UNIVERSITY OF CAPE COAST

SCIENCE LEARNING SELF-EFFICACY OF SENIOR HIGH SCHOOL STUDENTS

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BY

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Thesis submitted to the Department of Science Education of the Faculty of Science and Technology Education, College of Education Studies, University of Cape Coast, in partial fulfillment of the requirements for the award of Master of Philosophy degree in Science Education

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature:.. Date:...........................

Name: Januarius Felix Nomin

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis work laid down by the University of Cape Coast.

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ABSTRACT

Self-efficacy is an important attribute capable of shaping a person's behaviour. Perceived academic efficacy which plays an influential role in students' school success and academic choices has been found to be associated with levels of motivation, persistence, engagement, and academic achievements for science disciplines. This study, therefore, sought to investigate science learning self-efficacy of high school students in Ghana. A cross-sectional survey was used to collect quantitative data from 1,507 SHS 1 and SHS 2 students from six public schools in the Central Region. Questionnaires were used to collect data from students. Data were analysed using percentages, means, standard deviations, and a One-way Multivariate Analysis of Variance. The results from the study showed that students had positive perception about their science learning self-efficacy but were not confident in terms of practical skills. It is, therefore, recommended that teachers take active steps by planning and structuring science lessons to include more practical as a means to enhance students efficacy in practical skills to boost their overall perception of their science learning self-efficay.

KEY WORDS

Conceptual Understanding (CU)

Everyday Application (EA)

Higher Order Cognitive Skills (HCS)

Practical Work (PW)

Science Communication (SC)

Science Learning Self-Efficacy (SLSE)

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DEDICATION

In memory of my sister, Richardise Nomin.

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CHAPTER ONE

INTRODUCTION

This chapter entails the problem to be investigated and its justification. The purpose as well as the research questions to help find solution to the identified problem in relation to science learning self-efficacy is presented in this chapter. The significance to the study, delimitations, and limitations are further presented to clearly define the nature of the problem of science learning self-efficay of students' in senior high schools.

Background of the Study

Self-efficacy has been identified as a very important attribute capable of shaping a person's behaviour. Since its inception by Albert Bandura in 1977, self-efficacy has received great attention from countless researchers in the fields of social and behavioural sciences to predict and explain a wide range of human functioning (Honicke & Broadbent, 2016; Rittmayer & Beier, 2008; Usher & Pajares, 2008), and in the area of academic motivation and achievement (Artino, & La Rochelle, 2010; Schunk, Pintrich, & Meece, 2008). This shows that research on students' self-efficacy has received increasing attention during the last decade. According to Bandura (1977), self-efficacy describes an individual's way of thought about his or her capabilities to learn, organise, understand, and behave in specific situations in order to reach their goals as well as student's judgments of how well he or she can do class-related works (Bandura, 1986). Thus, self-efficacy affects people's feelings and ideas about themselves, which has the ability to cause them to make changes in their behaviour.

Self-efficacy beliefs lie at the core of human functioning (Bandura, 1977; 1986). It is not adequate for individuals to possess the requisite knowledge and skills to perform a task but they also must have the conviction that they can successfully perform the required behaviour(s) under typical and, importantly, under challenging circumstances (Bandura, 1977). People who have low self efficacy for accomplishing a specific task may avoid it, whereas those who believe they are capable are more likely to participate. More so, individuals who feel efficacious are hypothesized to expend more effort and persist longer in the face of difficulties than those who are unsure of their capabilities (Bandura, 1977). The tendency for efficacious people to put in more effort is of particular importance because most personal success requires persistent effort. As such, low self-efficacy becomes a self-limiting impediment.

In education, self-efficacy refers to learners' judgments of their own academic capabilities, and sense of competence related to their academic performance (Bandura, 1997). Capable students who are plagued by a loss of confidence in performing science-related tasks generally avoid science-related careers, which are on the rise in number and importance (National Science Board, 2010). Such students may close the doors to the personal challenges and fulfilment unique to careers in the sciences. It is not surprising, therefore, that in many countries, the number of students pursuing science-related university degrees remains relatively low, and the pipeline starts to leak at high school, with a relatively low proportion of students choosing to major in science related programmes (Maltese & Tai, 2011; National Science Board, 2018; OECD, 2017)

In order to succeed academically, then, students need a strong sense of task-specific self-efficacy, in order to maximise their learning, tied together with resilience to meet the unavoidable obstacles of life (Bandura, 1977). Self-efficacy is, therefore, a very crucial construct in the life of a student since it has the tendency to influence the capabilities of the student.

Statement of the Problem

Studies in recent times show that in many countries, the number of students pursuing science-related university degrees remains relatively low, and the pipeline starts to leak at high school, with a relatively low proportion of students choosing to major in science related programmes (Maltese & Tai, 2011; National Science Board, 2018; OECD, 2017). However, research shows that perceived academic efficacy plays an influential role in students' school success and in the academic choices they make (Schunk & Pajares, 2005). Self-efficacy has been found to be associated with levels of motivation, persistence, engagement, and academic achievements; both generally and for science disciplines (Honicke & Broadbent, 2016; Rittmayer & Beier, 2008; Usher & Pajares, 2008). It influences the choice and commitment in a task, the energy spent in performing it, and the level of the performance (Bandura, 1986; Bandura & Schunk, 1981; Hackett & Betz, 1989). Hence, self-efficacy is a key variable for the prediction of individual behaviour.

Aside students' beliefs about their academic capabilities influencing their current performance, it has been seen that self-beliefs affect subsequent academic and career choices (Pajares & Urdan, 2006). Admittedly, however, majority of students have the belief that if they have good self-efficacy then their ability to succeed in science tasks, will be higher (Britner & Pajares, 2001; Zeldin & Pajares, 2000). This is because students mostly depend on their self-efficacy in science to achieve the targets inside and outside classroom (Kupermintz, 2002; Lau & Roeser, 2002).

Again, students with high level of self-efficacy tend to have higher learning performance and academic success than students with low level of self-efficacy (Usher & Pajares, 2006). Hence, Self-efficacy plays a critical role in students' learning, motivational, cognitive, and behavioural outcomes (Pintrich & Schunk, 2002). However, students' self-efficacy for science tend to decline during late elementary and middle school and the decline is typically greater for girls (Barth et al., 2011; Rice, Barth, Guadagno, Smith, & McCallum, 2013; Rittmayer & Beier, 2008).

In terms of gender, starting in seventh grade, girls tend to underestimate their abilities in maths and science even though their performance remains the same as boys (Sadker & Sadker, 1995). This trend continues through high school and it is believed to be the cause of low female participation in science and science related careers as noted by Alper (1993, p. 410) that "…a loss of self-confidence – rather than any differences in abilities – may be what produces the first leak in the female science pipeline". There is every indication from the discussion, thus far, that self-efficacy beliefs are critical components of students' traits since it affects all aspects of the students' academic and behavioural well-being.

Unfortunately, performance of SHS students in science has dwindled in Ghana. In 2011, students' poor performance in science led to the description of their answers by the Chief examiner as 'scrappy and pedestrian' (WAEC Chief Examiner's Report, 2011). This situation was no better in the successive years of 2012, 2013, 2014, 2015 and 2016 as students showed weakness in the science subject (Abreh, Owusu, & Amedahe, 2018). In 2017, the Chief Examiner, again, lamented on the poor performance of students in science; describing it as "woeful" (WAEC Chief Examiner's Report, 2017). Although researchers have tried to investigate the causes of the poor performance of students in the science courses by looking at various probable factors that affect academic achievement (Abreh, Owusu, & Amedahe, 2018), one area they have not touched on in Ghana is students' science learning self-efficacy. Hence, the need for research on High School Students Science Learning Self-Efficacy was identified.

Research into students' Science Learning Self-Efficacy in Ghana needs immediate attention since thoughts are that self-efficacy may explain course selection patterns in high school that eventually lead to the under-representation of women in science (Tippins, 1991). Furthermore, a difficulty in promoting science learning self-efficacy is that the relations between science learning self-efficacy and its sources are complex and not fully understood (Dorfman & Fortus, 2019). According to Joët, Usher, and Bressoux, (2011); Usher and Pajares, (2008) these relations vary as a function of contextual and personal factors such as age, gender, ethnicity, cultural context, and educational environment. Therefore, the study explored science learning self-efficacy of some Ghanaian high school students in Forms 1 and 2, and those reading science and non-science programmes.

Purpose of the Study

The purpose of the study was to investigate the science learning self-efficacy of senior high school students in the Cape Coast Metropolis of the Central Region of Ghana. Specifically, the study

1. investigated senior high school students' perception of their science learning self-efficacy.
2. determined differences in science learning self-efficacy between males and females in senior high schools.
3. determined the differences in science learning self-efficacy between Form 1 and Form 2 students in senior high schools
4. determined differences in science learning self-efficacy between elective science students and non-science students in senior high schools.

Research Questions

The following research questions guided the study:

1. What is the perception of students about their science learning self-efficacy?
2. What differences exist in science learning self-efficacy between male and female students in senior high schools?
3. What are the differences in science learning self-efficacy between Form 1 and Form 2 students in senior high schools?
4. What differences exist in science learning self-efficacy between elective science and non-science students in senior high schools?

Significance of the Study

The outcome of this study is expected to increase the body of knowledge surrounding the understanding of high school students' science learning self-efficacy beliefs. With teacher, student, and school accountability, the findings of this study are expected to aid the understanding of students' science learning self-efficacy at the secondary level. In Ghana a growing amount of classroom strategies are identified in an effort to improve student motivation, but little or no information exists on self-efficacy specifically, science learning self-efficacy beliefs for high school students. The findings are expected to add to literature and serve as bedrock to enhance teaching strategies and program planning for Ghanaian high school students. Again, teachers, parents, and students may learn to recognise and understand the construct of self-efficacy and foster those experiences in order to increase motivation - both intrinsically and extrinsically, and provide the stamina needed to complete seemingly challenging tasks. The outcome of the study may also be useful to incorporate support for academic self-efficacy into courses and other programming related to student retention (Wernersbach, Crowley, & Bates, 2014).

Delimitation

This study covers only six randomly selected Senior High Schools in the Cape Coast Metropolis (one single sex girls' school, one single sex boys' school and four mixed sex schools). These randomly selected schools were made up of two schools each in the categories A, B, and C of the GES. In addition, sample for the study involved both students studying science and non-science courses as their major subjects. Participants in this study were made up of 1,507 and it included only high school students in forms 1 and 2 who volunteered to participate. Again, the study was delimited by its purpose, which was the exploration of science learning self-efficacy of Ghanaian high school students. Lastly, this research was conducted at the Cape Coast Metropolis in the Central Region of Ghana and may not be generalised to all high school students (Maxwell, 2013; Patton, 2002). The delimitations of the study, which were controlled by the reseacher narrowed the scope and focus of the study.

Limitations

The use of survey design was useful to gather a large amount of data but inherently, was not able to provide answers to in-depth or probing questions nor could this survey seek clarifications and determine the conditions or contexts related to how the students responded to the questionnaire items (Sarantakos, 2013). The research strategy could have potential impact on the findings because it focused on only the large data sets of a quantitative research strategy which was collected at one point in time without the voice of students, nonetheless the use of inferential statistics helped to make the findings rigorous enough.

Although the survey items were taken through rigorous validation process, it should be noted that the items were limited to the description of the various constructs. The context within which respondents were going to be was not captured by the items. Thus, the survey could not account for the various contextual factors that could influence students' responses. Geographical location could be a methodological limitation to the study since the study was conducted in one region. However, the selected school have national reach such that students come from various parts of the country so the effect of geographical location was minimised.

Definition of Terms

CU - ***Conceptual Understanding***: Basically, how students understand concepts (facts and principles) in science.

EA - ***Everyday Application:*** How science is used in our daily activities

PW - ***Practical Work:*** The ability of students to perform activities and experiments in the science laboratory using equipment.

HCS - ***Higher Order Cognitive Skills:*** The capability of students to think critically to solve a science problem or design an experiment to find solution or make a hypothesis.

SC - ***Science Communication:*** Students ability to make comments on issues relating to the science discipline.

SLSE - ***Science Learning Self-Efficacy:*** A self-belief and confidence that a student has the capability of learning science.

Form - conventionally used to indicate the academic level of students in the junior high and senior high schools in Ghana.

Program - used in this study to indicate students' course of study at the senior high schools.

Organisation of the Study

With the exception of 'Introduction' chapter, there are four other chapters made up of Literature review (Chapter 2), Methodology (Chapter 3), Results and Discussion (Chapter 4), and Summary, conclusion and recommendations (Chapter 5). The literature review chapter takes a critical look at the relevant literature that is related to this research. This comprised the theoretical underpinning of Bandura's self-efficacy theory; sources and nature of self-efficacy and its relation to science learning; how self-efficacy has been used to predict academic achievement of students; perception of students as far as their efficacy in science learning; and how males differ from females in terms of science learning self-efficacy.

The methodology chapter describes the research design and the broad paradigm under which this study falls; methods of data collection, selection of participants, the instrumentation process and how the collected data were analysed. The results and discussion chapter presents the results of this study based on analysis of the quantitative data. The discussion draws upon the quantitative results to make the necessary inferences. The thesis ends with the summary, conclusion and recommendation chapter where an overall summary of the research, its key findings, conclusion, recommendations and suggestions for future research are provided.

CHAPTER TWO

LITERATURE REVIEW

This chapter presents a review on thematic areas of related literature on science learning self-efficacy. The literature review has been written in terms of a theoretical review and empirical evidence. The theoretical review addresses key variables which are applicable and are relevant to explain the variables in the study while the empirical review addresses the findings of studies conducted by other researchers regarding students' science learning self-efficacy. Specifically, the review encompass Bandura's Self-Efficacy Theory, Sources of Self-Efficacy, Nature of Self-efficacy, self-Efficacy and Academic Achievement, Perception and Science Learning Self-Efficacy, and Gender differences and Science Learning Self-Efficacy.

Bandura's Self-Efficacy Theory

Social learning theory and imitation was propounded by Bandura based on the work of Neal E. Miller and John Dollard in the early 40s to steer away from the behaviour theory of that time and account for cognitive aspect to behaviour (Huitt & Monetti, 2008). Individuals do not only behave the way they have been told to do, but also respond to stimuli in a spontaneous manner, meaning that behaviour is not something necessarily acquired and consequently solidified by reinforcement only, but is subject to environmental influences as well as the individual's habits and worldview. Social cognitive theory is rooted in a view that individuals are agents proactively engaged in their own development and have the ability to make things happen by their actions.

In the social cognitive view, people are neither driven by inner forces nor automatically shaped and controlled by external stimuli. Rather, human functioning is explained in terms of a model of triadic reciprocity in which behavior, cognitive and other personal factors, and environmental events all operate as interacting determinants of each other. The nature of persons is defined within this perspective in terms of a number of basic capabilities (Bandura, 1986). Who one is and how they behave is an outcome of an interplay between the external world, the internal world and established behaviour patterns. For instance, when externally regulated, we may behave in such a way as to avoid punishment or attain a reward, while under interjected regulatory influence, when we attach our behaviour to a sense of self-esteem, we try to avoid guilt or shame with our behaviour (Darner, 2012). Similarly, how we behave and how we modify our behaviour may depend on our beliefs on self-efficacy.

Although Bandura and Walters contributed significantly to their field with their work 'Social Learning and Personality Development', written in 1963, it was in the 1970s that Albert Bandura identified self-beliefs as the missing piece of the puzzle which represented the cognitive aspect of his theory, as explained in his work 'Self-efficacy: Toward a Unifying Theory of Behavioural Change'. Bandura dubbed his theory 'cognitive' as opposed to 'social learning' not only to distance it from prevalent social learning theories contemporary to his own, but also to underline how crucial cognition is regarding people's capability to construct reality, self-regulate, encode information, and perform behaviours (Pajares, 2002). His theory is a framework that encompasses the origins or sources of efficacy beliefs, their structure and function, the processes through which they produce diverse effects, and the possibilities for change (Brouwers & Tomic, 2000).

Self-efficacy was introduced by Bandura in 1977, with a suggestion that environmental influences, one's own behaviour and internal personal factors, such as cognitive, affective, and biological processes, influence our behaviour (Tobery-Nystrom, 2011). As far as students are concerned, their faith in the ability to study and their own strength as individuals as well as professionals significantly affects their engagement in learning and schooling in general. Students who are confident in their capability to organise, execute, and regulate their problem-solving or task performance at a designated level of competence are demonstrating high self-efficacy (Bandura, 1986). Where Bandura's theory differs from other self-efficacy theories is that apart from the element of personal competence, it is of contextual nature, as it is task or situation-specific, thus requiring of the individual to exercise judgment as well as stir motivation and self-regulatory processes to determine a course of action and the use of resources, and attain a set goal (Pajares, 2002). Few people may confuse self-efficacy for self-esteem but the two constructs have striking differences. Self-efficacy primarily resides at the level of self-beliefs, it is also intrinsically related to action and behaviour. This is where it differs from 'self-esteem', which would seem to be a more passive concept, without a necessary relationship to action. Whereas self-esteem is the individual's judgement of selfworth, efficacy is the individual's judgement of their capacity to act and exert agency.

Several years after self-efficacy was discovered, there was a lot of confusion surrounding how the construct could be measured. Bandura (1986) pointed out that students' sense of self-efficacy is not necessarily uniform across the many different types of tasks students are required to perform or across different subject matter. Therefore, measuring student self-efficacy should be done on multiple facets. Thus, the measurement of students' self-efficacy should not be narrowed down to only one or few aspects of the factors which constitute student self-efficacy. If student self-efficacy is important in learning science, then instructors may choose to monitor and address self-efficacy alongside monitoring and addressing science concepts. The construct of self-efficacy helps to explain the finding that the behaviour of individuals is not always accurately predicted from their capability to accomplish a specific task. How a person believes they will perform is often more important.

As a performance-based measure of perceived capability, self-efficacy differs conceptually and psychometrically from related motivational constructs, such as outcome expectations, self-concept, or locus of control. Self-efficacy beliefs have been found to be sensitive to subtle changes in students' performance context, to interact with self-regulated learning processes, and to mediate students' academic achievement. In Education, self-efficacy is noted to be a key contributing factor to learners' success, as it influences the choices learners make and the courses of action they pursue (Pajares, 2002). The theory is therefore relevant to this study and serves as the bedrock to support the study.

Sources of Self-Efficacy

According to Bandura (1977), there are four sources of efficacy expectations: mastery and experience, physiological and emotional states, vicarious experiences, and social persuasion. According to Bandura, mastery and experience are the most powerful sources of efficacy information. The thought of a performance being successful raises efficacy beliefs, contributing to the idea that performance might be proficient in future. The perception that one's performance has been a failure lowers efficacy belief, contributing to the expectation that future performances will also be inept (Omrod, 2000).

The first of the proposed sources of self-efficacy, mastery experience, according to Trujillo and Tanner (2014), relates directly to an individual's previous experiences at completing a related task. The extent to which the individual succeeded or perceived success is thought to impact their self-efficacy with respect to completing the task (Trujillo & Tanner, 2014). In the classroom, it is possible for a student to build mastery for interpreting graphs after having multiple successful experiences doing so. Emotional and psychological states are those internal feelings experienced in association with successful versus unsuccessful events; joy or frustration, satisfaction or fear, for example; students may perceive their success at a particular task by the feelings they experience related to that task. Students who experience relief after answering a difficult exam question correctly is an example of students who gain self-efficacy out of the way they feel after completing a task

(Usher & Pajares, 2008). The level of arousal, either of anxiety or excitement, adds to the feeling of mastery or incompetence. Attributions also have a hand in the development of self-efficacy among students. If success is attributed to internal or controllable causes such as ability or effort, then self-efficacy is enhanced. But if success is attributed to luck or intervention of others, the level of self-efficacy may be adversely affected (Bandura, 1993).

Social persuasion refers to the external verbal encouragement or support received from peers, instructors, or other community members (Trujillo & Tanner, 2014). According to Bandura (1997), it is easier to sustain a sense of efficacy, especially when struggling with difficulties, if significant others express faith in one's capabilities than if they convey doubts. Students in the classroom may benefit from the social persuasion of their friends' positive comments about how well they can do. This is an indication that verbal persuasion which comes in various forms such as support, criticism, encouragement, advice, and expectations, also influences perception of abilities, with increase in perceived self-efficacy in the case of encouragement and, on the contrary, a decrease in it in case of negative prognoses (Gangloff & Mazilescu, 2017). These perceptions according to Gangloff and Mazilescu (2017), are communicated verbally but also, they can be conveyed through non-verbal cues.

Reports of several studies show that trainers manifest, oftentimes without being aware of it; Their expectations regarding learners through the attention they pay to them, through the manner in which they look at them and speak to them, through the manner in which they bring them together, the difficulty of tasks they attribute to them, or the degree of autonomy they grant them (Brophy & Good 1986). This persuasion varies according to factors such as the degree of competence perception, reliability or attractiveness of the persuasive source (Maddux & Stanley, 1986). According to Lecomte (2004), the persuasive effect is especially effective if the person already has a good reason to believe they can act efficiently. One of the forms of verbal influence most studied in the field of training is evaluative feedback, which informs learners on the state of their performances. Perceived self-efficacy, for example, has been manipulated through feedback announcing to participants that by comparison with the performance of other subjects with the same level of training, their own performance has been superior or inferior (Gangloff & Mazilescu, 2017).

Although social persuasion alone may be limited in its power to create enduring increases in self-efficacy, persuasion can contribute successfully to the extent that a persuasive boost in self-efficacy leads a person to initiate the task, attempt new strategies, or try hard enough to succeed (Bandura, 1982). Social persuasion may counter occasional setbacks that might have instilled enough self-doubt to interrupt persistence. The potency of persuasion depends on the credibility, trustworthiness, and expertise of the persuader (Bandura, 1993).

The last source of self-efficacy is vicarious learning. It occurs when one observes the experiences of others. It also refers in other words to the kind of experiences or learning in which the skill in question is modelled by someone else. According to Bandura (1977) the degree to which the observer identifies with the model controls the efficacy effect on the observer. Thus, if the observer identifies with the model highly then also the efficacy effect on the observer will be high, or in other words, the more closely the observer identifies with the model, the stronger or higher the impact on efficacy. When a model with whom an observer identifies performs well, the efficacy level of the observer is positively enhanced. But when the model performs poorly, the efficacy expectations of the observer decreases. Individuals perceived to be at the same ability level are often models of vicarious experience, but models can also be identified based on characteristics such as ethnicity, gender, or access to resources. For students, vicarious experience frequently occurs when one compares oneself with another in an attempt to determine what the “norm” is. For example, a student receives a grade on an exam and learns how the grade compares with another student’s grade or the mean achieved by the class.

Self-efficacy is broadened through peer influences. Peer relationships are very important in this model, and play a crucial role in developing self-knowledge. People with low self-efficacy can become socially withdrawn but also, those with high self-efficacy may also socially alienate themselves, for example, through aggressive behaviour. Once the child starts school, teachers, fellow children and the general school culture all impact on the development of cognitive and academic self-efficacy. Through adolescence, risky behaviour experimentation is part of the process of development and most adolescents negotiate this transition successfully. For those with pre-existing low self-efficacy, the new demands of adolescence can cause problems. For those in impoverished environments, there is the added difficulty of finding positive life paths.

In their study, Fencl and Scheel examined the contributions of active-learning strategies to the sources of self-efficacy for students in a non-majors physics course (Fencl & Scheel, 2005). They found that collaborative learning positively impacted all sources of self-efficacy monitored. While the researchers found that both classroom climate and the sources of self-efficacy correlated with use of active-learning strategies, the social persuasion and vicarious learning categories had the most significant associations. These data suggest that instructors in undergraduate biology classrooms may be able to foster increases in self-efficacy and subsequently impact conceptual learning by encouraging students (social persuasion) and by providing role models for students to identify with in biology (vicarious learning).

Nature of Self-Efficacy

Beliefs about Self-efficacy cut across every aspect of human behaviour being it social, moral or academic. In the words of Bandura, how people behave can often be predicted by the beliefs they hold about their capabilities, which he called self-efficacy beliefs, more than predicting it by what they actually are capable of doing (Pajares & Schunk, 2001). And while Bandura's influence on educational psychology has covered a wider range and perspective, his social cognition theory, and, for that matter, the self-efficacy component of the theory, is believed by scholars, researchers, and stakeholders in education to be his most enduring contribution to the study of academic achievement, motivation, and learning (Pajares, 2002).

Self-efficacy is a powerful tool in teaching, learning and motivation (Bandura, 1977). The success of students' learning depend, to a great extent, on students' self-efficacy and confidence in their capacity to face up challenges involved in learning (Rodríguez, Núñez, Valle, Blas, & Rosario, 2009). Self-efficacy plays a major role in how students select assignment and activities, shaping their efforts and perseverance when addressing certain challenges, and even in their emotional response to difficult situations. Thereby, ultimately accounts for a cognitive construct that mediates between knowledge and actions.

According to Bandura (1997); Schunk (2001); Yang and Cheng (2009), Students' perceived self-efficacy is often defined as how students perceive their own ability to learn an activity, solve a task or problem successfully, or perform behaviours at designated levels, which influences students' choice of effort, persistence, tasks, and achievement (Schunk, 2001). People select and participate in an activity based on their belief that they are able to accomplish it (Bandura, 1997; Trujillo & Tanner, 2014), which determines how individuals feel, think, motivate themselves, and behave (Pajares, 1996).

Trujillo and Tanner, (2014) asserted that Self-efficacy is documented to be domain specific, meaning one may have high self-efficacy in one discipline, but that level of self-efficacy does not necessarily transfer to a related discipline and has been shown to mediate a number of factors, such as academic achievement, perseverance, and self-regulated learning. Komarraju and Nadler (2013) found that of three separate factors studied, self-efficacy was the only factor that predicted grade point average (GPA). Another factor that correlates with an increase in self-efficacy is perseverance. This indicates that students who have higher self-efficacy are more likely to persist in the face of difficulty (Zimmerman, 2000). Therefore, increasing students' self-efficacy increases their capacity to self-regulate their learning, and thus their potential to tackle goals that are more challenging. Sawtelle, Brewe, and Kramer (2012), also noticed the effect of self-efficacy in studying gender differences in physics self-efficacy. In spite of the fact that a large body of research studies have shown the positive effect of self-efficacy on academic performance, a study in biology education has suggested that efforts at improving students' self-efficacy to affect academic performance of students may be ineffective in an introductory non major biology course (Lawson et al., 2007). Besides, a study conducted on geoscience students who had low self-efficacy but strong academic backgrounds received the same grades as those with high self-efficacy and weaker academic background (McConnell et al., 2010).

Efficacy beliefs vary between individuals and will actually fluctuate within an individual for different tasks (Bandura, 1997). In many activities, self-efficacy contributes to self-esteem and affect how people approach new challenges, and will contribute to performance since these beliefs influence thought processes, motivation, and behaviour (Bandura, 1997; 1986). Self-efficacy is not static and can change over time resulting from periodic reassessments of how adequate one's performance has been (Bandura, 1986). For example, in a college population, Chemistry laboratory self-efficacy increased over the course of a school year whereas Biology self-efficacy decreased over the same duration (Smist, as cited in Tenaw, 2013). Bandura's accounts on self-efficacy provide extensive evidence to suggest that perceptions of self-efficacy are powerful determinants of achievement outcomes in varied fields.

Self-Efficacy and Academic Achievement

Academic achievement refers to the extent to which a student, teacher, or institution has achieved their short or long-term educational goals. Cumulative Grade Point Average (GPA) and completion of educational benchmarks such as secondary school diplomas and bachelor's degrees represent academic achievement. It is commonly measured through examinations or continuous assessment but there is no general agreement on how it is best evaluated. A study conducted by Wilke (2003) used the Motivational Strategies and Learning Questionnaire to test the impact of active-learning strategies, such as think–pair–share, pause procedure, and minute papers in a physiology course. The study found an increase in students' self-efficacy which was associated with increased academic achievement, as measured by course grades, in the context of the implementation of active learning strategies. In the field of education, a learner's belief in his or abilities to succeed play crucial role in his commitment and performances. Hence, Academic self-efficacy is an individual's conviction that they can successfully achieve a designated level on an academic task or attain a specific academic goal (Bandura, 1997; Eccles & Wigfield, 2002; Elias & Loomis, 2002; Linenbrink & Pintrich, 2002; Schunk & Pajares, 2002). Academic self-efficacy was defined by Bandura (1997) as an individual's belief that he or she can achieve at a certain level in an academic task or accomplish a specific academic goal. In terms of engagement, numerous studies indicate that the learners rarely engage in an activity which they do not consider themselves capable of achieving. More generally, perceived self-efficacy predicts school results, the choice of their study programme and their professional choices (Lent et al., 1991).

In the view of Gangloff (2017), people with high self-efficacy choose challenging activities, set hard-to-reach goals, and better control their efforts to achieve goals, manage stress and anxiety, and achieve better results. Gangloff (2017) reported that children with the same level of competence perform differently according to the intensity of their perceived efficacy. Children who have very strong belief in their efficacy have solved the most mathematical problems, have chosen to analyse more thoroughly those where they have failed, and have abandoned erroneous strategies more rapidly; the beliefs of efficacy also predicted interest and positive attitudes towards mathematics. Similarly, at the university, students who have a high perceived self-efficacy are better able to regulate their learning and succeed better than those who doubt their intellectual capacities (Wood & Locke, 1987). The meta-analysis of Multon, Brown and Lent (1991) of academic achievement, conducted on children and adults, also shows that efficacy beliefs contribute significantly to academic performance. Similarly, still in the educational field, but focused on profession, Bandura and Locke (2003) indicated that the new recruits within an organisation who have a strong perceived self-efficacy learn and succeed better during their training period than colleagues with weak perceived self-efficacy.

According to Tenaw (2013) self-efficacy predicts intellectual performance better than skills alone, and it directly influences academic performance through cognition. Although past achievement raises self-efficacy, it is students' interpretation of past successes and failures that may be responsible for subsequent success. Perceived self-efficacy predicts future performance or achievement better than past performance. Self-efficacy beliefs also contribute to performance since they influence thought processes, motivation and behaviour. Fluctuations in performance may be explained by fluctuations in self-efficacy. For example, varying beliefs in self-efficacy may alter task outcome, whether it involves two similarly-skilled individuals or the same person in two different situations (Bandura, 1997). Individuals who have high self-efficacy attempt challenging tasks more often, persist longer at them, and exert more effort. If there are failures, individuals with high levels of efficacy attribute it to lack of effort. When they succeed, they credit their achievement to their abilities. The perception that their abilities caused the achievement affects the outcome rather than their actual abilities. Individuals who see themselves as having low levels of efficacy shy away from difficult task, slacken their efforts and giving up in the face of the slightest adversity, dwell on personal deficiencies lower their aspirations, and suffer much anxiety and stress. Such self-misgivings undermine performance.

In a meta-analysis of 39 studies from 1977 to 1988, positive and statistically significant relationships were found among self-efficacy, academic performance, and persistence for a number of disciplines (Multon, Brown, & Lent, 2001). Out of the studies analysed, 28.9 % involved higher education. Four factors affected the link between self-efficacy and academic performance. One factor was the time period when the two were assessed. A stronger relationship resulted post-treatment meaning that experimental manipulations to change self-efficacy beliefs were successful not only in raising self-efficacy but in enhancing academic performance as well. Another factor involved a stronger link between self-efficacy beliefs and performance for low-achieving students.

Kiran and Usher (2015) studied achievement and self-efficacy in science. Their study involved 3,603 Turkish seventh grade students and 127 science teachers. Instruments used in the study were teacher sense of efficacy scale, motivation strategies for learning questionnaire and science achievement test. The study found a significant positive correlation between science self-efficacy of students and science achievement ($r = .24$, $p < .01$). The study also found out that teacher self-efficacy was not significant predictor of students' science achievement ($t = 1.94$, $p > 0.001$). However, students' self-efficacy was found to be a significant predictor of science achievement ($t = 13.47$, $p < 0.001$).

A strong relation between self-efficacy and general performance of the individuals were observed by Stajkovic and Luthans (1998) through a research on 114 experimental studies, which had considered the relationship between Self-efficacy and performance found out that there is a strong, positive relationship between the self-efficacy and the performance. Multon, Brown, and Lent (1991) through a research on 38 studies within the years 1977 to 1988 found the positive relationship between the self-efficacy and the academic achievements.

Triantoro (2013) studied the effect of self-efficacy on students' academic performance. The main purpose of the study was to discuss how self-efficacy developed and the way it influences students" academic performance in addition to social interaction with peers. A scenario was given to Pakistani schools‟ student by solving mathematical problems. The study was designed to study the impact of self-efficacy on 15 students on the 5th grade of a local school. Content analysis of interviewees' responses showed that students with high self-efficacy planned to study complex subjects in future.

Alsharif and Yongyue (2016) studied students' perception of self-efficacy following medicinal chemistry skill laboratory exercises. The main objective of the study was to investigate student perceptions of self-efficacy in meeting medicinal chemistry course related educational outcomes and skills following a medicinal chemistry skills laboratory. Four activities were implemented in a pharmacy skills laboratory (PSL) for 121 second-year pharmacy students who worked individually for three of the four activities. An independent t-test was conducted to compare the mean of students' responses on meeting course outcomes based on the 70% anchor for the perspective confidence on meeting course outcomes. The post-PSL scores on all self-efficacy questions improved. Most students reported skill development in all exercises. Students and clinical faculty's qualitative responses indicated they felt exercises were effective. The result also indicated that students perceived the training programme to have given them self-efficacy in critical thinking, communication, integrate medical chemistry and pharmacology and design appropriate therapy to meet patient need.

Perception and Science Learning Self-Efficacy

The word perception in etymological terms originated from the Latin word, 'percipere', (to perceive). According to Fazio and Williams (1986), perception can be described as those subjective experiences of objects or events that ordinarily result from stimulation of the receptor organs of the body. This stimulation is transformed or encoded into neural activity (by specialised receptor mechanisms) and is relayed to more central regions of the nervous system where further neural processing occurs. They went on to explain that, it is the final neural processing in the brain that underlies or causes perceptual experience; and therefore perception-like experiences can sometimes occur without external stimulation of the receptor organs. Also, Greenberg and Baron (2008) define perception as the process through which we select, organise and interpret information gathered by our senses in order to understand the world around us. In addition, Kreitner and Kinicki (2007) of Arizona University, have explained perception in a manner that directly relates to information processing, and which can be directly associated with the learning of concepts. They viewed perception as the cognitive process that enables us to interpret and understand our surroundings. Perception allows us to take the sensory information in and make it into something meaningful (Daniel, 2011). And this involves developing critical thinking that will lead to specific ideas when solving a problem (Ciccarelli & White 2013).

Daniel (2011) viewed perception as those processes that give coherence and unity to experiences. To the author, it includes factors such as attention, constancy motivation, organization and learning. Daniel (2011) further explains that perception is a social construct which emanates from previous experiences but maybe expressed individually. This means that perception is not innate because it depends on the importance of the percept to perceiver (Ciccarelli & White 2013).

Pajares (1996) found that self-efficacy of students who are gifted was based on their perceptions of their cognitive ability. Zimmerman and Kitsantas (2005) suggest that high efficacy students perceive learning to be more of the responsibility of the learner than the teacher. And that it is a students' self-efficacy to complete a task which is the most important variable in learning not the teachers' self-efficacy. Majority of gifted students attribute their perceptions on positive self-perceptions as excellent students. Students believe that their colleagues who have high self-efficacy, like to study alone without asking for help (Jungert, 2009). The motive for mastering academic materials in many situations is that the knowledge will be needed in future. If students find out that current learning is instrumental to future success, they will persist to master the task (Greene, Miller, Crowson, Duke, & Akey, 2004).

Lent, Hackett, and Brown, (1999) reported that students confirm that efficacy beliefs have a strong influence on individual's occupational developments and pursuits, career interests, career aspirations, career related activities and career performance. According to O'Brien, Friedman, Tipton, and Linn (2000), individual students who have high perceived self-efficacy pay more attention to satisfying educational requirements and attaining professional positions. Thus, these students have been found to have a greater interest in them, prepare themselves better educationally and show greater staying power in their quest for challenging careers. In other words, students believe that their perceptions of their abilities influence their career aspirations and motivation for developing these capabilities and skills.

Previous research has found positive links between perceptions of the relevance of skills and motivation for further learning (Lizzio & Wilson, 2004). Students' positive perception is essentially important for science adoption in education and its effectiveness and implementation. There is, again, positive link between job satisfaction and occupational self-efficacy (Erwins, 2001) and between high academic self-efficacy beliefs and school-to-work transition (Pinquart, Juang, & Silbereisen, 2003).

Tas and Busher (2010) studied perception of identity in science education among secondary school students in England. The study employed a mixed method to explore the perceptions students hold about their efficacy levels in science. The results of the study seemed to show that gender biases hampered to the efficacy of female students. When students were asked about why they think it is necessary to be highly effective as a science student, it seemed that students perceived high efficacy in science as being able to give individual student the opportunity to heal everyday life in future. It was also mentioned that being highly efficacious in science allows students to understand how things work, others stated environmental issues. There were a range of other responses received from had to do with high self-efficacy in science allows for understanding of nature, develop the quality of the food we eat. Issue linked to creation of weapons and medicine were also identified by students as reason for being self-efficacious in science.

Yang (2010) conducted a study on improving students' perception of self-efficacy through peer, instructor, and self-evaluation of class participation. The study was conducted among 17 undergraduate students who were enrolled in teacher education programmes at the University of North Carolina Pembroke. The participants were recruited from two sections of an introduction to science education course. Instruments used for the study include General self-efficacy scale, self-efficacy for college learning and student self-evaluation. An experiment treatment was given to students and were required to complete three individual assignments through complex review. There was a two-time measurement of the perceived self-efficacy and of the student evaluation. The results of the study indicated that perception of self-efficacy increased for both the General Self-Efficacy Scale and the self-efficacy Scale for College Learning with 5.35% and 5.4% respectively. Students perceived self-efficacy to be enhanced by the participation in peer review processes.

Sex Differences and Science Learning Self-Efficacy

Sex refers to the biologically assigned roles and responsibilities of men and women in nature that are created in the families, societies and cultures. The concept of sex also includes the expectations held about the characteristics, aptitudes and likely behaviours of both women and men (femininity and masculinity). Sex roles and expectations are learned. They can change over time and they vary within and between cultures (March, Smyth, & Mukhopadhyay, 1999).

Sex biases in science classrooms has been and still continues to be a problem (American Association of University Women, 1999). In spite of the improvements made over recent decades, girls are still less likely than boys to take chemistry and higher-level mathematics and science courses in schools of higher learning (American Association of University Women, 1999). Starting from 7th grade, girls tend to underestimate their abilities in mathematics and science despite the fact that their performances remains the same as boys (Sadker & Sadker, 1995). The trend continues through high school and results in a loss of self-confidence rather than any difference in abilities, may be what produces the first leak in the female science pipeline (Alper, 1993, p. 410).

Confidence has been strongly correlated with the tendency for students to continue with opting for science course (Jewett, 1996). It has been thought that self-efficacy may explain course selection patterns in schools which eventually leads to the under-representation of women in science (Andrew, 1998). Regardless of gender, more career options, including potentially higher career aspirations, are considered by those students who possess a high degree of self-efficacy (Bandura, 1986; DeBacker, 1999). In its importance, efficacy beliefs partly shape the courses that lives take (Bandura, 1997). If a female believes that it is not likely to succeed in Mathematics or Science, this altered perception may then subsequently manifest itself in lower grades or in avoidance of Mathematics and Science courses altogether. In the same vein, If females perceive their abilities to be low in science then a whole technological sector of highly-esteemed or high paying careers may become off-limits to them. In a chemistry class, a statistically significant finding was reported with males scoring higher scores than females in science self-efficacy for laboratory skill (Smist, 2003). The study also stated that females had lower self-efficacy scores than males for the sciences; however, the finding was not statistically significant. High school male students were found to have higher self-efficacy in physics, chemistry and in the laboratory. The study also found female students scoring higher in self-efficacy than males in biology.

In a study conducted by DeBacker and Nelson (2000), perceived ability was the greatest predictor of semester grades for females in high school biology. Also, in the study, females' perceived ability was negatively associated with stereotyped beliefs about science. Effort, persistence and achievement appeared to have a stronger association with perceived ability for females than for males in the population studied. The study again found that high school girls scored lower than boys on perceived ability in biology, accelerated chemistry, physics, and advance placement physics. The study concluded that regardless of achievement level, girls scored lower in self-efficacy.

Tenaw (2013) in reporting a 6-year experience as a chemistry teacher, stated that students had varying levels of confidence in their abilities for success in various chemistry courses. Female students seemed to express the highest doubts in their capabilities whereas male students more often than not felt overconfident. These variations in confidence will affect their learning of science. Therefore, self-efficacy in science learning affects science learning, choice of science, amount of effort exerted, and persistence in science (Kennedy, 1996).

A study of first year university students adapted and validated the physics self-efficacy scale before administering it four times in one year to the physics cohort at the University of Sydney (Lindstrom & Sharma, 2011). Sample for the study was 122 and 281. Investigating whether gender and prior formal physics instruction matter to students' physics self-efficacy, it was found that both gender and prior formal physics instruction indicated significant effect on the physics self-efficacy of any subgroup, suggesting a male over confidence in learning physics. Investigating correlations between students' physics self-efficacy and end-of-semester physics examination scores, these only seemed to develop after a relatively long time of physics study (of the order of a year or more); females developed such a correlation faster than males. The study concluded that gender and formal instruction in physics do matter when studying physics self-efficacy (Lindstrom & Sharma, 2011).

A study conducted by Tenaw (2013) had the objectives of investigating the level of self-efficacy, gender differences in self-efficacy and achievement and also the relationship between self-efficacy and achievement for students. The study selected a sample of 100 students who completed the self -efficacy survey and the ACI achievement test. The study used independent t-test to estimate the difference in self-efficacy and achievement with respect to gender and conducted a Pearson Product Moment Correlation analysis to investigate the relationship between self-efficacy and achievement. The study results indicated that students have moderate (50.08) level of self-efficacy and there was no statistically significant difference in self-efficacy with respect to gender ($t(98) = 0.161$, $p > 0.01$), but the study also found a statistically significant relationship between self-efficacy and achievement ($r = 0.385$, at 0.01).

Burge, Raelin, Reisber, Baile, and Whitman, (2010) conducted a study on self-efficacy in female and male undergraduate engineering students. The study compared self-efficacy students of four institutions. The study captured data from about 80% of second-year population at Virginia Technology. The primary scales used were work self-efficacy, career self-efficacy, and academic self-efficacy. The results of the study revealed some significant differences by gender. With the exception of academic self-efficacy, which is significantly higher among males, every other significant difference favoured the female population. Women were found to have higher career self-efficacy and benefited far more from mentorship.

CHAPTER THREE

RESEARCH METHODS

This chapter presents a description of the research design, population, the sample and sampling procedures used for the research. It also gives a detailed description of data collection instruments and data collection procedures as well as procedures of data analysis.

Research Design

The survey design was used for the study. Specifically, the study adopted the cross-sectional survey where data was collected from respondents at a point in time. This design helped to measure Ghanaian senior high school (SHS) students' science learning self-efficacy in a short amount of time. A survey was used because it facilitated the gathering of data from students in different schools, with the intention of describing the beliefs of students about science learning self-efficacy, determining the differences between males and females in high schools; differences that exist between form one students and form two students and differences between science students and non-science students with regard to science learning self-efficacy. The design was deemed appropriate for the study because it gave clear meaning to science learning self-efficacy among high school students on the basis of data gathered at a particular point in time (Cohen, Manion & Morrison, 2007).

The design was used with greater confidence regarding its ability to provide appropriate data to successfully respond to the research questions. The survey also allowed the collection of large amounts of data within a short period of time. As regards, and considering the nature of the study, the survey design was deemed the most appropriate design for this study because it described some aspects of the study population since sample selection of individuals who completed questionnaires was unbiased (Fraenkel, Wallen, & Hyun, 2012).

Population

The population for the study included all Senior High School students within the Central region of Ghana. The target population consisted of first and second year students within the Cape Coast Metropolis. The third years were not included in the study because at the time they had completed school and left campus.

Sampling Procedure

First, the schools were categorised into three (3) groups, (Girls Schools (GS), Boys Schools (BS), and Mixed schools (MS) for purposes of selecting schools across the school types. Secondly, the schools were put into three (3) categories according to the GES high school categorisation (Grade A, Grade B, and Grade C) for purposes of selecting representative schools across each school category. There are ten (10) senior high schools within the Cape Coast Metropolis made up of five single sex high schools and five mixed sex high schools. The single sex senior high schools comprise of three Boys' high schools and two Girls' high schools. In addition, five of these schools are Grade A schools, and these high schools are all single sex schools. There are two Grade B schools and three schools in Grade C.

To select the representative schools for each of the school categories, a stratified random sampling was conducted among the schools to select two schools each from Grade A, Grade B, and Grade C high schools making a total of six schools sampled for the study out of the 10 high schools within the catchment area of Cape Coast Metropolitan Assembly; with sample schools in Grade A comprising one Boys high school and one Girls high school. The two sample schools in Grade B were both mixed sex schools as well as the two sample schools in Grade C were also mixed sex schools.

Eight intact classes were selected in each school that was part of the schools sampled for the study. The classes were made up of two science classes and two non-science classes in forms 1 and 2, respectively. In a school, if the number of science classes as well as non-science classes were more than two in both form 1 and form 2, as was predominantly in most of the high schools that were sampled for the study, the simple random sampling technique was employed to select two classes for science program and two classes for the non-science programmes. The researcher noted that the number of students in a class varied from one school to another school and the difference was huge especially, in the non-science classes. However, once a class was chosen, every student in that class, irrespective of the class size, automatically became a participant for the study. In all, the participants for the study were 1,507 instead of the 1800 high school students that was estimated for the study, which constituted 83.7%. Table 1 shows the characteristics of the respondents.

Table 1: D**emographic Characteristics of the Respondents**

Variables	Sub-scale	Freq.	Percent %

Students' sex	Male	797	52.9
	Female	710	47.1
Age ranges	12 - 15	306	20.3
	16 - 19	1180	78.3
	20 - 25	21	1.4
School type	Boys	201	13.3
	Girls	340	22.6
	Mixed	966	64.1
Form of Students	Form One	828	54.9
	Form Two	679	45.1
Programme	Science	682	45.3
	Non-Science	825	54.7
School Category	Category A	541	35.9
	Category B	422	28.0
	Category C	544	36.1

Source: Fieldwork, Nomin (2019).

Table 1 indicates that the majority of the students were males (n=797, 52.9%). With respect to the age ranges, the results show that the students within 16 - 19 years were the majority (n=1180, 78.3%). On the basis of school type, the Mixed school were the majority (n=966, 64.1%). This could be due to the fact that schools in both Category B and C were all mixed schools, hence the larger student population as regards this study. In relation to the form of students, those in Form One were the majority (n=828, 54.9%). This could be due to the fact that in some of the schools selected for the study, the form two students were not attending classes regularly which was basically as a result of students absenteeism being high in these schools. Therefore, it was difficult getting intact class in form two. The non-science recorded the highest number (n=825, 54.7%). This could be as a result of the fact that the non-science classes, made up of Business and Arts students, mostly had larger class sizes in the schools selected for the survey. For example, one of the schools in Category C had 78 students in one of the Arts classes which formed part of the sample for this survey. Lastly, on the school category, those in category C were the majority (n=544, 36.1%).

Data Collection Instrument

The data collection instrument for the study was a questionnaire. The questionnaire was structured based on the research questions. The first section of the questionnaire consisted of items that investigated the demographic characteristics of the respondents. Thus, the age, sex, form, and programme.

For the second section, an existing self-efficacy instrument was used. Because of the complex and multidimensional nature of variables being studied, it was appropriate to use an existing instrument (Punch, 2009). The only instrument for data collection was the science learning self-efficacy questionnaire from Lin and Tsai (2013) that was adapted. Although the content was appropriate for the study and easy to understand by the students which made it suitable for the Ghanaian context, few modifications were done to the instrument. The examples given on the item ‘I can understand and interpret social issues related to science (eg. Nuclear power usage and genetically modified foods) in science manner’ was modified to read as ‘I can understand and interpret social issues related to science (eg. Spread of Ebola virus and HIV virus) in science manner.’

The items on the questionnaire were all closed ended, with response scores ranging from 1-5 on a five-point Likert scale, where 1-Strongly Disagree, 2-Disagree, 3-Neutral, 4-Agree, and 5-Strongly Agree. The second section of the questionnaire had 5 sub-sections; Conceptual Understanding (CU), Everyday Application (EA), Practical Work (PW), Higher Order Cognitive Skills (HCS), and Science Communication (SC).

Validity and Reliability of Instrument

Lin and Tsai (2013) from whose survey items were pooled from for this study conducted construct validity tests as a means of ensuring that items on their questionnaire measured what it sought to measure. One way to ensure construct validity is through self-reporting (Smith & Mackie, 2000). Here, people with similar characteristics as the respondents are asked to respond to the items. Since the items for this research came from authors in a geographical area different from the Ghanaian context, it was only appropriate that steps were taken to ensure validity and reliability of the items.

Therefore, I gave the instrument to one science adviser, two science teachers who have been teaching science at the high school level and my two supervisors to review. The science adviser’s opinion was sought as he is one of the Examiners for high schools in Ghana and was in a good position to provide advice on how students are doing in their schools concerning learning of science as well as provide informed decisions about the items’ relation to the curriculum. Science teachers of similar experience of teaching science in the sampled population were used to review the questionnaire as it is a very good idea to have a small group of people who are typical of your population to go through an instrument before it becomes finalized (Punch, 2009). My supervisors are experienced science educators and have been teaching science courses. The review committee's role was to check to make sure that items on the questionnaire were in line with the science content as well as measure self-efficacy. They also checked to make sure the items were appropriate for Ghanaian high school settings as well as to ensure they were really measuring science learning self-efficacy . The suggestions of this group of people were taken and the items on the instrument were maintained as they were. Having experts review my instrument was to ensure that items were complete, relevant and arranged in appropriate format which would yield a high level of content validity (Archambault & Crippen, 2009). The reliability of the instrument was taken again for the final data. The instrument measures CU with 4 items (reliability coefficient = .78), EA with 4 items (reliability coefficient = .77), PW with 4 items (reliability coefficient = .80), HCS with 6 items (reliability coefficient = .88), and SC with 4 items (reliability coefficient = .86), making 32 items in all.

Pilot Testing

The refined questionnaire was piloted on a small group of students. The questionnaire was given to students of one school for them to try it out. Fifty students completed the trial questionnaire**.** The responses from these students were collated and used to determine the reliability of the instrument before it was sent out for the main study. Since the construct of self-efficacy has different sub-constructs, it is multidimensional in nature. Hence, the instrument used to measure it was also multidimensional and therefore the reliabilities for the various sub-constructs were determined separately. This was done using Cronbach's alpha reliability since the items on the instrument were not scored dichotomously. Moreover, the emphasis was on how items under sub-constructs related to each other. The SPSS version 22 was used for the statistical analysis. Conceptual Understanding (CU) had a coefficient alpha = .57, Everyday Application reliability coefficient (EA) = .70, Practical Work (PW) had a coefficient alpha of .77, High order Cognitive Skills (HCS) = .80, and Science Communication (SC) = .74. These reliabilities were conducted to find out how the items under a sub-construct relate to each other. Gray (2004) has it that reliability coefficients are measured by using a scale from 0.00 (very unreliable) to 1.00 (perfectly reliable). Since all the values were above 0.5, none of the items was deleted though the sample was small. The items were considered to be very reliable to fairly reliable therefore none of the items was deleted at this stage.

Data Collection Procedure

Data collection was done by the researcher together with three field assistants who were educated on the purpose of the study and on pertinent issues in the data collection instrument. Letters of introduction were received from the Department of Science Education of the University of Cape Coast. The introductory letters were delivered to the institutions which were included in the study. The Administrative heads of the respective schools were contacted to schedule date and time for the actual data collection exercise once the study received approval from the head teachers of the schools. Teachers had been informed already about the exercise therefore there was minimal or no impediment on the way. The questionnaires were delivered to students by myself with assistance from my two colleagues and in some cases teachers in the schools also assisted to facilitate the process. Students were given ample time to complete the questionnaires before they were collected. Averagely, students used twenty (20) minutes to complete the questionnaires. In each class, the purpose of the study was explained to students, and the students were assured of strict confidentiality and anonymity. This procedure was used to collect data from all six schools that participated in the study.

Data Processing and Analysis

The data collected was analysed according to the research questions. The field data was collated, and questionnaires were given serial numbers to facilitate easy identification. It is necessary to observe these precautions to ensure quick detection of any source of errors when they occur in the tabulation of the data. After editing and coding, the data was entered into the computer using the Statistical Package for the Social Sciences (SPSS version 22.0) software. Before performing the desired data transformation, the data was cleaned by running consistency checks on every variable. Corrections were made after verification from the questionnaires.

In analysing the data, the likert scale responses were assigned values from 5 to 1. To find the test value as the criterion measure, the scores on the five point likert scale were added together and divided by the total number of the scales. That is 5+4+3+2+1 = 15/5 = 3.0. Therefore, items which recorded mean scores above 3.0 indicated positive students' perception about science learning self-efficacy, while items which scored mean scores below 3.0 indicated that students' had negative perception about science learning self-efficacy. The data were analysed based on the research questions set for the study using both descriptive and inferential statistics. Research question one was analysed using mean and standard deviation. However, in interpreting the data, the normal decimal point values interpretation was used with a threshold of 0.5 hence a mean score value of 3.5 could be described as 'agreed' using the normal decimal point interpretation while a mean score of 3.4 still remains uncertain.

Data on research question 2 was analysed by conducting a One-way Multivariate Analysis of Variance (MANOVA) to compare mean scores of the sub-constructs of science learning self-efficacy between male students and female students from the participating schools. The analysis was conducted to investigate the difference in science learning self-efficacy levels of male and female students, at a significance level of 0.05 (2-tailed). Students' science learning self-efficacy was measured as a dependent variable with five levels (CU, EA, PW, HCS, and SC), sex was also dichotomous variables with two levels (Males and Females). Similarly, research questions three and four were analysed using a One-way Multivariate Analyses of Variance. In research question three, MANOVA was used to compare mean scores of the sub-constructs of science learning self-efficacy between form one students and form two students from the participating schools. The analysis was conducted to investigate the difference in science learning self-efficacy levels of form one and form two students, at a significance level of 0.05 (2-tailed). Students' science learning self-efficacy was measured as a dependent variable with five levels (CU, EA, PW, HCS, and SC), form was a dichotomous variable with two levels (form one and form two). The same MANOVA was used in research question four to compare mean scores of the sub-constructs of science learning self-efficacy between science students and non-science students from the participating schools. The analysis was conducted to investigate the difference in science learning self-efficacy levels of science students and non-science students, at a significance level of 0.05 (2-tailed). Students' science learning self-efficacy was measured as a dependent variable with five levels (CU, EA, PW, HCS, and SC), study programme was a dichotomous variable with two levels (science and non-science). The One-way Multivariate Analysis of Variance is appropriate when you have a continuous variable (science learning self-efficacy) with levels as the dependent variable and the independent variable is dichotomous variable and you want to find differences in mean scores of the two sub-groups which constitute the dichotomous variable (Pallant, 2005). Therefore, the appropriate test tool to use was MANOVA. The results and output of data analyses from SPSS is presented in the Chapter 4.

Ethical Consideration

The researcher sought permission from the head teachers of the various schools. By way of seeking permission, the researcher sent ethical clearance forms to the schools, waited for approval from the administration of all the schools before the data collection process commenced. Reasons for the research work was explained to the respondents during the administration of the questionnaires and they were assured of strict confidentiality and anonymity. No deception was used in the study.

CHAPTER FOUR

RESULTS AND DISCUSSION

In this chapter, the results obtained from analysis of the data on science learning self-efficacy of senior high school students in Cape Coast Metropolis are presented and discussed with respect to the four research questions formulated to guide the study.

Research Question 1: what is the perception of students about their science learning self-efficacy?

The first research question sought to explore students' perception about their science learning self-efficacy. The results of this question were presented in two stages, first, mean scores of students' responses on each item were calculated to find how they responded to the items under each sub-scale. The sub-scales are practical work (PW), higher order cognitive skills (HCS), conceptual understanding (CU), everyday application (EA), and science communication (SC). The item by item analysis was done to identify how students reacted to specific items measuring self-efficacy. Second, the overall self-efficacy was calculated from the mean scores of the various sub-scales. This could lead to targeted science-based development programmes as well as provide cues to what areas students' education programmes should focus. Also, since perception is a powerful tool capable of influencing students' beliefs about their capabilities it was important to do the item by item analysis before the grand mean for the individual sub-scales. Table 2 presents students' response patterns for the items of the PW sub-scale.

Table 2: Mean scores for Practical Work items

Practical Work (PW)	M	SD

I can write a laboratory report to summarise the main findings	3.1	1.2
I know how to set up equipment for laboratory experiment	3.3	1.3
I am confident that I could analyse a set of data	3.4	1.1
I know how to use equipment in the science laboratory	3.9	1.0

Source: Field survey, Nomin (2019) Mean score for the sub-construct (3.4)

Students' response to the items of PW revealed that they were not certain with regard to writing laboratory report to summarise main findings of scientific enquiry. Aside this item that recorded the lowest mean score, the students had mean scores that were less than 3.5 for the items 'I know how to set up equipment for laboratory experiment' and 'I am confident that I could analyse a set of data' under this sub-scale. Admittedly, however, there was a high mean score recorded by students showing that they know how to use equipment in the science laboratory with the lowest standard deviation showing the level of congruence for this item. If students have not had enough opportunities to practice what they learn, then their laboratory skills will definitely fall short and hence it was not surprising that their mean score (M = 3.4) for PW was generally low as compared to the other sub-scales of the SLSE construct.

Senior High School Students from the Cape Coast Metropolis in this study had a mean score of 3.9 and below for all the items for the HCS sub-scale as can be seen in Table 3.

Table 3: Mean score for Higher Order Cognitive Skills items

Higher Order Cognitive Skills (HCS)	M	SD

I am able to design scientific experiments to verify my hypothesis	3.3	1.1
I am able to propose many viable solutions to solve a science Problem	3.4	1.1
I am able to critically evaluate the solutions of scientific problems	3.4	1.0
I am able to make systematic observations and inquiries based a specific science concept or science phenomenon.	3.6	1.1
When I am exploring a scientific phenomenon, I am able to Observe its changing process and think of possible reasons behind it.	3.6	1.3
When I come across a scientific problem, I will think actively over it first and devise a strategy to solve it	3.9	1.0

Source: Field survey, Nomin (2019) Mean score for sub-construct (3.5)

Students seemed to have confidence in their higher order cognitive abilities. However, students' response pattern demonstrated their uncertainty to: design scientific experiments to verify hypothesis; propose many viable solutions to solve a science problem and, critically evaluate the solution of scientific problems as mean scores for these items were below the midpoint. Contrary to the above, students' response pointed to the fact that they can make systematic observations and inquiries as well as observing changing process and think of possible reasons behind it when they are exploring a scientific phenomenon. Particularly, students' were more positive that when they come across a scientific problem, they will think actively over it first and devise a strategy to solve it, and this was evident in the mean score (M=3.9, SD=1.0).

Senior High School Students agreed that they are able to explain everyday life using scientific theories as well as use scientific methods to solve problems in everyday life. Senior high school students in the Cape Coast Metropolis had mean scores that were above 3.5 for all the other items under this sub-scale. Therefore, all the values gave indications to believe that students' were relatively confident in their ability to explain everyday life using scientific theories and in the use of scientific methods to solve problems in everyday life especially, in understanding and interpreting social issues related to science in a science manner. Table 4 summarises the results for students' mean scores for the items of Everyday Application sub-scale

Table 4: Mean score for Everyday Application items

Everyday Application (EA)	M	SD
I am able to explain everyday life using scientific theories	3.7	1.1
I am able to use scientific methods to solve problems in everyday life	3.7	1.1
I can understand and interpret social issues related to science in a science manner	3.9	1.1
I am aware that a variety of phenomena in daily life involve science-related concepts.	4.0	1.0

Source: Field survey, Nomin (2019) Mean score for the sub-construct (3.8)

Students demonstrated higher level of understanding of concept with lowest mean score of 3.5 indicating high belief in interpreting graphs/charts related to science. Students as well showed a high level of confidence in their ability to choose the right or appropriate formula to solve a science problem. This means that for the rest of the items measuring conceptual understanding, students demonstrated a confidence level which was above average. Senior high school students showed that they can link the content among different science subjects and establish the relationship between them. The highest mean score recorded for the sub-scale gave indication that senior high school students are exceptionally confident in their capability when it comes to the definition of basic science concepts. Table 5 presents students mean scores for the various items of CU sub-scale.

Table 5: Students mean score for Conceptual Understanding items

Conceptual Understanding (CU)	M	SD
I feel confident when I interpret graphs/charts related to science	3.5	1.1
I can choose an appropriate formula to solve a science problem	3.7	1.1
I can link the content among different science subjects and establish the relationship between them	3.8	1.0
I know the definition of basic science concepts very well	4.4	0.8

Source: Field survey, Nomin (2019) Mean score for the sub-scale (3.9)

The response of students show that they were confident and comfortable to some extent when it comes to their understanding of science concepts. The highest mean score under this sub-scale was for the item 'I know the definition of basic science concepts very well'. However, the score of 4.4 that translated as 'agreed', the standard deviation of 0.8 was relatively lower as compared to that of the other items under the same sub-scale. This indicate congruence in the response of this item.

The science students had a mean score of 3.9 and above for all items under the sub-scale SC. They seemed to agree that they feel comfortable discussing science content with classmates as well as giving clear explanation on what they have learned to others. The mean scores for the items under SC are summarized in Table 6.

Table 6: Students mean score for Science Communication items

Science Communication (SC)	M	SD
I am able to comment on presentations made by my classmates in a science class	4.0	1.0
I am able to clearly explain what I have learned to others	4.1	1.0
I feel comfortable discussing science content with classmates	4.1	1.0
In science class I can clearly express my opinion	3.9	1.1

Source: Field survey, Nomin (2019) Mean score for the sub-scale (4.0)

Students seemed so sure about their ability to express their opinion in science class. Students scored a mean of 3.9 for this item which was above the 'uncertainty' threshold of 3.4. The spread for the response to this item seemed to be very wide since the standard deviation (1.1) for the item was the biggest when compared to the other items under the same sub-scale. In terms of discussions on science content related issues, students espressed the opinion that they were comfortable discussing science content with classmates. This was evident in their mean score for this item. Similarly, students articulated the view that they were able to clearly explain what they have learned to others. Students' response pattern also indicated that they were able to comment on presentations made by their colleagues.

Overall, Means and Standard deviations for students' perception about their science learning self-efficacy as captured by the various sub-scales are as shown in Table 7.

Table 7: SHS Students' Mean Scores on the Sub-constructs of SLSE

Sub-scales	M	SD

Practical Work	3.4	0.9
Higher Order Cognitive Skills	3.5	1.1
Everyday Application	3.8	0.8
Conceptual Understanding	3.9	1.0
Science Communication	4.0	1.0

Source: Nomin, (2019)

The results in Table 7 show that Senior High School students in the Cape Coast Metropolis were positive about their science learning self-efficacy. This was evident in the mean scores for the various sub-constructs: science communication (M=4.0, SD=1.0); conceptual understanding (M=3.9, SD=1.0); everyday application (M=3.8, SD=0.8); higher order cognitive skills (M=3.5, SD=1.1) . However, in Practical Work (M=3.4, SD=0.9), students seemed unsureabout their science learning self-efficacy particularly, this was evident intheir mean score for practical work.

Furthermore, since the demographics of students in this study was also multidimensional with six sub-scales (sex, age, form, school type, program, and school category), means and standard deviations of sub-constructs of science learning self-efficacy were calculated for the various groups. This was done to enhance further analysis of data which explored the differences in these groups with regard to students' science learning self-efficacy. Since gender plays a role in self-efficacy beliefs, it was appropriate the views of males and females are gouged in respect of their self-efficacy beliefs. The results on perception of males and females on science learning self-efficacy is presented in Table 8.

Table 8: SHS Male and Female Students' Mean Scores on Sub-construct of SLSE

Sub-scales	Male		Female	
	M	SD	M	SD
Practical Work	3.4	0.9	3.4	0.9
Higher Order Cognitive Skills	3.5	0.7	3.5	0.7
Everyday Application	3.8	0.8	3.8	0.7
Conceptual Understanding	3.9	0.7	3.8	0.7
Science Communication	4.0	0.8	4.0	0.8

Source: Nomin (2019)

From Table 8, male students and female students both showed a higher affinity for science communication with a mean of 4.0 each, as well as conceptual understanding and everyday application. they also demonstrated above average confidence in their higher order cognitive skills. On the subject of practical work, however, male students and female students both demonstrated some level of uncertainty, giving a strong indication that male students' and female students' in this study perceived themselves as not confident enough when it comes to science practical work. Again, the spread for this sub-scale was the highest as compared with the rest of the sub-scales which indicates varying views from male students and female students in their response to items of the sub-scale.

The students that participated in this study were from SHS 1 and SHS 2 which in this study was termed as 'Form' by the researcher. Hence, means and standard deviations for these two groups were calculated to find the perceptions of

Form 1 and Form 2 students in Ghanaian high schools about their science learning self-efficacy. It appeared that form 1 students had confidence in thier practical work abilities and Form 2 students were unsure of their practical work. Again, Form 1 students demonstrated a stronger affinity for science communication. Also, they showed a relative understanding of concept in science and that they could apply science in their everyday life. The results of Form 1 students and Form 2 students about their science learning self-efficacy is presented in Table 9.

Table 9: SHS 1 and SHS 2 Students' Mean Scores on Sub-constructs of SLSE

Sub-scales	Form 1		Form 2	
	M	SD	M	SD
Practical Work	3.5	0.9	3.4	0.9
Higher Order Cognitive Skills	3.6	0.7	3.5	0.7
Everyday Application	3.8	0.8	3.8	0.7
Conceptual Understanding	3.9	0.7	3.8	0.7
Science Communication	4.1	0.8	3.9	0.8

Source: Nomin (2019)

Means scores for Form 2 students on their perception about science learning self-efficacy was fascinating comparing with the results of form 1 students. There were marginal differences in the mean scores of all the sub-constructs of science learning self-efficacy. Practical work seemed to be a problem for both years but the mean scores suggests that form 2 students had a bigger challenge that form 1 students. Although the affinity for science communication was the highest among the sub-constructs, the mean score of Form 2 students was still lesser than that of form 1, falling below the agreed threshold of 4.0.

Again, high schools in Ghana offer variety of learning programs ranging from Business, Arts, Science, Home Economics, and Technical skills. However, participants for the study were students reading Business, Arts and Science. The decision to select Business and Arts students was informed by the fact that students in Ghanaian high schools offering Home Economics have the option to choose between Chemistry and Biology as part of their elective subjects. Hence it was difficult putting them in any of the sub-groups. Also, the number of high schools offering Technical Skills in the Cape Coast metropolis are very few. Even if a school offers the course, the number of classes, at most, were two, hence getting enough data for the study was going to be problematic. As a results, these programs were exempted. Students from the Business and Arts classes were put together and named as "non-science students" in this study to distance them from those reading Elective Science in high schools in Ghana. The mean scores for these two sub groups of programs under this study were calculated to find their perception about science learning self-efficacy.

Science students scores 4.0 and above for everyday application, conceptual understanding, and science communication. Relatively, their perception about practical work as well as higher order cognitive skills were also good. The results of science students on their perception about science learning self-efficacy is as shown in Table 10.

Table 10: Science Students' and Non-science Students' Mean Scores on Sub-constructs of SLSE

Sub-scales	Science		Non - Science	
	M	SD	M	SD
Practical Work	3.7	0.8	3.2	0.9
Higher Order Cognitive Skills	3.8	0.7	3.4	0.7
Everyday Application	4.0	0.6	3.6	0.8
Conceptual Understanding	4.1	0.5	3.6	0.7
Science Communication	4.2	0.7	3.9	0.8

Source: Field survey - Nomin, (2019)

Overall, science students in this study demonstrated that they were confident in themselves about their efficacy in learning science. The results prove to the fact that science students do not only have positive perception about how well they could communicate science but also understand the concepts they communicate and its application in everyday life. Means scores for 'non-science students were also calculated. A strong affinity for science communication was also recorded for non-science students. Admittedly, non-science students showed a lack of practical work as it recorded the lowest mean score. This is no news because these students do not engage in any form of science laboratory practical.

Research Question 2: What differences exist in science learning self-efficacy between males and females students?

The second research question sought to find whether sex of the students influence their science learning self-efficacy on the various sub-scales. A One-way Multivariate Analysis of Variance (MANOVA) was used to analise the data for the research question. The five sub-constructs on science learning self-efficacy namely Conceptual Understanding (CU), Everyday Application (EA), Practical Work (PW), Higher Order Cognitive Skills (HCS), and Science Communication (SC) were used as the dependent variables. The independent variable was sex made up of males and females. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity with no violations of assumptions noted. The results are presented in Table 11.

Table 11: Multivariate Results on Sex Differences Against Sub-constructs of Self-Efficacy in Science Learning

Sub-scales	Male M	Female M	F	p	eta squared
Conceptual Understanding	3.9	3.8	0.43	0.51	0.00
Everyday Application	3.8	3.8	3.00	0.08	0.00
Practical Work	3.4	3.4	0.02	0.89	0.00
Higher Order Cognitive Skills	3.5	3.5	0.00	0.97	0.00
Science Communication	4.0	4.0	0.73	0.39	0.00

Source: Field Data - Nomin, (2019) *Significance at $p \leq 0.05$, n=1,507

The results in Table 11 show that there is no statistically significant difference between males and females on the combined dependent variables: *F* (5, 1,501) = 1.60, *p* = .157; Wilk's Lambda = .995. This means that males and females from the schools sampled do not differ in terms of their science learning self-efficacy.

Research Question 3: What are the differences in science learning self-efficacy between Form 1 and Form 2 students'?

The third research question for this study sought to ascertain whether differences exist between students in form one and students in form two in their science learning self-efficacy. A one-way multivariate analysis of variance was conducted to see if statistically significant differences exist between form one and form two students and their science learning self-efficacy. The results have been presented in Table 12

Table 12: Multivariate Results on Form 1 and Form 2 Students Against Sub-constructs of Science Learning Self-Efficacy.

Sub-scales	Form One M	Form Two M	F	p	eta-squared
Conceptual Understanding	3.87	3.83	1.11	0.29	0.00
Everyday Application	3.83	3.78	1.80	0.18	0.00
Practical Work	3.46	3.37	3.55	0.06	0.00
Higher Order Cognitive Skills	3.58	3.50	4.34	0.04*	0.00
Science Communication	4.10	3.90	23.12	0.00*	0.01

Source: Field Data-Nomin, (2019) *Significance at p≤0.05, n=1,507

From Table 12, there was a statistically significant difference between students in form 1 and students in form 2 on the combined dependent variables: *F*

(5, 1,501) = 5.293, p = .000; Wilk's Lambda = .983. As a result, further analysis was done to find where the differences lie. A more strict alpha level was set to .01 by dividing the original alpha of .05 by the number of dependent variables to obtain the bonferroni alpha level. When the results for the dependent variables were considered separately, the only difference to reach statistical significance, using a Bonferroni adjusted alpha level of .01, was Science Communication: F (1, 1,505) = 23.416, p = .000, partial eta squared = .015. An inspection of the mean scores indicated that form one students reported slightly higher levels of Science Communication (M=4.096, SD=.027) than form two students (M=3.899, SD=.030). Higher Order Cognitive Ability showed significance on the combined mean but could not meet the Bonferroni adjusted alpha level of .01, which means that form 1 and form 2 students in this study are relatively at the same level on the subject of their cognitive abilities in the higher order.

Research Question 4: What differences exist in science learning self-efficacy between elective science and non-science students?

The fourth research question for this study sought to explore whether there is any differences in science learning self-efficacy between senior high school students reading science courses and those reading non science courses. A One-way Multivariate Analysis of Variance was conducted to see if statistically significant differences exist between students' academic program and their science learning self-efficacy. The results have been presented in Table 13.

Table 13: Multivariate Results on Science and Non-science Students Against Sub-constructs of SLSE

Sub-scales	Science M	Non-Science M	F	p	eta-squared
Conceptual Understanding	4.1	3.6	253.73	0.00*	0.14
Everyday Application	4.0	3.6	97.65	0.00*	0.61
Practical Work	3.7	3.2	142.58	0.00*	0.09
Higher Order Cognitive Skills	3.8	3.4	130.74	0.00*	0.08
Science Communication	4.2	3.9	47.96	0.00*	0.03

Source: Field Data (2019) *Significant difference exists at $p \leq 0.05$, n=1,507

The results from Table 13 show that there was a statistically significant difference between students reading science and students offering non-science programs on the combined dependent variables: F (5, 1,505) = 59.565, p = .000; Wilk's Lambda = .834. Hence, a posthoc analysis was conducted to find where the differences lie. When the results for the dependent variables were considered separately, all the sub-scales reached statistical significance, using a Bonferroni adjusted alpha level of .01, Conceptual Understanding: F (1, 1,505) = 253.725, p = .000, partial eta squared = .144, Everyday Application: F (1, 1,505) =97.654, p = .000, partial eta squared = .061, Practical Work: F (1, 1,505) = 142. 583, p = .000, partial eta squared = .087, Higher Order Cognitive Skills: F (1, 1,505) = 130.735, p = .000, partial eta squared = .080, Science Communication: F (1, 1,505) = 47.958, p = .000, partial eta squared = .031. An inspection of the mean scores indicated that science students reported higher levels of Conceptual Understanding (M=4.133, SD=.024) than non-science students (M=3.613, SD=.022). In Everyday Application science students (M=4.009, SD=.027) had higher mean score than non-science students (M=3.643, SD=.025). Science students reported higher mean score in Practical Work (M=3.708, SD=.033) than non-science students (M=3.178, SD=.030). Again, science students in this survey reported higher levels in their Higher Order Cognitive Skills (M=3.773, SD=.027) than non-science students (M= 3.352, SD=.025), and in Science Communication science students (M=4.161, SD=.030) reported slightly higher levels than non-science students (M=3.881, SD=.027).

As stated by Tabachnick and Fidell (2007), the Partial eta squared values provide the researcher with an indication of the proportion of variance in the new combined dependent variable that can be accounted for by the factor 'group'. A rule of thumb is that values larger than .14 (or 14%) indicate a large effect. In this study, the effect size was large; about 14.4% of the variance in the linear combination of the DVs was accounted for by program. Further evidence can be seen in the means. We can see from the research question four output table that conceptual understanding has a statistically significant effect on both science and non-science students ($F(1, 1505) = 253.725$, $p = 0.000$, partial eta squared = .144). It is important to note we have to make an alpha correction to account for the five ANOVAs being run, by applying a Bonferroni correction. As such, in this case, we accept statistical significance at $p < .01$ since there were the five univariate ANOVA test statistics.

Again, partial eta squared values are reported showing the amount of variance in the dependent variables. For the rest of the DVs, magnitude of the difference was small, based on Cohen (1988) guidelines. EA accounts for approximately 6% of the variance; PW approximately 9% of variance in science self-efficacy; HCS 8%; and SC approximately 3%. The two groups (science and non-science students) differed on science learning self-efficacy and it was largely in their conceptual understanding.

Discussion

The results of senior high school students' perception of their science learning self-efficacy showed that the students had a relatively high perception about their science learning self-efficacy. The participants of this study displayed mean scores which were above the midpoint in terms of higher order cognitive skills, everyday application, conceptual understanding, and science communication, indicating that senior high school students included in this study perceive themselves as efficacious in science learning, with the exception of practical work, where students displayed uncertainty. This results is in line with previous research by Pajares (1996) who found that self-efficacy of students who are gifted was based on their perceptions of their cognitive ability. Zimmerman and Kitsantas (2005) suggest that high efficacy students perceive learning to be more of the responsibility of the learner than the teacher. And that it is a students' self-efficacy to complete a task which is the most important variable in learning not the teachers' self-efficacy.

Again, previous research has found positive links between perceptions of the relevance of skills and motivation for further learning (Lizzio & Wilson, 2004) between job satisfaction and occupational self-efficacy (Erwins, 2001) and between high academic self-efficacy beliefs and school-to-work transition (Pinquart, Juang, & Silbereisen, 2003). So it is anticipated that since students in this study demonstrated positive perception about their self-efficacy in learning science, it will fuel their passion for acquiring higher academic degrees and become self confident in their future occupations and also transition well from school to work. O'Brien, Friedman, Tipton, and Linn (2000), found that individual students who have high perceived self-efficacy pay more attention to satisfying educational requirements and attaining professional positions have been found to have a greater interest in them, prepare themselves better educationally and show greater staying power in their quest for challenging careers. In addition, Lent, Hackett, and Brown (1999) reported that students confirm that efficacy beliefs have a strong influence on individual's occupational developments and persuits, career interests, career aspirations, career related activities and career performance.

Since the students in this study have a high perception of their science learning self-efficacy, it is believed that their perceptions of their abilities will influence their career aspirations and motivation for developing the appropriate capabilities and skills that will facilitate their attaining of their educational and career goals.

Lending further results, Yang (2010) conducted a study on improving students' perception of self-efficacy through peer, instructor, and self-evaluation of class participation. Students perceived self-efficacy to be enhanced by the participation in peer review processes. Bandura's accounts on self-efficacy provide extensive evidence to suggest that perceptions of self-efficacy are powerful determinants of achievement outcomes in varied fields as well as group of individuals. Students' positive perception is essentially important for science adoption in education and its effectiveness and implementation. Hence, it is expected that students' positive perception in this study will serve as motivation towards their achievement outcomes.

In this study, Ghanaian high school students' science learning self-efficacy was found not to differ between males and females. This results contradict Tas and Busher (2010) who studied perception of identity in science education among secondary school students in England and the results showed that gender biases hampered to the efficacy of female students. Despite, the improvements made over recent decades, girls are still less likely than boys to take chemistry and higher-level mathematics and science course in schools of higher learning (American Association of University Women, 1999). Sadker and Sadker, (1995) found that girls from 7th grade, tend to underestimate their abilities in mathematics and science despite the fact that their performances remain the same as boys. The trend continues through high school and results in a loss of self-confidence rather than any difference in abilities may be what produces the first leak in the female science pipeline (Alper, 1993, p. 410).

The outcome of the current study contradicts Tas and Busher (2010) as well as Sadker and Sadker (1995). in the current study, efficacy in learning science was found to be at par between males and females. This indicates that in learning science, both males and females students' in Ghanaian high schools have similar perception of their abilities. This is a positive development which can be harnessed to promote the learning of science among females in the country since the participation of females in science related areas have dwindled over the years.

Again, the fact that there is no difference between males and females in terms of their science learning efficacy beliefs, it can be extrapolated that the nature and difficulty of science is not a factor that is influencing low participation of females in science in Ghana.

The importance of self-efficacy beliefs was brought to bear by DeBacker and Nelson (2000) when they revealed that perceived ability was the greatest predictor of semester grades for females in high school biology. They further accentuated that females' perceived ability was negatively associated with stereotyped beliefs about science. The study concluded that regardless of achievement level, girls scored lower in self-efficacy. Such negative perception and stereotypical beliefs about science has the tendency to prevent females from pursuing science related programmes at the higher level. If females perceive their abilities to be low in science, a whole technological sector of highly-esteemed, high paying careers may become off-limits to them. Fortunately, females in this study did not exhibit such negative stereotype and perception about science.

Lindstrom and Sharma's (2011) study on self-efficacy of first year university physics students: do gender and prior formal instruction in physics matter? adapted and validated the physics self-efficacy scale before administering it four times in one year to the first physics cohort at the University of Sydney. Sample for the study was 122 and 281. Investigating whether gender and prior formal physics instruction matter to students' physics self-efficacy. It was found that both gender and prior formal physics instruction had significant effect on the physics self-efficacy of any subgroup, suggesting a male over confidence in learning physics. Again, investigating correlations between students' physics self-efficacy and end-of-semester physics examination scores, self-efficacy only seemed to develop after a relatively long time of physics study (of the order of a year or more); females developed such a correlation faster than males. The study concluded that gender and formal instruction in physics do matter when studying physics self-efficacy (Lindstrom & Sharma, 2011). The issue of gender differences and self-efficacy seem to vary across various research findings. A number of studies on self-efficacy conclude on the fact that males are dominant in science learning self-efficacy. However, other researchers oppose this view because their studies found otherwise, suggesting female dominance in some subject specific science discipline. In addition, self-efficacy beliefs differed by the subject area (Huang, 2013). High school male students were found to have higher self-efficacy in physics, chemistry and in the laboratory whiles female students were found scoring higher in self-efficacy than males in biology. (Smist, 2003). The outcome of this study contradicts both opposing views. Clearly, more research is needed to clarify whether sex is a predictor of students science learning self-efficacy. Perhaps, the issue must be contextualised rather than globalised.

The results from research question three is consistent with results of other studies (Brouse et al., 2010; Deci & Ryan, 2000). It seems that the levels of intrinsic motivation decrease from freshman years to senior years (Deci & Ryan, 2000), just as Brouse et al. (2010) found that students' motivation declined with the years they spent in college. Self-efficacy is not static and can change over time resulting from periodic reassessments of how adequate one's performance has been (Bandura, 1986). According to Bandura, (1977) Efficacy beliefs vary between individuals and will actually fluctuate within an individual for different tasks. For example, in a college population, Chemistry laboratory self-efficacy increased over the course of a school year whereas Biology self-efficacy decreased over the same duration (Smist, as cited in Tenaw, 2013). Taken together, these results suggest that the construct of self-efficacy helps explain the finding that the behavior of individuals is not always accurately predicted from their capability to accomplish a specific task. How a person believes they will perform is often more important. Perhaps like other types of beliefs, self-efficacy beliefs are formed through personal experiences and persuasions received from others (Bandura, 1986). Research has shown that adolescents' science learning self-efficacy tends to decline during late elementary and middle school (Barth et al., 2011; Rice et al., 2013; Rittmayer & Beier, 2008). This decline may be one of the causes for the relatively low proportion of students choosing to major in science studies and to pursue science-related careers (Maltese & Tai, 2011; OECD, 2017).

Recent research on science learning self-efficacy confirming the significance of students' efficacy beliefs and in science-related disciplines and professions (Ballen et al., 2017; Ferrell & Barbera, 2015) essentially illustrate the value of self-efficacy in supporting the type of self-regulated learning, engagement, and, ultimately, identification with a discipline (Chemers et al., 2011; Honicke & Broadbent, 2016; Robnett et al., 2015; Zimmerman et al., 1992) that encourages success in fields such as math, biology, physics, and chemistry. According to Mcbride, Oswald, Beck and Murray, (2019) little attention has been given to the role of science self-efficacy for nonmajors taking science as a general education requirement although a demonstrated importance of efficacy beliefs in supporting successful engagement with science exists. Thus, in this context, persistence in and connection to science as a disciplinary focus is less of a concern. In spite of this, the importance of science literacy as a goal of the liberal arts curriculum (DeBoer, 2000; Meinwald & Hildebrand, 2010; Randal, 2010) suggests the need to better understand the mechanisms that support science self-efficacy in this unique environment (Mcbride, Oswald, Beck & Murray, 2019).

The results of this study points out uniquely to the differences in science learning self-efficacy between science students and non-science students with regard to conceptual understanding in science.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter of the study contains summary of findings and conclusions of the study. It also gives recommendations that could be implemented as well as recommendations for future research.

Summary

Students' self-efficacy is an important issue in the field of education, especially when a society wants to elevate its quality of education and the future of its citizens in the end. Hence, investigating Senior High School Students' Science Learning Self-Efficacy was very imperative. This is to achieve the overarching goal of making the individual learner a responsible citizen in a democratic society. Specifically, the study sought to assess Ghanaian high school students' perception of their science learning self-efficacy, estimate the differences that exist in gender, form, and program of the students in this study in relation to science learning self-efficacy. In the quest of achieving these objectives, the survey design was employed for the study. In selecting the sample, stratified random sampling was used to select the schools for this study. The questionnaire used for the data collection was adopted from Lin and Tsai (2013). Ethical consideration was ensured before the actual data collection. The data collected were analysed using descriptive statistics (means and standard deviation) and inferential statistics (a One-way Multivariate Analysis of Variance).

Key Findings

The following findings emerged from the study:

1. It was evident from the results of this study that the sampled Ghanaian high school students in the Cape Coast Metropolis have a positive perception in their Everyday Application, Conceptual Understanding and Science Communication of their Science Learning Self-Efficacy except practical work.

2. It was found that there was no statistically significant difference between males and females high school students' in terms of Practical Work, Conceptual Understanding, Everyday Application, High Order Cognitive Skills, and Science Communication. This means that sex of high school students in the Cape Coast Metropolis is not a significant predictor of their science learning self-efficacy.
3. Again, the results show that there is no statistically significant difference between Form 1 and Form 2 students with respect to Conceptual Understanding (CU), Everyday Application (EA) and Practical Work (PW). However, significant difference did exist between Form 1 and Form 2 students with respect to High order Cognitive Skills (HCS) and Science Communication (SC) with Form 1s' reporting higher levels of Science Communication than Form 2s'.
4. The results finally showed that there was statistically significant difference in all the science learning self-efficacy (SLSE) sub-scales in relation to students' program of study in high school, and this was largely predicted by their Conceptual Understanding (CU) with variance of 14.4%.

Conclusions

Based on the findings of the study, it can be concluded that there is lack of Practical Work in Ghanaian high schools for which reason students seemed not to be so positive about their perception of their science learning self-efficacy.

From the study, it can be asserted that males and females high school students of this study are at the same level on the subject of their science learning self-efficacy. There is a reason to believe from the findings of this study that males and females in senior high schools in Cape Coast perform equally in science learning.

Judging from the findings of the study, it can also be concluded that senior high school students in Form 1 communicate better in science than those in Form 2. In terms of Higher Order Cognitive Skills, Form 1 students, again, perceived their cognitive abilities to be of higher levels than students in Form 2.

Finally, it is concluded that high school science students of this study perceived their efficacy in science Conceptual Understanding, Practical work, Everyday Application, High Order Cognitive Skills and Science Communication to be better than those of non-science students. Therefore, high school science students in the Cape Coast Metropolis are positive and confident in their science learning self-efficacy.

Recommendations

The results from this research have several implications and recommendations. It is envisaged that the following recommendations based on the findings of this study will provide useful information to improve the use of self-efficacy instrument as a measure for assessing students' efficacy and improve the level of students' efficacy in the learning of science in senior high schools. Thus, based on the findings of this research, it is recommended that:

1. teachers take active steps by planning and structuring science lessons to include more practical work as a means to enhance students efficacy in practical skills since students showed a relatively low perception in their practical work efficacy.
2. teachers should not treat males differently from females in performance of science tasks since males and females do not differ in science learning self-efficacy.
3. efforts should be made by high school science teachers to employ techniques that will enhance higher order cognitive abilities right from first year to sustain students' interest in science and boost their self-efficacy, particularly, in how they communicate as they move from Form 1 to Form 2.
4. Also, efforts should be made by science teachers in high schools to encourage non-science students to boost their confidence in learning science and thereby expend more energy in face of challenging science tasks.

Suggestions for Further Research

The findings of the study have given certain indications concerning possible directions for further research. This study was delimited and subject to certain limitations. It is therefore recommended that certain dimensions of the study be looked at again to provide a more comprehensive picture with regard to the teaching and learning of Science in senior high schools in Ghana. The following areas can therefore be looked at:

1. A further study could be conducted to examine the link between student achievement levels and teacher efficacy

2. Teacher qualification has been identified as one of the factors that influence the efficacy levels of teachers and hence the teaching and learning of science in senior high schools in Ghana. A further study could be done to assess the connection between teacher qualification and their science teaching self-efficacy in Ghanaian high schools.

3. A study on students' prior science learning and the effect on science learning self-efficacy at high school could be done to find out how early exposure to science influence students science learning self-efficacy later at high school.

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APPENDIX A

UNIVERSITY OF CAPE COAST

COLLEGE OF EDUCATION STUDIES

DEPARTMENT OF SCIENCE EDUCATION

This questionnaire aims at investigating science leaning self-efficacy of Senior High School students. This research work is purely for academic purpose hence, the honest and sincere response you give will contribute a lot to the research. Please be assured that your responses will be treated with strict anonymity and confidentiality. Please provide the appropriate response by ticking (√).

Section A: Demographic Characteristics of Respondents

1. Sex: Male [ ] Female [ ]
2. Age: 12-15 years [ ] 16-19 years [ ] 20-25 years [ ]
3. School Type: Boys School [ ] Girls School [ ] Mixed Sex School [ ]
4. Form: Form One [ ] Form Two [ ]

Section C: Students' Science Learning Self-Efficacy

What is your opinion regarding the following statements considering how much you can do in science? For each of the statements please mark the response that best describes what you do. Please indicate by ticking (√) the appropriate response on of scale 1-5, where 1= **strongly disagree**, 2= **disagree**, 3= **neutral**, 4**= agree**, and 5= **strongly agree.**

Conceptual Understanding (CU)	SA	A	N	D	SD
14. I can choose an appropriate formula to solve a science problem.					
15. I can link the content among different science subjects (for example biology chemistry and physics and establish the relationship between them.					
16. I know the definition of basic scientific concepts (eg. Photosynthesis, gravity etc.) very well.					

17. I feel confident when I interpret graphs/charts related to science.					
Everyday Application (EA)	SA	A	N	D	SD
18. I am able to explain everyday life using scientific theories.					
19. I am able to use scientific methods to solve problems in everyday life.					
20. I can understand and interpret social issues related to science (eg. Nuclear power usage and genetically modified foods) in science manner.					
21. I am aware that a variety of phenomena in daily life involve science-related concepts.					
Practical Work (PW)	5	4	3	2	1
22. I know how to use equipment (eg. Measuring cylinders, measuring scales etc.) in the science laboratory.					
23. I know how to set up equipment for laboratory experiment.					
24. I can write a laboratory report to summarise the main findings.					
25. I am confident that I could analyse a set of data (i.e. look at the relationship between variables)					
Higher Order Cognitive Skills (HCS)	SA	A	N	D	SD
26. I am able to critically evaluate the solutions of scientific problems.					
27. I am able to design scientific experiments to verify my hypotheses.					
28. I am able to propose many viable solutions to solve a science problem.					
29. When I come across a scientific problem, I will think actively over it first and devise a strategy to solve it.					
30. I am able to make systematic observations and inquiries based on a specific science concept or science phenomenon.					
31. When I am exploring a scientific phenomenon, I am able to observe its					

	SA	A	N	D	SD
changing process and think of possible reasons behind it.					
Science Communication	SA	A	N	D	SD
32. I am able to comment on presentations made by classmates made in science class.					
33. I am able to clearly explain what I have learned to others.					
34. I feel comfortable discussing science content with classmates.					
35. In science class, I can clearly express my opinion					