Pre-Service Basic Science Teachers' Self-Efficacy Beliefs and Attitudes towards Science Teaching

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Abstract

The main purpose of the study was to explore preservice basic pre-service science teachers' self-efficacy beliefs and attitude regarding science teaching. Data were collected by administering science teaching self-efficacy beliefs and attitude towards science teaching instruments to 100 pre-service basic science teachers (92 males and 8females). Descriptive statistical techniques such as mean scores, standard deviations and percentages were used to analyse the data. Results of the study showed that the pre-service basic science teachers have very high level of self-efficacy beliefs and positive attitudes towards basic science teaching. However, the respondents had some reservations about their ability to facilitate hands-on activities and laboratory work in their future science lessons. It was recommended that science tutors should integrate science content into their science methods courses to improve the pre-service teachers' science content and pedagogical content knowledge.

Keywords: Pre-service Science Teachers; Self-Efficacy Beliefs; attitude; science teaching; colleges of education

1. Introduction

Over the past four decades, teacher education in Ghana has undergone a number of reforms (Government of Ghana, 1987, 2004) as a result of policy changes aimed at producing well trained teachers to meet the educational needs of the country. The Government of Ghana (2001, 2009) developed policies on science and technology education aimed at producing various categories of science professionals and technologists to facilitate the industrialization of the Ghanaian economy. This led to the upgrading of the 38 teacher training colleges into diploma awarding institutions and re-designated as colleges of education (Newman, 2013). Fifteen of the colleges of education are mandated to train competent science and mathematics teachers to teach science and mathematics at the basic schools in the country.

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, pre-service teachers are admitted into the colleges of education with varied science background. in fact most of the students are admitted into the science colleges of education with poor grades (C4 to C6) obtained in the West African Senior Secondary Certificate Examination (Akyeampong, 2001). This fact is corroborated by the poor performance of the pre-service teachers in the end of semester examinations in science conducted by the Institute of Education, University of Cape Coast (Institute of Education, University of Cape Coast, [IEUCC]. The Chief (2007, 2008, 2009) reported that over 70% of the pre-service teachers obtained D+.

Other factors that influence elementary science instructions are attitudes and beliefs toward teaching. Many research studies have reported that teachers' attitude toward science teaching is a strong indicator of both quality and quantity of science taught to the pupils (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 had low beliefs in their ability to teach science also developed negative attitudes towards science. These teachers eventually avoided teaching science.

Another factor that influences elementary science teachers' instruction is their self-efficacy beliefs (Aydin & Boz, 2010). The teacher's efficacy beliefs are indicators of his/her 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" (p.3). In the context of science teaching, self-efficacy consists of personal science teaching efficacy and science teaching outcome expectancy. Personal science teaching efficacy refers to the belief that one is capable of effective science instruction, while science teaching outcome expectancy refers to the teacher's beliefs about students' ability to learn science. 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) also asserted that knowledge and beliefs cannot be considered separately. In view of this one can deduce that pre-service 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 (Tschannen-Moran, & Woolfolk Hoy, 2001), student motivation (Midgley, Feldlaufer &Eccles, 1989; Lewandowski, 2005; Woolfolk Hoy, 2000), provides the foundation for teacher motivation (Adyin & Boz,

2010) and classroom management strategies (Ashton & Webb, 1986). Therefore it is important for colleges of educations to be mindful of the importance of pre-service teachers' self-efficacy beliefs and attitude towards science teaching during instructions. This is because there is positive relationship between strong science content knowledge and positive attitudes and high self-efficacy towards science teaching and vice versa (Stevens & Wenner, 1996).

It has also been observed by the junior researcher that during teaching practice programmes, pre-service teachers usually exhibit low efficacy beliefs and negative attitudes towards the teaching of science. This is made clear when they make comments such as 'am afraid I would not be able to teach science effectively and 'it is difficult to get materials to teach science'. The study therefore examined third year pre-service science teachers' self-efficacy beliefs and attitudes toward science teaching as they prepared for off-campus teaching practice. According to Aydin and Boz (2010), teachers' self-efficacy beliefs help us to predict their motivation and choice and to ascertain their actions in class. It is therefore important to determine the pre-service teachers' self-efficacy beliefs towards science teaching due to the fact that they will be teachers in the future. Any detection of low self-efficacy towards science teaching can be addressed before they complete their programme. A similar argument can be made for the study of pre-service teachers' attitude towards science teaching. The study was guided by the following research questions:

1. What are the levels of basic pre-service science teachers' self-efficacy beliefs toward science teaching?
2. What is the attitude of the basic pre-service science teachers towards science teaching?

2. Theoretical/Literature Review

The conceptualisation of teaching efficacy have been based on Bandura's (1977; 1997) social cognitive theory and his construct of self-efficacy. According to Bandura, self-efficacy is the belief in one's capabilities to deal with different situations and to perform a certain task required to produce given attainments and this belief is dependent on the individual's beliefs in his/her abilities (Bandura, 1997). Teachers' sense of efficacy is a construct derived from Bandura's (1986) theory of self-efficacy in which the generalised behaviour of an individual is based on two factors, (a) a belief about action and outcome and (b) a personal belief about his/her own ability to cope with a task. According to Bandura, the self-efficacy belief can be analysed in two dimensions as: 'personal efficacy and 'outcome expectancy'. Personal efficacy is the judgement about the individual's own values and beliefs in terms of personal competencies affecting an assigned responsibility. Outcome expectancy is a judgement about the individual's belief in a performance to be realised in a strategic test.

Teachers' efficacy beliefs have a crucial role on their performance and motivation (Lewandowski, 2005; Tschannen-Moran & Woolfolk-Hoy, 2001). Teachers with high expectations will work hard, apply management and strategies stimulating students' autonomy (Woolfolk Hoy, 2000) and deal with the needs of low level ability students very closely. It can be said that teachers' high self-efficacy beliefs are a factor which positively affect students' learning and thus quality of teaching.

To sum up, these studies revealed that teachers' self-efficacy beliefs are related to teacher effectiveness, student achievement, teaching anxiety and instructional strategies. Because of strong relationship between self-efficacy beliefs and teaching behaviours, teacher education programmes need to evaluate efficacy beliefs of their education students.

The word attitude is defined within the framework of social psychology as a subjective or mental preparation for action. A commonly used definition of attitude is a learned disposition to respond in a consistently favourable or unfavourable manner with respect to a given subject, object or event (Fishbein & Ajzen, 1975; Koballa cited in Bayraktar, 2011). Oppenheim (1992) also described attitude as a state of readiness or a tendency of a person to respond in a certain manner when confronted with a certain stimulus. Both definitions highlight a consistent behavioural response in relation to a given attitude. Attitudes are rooted in experience and become automatic routine conduct (Gunstone & White, 1998). Therefore, science teachers' actions in science classrooms may be based on their ideas and beliefs manifested in their attitudes towards science teaching and learning.

Science teachers' attitude towards science and science teaching has been cited by elementary school teachers as an obstacle to effective science instruction (Koballa, & Crawley, 1994). For example, motivation to undertake science activities requires the teacher to value the tasks (Pintrich, Marx & Boyle, 1992), which includes a view that science can have personal relevance for most people (Watters & Ginns, 1995). If the science teacher finds relevance of science in their context then they will be interested to teach it.

However, teachers' attitudes towards science teaching cannot directly be observed but must be inferred from what they say or do (Garrison & Magoon, 1972; Nespor, 1987; Pajares, 1992). What they say is reflected in their response to attitude scales (Aldridge, & Fraser, 2000; Simpson, & Oliver, 1990) and what they do can be determined through their classroom practices of that approach (Lumpe, Haney, & Czerniak, 1998). Indeed, the science teacher's classroom practices are functions of his/her attitude (Brickhouse, & Bodner, 1992). This informed the study and the development of the instrument for measuring teachers' attitude towards science instruction.

2.1 Pre-service Teachers' Self-Efficacy Beliefs towards Science Teaching

Many researchers have focused on self-efficacy and outcome expectancy in relation to teaching (Ashton & Webb, 1986; Enochs & Riggs, 1990; Gibson & Dembo, 1984; Guskey, 1988; Wool folk & Hoy, 1990). According to Ashton, Webb and Doda (1983) a teacher's sense of efficacy can be interpreted by the proposal of a blueprint which is made up of teaching efficacy, personal efficacy and personal teaching efficacy. 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/her 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 to produce change may depend on the origin of a teacher's sense of efficacy. Personal Teaching Efficacy is postulated by Ashton et al. as an accurate indicator of a teachers' behaviour. Teachers who have a high efficacy, for instance, have been found to have the propensity to use the inquiry and student-centred teaching strategies (Cantrell, Young & Moore, 2003). On the other hand teachers who tend to have a low sense of efficacy are rather prone to use teacher centred technique/methods like lecturing, and /or reading from prepared notes or even directly from textbooks (Czerniak, 1990).

In the view of Gibson and Dembo (1984), 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. On the hand teachers' low scores on both general teaching and personal efficacy relates to the amount of personal effort the teachers make in class and their persistence. 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 behaviour which is akin to his receptiveness to try out new concepts.

In a study to identify changes in pre-service elementary teachers' sense of efficacy in teaching science, Ginns, & Tulip (1995) reported that Science Teaching Efficacy (STE) and Science Teaching Outcome Expectancy (STOE) were not significantly correlated, the former being more dependent on personal traits such as internal locus of control and self-concept, whereas the latter was related to levels of aspiration, academic interest and satisfaction. The study concluded that the STOE is more easily influenced by the teacher education programme than the STE, as the latter is concerned more with global personality traits. It is, the concern of teacher educators to improve the students' sense of STE, as this has implications for the teachers' ability to teach science, and the children's ability to learn science (Riggs, & Enochs, 1990).
Kahraman, Yilmaz, Bayrak and Gunes (2014) investigated 114 Turkish pre-service teachers' self-efficacy beliefs of science teaching with respect to gender and grade. The participants completed the science teaching self-efficacy beliefs scale originally developed Enochs and Riggs (1990). The results indicated that the pre-service teachers had very high self-eccacy beliefs of science teaching.
In sum teacher self-efficacy has been related to teachers' classroom behaviour, their openness to new ideas and their attitudes towards science teaching. Riggs and Enoch (1990) suggest that teacher educators must be aware of their students' beliefs and plan for experiences which will have positive impact on teacher personal science teaching efficacy and outcome expectancy. It is therefore important to investigate pre-service basic science teachers' self-efficacy beliefs. This will serve as a key in understanding how to increase their sense of efficacy in science teacher education programmes.

For nearly three decades researchers have investigated teacher self-efficacy beliefs and made significant progress in understanding its nature, how it is related to other variables such as students' achievement and how it can be measured. Yet, little or no work seems to have been done on this construct involving pre-service teachers in colleges of education in Ghana. Therefore, this study was an attempt to bridge this gap. Also analysis of such beliefs may provide information that will direct training of science teachers capable of innovative science instruction in Ghanaian basic schools.

2.2 Attitudes toward Science Teaching

Interest in how teachers' 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. He insisted that 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). In a much broader sense, a person's attitude toward science conveniently summarizes his or her emotional response to basic beliefs about science. So attitudes help others predict the kinds of science related behaviours we are likely to engage in more accurately than almost anything else we can tell them (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 thought to influence future behaviours, such as interest in working on a science project and scientific activities. The quality of science instruction and teachers' attitudes toward science have been shown to positively influence students' attitude and achievement in science as well as their decision to enroll in science courses and pursue science and technology-related careers (Turkmen, 2008). Teachers with greater interest and appreciation for science tend to be more motivated to teach science, impart their interest to students, and encourage retention of students' natural curiosity. Again, teachers' attitude toward science is one of the major influences on students' attitude toward science. Turkmen and Bonnstetter (1999) studied 612 Turkish pre-service 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 results of this study indicated that pre-service Turkish science teachers had positive attitudes toward science and science teaching.

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, Esler & Baird, 1982; Mechling, Stedman, & Donnellon, 1982) while other studies (Stepans & McCormack, 1985; Feistritzer, & Boyer, (1983) have shown no relationship or even a negative relationship. However, most of these studies were

conducted using university students and none of them was conducted in colleges of education. Again, most studies that investigated the influence of factors such as teacher knowledge, efficacy beliefs and attitudes on science teaching were done in countries in Asia, and Europe while very little was conducted in Africa and Ghana for that matter (Ngman-Wara, 2012). Because of these reasons literature on these factors that affect the teaching of science is mostly from foreign sources. This study therefore sought to bridge the gap by investigating pre-service science teachers' self-efficacy beliefs and attitudes toward science teaching.

3. Methodology

A descriptive survey research design was used in this study. Descriptive surveys are used to learn about people's attitudes, beliefs, values, opinions and other types of information (McMillian & Schumacher, 2004).

3.1 Description of participants

Purposive sampling technique was used to obtain a sample of 100 pre-service (92 males and 8 females) third year science students from two Ghanaian science and mathematics Colleges of Education, Akasti College of Education (65) in the Volta Region and Ada College of Education (35) in the Greater Accra Region. Purposive sampling was used because the researchers deliberately targeted the final year science students who were preparing for their one year mandatory off-campus teaching practice or out-segment programme of the three year diploma programme run by colleges of education.

The pre-service teachers are educated through a three year diploma in basic education programme made up of two years of taught courses in science content and methodology. The method courses for teaching science include nature of science, science curriculum and curriculum material studies and assessment in science. The programme also includes on-campus teaching practice which prepares them for one year out-segment programme for the first ten months of their third year in partner schools after which they come back to campus for post out-segment orientation from the Ghana Education Service officials on their future professional development when there are engaged by the Service. They also write they final examinations on two education courses during this period.

3.2 Instrumentation

The instrument, Self-Efficacy Beliefs towards Science Teaching (STEBI-B) developed by Enochs and Riggs (1990) and Science Teaching Attitude Scale developed by Thompson and Shringly (1986) were used to collect data for the study. The STEBI-B scale was used to collect data on pre-service teachers' self-efficacy beliefs regarding science teaching. The instrument consists of a 23 item 5-point Likert-Type scale.The STEBI-B has two subscales, Personal Science Teaching Efficacy (PSTE) and Science Teaching Outcome Expectancy (STOE). The PSTE has 13 items while the STOE has 10 items. The Personal science teaching efficacy beliefs refer to the extent teachers believe that they have the capacity to positively affect students' achievement. The science teaching outcome expectancy reflects science teacher's beliefs that

student learning can be influenced by effective teaching. Each item of the scale consisted of a statement followed by five responses with weightings: strongly agree (5), agree (4), not certain (3), disagree (2), and strongly disagree (1). The respondents answered the questions by selecting one of the responses that best expressed their opinion on the item.

The Science Teaching Attitude Scale was used to collect data on pre-service science teachers' attitude toward science teaching. Its adoption and use was informed by the fact that it has proven to be efficient in many studies on pre-service teachers' attitudes with consistent results. The scale is also a Likert- type with 20 items. The responses are categorized with weightings as strongly agree (5), agree (4), not certain (3), disagree (2), and strongly disagree (1).

Pilot tests were carried out with 100 pre-service basic science teachers from a College of Education that shared similar characteristics with the sampled college to establish Cronbach reliability coefficients of the instruments. The Cronbach reliability coefficient of STEBI-B was found to be 0.87 and the subscales, PTSE subscale and STOE had reliability values of 0.89 and 0.76 respectively. The reliability coefficient of the attitude scale was .87.

3.3 Data Collection Procedure

The junior researcher administered the questionnaires. He obtained obtain permission from the Principal of each college to conduct the study and solicited the involvement of the selected pre-service teachers. The STEBI-B was administered first followed by the attitude scale after 45 minutes. The participants were guaranteed confidentiality and the instruments were filled anonymously with no identifying information. No time limit was given during completion of the questionnaires. The questionnaires were collected when a participant indicated that she/he had completed them.

3.4 Data Analysis

The data were analysed through SPSS software version 16 for windows. Descriptive statistics were used to describe and summarise the data. Negatively worded items were scored in reverse with strongly disagree (1), disagree (2) undecided (3), agree (4) and strongly agree (5). Accordingly, negative questionnaire items 3, 6, 8, 10, 13, 17, 19, 21, and 23 for STEBI-B and 1, 3, 5, 8, 9, 10, 12, 17, 18 for the attitude scale were scored inversely to produce consistent values between positively and negatively worded items. The participants' responses for each scale were categorised into agree, neutral or disagree and frequencies of their responses were determined and converted into percentages. The means and standard deviations of the responses were also determined. Mean ratings of 1.0 to 1.75 represent low, 1.76 to 2.25 moderate, 2.26 to 3.25 high and 3.26 to 4.00 very high. These criteria were used by Shamsid-Deen and Smith (2006) in a similar study. The Cronbach's alpha reliability coefficients for the STEBI-B scale and for the subscales, PTSE and STOE, were found to be 0.89, 88 and 80 respectively while that of the attitude scale was 0.89

4 Results

4.1 Background information of participants

The background information of the participant is provided in Table 1. The study sample consisted of 92% males and 8 % females. The dominant age group ranged between 24 and 26 years (39%, n=39) and less dominant age group was 31 and above (11%, n=11).

The pre-service teachers indicated six programmes they offered at the senior high school level. About a third (35 %) of the sample offered elective science at the Senior High School which is the most preferred requirement for science in the Colleges of Education. The programme with the second largest number of participants was Agricultural science (29 %) and the programme with the least number of participants was general arts (5 %). Further details are provided in the table.

Table 1. Background information on the participants

Variable	Category	N	Percent
Gender	Male	92	92
		8	8
	Female		
Age	18-20years	12	12
	21-23years	22	22
	24-26years	39	39
	27-30years	16	16
	>31years	11	11
Elective programme	Elective Science	35	35
	Agricultural Science	29	29
	Business	15	15
	Arts	5	5
	Technical	10	10
	Home Economics	6	6

4.2 Research question 1: What are basic pre-service science teachers' self-efficacy beliefs toward science teaching?

Table 2 presents the mean scores, standard deviations and percentage frequencies of respondent' scores for each item of STEBI-B scale. In addition, the table presents the descriptive statistics for each item of PSTE and STOE subscales. Mean ratings of 1.0 to 1.75 represent low, 1.76 to 2.25 moderate, 2.26 to 3.25 high and 3.26 to 4.00 very high. In this context, except for items 10 and 13, the pre-service teachers indicated very high level of self-efficacy beliefs regarding the teaching of science on both dimensions. The means scores of items of the STEBI-B scale ranged between 2.2 and 4.6 the standard deviations also

ranged between 0.6 and 1.3. Most of the items had mean scores above the general mean of 3.0 of the scale. Only items 10 (M= 2.2, SD =1.1) and 13 (M = 2.4, SD = 1.3) had mean scores less than the general mean of the scale. The overall mean score and standard deviation of the scale were 88.2 and 9.1 respectively. Generally the results indicate that the pre-service teachers exhibited high self-efficacy beliefs towards science teaching.

Table 2. Item mean scores, standard deviations and percentage frequencies of respondents' scores on items of STEBI-B Scale

subscale	Item number	Mean Score	Standard Deviation	AGREE	UNDECIDED	DISAGREE
PSTE	2	4.6	0.6	97.6	0.0	2.4
	*3	3.8	1.1	59.5	26.2	14.3
	5	4.4	0.8	78.6	14.4	7.0
	*6	3.7	1.1	11.9	16.3	67.0
	8	3.8	1.1	66.7	21.4	11.9
	12	4.0	0.9	81.0	9.5	9.5
	*17	4.1	0.9	85.7	9.5	4.8
	18	3.8	0.9	85.7	7.2	7.1
	*19	3.6	1.2	61.9	16.7	21.4
	20	3.6	1.3	61.9	21.4	16.7
	*21	4.4	0.9	88.1	9.5	2.4
	22	3.8	1.0	71.4	16.7	11.9
	*23	4.3	1.0	88.1	9.5	2.4
STOE	1	4.0	1.2	76.2	14.3	9.5
	4	3.8	1.0	78.6	11.9	9.5
	7	4.0	1.2	14.6	18.7	66.7
	9	4.4	0.7	90.5	7.1	2.4
	*10	2.2	1.1	14.3	9.5	76.2
	11	3.7	0.9	95.2	2.4	2.4
	*13	2.4	1.3	21.4	11.9	66.7
	14	3.8	1.0	73.8	11.9	14.3
	15	4.1	0.9	83.3	9.5	7.2
	16	3.4	1.1	88.1	7.5	4.4

*scoring reversed for negatively worded items; scale M =71.7, SD = 10.6

Similar trends are observed with the item mean scores of the subscales. The mean scores of the items of subscale PTSE ranged between 3.6 and 4.6 with subscale mean score of 45.2 and standard deviation of 13.4. The standard deviations of the items ranged from 0.6 and 1.3. The mean scores of the items of subscale STOE ranged between 2.2 and 4.4 with subscale mean score of 36.3 and standard deviation of 10.3. The standard deviations of the items ranged from 0.7 and 1.3. These results can also be interpreted that the pre-service basic school teachers have very high PSTE and STOE, that is, they have the capability to teach science effectively and a very high level of science teaching outcome expectancy.

The participants' percentage responses for each item of the STEB-B scale are presented in Table 2. The results indicated very high self-efficiency beliefs towards teaching science among the pre-service science teachers. 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 (Item 1). Similarly 78.6% of the respondents asserted that if the teacher found a more effective ways of teaching, the grades of students in science would improve (Item 4). Also, 66.7% of the respondents disagreed that ineffective science teaching is the most likely cause of students under achievement (Item 7). Contrary to this a similar percentage (66.7%) of the respondents indicated their general ineffectiveness in teaching science (Item 8). 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 (Item 10). This suggests that science teachers are partly the cause of students' performance. It is however heart-warming that 90.5% indicated that good teaching is the antidote to overcoming students' inadequate science backgrounds (Item 9). They may strive to attain that.

Respondents generally agreed (95.2%) that the teachers' extra attention to low achieving students could help them progress in class (Item 11) but 66.7% of the respondents disagreed with the statement that increased efforts in science teaching may not produce any desirable result (Item 13). About 73.8% of the respondents indicated that the teacher is generally responsible for students' achievement in science (Item 14) and 88.1% of respondents 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 (Item 16). These assertions are supported by majority of the respondents (83.3 %) who indicated that students' achievement in science is directly related to their achievement (Item 15).

About 98 % of respondents indicated their readiness to always adopt improved approaches to teach science (Item 2). 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 (Item 3). About 67% of the respondents also indicated that they would not be very effective in ensuring successful science experiments (Item 6). In addition, 85.7% of the respondents claimed they may not be able to explain the principle's underlying science experiments (Item 17). About 62 % of the pre-service science teachers were not confident of possessing the necessary skills for science teaching (Item 19). Many respondents (61.9%) would not want their science lessons to be observed if they have the choice (Item 20). This could well be because the respondents were not very confident they had what it takes to present a science lesson successfully.

On a more positive note, 71.4% of the pre-service science teachers believed that they generally welcome students' questions (Item 22) while 85.7% of the respondents claimed they have what it takes to answer students' questions (Item 18). Also 78.6% of them also indicated that they know the steps necessary to teach science effectively (Item 5). However, 88.1% of the pre-service teachers asserted that they do not know what to do to turn students to science (Item 23). 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.

Almost four-fifths of the respondents (81.0%) indicated that they understand science concepts well enough to teach science effectively (Item 12) yet 88.1 % of the respondents are at a loss as how to help a student understand a difficult concept (Item 21). This can be interpreted to mean they lack the pedagogical content knowledge to handle such difficult situations.

4.3 Research question 2: What is the attitude of basic pre-service science teachers towards science teaching?

The mean scores, standard deviations and percentage frequencies of the respondents' scores are presented in Table 3.

Table 3. Mean scores, standard deviations and Percentages 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	0.76	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	0.85	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	0.90	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 pupils 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	0.91	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 pupils about science	4.30	.76	91.1	6.3	2.6
14	I plan to integrate science into other subject areas	3.97	0.92	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 pupils construct science equipment.	4.15	0.81	83.6	10.1	6.3
20	Science is interesting	4.13	0.13	86.2	8.7	5.1

*scoring is reversed Scale mean score = 71.7, SD = 10.6

The mean scores ranged between 2.39 and 4.54 with the standard deviations ranging between 0.64 and 1.26. The overall item mean was 3.77 (SD = 1.15). Also, the scale means score was 71.7 with standard deviation of 10.61. The results indicated that the pre-service basic science teachers had very high positive attitude towards science teaching. This is also reflected in the percentage frequencies of the items of the attitude scale.

The percentage scores for the agree category ranged between 17.7 % and 95 % and those of the neutral category ranged between 3.8 % and 28.1 %, while those of the percentage scores for the disagree category ranged between 1.2 % and 70.8 %. Almost all the respondents (94.9 %) asserted to the fact that teaching of process science is important in the elementary school curriculum (Item 2). It is therefore not surprising that about 85 % of the respondents would enjoy laboratory/hands-on time when they teach science (Item 4). In the same vein 81 % of them would be interested in working on experimental science curriculum (Item 7). This is corroborated by 86.0 % of the respondents who would enjoy manipulating science equipment (Item 11). Again, about 84 % of the respondents would enjoy helping pupils to construct science equipment (Item 19). However, about 61 % of the respondents are afraid experiments would not work out well in class (12). These expressed attitudes should be enhanced through methodology courses and confidence of the pre-service teachers should be build to do away with their fear of failure in obtaining results from experiments.

Over four-fifths of the respondents indicated that science is interesting (Item 20). Also, 77.2 % of them indicated that science would be one of the preferred subjects to teach if given the chance (Item 15). This is supported by the assertion of about 76 % of the respondents that they feel comfortable with the science content in the elementary school curriculum (Item 6). This is not supported by their responses to some items. For instance, more than half (66 %) of the respondents indicated that they have a difficult time understanding science (Item 5) and a little over half of them fear that they would be unable to teach science (Item 3). Again 72.2 % indicated that they would feel uncomfortable teaching science (Item 1). A good number of respondents are afraid that they would not answer questions from their pupils (Item 10). These fears may be attributed to the pre-service teachers' poor foundation in science content and poor practical skills. This could be explained by the fact that almost two-thirds the pre-service teachers (65 %) studied other subjects not related to science at the Senior High School (see Table 2). This is supported by

Akyeampong's (2001) assertion that most of the pre-service teachers entered colleges of education with poor grades in science. These fears may also be due to poor pedagogical content knowledge.

It is however heart-warming to report that about 42 % of the respondents dread teaching science (Item 8) and 70.8 % of them are looking forward to teaching science in elementary classroom (Item 9). Again, 91 % of respondents hope to excite their pupils about science. Over half of the respondents (58.2 %) asserted that teaching science takes less effort (Item 17) and about 61 % also indicated that teaching science takes little time (Item 18).

Though 95 % of the respondents see science as important as reading and writing and mathematics (Item 16), a little over half (53.5 %) plan to integrate science into other subjects (Item 14).

5. Discussion

This section discussed the major findings of the study under themes derived from the research questions.

5.1 Pre-service basic science teachers' Science teaching self-efficacy level

Teacher efficacy implies the beliefs of teachers about their ability to teach science skills in such a way as to lead learners 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 teacher's self-efficacy beliefs has a direct bearing on their performance, hence the many educational researches focused attention on it. A number of researches concluded that the teacher's self-efficacy correlates with effective teaching and learning attitudes towards science (Anderson, Greene, & Loewen 1999; Ashton & Webb, 1986; Ross, 1992; Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998).

This study has found very high self-efficacy levels among the pre-service science teachers. This implies that the pre-service 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 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 pre-service teachers. This when done will serve as the foundation for their attitudes and beliefs (Sarikaya, 2004) towards effective science teaching.

The findings of this study also revealed rather very strong science teaching self-efficacy beliefs of the pre-service teacher. This means that the pre-service teachers are very determined to take up the responsibility of their students' learning achievements and goals. However, the relatively poor science

background in science (see Table 1) poses the question of whether these pre-service teachers are adequately ready to take up the challenge of effective science teaching in the basic school classrooms. About 71.4% of the pre-service teachers indicated that they will welcome student's questions and as high as 85.7% of the respondents claimed they have what it takes to answer student's questions. This is contrary to the finding of Wenner (1993) where only 2% of respondents in a similar study were positive of being able to answer student's questions. Even though the pre-service teachers overwhelmingly (97.6%) asserted that they would often adopt improved ways of teaching science, more than half of them (59.5%) (See Table 2) indicated they could teach other subjects better than science. Again, 61.9 % would not want their science lessons to be observed while 62 % were not confident of possessing the requisite skills for science teaching. These are low personal science teaching efficacy beliefs. These contradict some STEBI-B item percentages which indicate high science efficacy beliefs. This discrepancy between the STEBI-B items percentages agrees with the results of Bursal (2012) in a study involving pre-service elementary teachers. Bursal reported that while 94 % of his study subjects would welcome students' questions, 55 % said they would be able to answer students questions.

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 pre-service science teachers' assertion that they may not be able to answer students' questions. To ameliorate this problem among pre-service 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. This is because various studies suggest that teachers' efficacy may be significantly influenced by their teacher preparation programme (Flores, 2015) especially science method courses (Bayraktar, 2011; Bursal, 2010; Bleicher & Lindgen, 2009).

5.2 Attitude of Basic Science Pre-Service 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 (1981) indicated that behaviours are acquired by observing an actor. This could be a teacher. In the classroom students model the teacher by imitating whatever he or she does. Therefore the teacher's attitude about the student's learning can have a great influence on the student since the teacher's attitude has direct influence on that of the student.

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. About 95% 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. If the pre-service positive attitude towards laboratory and hands-on activities are extended into their future science lessons their pupils are likely to acquire essential process skills such as recording, communicating, predicting, inferring and interpretation of data. These skills are emphasised in the science syllabus across the basic school levels of education in Ghana (Curriculum Research Development Division, 2010, 2012). Essential process skills such as recording, communicating measuring together with higher order skills like predicting, inferring, hypothesizing etc. are acquired through activity –based lessons (Mastropieri & Scruggs, 1994). The pre-service teachers will also assist their pupils to conceptualise the science topics that will be taught. This is because increased conceptualisation of science topics among learners occurs through inquiry-based teaching that engages pupils in the investigative nature of science (Yara, 2009). In addition, pupils engaged in activity-based lessons develop increased creativity, better attitudes towards science, and have improved logic development, communication skills and reading-readiness (Haury & Rillero, 1994).

Ninety-five percent 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 pre-service teachers offered during their course of study and the demonstration lessons organised for them my their tutors. This is supported by Ginns' & Watters' (1990) assertion that the way people were taught science during their earlier school days also influences the attitudes they develop towards science and science teaching. So science tutors are encouraged to serve as role models, make science teaching and learning fun and design enough demonstration lessons for pre-service teachers in order to leverage positive attitudes of the latter.

The findings of the study also revealed significant negative attitudes of the pre-service science teachers towards science teaching that suggest low levels of personal science teaching efficacy beliefs. For instance, a good number of the respondents (72%) 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% 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 pupils' questions well enough and doubted their own ability to carry out successful science experiments. These negative attitudes could be attributed to their weak science background as found in this study in which 65 % of the respondents did not pursue elective science programme at the senior high school level. The findings confirm Stevens' and Wenner's (1996) assertion that high science content knowledge correlates positively with the desire of an individual to teach science while low or lack of adequate science content knowledge relates to low confidence and willingness to teach science. Also, research has shown that lack of adequate subject content knowledge in science results in decreased ability to guide pupils successfully through hands-on and laboratory activities in science lessons (Haury & Rillero, 1994). So these low levels of personal science teaching efficacy beliefs

will negatively affect the hands-on activities and laboratory work in the future science lessons of the pre-service teachers (Tosun, 2000). It is therefore crucial to help the pre-service teachers to acquire adequate subject content knowledge in science in order to develop positive attitudes towards science and science teaching. This can be done if tutors become more enthusiastic and resourceful in updating their students' science content knowledge (Ogunniyi, 1982).

6. Conclusions

The study was to determine pre-service basic science teachers' self-efficacy beliefs and their attitude towards science teaching. Two questionnaires, Self-efficacy Beliefs towards Science Teaching (STEBI-B) and Science Teaching Attitude Scale were administered to pre-service basic science teachers. Descriptive statistics were used to analyse the data. The results showed that the pre-service basic science teachers' self-efficacy beliefs towards science teaching were generally very high for both PSTE and STOE. This implies that most of the pre-service teachers were upbeat about their abilities to teach science in basic school classes during the out-of campus teaching practice or internship component of their training programme. However, the pre-service teachers' responses on some items of PSTE subscale suggested a low personal science teaching efficacy. In order to increase pre-service teachers' personal science teaching efficacy beliefs, college science tutors should integrate science content in their method science courses to upgrade the pre-service teachers' science content knowledge.

The results also found overall positive attitudes towards science teaching among the pre-service science teachers. Science teachers' attitude towards teaching of science plays a significant role in shaping the attitude of students towards the learning of science. Therefore the pre-service basic science teachers are more likely to develop positive attitudes towards science in their pupils during the internship period. This will have a positive effect on pupils' science achievement as well as their attitude towards science.

The findings of the study indicate a very high self-efficacy beliefs and positive attitudes of the pre-service teachers towards science teaching and learning. However, which component of the science education programme is more influential on the pre-service teachers' self-efficacy beliefs and positive attitudes towards science teaching could not be made implicit. Investigating the specific effects of components of the programme such as science content course, science methods courses and on-campus teaching practice would be useful to reach a more specific conclusion.

The research was also conducted in two out of fifteen science colleges of education. Similar researches may be conducted to obtain more general results, using samples from other science colleges of education across the regions of Ghana.

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