive general efficacy of teaching beliefs compared to Swedish and Sri Lankan teachers and also found that Sri Lankan teachers' personal efficacy beliefs were relatively higher than that of American teachers.

Furthermore, Campbell (1996) compared teacher efficacy beliefs of pre-service and in-service teachers in Scotland and America with using Gibson and Dembo scale. Campbell (1996) concluded that the two countries are equal in fostering teacher efficacy in their pre-service and in-service teacher education program. Another study on comparison of self-efficacy construct between countries was recently reported by Ho and Hau (2004). Their research examined and compared Australian and Chinese teachers' personal efficacy in instruction, discipline guidance and beliefs about external influences. Two staged studies were conducted with the participation of 316 Australian teachers and 411 Hong Kong Chinese teachers. A revised Teacher Efficacy Scale was administered. Results of multiple-group confirmatory factor analyses indicated highly comparable factorial structures of teacher efficacy for the two groups, although personal guidance efficacy was more differentiated from personal instruction and discipline efficacy among Australian teachers. All of these comparison studies indicated that despite teachers' self-efficacy had cross-culturally generalizable aspects, there were culture-specific features of the teacher efficacy construct.

In a study to identify factors contributing to preservice teachers' sense of efficacy, Cantrell et al. (2003) examined the efficacy beliefs of a sample of elementary preservice teachers (n=268) at three stages of their program starting with the introductory methods seminar courses, followed by advanced methods course, and finally, at the end of their student teaching. And also Cantrell et al. (2003) explored the relationships between the levels of efficacy beliefs and various factors such as gender, prior science experience, and science teaching time. The Science Teaching Efficacy Belief Instrument Form B (STEBI-B) developed by Enochs and Riggs (1990) was used to assess science teaching efficacy. Their study indicated that the males in their sample were more interested in science in high school. The largest increase in PSTE was for students in the methods group who were able to teach science to children for more than 3 hours across the span of their 3-week practicum.

This result suggested that there may be a significant increase in PSTE with the first successful science teaching experiences, which is supported by Bandura's (1997) suggestion that mastery experiences help to increase efficacy beliefs. Only significant effect found for STOE occurred in the student teaching group when students are applying their knowledge and skills to practice of teaching science to children. Another study by Huinker and Madison (1997) investigated the impact of methods courses on preservice elementary teachers' personal efficacy beliefs and outcome expectancy beliefs in science and mathematics teaching. Only 62 preservice elementary teachers were the subjects of this study. A pretest-posttest one-group research design was used each semester to collect quantitative data throughout the use of two teaching efficacy beliefs instruments, one for science (STEBI-B) and one for mathematics (the Mathematics Teaching Efficacy Beliefs Instrument-MTEBI-).

A series of individual interviews were conducted with a sample of subjects to gather qualitative data. They found that both science and mathematics methods course consistently had a positive influence on the preservice elementary teachers' beliefs in their ability to teach science and mathematics effectively. Similarly, Marrell and

Carroll (2002) examined the impact of science methods courses, student teaching and science content courses an elementary preservice teachers' science teaching self-efficacy. To measure the students' science teaching self-efficacy belief, students completed STEBI-B at the beginning and end of each course included in this study.

In this study, it would appear that the methods course positively impacted the elementary preservice teachers' PSTE. The scores on this scale significantly increased over the duration of each methods course. One suggested reason for this finding was that the method course included all of the components identified by Bandura (1986) that contribute to perceptions of self-efficacy. However, while Wingfield and Ramsey (1999), King and Wiseman (2001) found that methods courses did enhance self-efficacy, Cannon (2001) did not find that methods courses taken in conjunction with field experience enhanced self-efficacy. Ginns et al. (1995) have given attention to investigate changing in preservice teachers' sense of efficacy in teaching science. They used STEBI-B to monitor changes in teachers' sense of science teaching efficacy employing a pretest and repeated posttest, one group research design. The subjects were 72 students enrolled in a 3-year Bachelor of Teaching (Primary) program. The results indicated that, over three semesters of the program, there was significant difference between the pretest and posttest scores on the STOE scale, but no significant difference between pretest/post test scores on the PSTE scale. They concluded that changing beliefs about personal science teaching efficacy may be more difficult than changing beliefs about the potential for teachers to improve children's learning of science. Also, Hoy (2000) searched out whether there were differences in teachers' sense of efficacy between student teaching and the first year of teaching. The results indicated that efficacy rose during teacher preparation, but fell with actual experience as a teacher. Some researchers investigated whether there were interactions between teachers' efficacy beliefs and their classroom management beliefs. Woolfolk and Hoy (1990) indicated relationships between efficacy beliefs, as measured by the Teaching Efficacy Scale (Gibson & Dembo, 1984) and those control beliefs. This study included 182 preservice teachers. They found that teachers who scored high in both general teaching efficacy and personal efficacy were more humanistic in their control orientation.

On the other hand, only teaching efficacy made significant independent contribution to beliefs about pupil control ideology. Personal efficacy alone was not significantly correlated with pupil ideology. They also revealed that teaching efficacy was negatively correlated to bureaucratic orientation. In a similar study, regarding student control as measured by the Pupil Control Ideology Form (PCI) (Willower et al., 1967), Enochs, Scharmann, and Riggs (1995) administered the STEBI-B to a sample of 73 preservice elementary teachers. They reported an opposite result of Woolfolk and Hoy's (1990) study that teachers with higher science teaching self-efficacy (PSTE) scores also had more humanistic orientations toward control or management in the classroom, but the relationship between outcome expectancy (STOE) and pupil control ideology was not revealed. One suggested reason for this finding was that the respondent's lack of real classroom experience. In order to further explore the relationships between preservice teachers' sense of efficacy, task analysis and their beliefs about classroom management, Henson (2001) conducted a study among a sample of 127 preservice teachers varied in their education level (elementary, secondary and early childhood). Data were collected by three instruments of the Teacher Efficacy Scale (Hoy &Woolfolk, 1993), the Attitudes and Beliefs on Classroom Control (ABCC) Inventory (Martin, Yin & Baldwin, 1998) and the Means-End Teaching Task Analysis (Henson, Bennett, Sienty, & Chambers, 2000). He reported that the teaching efficacy variables provided different levels of prediction of classroom management beliefs, however, task analysis was found to be unrelated to management beliefs.

In a study conducted in Turkey by Savran, Çakıroğlu and Çakıroğlu (2004), Turkish preservice elementary teachers' science teaching efficacy and classroom management beliefs were explored. Specifically, the study explored the interrelationships between teacher efficacy beliefs and classroom management beliefs of participants. Data in this study were collected from a total number of 234 preservice elementary teachers utilizing Science Teaching Efficacy Belief Instrument and the Attitudes and Beliefs on Classroom Control (ABCC) Inventory. Their results indicated that participants expressed positive efficacy beliefs regarding science teaching. In addition, results of the study revealed that participants were interventionist on the Instructional Management subscale, whereas they favored non-interventionist style on the People Management subscale of the ABCC Inventory. Furthermore, no significant correlation between efficacy and classroom management beliefs was found. To sum up, these studies revealed that teachers' self-efficacy beliefs were related to teacher effectiveness, student achievement, teaching anxiety and instructional strategies. Because of strong relationship between self-efficacy beliefs and teaching behaviors, teacher education programs need to evaluate efficacy beliefs of their education students.

This study adopted the STEBI-B). Instrument by Enoch and Riggs (1990 to collect data on the preservice science teachers' efficacy beliefs. This is because it has been used widely on preservice teachers and it produced consistent results.

Preservice Teachers' Attitudes toward Science Teaching.

Interest in how attitudes toward science affect learning and science teaching has over the years gained prominence. In an earlier study, Allport (1935) expressed attitude as the most distinctive and indispensable concept in contemporary social psychology. Attitude toward science should not be confused with scientific attitude, which may be aptly labeled scientific attributes (e.g., suspended judgment and critical thinking). "I like science", "I hate science" and "Science is horrible!" are considered to be expressions of attitudes toward science because they denote a general positive or negative feeling toward the formal study of science or science as an area of research (Koballa & Crawley, 1985).

The study of attitude towards science has become an important concept for a number of reasons. First, attitudes toward science are taught to fulfill basic psychological needs, such as the need to know and the need to succeed. Second, attitudes toward science are taught to influence future behaviors, such as interest in working on a science project and scientific activities. Furthermore, results of nationwide assessments of attitude toward science indicate that Turkish students' attitudes toward science courses substantially decreased from Grade 5 through Grade 11(Baykul, 1990).

The teachers' attitude toward science is one of the major influences on students' attitude toward science; Shrigley (1972) investigated the status of the attitude of preservice elementary teachers toward science. The variables tested in this study were: the effect of sex difference, the effect of male elementary teachers, the effect of organized and incidental elementary science programs, the effect the number of high school science courses had on the science attitude of preservice teachers. The population for this study was 207 third year elementary education majors at the Pennsylvania State University. The science attitude scale was administered by the investigator during the first week of their enrollment in a science education course. Results of this study indicated that: There is no sex difference in science attitude of preservice teachers, sex difference would not have a more positive effect on the science attitude of their students, and an organized elementary science program affects the science attitude of preservice teachers positively. Either the student who enrolls in four or more high school science courses is the one with a more positive attitude toward science or the enrollment in more science courses affects the attitude positively.

Similarly, Türkmen and Bonnstetter (1999) studied Turkish preservice science teachers' attitudes toward science and science teaching by using a Turkish version of Science Teaching Attitudes Scale (STAS II) developed by Moore and Foy (1997). The sample size of the study was 612 freshman, second year, junior and senior science education major students of four different teachers colleges located in different parts of Turkey. Results of this study indicated that preservice Turkish science teachers have positive attitudes toward science and science teaching.

Fishbein and Ajzen (1975) described the relationship between beliefs, attitudes (intended or actual). Any attitude change must also deal with belief change and behavior change. If someone's attitude toward science changes, this change will be the same as the change in beliefs on science and science related behavior.

In a much broader sense, a person's attitude toward science conveniently summarizes his or her emotional response to basic beliefs about science. In addition to the fact that attitudes toward science serve as convenient summaries of our beliefs about science, they are important for other people for other reasons-they help others predict the kinds of science related behaviors we are likely to engage in more accurately than almost anything else we can tell them (Koballa & Crawley, 1985). According to them low knowledge levels of teachers results in their inability to teach science effectively hence it develops negative attitudes in them. This inadvertently results in their avoidance of teaching science.

Science Content Knowledge of Teachers

Low level of preparation, limited knowledge, negative beliefs regarding personal science teaching competency, and lack of confidence led Shymanski and Green (1982) to conclude that elementary teachers are simply reluctant to teach science. An explanation for this relationship between low science knowledge and a reluctance to teach science was offered by Victor (1961), who found teachers fear a loss of classroom prestige when providing science instruction.

Haury (1984) indicated in his thesis "Many elementary teachers may perceive themselves as having little personal instrumentality or control in a classroom situation involving science instruction" (p.6) which is consistent with Rotter's (1966) "locus of control" (LOC) construct. The essence of the LOC model is that the power of subjective belief held by an individual exerts greater control on his or her behavior than the objective fact of control. Haury (1984) concluded in his thesis that an internal LOC resulted in positive attitudes toward teaching science. The idea that feelings of competency, based on adequate preparation, would be likely to translate into positive attitudes toward teaching science is supported by previously cited research. Indeed, Lucas and Pooley (1982) reported that completion of introductory science units (astronomy and physical science) by preservice teachers resulted in "very significant improvement in student teachers' attitudes toward science teaching".

Many research findings have shown that in science and mathematics, more knowledgeable teachers were more likely to present problems in contexts that were familiar to the students and link problems to what children already know. In mathematics, teachers who deliver lessons through multiple representations are able to increase students' achievement while teachers who possess less knowledge in mathematics often result to the use of formula. Also in science, teachers who are more grounded in the subject matter science often use questions, alternative explanations, and inquiries (Alonso, 2002, Ander, 1995, Brickhouse, 1990, Cais, 2005).

Research has also found out that there is a link between the teachers' content knowledge and their ability to evaluate lessons (Cai, 2005). Teachers with strong content knowledge make better instructional decision which is not the case with those with weak content knowledge. Teachers who are more knowledgeable plan lessons that are logical, coherent and sequential (Lloyd, 2002; Lloyd, & Wilson, 1998; Manouchehri, 1998; Sherin, 2002). Smith (1997) cited the argument of some educational researchers that suggest that teachers at all levels need a good knowledge of the subject they teach and that a weak understanding of these teachers in science is a problem for them (Bennet, Carre & Carter, 1992; Harlen, Holroyd & Byrne, 1995; Kruger, Palacio, & Summers, 1992). However, it is important also to determine how much of the content knowledge is required of the preservice teacher to be able to successfully execute the task of translating science goals into achievements of his students. A number of studies on how the content knowledge of teachers is related what students learn in science and mathematics presented mixed outlooks. In science out of two relationships examined between teachers' content knowledge and students' achievement s, two correlated positively (Hill, Brown, & Ball, 2005; Lerderman, 1999; Mullens,., Murnane, & Willet, 1996)

Relative to the previously cited findings, Feistritzer and Boyer's (1983) finding was that no relationships existed between the number of college level science courses completed and teachers' subsequent attitude toward teaching science was somewhat surprising. They also reported an insignificant relationship between the number of college science courses taken and teachers' confidence relating to teach science.

In another study, Wenner (1993) investigated the relationship between attitude held by prospective teachers regarding their ability to affect science learning among elementary students and their level of science knowledge. One hundred sixty seven undergraduate students of a large North-Eastern state college, who were enrolled in an upper level course that focused on elementary science methodology, served as subjects in this study. He administered instrument that was composed of three parts: (1) survey information regarding high school and college science coursework, (2) general science knowledge as measured by the General Science Test, and (3) beliefs about science instruction measured by a slightly modified version of the Science Teaching Efficacy Belief Instrument (Riggs & Enochs, 1990). This study indicated a relatively low level of science knowledge among preservice elementary teachers consistent with the findings of Victor (1961) and Blosser and Howe (1969), a negative relationship between science knowledge and attitude toward teaching science. In addition, in follow-up study, Wenner (1995) found no increase in science content knowledge but did identify positive changes in efficacy beliefs. Research responding to shulhum's (1986) call for more attention to be given to teaching a particular subject matter has built evidence of the difference that teachers' levels of knowledge can make, in the way concepts are represented and the structure of the subject is translated for pupils (Aubrey, 1996; Hasweh, 1987; Smith, 1988; Wilson, Shulhum, &Richert, 1987). McDiarmid, Ball and Anerson (1989) argued that the preservice needed to be more knowledgeable in their subject matter as a foundation for their professional knowledge. In another study Ferguon and Womack (1993) revealed that more evidence is needed to conclude on what level of subject matter knowledge is adequate in as much as science teaching is concerned.

To determine what extent of science content knowledge is adequate for teaching practice, Bennet and Carre (1993) as part of a larger investigation into the beliefs and knowledge of graduates on a one year teacher education course, assessed their subject knowledge with a test. They found out that most of the teachers did not do well. Assessment of both content knowledge and beliefs, were reported by Stevens and Wenner (1996) as an important consideration in restructuring programs designed to enhance teacher competence in mathematics and science education. They examined relationships that might exist between e beliefs held by prospective teachers regarding their ability to affect science and mathematics learning among elementary students and their personal level of science and mathematics knowledge. Sixty-seven undergraduate students in a large North-Eastern state college who were currently enrolled in an upper level course focusing on methods for teaching elementary science and mathematics served as subjects in their study. They utilized three-part instrument. First of the instrument was aimed at securing information regarding general content knowledge in science and mathematics; whereas second part utilized a Likert-type scale to survey students' personal beliefs regarding science and mathematics instruction.

Finally, third part consisted of four questions regarding the number of science and mathematics courses taken in high school and college. They found weak knowledge base in science and mathematics among preservice teachers and negative relationship between beliefs and knowledge. They suggested that preservice elementary teachers may well need further background in mathematics and science presented at a level that connects with their current conceptual level and extends this in ways that might be meaningful for them as they enter a career in education. Furthermore, Tekkaya, Çakıroglu and Ozkan (2002) investigated Turkish preservice science teachers' understanding of science concepts, attitude toward science teaching and their efficacy beliefs regarding science teaching. Data were collected by Science Concept Test, The Science Teaching Efficacy Belief Instrument, The Science Teaching Attitude Scale, Biology/Physics/Chemistry Attitude Scales, and open-ended questions on 85 preservice science teachers. Findings of the study indicated that majority of the participants had misconceptions concerning fundamental science concepts. Results also revealed that they generally had positive attitudes toward science teaching and three different domains of science biology, physics, and chemistry. In addition, slightly positive self-efficacy beliefs were found among the most of the participants regarding science teaching, although they have misconceptions.

The foundation to the promotion of elementary teachers' knowledge of subject matter is the assumption that teachers who know more teach better. According to Cochram and Lytle (1999), this seemingly simple idea has framed many attempts to provide quality education through policy, research and practice by making the teachers' knowledge the focal point. Shulhum (1986), identified this as a missing paradigm in his studies of teachers' knowledge and this has since become an important aspect of educational research. However, there have been different methods used by researchers in studies involving teachers' knowledge. Fenstermacher (1994). In all it can be deduced from the literature that teachers' science content knowledge is a key factor in enhancing effective science teaching and learning. A strong science content knowledge of the preservice teacher leads to development of positive attitudes toward science teaching.

Science Content Knowledge of Teachers, Efficacy Beliefs and Attitudes

Many teachers stated that inadequate background in science and methods is the primary reason for their avoidance of science teaching. But if teachers have strong self-efficacy beliefs as to their ability to teach science, they should find the subject less stressful and will apply more effort in teaching it effectively, perhaps simply because they feel strongly that they can succeed. It appears that low personal self-efficacy may underlie science anxiety, poor attitudes toward science and the resultant reluctance to spend adequate time and resources teaching science.

In a much broader sense, a person's attitude toward science conveniently summarizes his or her emotional response to basic beliefs about science. In addition to the fact that attitudes toward science serve as convenient summaries of our beliefs about science, they are important for other people for other reasons-they help others predict the kinds of science related behaviors we are likely to engage in more accurately than almost anything else we can tell them (Koballa & Crawley, 1985). According to them low knowledge levels of teachers results in their inability to teach science effectively hence it develops negative attitudes in them. This inadvertently results in their avoidance of teaching science. Lucas and Pooley (1982) reported that completion of introductory science units (astronomy and physical science) by preservice teachers resulted in "very significant improvement in student teachers' attitudes toward science teaching".

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A number of studies on content knowledge of teachers is related to what students learn in science and mathematics presented mixed outlooks. In science, out of two relationships examined between teachers' content knowledge and students' achievements, two correlated positively (Hill, Brown, & Ball, 2005; Lerderman, 1999; Mullens, Murnane, & Willet, 1996).

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On the whole it can be inferred from the literature that preservice teachers' science content knowledge, efficacy-beliefs and attitude towards science teaching are very important factors in teacher preparation and they are inseparable. Preservice teachers with solid science content knowledge are more likely to adopt various methods to teach science and enhance learners' performance in science. This will also inculcate positive attitudes in the pre-service teachers toward teaching of science.

Summary

To sum up, the relationship between level of science knowledge, beliefs and attitude toward science teaching has been shown to be positive in some studies (Crawley, 1991; Manning et al., 1982; Mechling et al., 1982), while other studies (Stepans & McCormack, 1985; Feistritzer,& Boyer, (1983) have shown no relationship or even a negative relationship. According to Gieger (1973) students who have a positive attitude towards science are more likely to promote science and scientific research in a country. Therefore it follows that the beliefs teachers hold about science teaching is crucial to having a successful lesson.

However, most of these studies were conducted using university students and none of them was conducted in colleges of educations. In addition even though there have been a number of studies on the influence of factors such as teacher knowledge, efficacy beliefs and attitudes toward science teaching, most of them were done in Asia, Europe and others with very different conditions as far as education is concerned while very little was conducted in Africa and Ghana for that matter. In line with these this study focused on the self-efficacy, science content knowledge levels and attitudes toward science teaching of the preservice science teachers. In addition, this study will add to the existing literature in this direction.

CHAPTER THREE

METHODOLOGY

Overview

In this chapter, the methodology of the study is discussed. This include the research design, which described the research approach that was used for the study. It also include instrumentation, population and sample, validity reliability, data collection procedure, data analysis and ethical issues.

Research Design

The research design used in this study is descriptive survey. Descriptive survey is selected due to the fact that the study aims at collecting data on the population and describing through a systematic manner such characteristics as content knowledge in science, attitudes and efficacy-beliefs toward science teaching (Nworgu, 2006). It also provides the picture of a situation in which it can identify the effects that are evident and trends that are developing. This type of design involves either identifying the characteristics of an observed phenomenon or exploring possible correlations among two or more phenomena. It does not involve changing or modifying the situation under investigation, nor is it intended to determine a case –and- effect relationships (Leedy & Ormood, 2005). To Gay (2002) the descriptive study design determines and reports the way things are. It is directed toward determining the nature of a situation as it exists at the time of the study. It is versatile and practical in the sense that it identifies present conditions and point to recent needs. It also attempts to determine the incidence, distribution and interrelations among sociological and psychological variable. It focuses on vital facts about people and their beliefs, opinions, attitudes, perceptions e.tc.

Descriptive study interprets synthesizes integrate data, points to implications and interrelationships (Osuala, 1987).

On the contrary, there is the difficulty of ensuring that the question to be answered or the statement to be responded to using the descriptive design is clear and not misleading because survey results can be significant depending on the exact wording of the questions or the statements. It may also produce untrustworthy result because they delve into peoples' private matters that may not be completely truthful about the person. Also the questionnaires require subjects who can articulate their thoughts well and sometimes such thoughts in writing (Scifert & Hoffnury, 1991). To minimize the demerits listed above for this study, the questionnaires and the test items were scrutinized by experts and thereafter pilot tested to remove any ambiguity and ensure clarity of items.

Population

The target population was the third year students who were preparing to embark on their final one year teaching practice of the 3- year diploma in basic education programme in 15ScienceColleges of Education in Ghana. The accessible population was the third year preservice science teachers of two colleges of education who were about to start their one year teaching practice programme.

The 15 colleges spread all over the 10 regions of Ghana while the two sampled colleges of education are located in the Greater Accra and the Volta Regions respectively. The 15 colleges of education are science and mathematics designated colleges. These colleges offer elective science and mathematics alongside with general courses such as Social studies, education, and English language among others.

Sample

The sample of this study was 100 final year science students from the Ada and Akatsi Colleges of Education. The sample was made of 92 males and 8 female students. There were 65 preservice teachers chosen from Akatsi College of Education while 35 were from Ada College of Education. This was purposively done based on proximity, familiarity and accessibility to the researcher. Also the two colleges were chosen because they are all science colleges. The researcher in addition used the Elective Science classes in the two colleges of education as all members of the classes offered science and will teach science during their teaching practice programme.

Instrumentation

The science teaching efficacy beliefs instrument (STEBI-B) a test and an attitude scale for measuring preservice science teacher's attitude towards science teaching were used to collect data for the study.

The STEBI-B instrument constructed by Riggs and Enoch (1990) broadly to measure the science teaching efficacy beliefs of preservice science teachers. The instrument consist of 23 item 5 point Liket scale. It started from one (strongly disagree) to five (strongly agree) the scale consist of two sub-scales namely the personal science teaching efficacy (PSTE). This describes how best the preservice teachers believe they have the ability to effectively influence students' learning. The other subscale; science teaching outcome expectancy is the beliefs the preservice teachers have that their students' learning can be influenced by effective teaching. The respondents answered the questions by selecting each of the following responses: strongly agree (5), agree (4), undecided (3), disagree (2), and strongly disagree (1).The items that are negatively worded have a reversed scoring in order to award high scores to only positive beliefs.

The Science Teaching Attitude Scale

The Science Teaching Attitude Scale (Thompson & Shringly, 1986) has been used widely to measure the attitudes of preservice and in-service teachers toward science teaching. The scale is also a Likert type with 20 items. The responses are categorized as strongly agree-5 points, agree-4 points, uncertain-3 points, disagree-2 points, and strongly disagree-1 point. The Science Teaching Attitude Scale was adopted directly for use in the Ghanaian Colleges of Education. The adoption was informed by the fact that it has proven efficient in many studies on preservice teachers' attitude in many studies has provided consistent results.

Test

The instrument used to collect data on the preservice teachers' content knowledge of the science subject, was a test. The items of the test were written on topics in the JHS integrated science syllabus which they would be teaching during their teaching practice programme. The topics were selected from all the areas of the integrated science such as Biology, Chemistry, Physics and Agriculture. Topics such as basic electronics, reproduction and growth in plants, crop production atomic structure and the concept of atoms, diversity of matter and current electricity. These topics were selected because they are part of the course content of the colleges of education that the preservice science teachers treated. Also, these are part of a set of topics that elementary school teachers labelled as "challenging topics". There were a total of twenty multiple choice type test each with four options from which the respondents selected one as the correct answer. The items were scored using a rating of 0 and 1 for wrong and right responses respectively.

Validity

To ensure validity of the test colleague science tutors from my college and sister colleges were tasked to scrutinize the items and the topics selected to confirm they are within the course outline of the colleges and synchronize with topics in the basic school integrated science syllabus. A pilot test of the instruments was done with 50 preservice science teachers from the Volta Region this was to ensure that the items were clear and devoid of ambiguities. After the test the researcher had a discussion with the preservice teachers and realized that the items did not deviate from the topics they have studied in college.

Reliability

The reliability of the test items was ascertained through the test re-test approach. The researcher administered the instruments to the preservice teachers a second time during the pilot testing and the analysis of the results showed a positive correlation of 0.90 which indicated that the items were very reliable. To make sure that the lapse of time did not affect the result of the test, the second testing was done just the following day.

The STEBI-B and the Science Teaching Attitude Scales were found very high validity and reliability of 0.9 and 0.8 respectively as reported by (Morrel, & Carroll, 2003; Tekkaya, Cakiroglu, & Ozkan, 2004).

Pilot testing

In this study the researcher performed pilot testing to determine the validity and reliability of the test instrument. The instruments were piloted in a sister college that share similar characteristics with the sampled colleges but were not part of the actual study. This was done to reduce likely problems that could occur during the real study.

It also assisted in assessing the appropriateness and practicality of the instruments. According to Franenkal and Wallen (2000) pilot testing helps to reveal defects in the research plan. They explained that it reveals poorly worded questions and indicates whether instructions to respondents are clear.

Data Collection Procedure

Data collection was done through the use of a questionnaire and a test. To collect data the researcher visited the colleges twice. The first visit was used to seek permission from the authorities and also to establish a rapport with the preservice teachers. During the second visit, the questionnaires in addition to the test sheets were administered to the trainees personally with the help of colleague science tutors from the sampled colleges of education. The preservice teachers were given time to feel comfortable to complete the questionnaires and answer the test questions. The completed questionnaires and answer scripts were collected the same day

Data Analysis

The data collected was analyzed quantitatively using the Statistical Package for Social Sciences. The data for the achievement test was coded and keyed in to the SPSS and analyzed. Descriptive statistics was done using figures and percentages to describe characteristics of the respondents.

The data for STEBI-B and Science Teaching Attitude Scales were also analyzed using the descriptive statistics function of the SPSS to find mean scores standard deviations and percentages on the preservice science teachers' scores on STEBI-B. The reliability of the items on the STEBI-B Scale was determined by finding the Cronbach alpha for the PTSE and STOE items Mean scores and standard deviations on the preservice science teachers' scores as well as percentages were used to describe the characteristics of the preservice science teachers. The mean scores range of 2.21 to 4.60 for both PSTE and STOE indicates moderate to very high efficacy beliefs of the preservice science teachers. For the purpose of easy computations the researcher collapsed the five categories of responses three.

Ethical Issues

In this study steps were taken to address a number of ethical issues that are considered important in social research such as informed consent, anonymity and confidentiality. In the first place the researcher through colleague science teachers, introduced himself to the preservice teachers and informed them about the study and obtained their consent to participate in the study. Secondly the names of the individual respondents were not included in the study as well as not linking the data to individual respondents as a way of ensuring privacy of the respondents. In addition, the researcher assured the respondents that no individual participant's data would be released or made public in a way that would show any identity.

CHAPTER FOUR

RESULTS

Overview

In this chapter, the analyses of data from questionnaires and test administered to preservice science teachers are presented. Theanalysis was done in two parts: the first part dealt with the background information of the preservice teachers and their courses of study at the senior high schools. The second part dealt with the pre-service teachers' efficacy beliefs, attitudes and content knowledge.

Background information on the sample

The study sample was 100 pre-service teacher (92 males and 8 females). The data on the pre-service teachers' background was obtained from inspection of completed application forms of the pre-service teachers for entry into the colleges of education. Figure 1shows that for the study sample 92% (n=92) were males and 8% (n=8) were females.

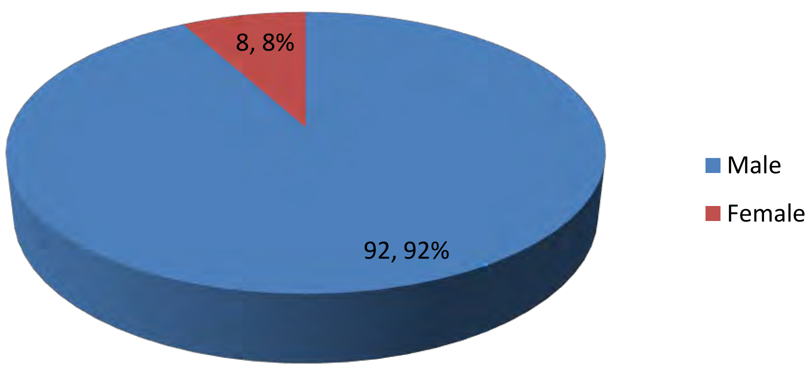

Figure 1: Gender of Pre-service Teacher Respondents

Table 1 provides the age distribution of the sample as presented in the study. The dominant age group ranges between 24 – 26 years (39%, n=39) followed by 21 – 23 years (22%, n=22), followed by ages 27 – 30 years (16%, n=16), followed by ages 18 – 20 years (12%, n=12), and finally ages 31 and above (11%, n=11).

Table 1 Age distribution

Age (Years)	Frequency	Percentage (%)
18 – 20	12	12
21 – 23	22	22
24 – 26	39	39
27 – 30	16	16
31 and above	11	11
Total	**100**	**100**

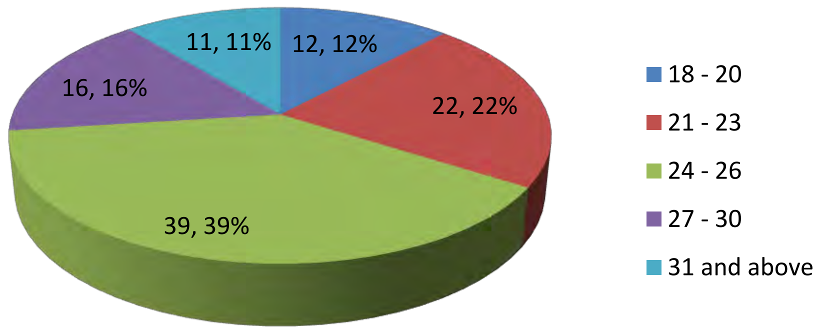

Figure 2: Age Distribution of Respondents

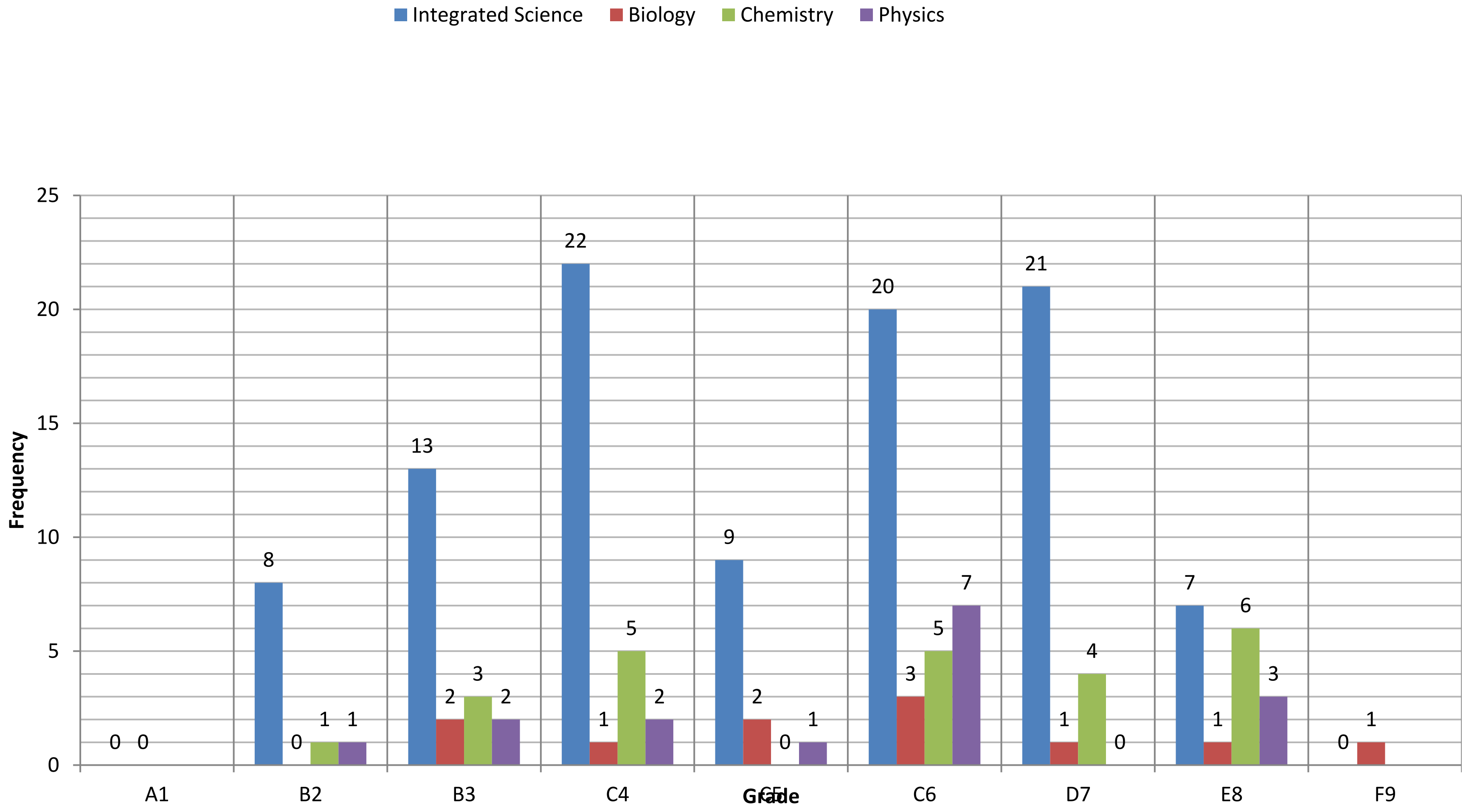

Figure 3: Bar graph of Grades in Integrated Science, Biology, Chemistry and Physics

Entry grades of preservice teachers

The study sample consisted of 100 preservice teachers made up of 92.92% males and 8.8% females. Data were collected through questionnaire and presented in a bar chart in figure 3. The analysis of the grades is done subject wise and limited to only the grades obtained in the sciences such as Integrated Science, Biology, Chemistry and Physics.

Integrated Science

From figure 3 the best and worst entry grades of the respondents in Integrated Science was B2 and E8 respectively. Only 8% (n=8) of the respondents entered the college with B2 while 7% (n=7) of the respondents entered with grade E8. Majority of the respondents (22%) entered with a grade of C4, followed by D7 with 21% (n=21), followed by C6 with 20% (n=20), then B3 with 13% (n=13), then C5 with 9% (n=9) and B3 with 8% (n=8) and finally E8 with 7% (n=7). No student entered with an A1 grade. About a third of the respondents entered the Colleges of Education with weak grades (D7 and E8) and who would not have been admitted. For the current admission period since the required minimum requirement is now grade C6.

Biology

The total number of students who offered biology was 11. The best and worst entry grades of the respondents in Biology were B3 and F9 respectively. Only 18% (n=2) of the respondents entered the college with grade B3 while 9% (n=1) of the respondents entered with grade F9. Majority of the respondents (28%, n=3) entered with a grade of C6, followed by B3 and C5 respectively with 18% (n=2). This was followed by C4, D7, E8 and F9 respectively with 9% (n=1). No student entered with an A1 or B2 grade. It can be seen that about a third of the respondents entered the Colleges of

Education with weak grades (D7, E8 and F9) and who would not have been around for the current admission period since the required minimum requirement is now grade C6.

Chemistry

The total number of students who offered Chemistry was 24. The best and worst entry grades of the respondents in Chemistry were B2 and E8 respectively. Only 9% (n=1) of the respondents entered the college with grade B2 while 25% (n=6) of the respondents entered with grade E8. Majority of the respondents (25%, n=6) entered with a grade of E8, followed by C4 and C6 respectively with 21% (n=5). This was followed by D7 with 17% (n=3) and finally grade B2 with 4% (n=1). No student entered with an A1 grade. It can be seen that about 42% (n=10) of the respondents entered the Colleges of Education with weak grades (D7 and E8) and who would not have been around for the current admission period since the required minimum requirement is now grade C6.

Physics

The total number of students who offered Physics was 16. The best and worst entry grades of the respondents in Physics were B2 and E8 respectively. Only 6% (n=1) of the respondents entered the college with grade B2 while 19% (n=3) of the respondents entered with grade E8. Majority of the respondents (44%, n=7) entered with a grade of C6, followed by E8 with 19% (n=3). This was followed by B3 and C4 with 12% (n=2) respectively and finally grade B2 and C5 with 6% (n=1) respectively. No student entered with an A1 grade or D7 grade. It can be seen that about a fifth of the respondents entered the Colleges of Education with weak grades (E8) and who would not have been around for the current admission period since the required minimum requirement is now grade C6.

Judging from these analysis, it is clear that the weak science background of the preservice science teachers could not be delinked from the weak passes that the preservice teachers obtained from their end of semester examinations. This is because they had to cope with a more deep science content courses that are offered in the colleges of education than they did in the senior high schools. Also this could be associated with the low science content knowledge exhibited by most of the preservice teachers in the colleges of education.

Data on the number of years the preservice teachers spent at home after their first sitting of the WASSCE was collected through the questionnaire. The number of years were analysed in percentages and the results presented in Table 2.

Table 2: The number of years spent at home after SHS.

Year(s) spent at home	Frequency	Percentage (%)
1 year	34	34
2 years	28	28
3 years	22	22
4 years and above	16	16
Total	**100**	**100**

The number of years respondents stayed at home before entering into the college of education ranged from 1 to 4 years and above. Majority of the respondents (34%, n=34) stayed at home for one year. It was also observed that 28% and 22% of the respondents stayed at home for two and three years respectively before entering the colleges. There were 16% (n=16) of the trainees who indicated that they spent four years and beyond at home before entering the colleges. This result indicated that 66% (n=66) of the respondents of the sample spent at least two years at home after the WASSCE before entering the colleges of education. This could be attributed to the fact that those students were not able to pass all their subjects at a sitting to enable them get admission into the colleges of education. Obviously most of them could not obtain good passes in science and mathematics.

The preservice teachers indicated six categories of courses that they offered at the senior high school level. The table indicated that 35 % of trainees offered elective science at the Senior High School which is the most preferred requirement for the Science programme in the Colleges of Education. The table also indicated that 29% of teacher trainees offered agricultural science while 36% of trainees offered business and other subjects from the sampled colleges. The Agricultural Science students offered either elective chemistry or physics in addition as revealed from their entry forms to the colleges while Home Economics students offered only Chemistry.

Table 3 Courses offered by the preservice teachers at the senior high level

This data was collected using questionnaires and analysed using simple percentages.

Courses Offered	Frequency	Percentage (%)
Elective Science (Chemistry, physics, Biology)	35	35
Agricultural Science	29	29
Business	15	15
Arts	5	5
Technical	10	10
Home Economics	6	6
Total	**100**	**100**

From the analysis, about 65% of the preservice science teachers did only one elective science subjects out of the three. This imply that about 65% of them were compelled to study two of the three elective science courses which are totally new to them. This undoubtedly was difficult to many of them since they did not have good foundation in this courses. The result was poor performance in this courses.

ResearchQuestion1: **What are the pre-service teachers' science teaching efficacy-beliefs toward science teaching?**

The STEBI-B Instrument was used to collect data from the sample to answer question 1 Descriptive statistics were used to analyse the respondents' scores on the STEBI-B. The scores of negatively worded items were reversely scored at the beginning of the statistical analysis to provide consistent values. High mean score on negatively worded item indicated a positive teaching efficacy belief. The Cronbach reliability coefficient for the two subscales were found to be 0.87 and 0.86 for PSTE and STOE in that order with an alpha value of 0.75. Table 4 presents the mean score and standard deviations of respondent' scores for each item of STEBI-B scale. The item mean ranged from 2.21 to 4.60 and most of the items had mean scores above the general mean of the scale which is quoted at (3.0). Only item 10 and 13 had mean scores less than the general mean of the scale. While the mean of item 10 stood at 2.21 that of 13 was 2.40. This indicates that on the whole the preservice teachers exhibited high self-efficacy beliefs regarding science teaching. In addition, the table presents the descriptive statistics for each item on the subscales. Appendices A shows the STEBI-B Scale.

Total Scale MS and SD score were 86.43 and 9.1 respectively. The participants' responses for each item were categorised into agree, neutral or disagree and converted into numbers, frequencies or percentages.

Table 4 displays percentages of responses to each item that fell into three collapsed categories for the Personal Science Teaching Efficacy (PSTE) and Science Teaching Outcome Expectancy (STOE) subscales.

Table 4 Item Means, Standard Deviations and Percentage of Respondents' on the Science Teaching Efficacy Belief Instrument (STEBI-B)

SUBSCALE	ITEM NUMBER	MEAN SCORE	S.D	AGREE (%)	NEUTRAL (%)	DISAGREE (%)
PSTE	2	4.60	0.63	97.6	0.0	2.4
	*3	3.76	1.12	59.5	26.2	14.3
	4	3.78	1.00	78.6	11.9	9.5
	*6	3.69	1.12	11.9	16.3	67
	*7	3.98	1.20	14.6	18.8	63.8
	12	3.95	0.94	81.0	9.5	9.5
	*16	3.42	1.13	45.2	35.8	19
	17	4.11	0.86	85.7	9.5	4.8
	*18	3.83	0.93	69.0	23.8	7.2
	*19	3.57	1.21	61.9	16.7	21.4
	20	3.57	1.31	61.9	21.4	16.7
	21	4.38	0.85	88.1	9.5	2.4
	*22	3.81	1.04	66.7	21.4	11.9
Total		**50.45**	**13.34**			
STOE	1	4.00	1.21	76.2	14.3	9.5
	5	4.40	0.80	93.0	4.6	2.4
	8	3.76	1.07	66.7	21.4	11.9
	9	4.40	0.73	90.5	7.1	2.4
	*10	2.21	1.11	14.3	9.5	76.2
	11	3.68	0.93	95.2	2.4	2.4
	*13	2.40	1.31	21.4	11.9	66.7
	14	3.78	1.00	73.8	11.9	14.3
	15	4.09	0.85	83.3	9.5	7.2
	23	4.26	1.03	88.1	9.5	2.4
Total		**28.82**	**10.04**			

*Scoring Reversed for Negatively worded Items

For the PSTE subscale the possible minimum score is 13 (least efficacious) and the maximum score is 65 (most efficacious) because it includes 13 items with five category response scale. For the STOE subscale the possible minimum score is 10 (least efficacious) and the maximum score is 50 (most efficacious) because it includes 10 item with five category response scale.

In this context, the preservice teachers indicated efficacy beliefs regarding the teaching of science on both dimensions. For the PSTE subscale, raw scores ranged from 17 to 65 with a mean scores of50.45 and standard deviation of 13.34.Likewise, for the STOE subscale, a mean score of 28.82 and deviation of 10.04 was calculated.

The mean score for the total scale is 86.43 with a standard deviation of 9.1.

From table 4, majority of the respondents (76.2%) largely agreed that a little extra effort exerted by the science teacher could make the students perform better than usual. Similarly 93% of the respondents asserted that if the teacher found a more effective ways of teaching, the grades of students in science would improve.

Also, 66.7% of the respondents agreed that ineffective science teaching is the most likely cause of students under achievement, while 90.5% indicated that good teaching is the antidote to overcoming students' inadequate science backgrounds.

In addition 76.2% of the respondents disagreed with the fact that the low science achievement of some students cannot generally be blamed on their teachers.

Respondents generally agreed (95.2%) that the teachers' extra attention to low achieving students could help them progress in class and disagreed (66.7%) with the fact that increased efforts in science teaching may not produce any desirable result.

About 73.8% of the respondents indicated that that the teacher is largely responsible for students' achievement in science and 88.1% of them also shared the view that if parents commend their wards for their interest in science, it is a commendation of the outstanding performance of the child's teacher. Also 97.6% of respondents indicated their readiness to always adopt improved approaches to teach science. On the contrary, a little more than half of the respondents (59.5%) were of the view that they could not teach science as well as they could teach other subjects. About 62% of the respondents also indicated that they will not be very effective in ensuring successful science experiments. In addition, 45.2% of the respondents claimed they may not be able to explain the principle's underlying science experiments while 69% of the preservice science teachers were not confident of possessing the requisite skills for science teaching. Many respondents (61.9%) would not want their science lessons to be observed if they have the choice.

This could well be because the respondents were not very confident they have what it takes to present a science lesson successful.

A good number of the preservice science teachers (71.4%) believed that they generally welcome students' questions while 85.7% of them claimed they have what it takes to answer students' questions and 78.6% of them also indicated that they know the steps necessary to teach science effectively. However, 66.7% of the preservice teachers asserted that they do not know what to do to turn students to science. This could be because the respondents lacked the confidence or creativity in helping students to be more interested in science and learning science as a whole.

Research Question2. What is the science content knowledge level of the preservice teachers?

The data on the preservice teachers' science content knowledge was collected through an achievement test conducted for them. The test was made of 20 objective items. The questions were made up of 8 Biology questions and 6 questions each for physics and chemistry respectively. Each correct response was scored one mark out of a total of 20 marks. The respondents' scores on the Science Achievement Test were analysed by utilizing descriptive statistics. The possible minimum score was 0 and the maximum score 20.

The result of the analysis are presented in table 5

Table 5 Scores of Preservice Teachers' Achievement Test

Test Score	Frequency	Percentage (%)
0-4	3	3
5-9	20	20
10-14	70	70
15-19	7	7
Total	**100**	**100**

In this study, the pre-service science teachers exhibited relatively low level of science content knowledge on the selected topics in the test. Between 3% - 70% of the preservice teachers scored marks ranging from 0 to 14 out of 20. The mean score was 10.38with a standard deviation of 3.18

About 23% of the preservice teachers obtained marks lower than the mean score whiles a few scored marks above the mean score. This performance shows a low level of science content knowledge of the preservice teachers on the selected topics from the basic school integrated science syllabus.

Table 6 Mean Scores of Achievement Test Grouped according to test items

Test Item Areas	Mean Score
Biology	4
Chemistry	3.8
Physics	3.3

The total score for the biology questions was 8 that of chemistry and physics were 6 each. It can be seen from the table that the preservice teachers performed better in Biology than in physics and chemistry. Generally most students hold the perception that Chemistry and Physics are more difficult than Biology. Because of this perception they develop a phobia for these areas of the subject hence some do not perform well in them.

Research Question 3

What is the attitude of the preservice science teachers towards science teaching in selected colleges of education?

Descriptive statistics was used to analyse the respondents' scores on the Science Teaching Attitude Scale. The respondents' scores on the Science Teaching Attitude Scale were analysed using descriptive statistics. The possible minimum scores is 20 (negative attitude) and the maximum score is 100 (positive) attitude. The scores were organised into means cores standard deviations and percentages. The results are presented in Table 6.

Table 7: Mean scores, standard deviations and Percentage frequencies of Respondents' Score on Science Teaching Attitude Scale

Item Number	Item Description	Mean	SD	Agree (%)	Neutral (%)	Disagree (%)
*1	I will feel uncomfortable teaching science.	3.74	1.16	72.2	10.1	17.7
2	The teaching of science process is important in the elementary classroom	4.44	.76	94.9	1.3	3.8
*3	I fear that I will be unable to teach science adequately	3.35	1.26	51.9	17.7	30.4
4	I will enjoy the lab/hands on time when I teach Science	4.08	.85	84.8	8.9	6.4
*5	I have a difficult time understanding science	3.63	1.16	65.8	11.4	22.8
6	I feel comfortable with the science content in the elementary school curriculum.	3.92	1.11	75.9	7.6	16.5
7	I would be interested in working on an Experimental science curriculum	4.05	.90	81.0	11.4	7.6
*8	I dread teaching science	3.14	1.18	41.7	24.1	34.2
*9	I am not looking forward to teaching science in my elementary classroom	3.80	1.15	16.5	12.7	70.8
*10	I am afraid that students will ask me questions that I cannot answer	3.80	1.15	70.8	8.9	20.3
11	I will enjoy manipulating science equipment.	4.25	.91	86.0	8.9	5.1
*12	In the classroom, I fear science experiments won't turn out as expected.	3.54	1.23	60.8	16.4	22.8
13	I hope to be able to excite my students about science	4.30	.76	91.1	6.3	2.6
14	I plan to integrate science into other subject areas	3.97	.92	53.5	28.1	12
15	Science would be one of my preferred subjects to teach if given the choice.	3.96	1.07	77.2	16.5	6.3
16	Science is as important as reading-writing and mathematics	4.54	0.64	95.0	3.8	1.2
*17	Teaching science takes too much effort.	2.39	1.10	17.7	24.1	58.2
*18	Teaching science takes too much time	2.46	1.10	19.0	20.2	60.8
19	I will enjoy helping students construct science equipment.	4.15	.81	83.6	10.1	6.3

*Scoring Reversed For These Items.

The mean score of the respondents' score on the Science Teaching Attitude Scale ranged from 2.39 to 4.54. The standard deviation ranged from 0.64 to 1.26.The overall mean score is 3.77 with a standard deviation of 1.15. This study indicated generally a positive attitude of the preservice science teachers on the Science Teaching Attitude Scale.

From table 7, as high as 94.9% of the preservice teachers agreed that the teaching of science process is important in the elementary schools and an equally high percentage of respondents (83.6%) asserted to the fact that they would enjoy helping students construct science equipment. As many as 77.2% of them indicated that science is their preferred subject to teach given the choice. Along the same line, 70.8% of the respondents disagreed on the fact that they were not looking forward to teaching science in the basic school classrooms, a positive attitude. As many respondents, 91.1% were hopeful of being able to excite their students about science. In addition, 81.0% of the preservice teachers indicated they would be interested working on a science project whiles 17.7% of respondents indicated that science teaching takes much effort just as 19% of them said that science teaching takes too much time. In contradiction with the very many positive attitudes indicated by the respondents on the science teaching attitude scale, 72.2% of them asserted that they would feel uncomfortable teaching science while 51.9% indicated that they feared they would not be able to teach science adequately. Also, 65.8% of the respondents agreed that they have difficult time understanding science while an average number of respondents (41.7%) asserted that they dreaded teaching science. In addition, as many as 70.8% of respondents indicated that they were afraid students will ask questions they could not answer. Finally 60.8% of respondents indicated they fear that science experiments may not turn out as expected.

CHAPTER FIVE

DISCUSSION

Overview

This chapter presents the discussions based on the findings of this study according to the research questions that guided the study. The discussion was based on the following themes; preservice science teachers' science content knowledge the science content knowledge levels the preservice science teachers' self-efficacy beliefs towards science teaching and the attitudes of preservice science teachers towards science teaching.

Major Findings

1. The final year preservice teachers have generally low science content knowledge of some topics in the basic schools' integrated science syllabus with a mean score of 10.38 and a standard deviation of 3.18. About 70% of the preservice teachers scored marks ranging from 3 to 14 out of 20 with 17 out of 20 as the highest score.
2. The preservice science teachers exhibited moderately positive attitudes toward science teaching; the overall mean score is 3.77 with a standard deviation of 1.15.
3. Most of the preservice science teachers did not have strong science background before entering the colleges of education. Only 21% entered the college with grades better than grade 'C'.
4. The preservice science teachers exhibited generally high efficacy beliefs towards science teaching
5. Most of the preservice science teachers entered colleges of educations with weak backgrounds in science

Discussions of Findings

This section discussed the major findings the study with their seeming implications based on findings from the respondents.

Science content knowledge level of the preservice science teachers

This study has found a low science content knowledge level among the preservice science teachers with a mean score of 10.38 and a standard deviation of 3.18. About 70% of the preservice teachers scored marks ranging from 3 to 14 out of 20 with 17 out of 20 as the highest score. This finding indicated that the preservice science teachers do not possess deep enough science content knowledge to be able to teach and explain science concepts in the national basic schools' integrated science curriculum effectively. The reason for the low science content knowledge level of the preservice teachers could be attributed bad teaching of the subject at the lower levels. This finding agrees with (Franz &Enochs, 1982) who reported that elementary school science teachers in a similar study asserted that their major hurdle in effective science teaching is lack of adequate science content knowledge.

There is the general understanding that poor background knowledge in science is mostly responsible for lack of readiness and inability of basic school teachers to teach science effectively. Low levels of science content knowledge have also been found by other researchers from other parts of the world (Blosser & Howe, 1969; Baxter& Leinhardt, 1990; Wenner, 1996). Teachers at all levels of education need a sound knowledge of the courses they teach (Bennett, Carre Carter, Wrag, cited in Smith, 1997). To them, poor scientific knowledge is a major problem to many basic school science teachers. The responses to the achievement test conducted also revealed that most of the preservice science teachers responded correctly to the biology oriented questions more than they did for chemistry and physics respectively. The implication of low content knowledge levels and the inclination of the preservice science teachers towards only an aspect of the fields of science better than others in their classroom teaching means that prospective teachers will not be able to teach science to conceptual levels. In addition, teachers are likely to skip topics in the national science curriculum that they do not have the requisite knowledge in.

Preservice science teachers' Science teaching self-efficacy level

Teacher efficacy implies the beliefs of individual teachers about their ability to deliver teaching skills in a way as to leading learners to achieve their learning goals. It involves judgement of the individual teacher's strengths in helping students to achieve relevant goals (Tschannen-moran & Woolfolk Hoy, 2001).

The science teachers ' self-efficacy beliefs has a direct bearing on their performance, hence the many educational researches focus attention on it. These researches all concluded that the teacher's self-efficacy correlates with effective teaching and learning and attitudes (Anderson, Greene, & Loewen 1999; Ashton & Webb, 1986; Ross 1992; Tschannen-Moran et al., 1998).

Teachers with high efficacy see themselves as capable of motivating and teaching student believes that can make their students learn. These teachers also think that they have the repertoire to deal with real classroom occurrences (Friedman &Kass, 2002) Bandura (1997) cited by Palmer (2006) indicated that enactive mastering experiences are usually the most powerful sources of self-efficacy, however it is also argued that there are other sources of teacher self-efficacy and science content knowledge is a very significant source of self-efficacy (Schoon & Boone, 1998) cited by Palmer (2006).

To this end preservice science teachers need to acquire more of the content knowledge in the subject that they will be teaching. This will make the preservice teachers increase their self-efficacy science teaching efficacy beliefs of preservice science teachers can be improved by demonstration lessons conducted for the preservice teachers. In doing this the tutor mimics the basic school teacher while the preservice teacher assumes the role of the basic school students (Posnanski, 2002).

This study has found very high self-efficacy levels among the preservice science teachers. This implies that the preservice teachers have quite a strong conviction of their ability to execute teaching skills effectively and will be able to lead their pupils to successfully achieve their learning goals. Most of the respondents acknowledged that students who scored high marks on the students achievement tests in science is highly related or influenced by the efforts of the science teacher and those inadequacies in the student's science background can be overcome when students are effectively engaged in constructive activities. The respondents generally agreed (95.2%) that an additional effort by the science teacher can transform a low achiever in class to high achiever. Due to the very strong correlation between science teaching efficacy beliefs and science teaching behaviours teacher preparation institutions should endeavour to increase the self-efficacy of their preservice teachers. This when done will serve as the foundation for their attitudes and beliefs (Sarikaya, 2004)

The findings of this study revealed rather very strong self-efficacy beliefs of the preservice teacher. This means that the preservice teachers are very determined to take up the responsibility of their students' learning achievements and goals. However the relatively low level of their content knowledge in science poses the question of whether these preservice teachers are adequately ready to take up the challenge of effective science teaching in the basic school classrooms. 71.4% of the preservice teachers indicated that they will welcome student's questions but contrary to the finding of Wenner (1993) where only 2% of the respondents were positive of being able to answer student's questions as high as 85.7% of the respondents claimed they have what it takes to answer student's questions.

Even though the preservice teachers overwhelmingly (97.6%) asserted that they will often adopt improved ways of teaching science, more than half of them (59.5%) of them (see table 4) indicated they could teach other subjects better than science. This is a low efficacy belief. A study by Enochs and Riggs (1990) indicated that preservice science teachers who were very efficacious have the ability to plan and execute activity based lessons. They normally spend more time on hands on activities to ensure that students acquire deeper understanding of concepts.

Due to the strong relationship that links science teaching efficacy beliefs and science teaching behaviours, it is expedient for initial teacher training institutions to intensify various programmes that would build and serve as sources of self-efficacy to the preservice science teacher so as to boost their self- efficacy levels.

The generally high science teaching self- efficacy levels found in this study, might be partly attributed to the many pedagogical courses they offered during their two years of study in the college (Czerniak & Chiarelott, 1990; Cantrell, Young &Moore, 2003). However the low background knowledge in science could be responsible for some of the preservice science teachers' assertion that they may not be able to answer students' questions. To ameliorate this problem among preservice teachers, adequate science content courses should be mounted to equip them adequately before they embark on their one year internship programme where real teaching is done.

Attitude of the preservice teachers to science and science teaching

Attitude as a concept is concerned with an individual's way of thinking, acting and behaviour. It has very serious implications for the learner, the teacher, the immediate social group with which the individual learner is associated and the entire school system. Attitudes are formed as a result of some learning experiences. They may also be learned by following the examples or opinion of teacher parent or a friend. This is mimicry or imitation which also has a part in the teaching and learning situation. In this respect the learner draws from his teacher's disposition to form his own attitude, which may likely affect his learning outcome.

Bandura (1971) indicated that behaviours are acquired by observing an actor. This could be the teacher. In the classroom students modelled the teacher by imitating whatever he or she does. Therefore the teachers' attitude about the students learning could have a great influence on the since the teachers' attitudes have has direct influence on that of the students.

This study has found both positive and negative attitudes of the pre-service science teachers based on their responses on the science teaching attitude scale. Igwe (2002) cited by (Yara & Olatunde, 2009) was of the view that motivation of both the teacher and students is key to ensuring effective and captivating teaching of science in other to cultivate positive attitudes needed to enhance greater academic achievements. This Study has found both positive and negative attitudes among the pre-service science teachers who were just about to start their one year mandatory internship programme. 94.9% of the respondents asserted that teaching of science process is important in the basic school while 84.8% of them indicated that they will enjoy laboratory and hands on activities when they teach science in their classes. These are positive attitudes and are very crucial as far as science teaching and learning is concerned.

Increased conceptualisation of science topics occurs through inquiry-based teaching that engages students in the investigative nature of science. 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 & Scrugs, 1994). Students engaged in activity-based lessons develops increased creativity, better attitudes towards science, and have improved logic development, communication skills and reading-readiness (Haury & Rillero,1994). 95 % of the respondents in this study agreed that science teaching and learning is important as other subjects. The positive attitudes could be attributed to the science method courses the preservice teachers offered during their course of study and the demonstration lessons organised for them my their tutors. As found by Ginns & Watters (1990), the way people were taught science during their earlier school days also influences the attitudes they develop towards science and science teaching. When students have fun during science activities and investigating natural phenomena it helps to build positive attitudes towards science later (Stevens &Wenner, 1996). It implies that tutors of science in the colleges of education should serve as role models, making science teaching and learning fun and design enough demonstration lesson sessions for trainee teachers in order to build positive attitudes.

The analysis of data in this study also revealed significant negative attitudes of the preservice science teachers. A good number of the respondents (72%) asserted that they will feel uncomfortable teaching science while 51.9% indicated that they feared they will not be able to teach science adequately. Also 65% of them affirmed that they do not find it easy understanding science while 70.8% said they fear they may not be able to answer students' questions well enough and doubted their own ability carry out successful science experiments. These negative attitudes could stem from the fact that the preservice science teachers have weak science content knowledge as found by this study. High subject content knowledge correlate positively with the desire of an individual to teach science while lack of adequate subject content knowledge relates to low confidence and willingness to teach science (Stevens & Wenner,1996). Also research has shown that lack of adequate subject matter knowledge in science results in decreased ability to guide students successfully through hands on and laboratory activities in science lessons. According to Tosum (2000) negative attitudes of science teachers negatively affects their science teaching self-efficacy levels.

It is very important to note that the teachers' dispositions to work affect their devotion to work. This has very much affected the attitude of students towards learning of science which invariably results in their poor performance in science. The positive attitude of students towards science can be improved by tutors becoming more enthusiastic, teachers becoming resourceful and adopting helpful behaviour and teachers updating their subject content knowledge and making science teaching and learning fun (Ogunuyi, 1982).It is therefore crucial to help the preservice teachers to acquire adequate subject content knowledge in science in order to develop positive attitudes towards science and science teaching.

CHAPTER SIX

CONCLUSIONS RECOMMENDATIONS AND SUMMARY

Overview

This chapter presents the conclusions made on this study with regards to the findings, the recommendations that are made to address the negative findings as well as sustain the positives and summary of the study.

Summary

The purpose of this study was to examine the science content knowledge of preservice science teachers, their attitudes toward science teaching and their science teaching self-efficacy beliefs toward the teaching of science in Science and Mathematics Colleges of Education in Ghana. Three main instruments, the science teaching efficacy belief Instrument (STEBI-B) Scale by Enoch and Riggs, 1990, science teaching attitude scale (Thompson & Shringly, 1986), and a test were used to collect a quantitative data in this study. The STEBI-B Scale and the Science Teaching Attitude Scale were used to collect data on the science teaching efficacy beliefs and attitude toward science teaching by the preservice teachers respectively, while the test was used to collect data on the science content knowledge levels of the preservice teachers. Descriptive statistics and simple percentages were used to analyse the data. Frequencies, percentages, means and standard deviations of the data calculated and used to establish science teaching efficacy beliefs, attitudes and science content knowledge levels of the preservice science teachers.

Conclusions

The acquisition of scientific knowledge depends on the way instructions are presented to the learner, the way the learner actively interacts with the learning experiences presented to him and the environment within which the learning takes place.

In conclusion the result of this study indicates that the preservice science teachers have generally high self-efficacy beliefs regarding science teaching. This implies that most of the preservice teachers were upbeat about their abilities to teach science in their basic school classes if posted. The results also found overall positive attitudes among the preservice teachers on the Science teaching attitude scale. The science content knowledge of the preservice teachers was found to be moderate regarding the topics in the test. The performance on the test could be largely attributed to the weak backgrounds of the preservice teachers with which they were admitted into the colleges. Teachers' attitude towards the teaching of science plays a significant role in shaping the attitude of students towards the learning of science.

Teachers' attitude towards science is a significant predictor of pupils' science achievement as well as their attitude towards science. Students' positive attitude towards science could be enhanced by teachers' enthusiasms, resourcefulness and helpful behaviour, teachers' in-depth knowledge of the subject matter and their making science quite interesting. It is on this premise that the attitude of the teacher, his or her disposition to the subject, students, and classroom environment could make or unmake the attitude of the students towards the learning of science. The attitude of the science teacher can mould the attitude of the students to want to learn or not. Hence the science teacher should be psychologically prepared to teach the subject given that every other requirement is met. The moderate level of science content knowledge among the preservice teachers is a matter of concern and could be cited as leading contributor to the negative attitudes expressed by the preservice teachers. The study has, however found very high science teaching efficacy beliefs among the preservice teachers which can be greatly attributed to the number of science method and general pedagogical courses they studied in the college.

Recommendations

Based on the findings of this study the following recommendations are made by the researcher in order to improve the quality of science teachers that are produced from the colleges of education.

1. The curriculum of the colleges of education should be revised and aligned with that of the basic schools in order to have the preservice teachers well versed in the concepts that they will be teaching in their prospective schools
2. The science background of the prospective candidates that are admitted to the colleges of education should be thoroughly scrutinised and be the baseline for their admission.
3. Science tutors of the colleges of education should adopt the right attitudes towards the teaching of science so as to help their students also develop such positive attitudes.

Suggestions for Future Research

This study did not establish any strong relationship between such factors as self-efficacy beliefs science content knowledge levels and attitudes of preservice science teachers in selected colleges of education in Ghana. It is therefore suggested that future studies in this direction be interested in finding out how science content knowledge levels of Ghanaian preservice science teachers influence their self-efficacy beliefs and attitudes toward science teaching.

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APPENDICE A

QUESTIONNAIRE

This questionnaire to seek collect date for research purpose only. The information you shall give, will be treated with uttermost confidentiality, hence the need for honest responses.

You are assured that the outcome of the research will go a long way to benefit students in terms of their academic needs and also help to structure a better curriculum that will address lapses in pre-service teacher preparation.

This questionnaire consists of sections A, B and C.

SECTION A

This section requires you to tick the appropriate option provided below [ ] where necessary.

1. Gender: male [ ] female [ ].
2. When did you complete SHS?
3. When did you gain admission into the college?
4. What was your grade in that qualified you in to college?
5. What was your grade in integrated science?
6. Which programme did you read at the SSSCE/WASSCE elective science [ ] business [ ] General Art [ ] Agric [ ] Home economic and Arts [ ].
7. How many times did you sit for SSSCE/WASSCE?
8. What was your grade in the sciences?

SECTION B

This section seeks to find out efficacy about science teaching. In the 5 point like scales provide below, tick the column that honesty corresponds to your efficacy belief.

I feel very efficacious about the following as far as science teaching is concerned.

STEBI-B SCALE

SKILLS	STRONGLY AGREE	AGREE	NOT SURE	DISAGREE	STRONGLY DISAGREE
When a student dose better than usual in science, it is often because the teacher exerted a little extra effort.					
When the science grades of students improve, it is often due to their teaching having found a more effective teaching approach.					
If students are underachieving in science, it is most likely due to ineffective science teaching.					
The inadequacy of a student's science background can overcome by good teaching.					
The low science achievement of some students cannot generally be blamed on their teachers.					
When a low-achieving child progresses in science, it is usually due to extra attention given by teaching.					
Increased efforts in science teaching produce little change in some students' science achievement.					
The teacher generally responsible for the achievement of student in science.					
Students' achievement in science in directly related to their teacher's effectiveness in science teaching.					
If parents comment that their child is shoeing more interest in science at school, it is					

probably due to the performance of the child's teacher.					
I will continually find better ways to teach science.					
Even if I try very hard, I will not teach science as well as I will teach most subjects.					
I know the steps necessary to teach science concepts effectively.					
I will not be very effective in monitoring science experiment.					
I will generally teach science ineffectively.					
I understand science concepts well enough to be effective in teaching elementary science.					
I will find it difficult to explain to students why science experiments work.					
I will typically be able to answer students' science questions.					
I wonder if I have the necessary skills to teach science.					
Given a choice; I will not invite the principal to evaluate my science teaching.					
When a student has difficulty understanding a science concept, I will usually be a loss as to how to help the student understand it better.					
When teaching science, I will usually welcome student questions.					
I do not know what to do to turn students on to science.					

SCIENCE TEACHING ATTITUDE SCALE

SKILLS	STRONGLY AGREE	AGREE	NOT SURE	DISAGREE	STRONGLY/DISAGREE
I will feel uncomfortable teaching science					
Teaching of science process is important in the elementary classroom.					
I fear that I will be an enable to teach science adequately.					
I will enjoy the lab/hands on time when I teach science.					
I have a difficult time understanding science.					
I feel comfortable with the science content in the elemental science curriculum.					
I would be interested in working on an experimental science curriculum.					
I dread teaching science.					
I am not looking forward to teach science in my elementary classroom					
I am afraid that students will ask me questions that I cannot answer.					
I enjoy manipulating science equipment					
In the classroom, I fear science experiment won't turn out as expected					
I hope to be excited into other subject areas					
Science would be one of my preferred subjects to teach if given a choice.					
Science is as important as reading waiting and mathematics					
Teaching takes too much effect.					
Teaching science takes too much time.					
I will enjoy helping students construct science equipment.					

APPENDIX B

Test

Circle the correct answer

1. An example of a noble gas is
   a. Chlorine

   b. Neon

   c. Nitrogen

   d. Oxygen

2. The structure that sperms temporarily in the male reproductive system of humans.
   a. Epididymis

   b. Scrotal duct

   c. Sperm duct

   d. Testes

3. Which of the following properties of alcohol as thermometric liquid is correct?
   a. it is opaque

   b. it does not wet glass

   c. it has very low freezing point

   d. it has high freezing point

4. In which of the following vegetation zones does millet and sorghum grow well?
   a. Coastal savanna

   b. Forest zone

   c. Guinea savanna

   d. Transition zone

5. Which of the following practices in the home can prevent infection?
   a. Covering one's food

   b. Drinking unclean water

   c. keeping tone's surroundings untidy

   d. Sharing towels and sponges

6. An example of a semimetal is
   a. Calcium

   b. Lithium

   c. Silicon

   d. Sodium

7. Which kind of energy transformation takes place in an electric motor?
   a. Chemical energy to electrical energy

   b. Chemical energy to mechanical energy

   c. Electrical energy to light energy

   d. Electrical energy to mechanical energy

8. In flowering plant the stamen in made up of
   a. Anther and stigma

   b. Anther and filament

   c. Stigma and filament

   d. Stigma and style

9. Which of the following statements about a transistor is correct?
   a. It can be used to amplify current

   b. It is similar to three diodes

   c. It consists of two leads only

   d. It has three junctions

10. An atom has 6 protons 7 neutrons in its nucleus. What is its mass number?
    a. 1

    b. 6

    c. 7

    d. 13

11. A record of daily activities on a farm is termed
    a. Labour record

    b. Inventory record

    c. Farm diary

d. Production record

12. Which of the following devices work(s) on the principle of transmission of pressure in fluids?

I. Water pumps
II. Syringes
III. Bicycle brakes

a. I only

b. I and II only

c. II and III only

d. I, II and III

13. Which of the following substances is a salt?

a. H_2SO_4

b. NaOH

c. HCL

$CaCl_2$

14. In an n-p-n, the type collector is connected to the positive terminal of the battery thus making it

a. Base-collector junction reverse biased

b. Base-collector junction forward biased

c. Base-emitter junction reverse biased

d. Base-emitter junction forward biased

15. Which of the following chemical symbols is that a metal

a. Ca

b. P

c. p

d. S

16. All the living and non-living things that surround an organism constitute its

a. Community

b. Ecosystem

c. Environment

d. Habitat

17. Which of the following modes of transfer is the thermos flask designed to minimize?
    I. Conduction
    II. Convection
    III. Radiation
    a. I and II only
    b. I and III only
    c. I, II and III only

18. An atom of an element is represents as $^{25}\mathbf{X}$. What is the respective number of neutrons and protons in the atom?
    a. 12 and 13
    b. 12 and 25
    c. 13 and 12
    d. 25 and 12

19. The anemometer is instrument used in determining
    a. Amount of rainfall
    b. Speed of wind
    c. Relative humidity
    d. Intensity of light

20. Which of the following characters is not acquired through heredity?
    a. Language spoken
    b. Shape of nose
    c. Colour of eye
    d. Temperament