UNIVERSITY OF EDUCATION, WINNEBA

IN-SERVICE NEEDS OF PRIMARY SCHOOL TEACHERS IN SCIENCE TOWARDS THE IMPLEMENTATION OF THE STANDARDS BASED CURRICULUM

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DECLARATION

STUDENT'S DECLARATION

I, TAHIRU KWADWO MUSTAPHA, declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE:…………………………….

DATE:…………………………………….

SUPERVISOR'S DECLARATION

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

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DEDICATION

To Prof. Asonaba Kofi Addison and my two girls Khadijatu Tahiru Mustapha and Yasmeen Adisiwaa Mustapha

.

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ABSTRACT

The purpose of the study was to identify Primary school teacher's in-service needs in Science towards the implementation of the standards-based curriculum in the Kintampo North Municipality of the Bono East Region. The study employed Sequential Explanatory Mixed Method Design with a sample of 240 primary school teachers. An adapted Science Inventory of Needs (STIN) and interview guide was used to seek their prevalent in-service needs. The questionnaire had six dimensions, namely management of science instruction, diagnosing and evaluating students, generic pedagogical knowledge and skills, knowledge and skills in science subjects, administrating science instructional facilities and equipment and planning science instruction. Descriptive statistics, thematic analysis and Chi square test were used to analyse the data. The results indicated that the highest rated prevalent in-service needs were generic pedagogical knowledge and skills and planning science instruction with diagnosing and evaluating students as the least. The Chi square tests, conducted at the 0.05 level of significance, showed that there were statistical differences between urban teachers' in-service needs in favour of the Primary school teachers from rural schools in science for knowledge and skills in science subjects, administering science instructional facilities and equipment, planning activities in science instruction and school location, gender has influence on the perceived professional development needs of primary school teachers. The male teachers expressed more need for professional development than their female counterpart. The study recommended among others that for an effective professional development, the organisers assess prevalent in-service needs of the teachers before planning to solicit the teachers' participation and for meaningful professional development programme.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter presents the background to the study about the problem, which led to the Statement of the problem. It continues with the purpose of the study, as well as the research objectives. The research questions and the significance of the study formed part of this chapter. The chapter ends with delimitation and limitation of the study.

1.1 Background to the Study

Ghana as a developing country considers science and technology education as the bedrock for economic stability and growth hence, subscribes to the goal "science for all" (Quansah et al. 2019). This "science for all" movement has brought about innovations at all levels of education to address the needs of the individual, society and the nation so far as effective learning of science is concerned. The teaching of science has become a complex task in that teachers are expected to master new skills and content, take on new responsibilities, and change their practice (Rasku-Puttonen et al, 2004). Such reform-driven expectations require teachers not only to learn new ways of teaching, but also be given opportunities to acquire and practice the new knowledge and skills needed to implement these innovations. It is therefore pertinent to ensure that new knowledge is instilled into teachers to make them competent and ready to meet current challenges in the subject they teach, because teachers are the link between policy and practice (Cohen & Hill. 2000).

Educators, policy makers and reformers have identified professional development as the vehicle for teachers to acquire growth in knowledge, skills and judgment (Guskey, 2000). While this short term 'skills and knowledge' approach can be valuable and efficient in disseminating information and ideas, it has been shown to be quite ineffective in challenging and supporting more fundamental aspects of teaching practice and beliefs practices (Treagust, 2006). This is because majority of teacher professional development programmes use defective models: a top-down, one-shot and lecture approach (Adsit,2004). This mostly does not reflect teachers' needs, interests, experiences, knowledge base, or instructional realities. As noted by Boyle et al. (2004), this phenomenon discourages most teachers from attending or participating in professional development sessions because they consider it to be ineffective and time wasting. Amir (1993) advised that an effective professional development programme should aim at meeting the stated concerns of teachers. Parkinson (2004) consented by stating that the first step in designing a curriculum for continuous professional development is assessment of teachers' needs. Needs assessment is one key means of determining areas in which teachers desire help (Rossett, 1997) and what training they will need (Che Omar, 2014).

If teachers' needs are assessed, planning and implementing of professional development programmes by the organisers will be systematic and teachers will respond and benefit from the programme. Careful planning and implementation of professional development can build strong correlations between teacher knowledge and student achievement (Darling-Hammond et al, 2009). Despite the consensus that teachers' needs, interests, and preferences should drive the planning and implementation of professional development programmes, research has consistently pointed to the fact that in-service experiences rarely consider teachers' needs, interests, or preferences (Conkle, 1994). Lubben (1994) argued that in-service activities are usually structured on the basis of the observations of in-service providers and the requests of educational administrators, without consulting teachers to identify their priority needs. There is therefore the need to assess science teachers' needs for professional development. It has been argued that professional development programmes in the form of professional development can improve teachers' competence (Sandholtz, 2002). The Government of Ghana therefore with the Japan International Cooperation Agency (JICA) introduced a 5-year Science, Technology and Mathematic (STM) project in March 2000 under the free Compulsory Universal Basic Education (FCUBE) policy to improve the teaching of science and mathematics in terms of contents and instructional practices at upper primary and JHS levels through professional development programmes. It has however been observed that, this intervention did not have the desired impact on teachers' work output especially in instructional practices at the classroom level (Ghana Education Service [GES], 2007). This observation may be attributed to the poor manner in which the professional development of teachers was conducted. Even though some training needs have been identified for effective professional development of teachers in some areas in Ghana and other countries, it is, however, not clear which needs would be relevant for the development of teachers' competencies in the Bono East Region of Ghana. The Bono East Region was chosen because of the poor academic performance of learners in the Basic Education Certificate Examination (BECE) in the region over the years, (Danso-Wiredu & Sam 2019).

In Ghana, many of the classroom practitioners who teach various subjects including science at the primary are non- professionals who have little or no relevant content and pedagogical knowledge (UNESCO, 2016). Even though these teachers might have used various kinds of coping strategies and safety net in their teaching (Idris, 2002), they still need in-service programmes to teach science meaningfully and effectively. In the face of recent curriculum reforms at various levels of pre-tertiary and education, there is the need for the conduct of effective and regular professional development sessions for all basic school teachers. Teachers are expected to update their skills and competences in content and pedagogical knowledge in congruence with the demands and provisions of the standards based curriculum. Professional development is a big opportunity for teacher development and for successful implementation of curriculum innovations (Mizuno et al, 2012). As noted by Fessler and Christensen (1992), to be successful in meeting the requirements of any curriculum innovation, teachers must not only know what types of changes are needed, but they must also have the tools and skills to implement the changes which can be achieved through professional development.

In Ghana, several pre-tertiary curriculum changes have been implemented by different governments over the last few decades. The changing educational demands and needs of Ghanaians prompted need analysis which culminated into ~~these~~ modifications in the form of ~~a~~ new curriculum. In September 2019, the government of Ghana, in collaboration with the National Council for Curriculum and Assessment (NaCCA) and the Ghana Education Service (GES), implemented a standard-based curriculum in Basic schools (i.e., from kindergarten to primary six). The new curriculum represents a significant departure from the country's long-standing objective-based curriculum. The rationale for reviewing the objective-based curriculum, according to the National Council for Curriculum and Assessment (2019), was to shift from merely passing examinations to building character, nurturing values, and raising literate, confident, and engaged citizens who can think critically. According to Danso-Wiredu and Sam (2019), Science is a curriculum innovation in the Ghanaian science curriculum, and if teachers' needs are identified and addressed, it will lead to its effective implementation of the standards-based curriculum.

According to Che Omar (2014), need analysis will identify teachers that need training and what training they will need towards the implementation of the standards- based curriculum. Ministry of Education Youth and Sports as cited in Quaicoo, (2006) reported that the issue of improving the quality of teachers is fast becoming a key concern in the search for ways to improve science education at all levels especially at the primary. (Quaicoo, 2006) Stated in his study that within the framework of the Free Compulsory Universal Primary Education (CUBE) reform programme, new teacher education policy has been put forward in an attempt to improve the quality of degree teachers to effect positive changes in the school system. There is the belief that recently trained teachers often lack important skills and qualities that would make them better prepared to handle the new direction of curriculum reform and practice (Yeo & Tan, 2021).

In fact, some stakeholders of primary schools have questioned the caliber of teachers recently produced from the country's teacher training colleges and universities, arguing that they lack the commitment and skills that would otherwise make them successful teachers (Nisha & Sudeepkumar, 2016). In order to improve professional development, learning communities need to be established between schools and tertiary education institutions and also between experienced mentor teachers (in-service teachers) as well as between teacher educators and in-service teachers (Nwokenna, et al, 2016). Nwokenna, et al, (2016) argued that collaboration within professional development communities and learning communities alike could be seen as learning about teaching and teaching about learning. This learning from one another could only be possible when one of the parties or participants is an experienced teacher or mentor or teacher educator (Ronfeldt et al, 2015). According to Johnson et al, (2012), this symbiotic collaboration also provides solutions for concurrent effective teacher education and therefore the improvement of the preparation of teachers professional development. Underpinning all the concern and remarks about teacher quality in Ghana is perhaps the important question: What kind of science teacher does the teacher education system produce?

International evidence suggests that the quality of primary education, especially in mathematics and science, has a stronger impact on economic growth than years of schooling. Equitable access to primary education for poor students, and especially girls is an additional factor enhancing countries' economic growth performance (Paarup Nielsen, 2006). However, this also depends on an adequate supply of qualified teachers who can lance interest in science through innovative teaching. Ghanas' progress against these international benchmarks reveals that developments in primary education still have a long way to go. Of all, of the approximately 14,000 primary teachers in public schools, about a fifth are not professionally qualified, and the statistics for science suggests that, less than 19 percent and 13 percent approximately as indicated by the Netherlands Programme for Post-Secondary Education and Training Capacity (Akyeampong et al, 2007) the general science stream in primary school currently stands between 13 to 15 percent of all students although elective science subjects can be selected in other more practical streams overall participation in physics has declined to 15 percent of examination candidates. According to the Ghana Education Service, (2020), in chemistry to 21 percent, 24 percent in biology to 28 percent education in general, and science education, for that matter, is a battle to contend with Ghanaians. According to Adu, and Oduro (2017), the analysis of the historical panorama of science education in Ghana leads to the conclusion that science curriculum innovation is continuously in the state of flux. The lessons of 1987, 1997 and 2007 education reforms in Ghana are particularly important at the time when the international community is pressing and supporting African states to improve access to primary education as a strategy for poverty alleviation to date, continuous modification of science curriculum innovation in Ghana has been planned and hence implemented to suit the nation due to changes in globalisation. More to that, all the educational reforms implemented in Ghana since September 1975, (the beginning of the implementation of the Dzobo Education Reforms of 1974), were aimed at providing well trained citizens. This involved the acquisition of the requisite skills and knowledge needed to meet the needs of the nation. At the primary school level, the emphasis in science teaching would be on innovation and problem-solving.

According to the new educational reforms, continuous teacher development will be undertaken to upgrade and update the competencies and skills of serving teachers. Also open universities and distance learning colleges shall be established to train and retrain teachers with regards to the reforms (Parkinson, 2020). These needs are to be addressed urgently to make the reforms succeed which augments this research curriculum development is the process of creating new or alternate curricula or modifying existing ones. It is also defined by Adentwi (2000), as the developmental apes through which an incipient curriculum, and also an existing curriculum passes through until it is ready for wide scale use in classrooms. Dennis et al. (2004), Day (2000) and Parkinson (2004) concur by negotiating that the first step in designing a curriculum for continuous professional development is revelation and assessment of teachers' meds. Although it is well-known that teachers play a crucial role in efforts to implement curriculum innovations, teachers' role can be examined from different perspectives. Studies on teacher change and curriculum innovation suggested a bottom-up approach instead of the traditional top-down innovation model (Driel, Beijaard, & Verloop, 2001; Fincher & Tenenberg, 2007; Richards, Gallo, & Renandya, 1999). In the traditional top-down innovation model, teachers are usually blamed for the failure of an innovation, where change is viewed as the transmission of ideas from curriculum developers or researchers to teachers (Fincher & Tenenberg, 2007; Levy & Ben-Ari, 2007). In contrast, the bottom-up or more teacher-oriented approach suggests that the role of teachers in curriculum innovation is not merely executing the innovative ideas of others. Quansah et al. (2019). argued that such innovation is triggered by the interface between internal affairs and external global factors, which leads to the production of a local made science curriculum; Ghana is not an exception to this assertion Ghana's school curriculum is not only recognized in Ghana, however, it is also accepted in the international arena as Compared to the other subjects in the school curriculum, changes in the science Curriculum appear to occur at a much faster pace, National Council for Curriculum and Assessment (2019).

This might be due to significant impact we created by science and technology on the advancement of human civilization. As a result, to keep abreast with the changes in globalisation, teachers must be well-equipped with the necessary knowledge and skills so that what is outlined in the curriculum is realized in the classroom. In other words, teachers must deliver their lessons effectively as envisaged in the National Council for Curriculum and Assessment (2019).

As a facilitator of knowledge, skills and values to the mass population, teachers in many other parts of the world are always considered as their nation's greatest asset (Osman, Halim, & Meerah, 2006). In Ghana, the situation does not only call for the need to equip teachers with the necessary knowledge and skills per se, but includes tackling issues pertaining to the quality of teaching and learning Science.

Arguably, Ghana, like many other countries in the world, is confronted with the problem of inadequate degree teachers especially in the teaching of science. As a result, teachers with various subject majors or backgrounds often end up teaching science subjects which they were not trained to teach, (Mensah & Adjei, 2018). Though these teachers might use various kinds of coping strategies in their teaching, they may be in dire need for professional development programmes in order to teach science meaningfully and effectively whilst filling the gaps in content knowledge and pedagogical content knowledge in the subject that they are required to teach (Zakaria, et al, 2009). Effective professional development programme should include programme development and orientation geared towards meeting the stated needs of the teachers' concern (Asamoah, 2019). In this regard, a study conducted by Kamariah et al, (1988) on the perceived needs of secondary school teachers in Malaysia concluded that the most prevalent need of teachers then was providing for students' safety in the science laboratory. It could therefore be argued that teachers perceived in-service needs, is in contrast to the current accepted view of priority needs which lead to effective science teaching, namely developing students' understanding and creating meaningful learning (Harlen, 1997).

Ghana is no exception since organisers of professional development programmes do not consider the priority of the curriculum implementers thus the needs of teachers (Mensah & Adjei, 2018). The approach in Ghana, for the organisation of professional development can be likened to a top-bottom approach where the aim of the training is not realized because the specific and immediate needs of teachers are not met (Mensah & Adjei, 2018).

In a similar vein, Baird and Rowsey (1989), based on their survey of primary school teachers needs concluded that without accurate data on teachers' needs, planning is not only difficult, but results generated are likely to be disappointing to both teachers and those who offer professional development programme courses. Baird and Rowsey (1989) also highlighted teachers' complaints that much time spent during professional development programme and activities had been wasted where such programmes were not applicable in meeting their respective classroom needs. Thus, it is timely that another comprehensive assessment professional needs of primary school science teacher's conducted here in Ghana. Many countries report that teachers express a strong preference for urban postings (Okyere, 2019).

In Ghana, for example, over 80% of teachers said they preferred to teach in urban schools (Akyeampong & Lewin, 2002). There are a number of rational reasons why teachers may prefer urban postings. One of the concerns about working in rural areas is that the quality of life may not be as good. Teachers have expressed concern on the quality of accommodation (Akycampong & Lewin, 2002). The classroom facilities, the school resources and the access to leisure activities Kabole (2013). Health concerns are a second major issue. Teachers may perceive that living in rural areas involves a greater risk of contracting diseases (Akyeampong & Lewin, 2002), and less access to healthcare (Kabole 2013). Nielsen-Marsh, and Hedges (2002), described teachers reluctance to accept a rural position. There is a profound fear among newly trained teachers with a modern individualistic outlook that if you spend too much lime in an isolated village without access to further education, you become a village man a term which strongly conveys the perceived ignorance of rural dwellers in the eyes of some urban educated Ghanaians.

Female teachers may be even less willing to accept a rural posting than their male counterparts, and rural areas may have fewer female teachers than urban areas Hogan, (2009). In some cases posting single women to unfamiliar areas may cause cultural difficulties, and may even be unsafe for their health and marriage as well Rust and Dalin, (1990; Bhatta et al, 2009). For unmarried women, posting to an isolated rural area may also be seen to limit marriage prospects (Nielsen-Marsh, & Hedges. (2000). In some countries, like Ghana, teachers are posted to areas where their services are needed as a matter of government policy (Nielsen-Marsh & Hedges, 2000). For married Women, a rural posting may mean separation from her family, as the husband may not move for cultural or economic reasons. Where women have been posted to rural areas they may come themselves as having been treated unfairly by the system and thus seek early transfers (Nielsen-Marsh, & Hedges, 2000). Teachers may also see rural areas as offering fewer opportunities for professional advancement. Urban areas offer easier access to further education (Nielsen-Marsh & Hedges, 2000).

In addition, teachers in rural areas are less likely to have opportunities to engage in other developmental activities, or in national consultation or representative organizations. Teachers in rural areas may even find it more difficult to secure their entitlements from regional educational administrations, sometimes to the extent of having put up with obstacles or corruption by officials (Nielsen-Marsh, & Hedges, 2000).

The factor of gender disparity which is also significant in teacher recruitment needs to be considered. Female teachers make up 84%, 33%, 23% and 20% of pre-primary, primary, lower secondary (Junior Secondary School) and upper secondary teachers respectively as reported by the United Nations Educational Scientific and Cultural Organisation (UNESCO, 2016).

Misconceptions of females' participation in science related subjects and careers are well documented in Science, Technology, Mathematics, and Engineering reports and other sources (Anamuah-Mensah, 2008). The studies have revealed that negative misconceptions and stereotyped attitudes are the major factors contributing to the negative attitudes on the part of girls towards the study of science. Gender studies have shown that society in general and girls in particular, consider science as a male domain - that science is either too mechanical or too technical for girls. Girls are also considered as not being able to reason or work scientifically (Agholor, and Okebukula and Eshun as cited by Amoah, (2019). Technical subjects are considered suitable for boys only and girls who study them are considered un-ladylike boys who study the so called 'feminine subjects' like secretary ship and cookery are laugh at by their friends and considered weak, lazy and poor achievers (Ellis, 2018). Over the years, those who attempted to cross the gender barrier did so against several odds and only a few bold ones manage to succeed (Ellis, 2018). In the new educational reforms currently going on in Ghana, where both boys and girls are expected to study all subjects at primary educational level, reports reaching us indicate that the few boys who eventually decide to study the so called feminine subjects like cookery at secondary schools are given names such as Mr. Apron". Girls who choose to do technical subjects are called "Mrs. Hammer" (Ellis, 2018). The resultant effect of this problem is the apparent vast areas of job opportunities which seem to be available for men and very limited opportunities for women. Gender related issues are now being incorporated into in-service and pre-service training for teachers. Ways of presenting the sciences to make girls feel comfortable with them are focused on teachers' language and teacher-student classroom interaction should be devoid of gender bias. Gender balanced curriculum materials call for curriculum developers and text book writers to be sensitized on the use of examples, (particularly tools and machines) charts and equipment which emphasize the male image of science.

Another significant point is that those who teach science at the Primary school level are from diverse groups and thus require different needs. High quality in-service programme designed to meet those perceived needs of teachers are necessary if teachers are to respond and benefit from staff development program.

The researcher intends to compare the in-service needs of primary school teachers across gender, geographic location and area of subject specialization in the in the Kintampo North Municipality.

1.2 Statement of the Problem

The level of teachers' knowledge of a subject is crucial and has been shown to be a good predictor of student achievement (Darling-Hammond, 1999). According to Quan-Baffour (2007), a teacher who is competent and knowledgeable in his or her subject can teach it well and is more likely to establish a good rapport with students to create a democratic classroom climate, maintain an orderly and learning-focused environment, motivate learners, and provide co-operative interaction that can maximize learning. Kum et al. (2014) stated that, to be competent and knowledgeable enough to carry out his duties effectively, the teacher must undergo comprehensive training and continue to learn throughout his or her teaching career. In many developing countries, including Ghana, there are issues of teacher shortages and as such in some schools science teaching is done by unqualified teachers (Aragon, 2016). Such people come from various fields of specialisation among other mathematics, arts, sociology, forestry, and home economics. As noted by Hervie and Winful. (2018), Ghana, like many other countries in the world is confronted with the problem of inadequate trained, teachers. This is particularly problematic considering the fact that the new standards-based curriculum implemented in Ghanaian basic schools since the 2019/2020 academic year demands as well as the National Teacher Education Curriculum Framework (NTECF) implemented in 2019 clearly outline the desired qualities of a new generation of Ghanaian teachers as personnel who are well equipped with relevant professional skills, attitudes, content and pedagogical knowledge needed to nurture a new generation of globally competitive Ghanaian school graduates (NTCF, 2020).

The limited content and pedagogical knowledge of these unqualified science teachers has an impact on the quality of science teaching and learning as well as student achievement in this crucial subject (Kind and Chan, 2019). Though these teachers might use various kinds of coping strategies in their teaching, they urgently require effective and regular professional development programmes towards the effective implementation of the standards-based curriculum in order to teach meaningfully and effectively. This professional development will help to fill the gaps of content knowledge as well as pedagogical content knowledge in the subjects that they are required to teach (Subahan et al, 2001). A study in Malaysia by Berenson et al, (1991) found that 58% of the teachers felt unqualified to teach science and only 8% would elect to teach science. Additionally, 37% of these teachers requested more in-service courses dealing with science content. An analysis of the performance of BECE candidates in the science paper consistently reveals a poor performance (WAEC, 2018 – 2022). The situation is no different in the Kintampo Municipality where a review of the BECE spreadsheet of the candidates within the last 5 years shows that consistently, a significant percentage of the candidates recorded poor grades in the science paper. Considering the fact that these JHS students are products of the primary schools within the municipality, it can be argued that to some extent their entry behaviour to the JHS played a crucial role in their observed poor performance. As noted by Twumasi and Afful (2022) the performance of students at the JHS is influenced to a large extent by the entry behaviour from the primary school**.** An analysis of the academic profiles of the teachers within the district reveals that many of them do not have a science background. The finding suggests that in-service need of teachers is crucial in enhancing their effectiveness in the teaching of the subject. However, anecdotal records show that organizers of in-service professional development in Ghana fail to meet the specific needs of teachers in such programmes. Often the experiences and views of those who are the direct beneficiaries of science are seldomly given voice in the consideration of programme restructuring or reform (Beck et al, 2010). This suggests that in-service professional development programmes regimes have been general without delving in the needs of the participants. This study seeks to fill that gap by looking at the professional development needs of the participants. Furthermore, from the literature it is deduced that studies conducted on in-service professional development programmes among Ghanaian basic schools teachers have always been conducted with the quantitative approach. For instance, Rizvi and Khamis (2009) conducted a study on the evaluation of primary school and secondary teachers' options about in-service teacher training. Because the implementation of the standards-based curriculum is in its teething stages, studies on professional development for teachers towards the implementation are eventually non-existents. The regional context of Kintampo North Municipal, located in the Bono East Region of Ghana, provides a unique setting for the study. The Bono East Region is known for its diverse socio-economic and cultural background, which can influence the educational experiences and needs of teachers and students. By focusing on this specific region, the research thesis aims to contribute to the understanding of teacher professional development requirements within a distinct regional context.

Secondly, the introduction of the standards-based curriculum by the Ghana Education Service (GES) in Ghana has significant implications for science education. The standards-based curriculum emphasizes learner-centered approaches, critical thinking, and problem-solving skills, requiring teachers to adopt new instructional strategies and pedagogical approaches. This curriculum reform places additional responsibilities on teachers to effectively implement the new standards and deliver quality science education to primary school students. Therefore, investigating the in-service needs of teachers in science education within the context of the standards-based curriculum is essential for ensuring successful curriculum implementation.

To further support the selection of Kintampo North Municipal, existing literature provides evidence of the challenges faced by primary school teachers in science education in similar regional contexts within Ghana. For instance, a study conducted by Dzisi and Anyidoho (2019) in the Bono East Region highlighted the inadequate content knowledge, pedagogical skills, and resources among teachers, specifically in science education. Similarly, Adu-Gyamfi and Adu-Gyamfi (2016) in the Ashanti Region revealed challenges in implementing learner-centered approaches and integrating practical activities into science lessons. These findings suggest that primary school teachers in the Kintampo North Municipal, as part of the Bono East Region, likely encounter similar challenges and require targeted support for effective science instruction. This study therefore seeks to fill that gap by using the standards based curriculum as the reference for professional development in science for primary school teachers. For this reason, the concept of professional learning communities (PLC) was introduced to help address the challenges of teachers with regards to the implementation of the primary school curriculum (NaCCA, 2019). Even though there is a dearth on information regarding the effectiveness of the PLC intervention, Dampson (2021) observed that generally, the intervention has failed to meet most of the intended targets. As identified by Dampson (2021), the conduct of the PLC sessions in Ghanaian basic schools is fraught with issues including low levels of collective learning and application, absence of shared personal practice as well as the absence of supportive structures and conditions. Thus the study sought to identify the in-service needs of primary schools teachers within the Kintampo North Municipality with respect to the teaching and learning of science. This will ensure that various science-based professional development programmes interventions within the Municipality are organised, based on the identified professional needs of primary school teachers so far as the teaching and learning of science is concerned.

1.3 Purpose of the Study

The purpose of the study was to investigate primary school teachers' in-service needs in science towards the implementation of the standards-based curriculum in the Kintampo North Municipality.

1.4 Research Objectives

The objectives of the study were to:

1. Findout the most prevalent in-service needs of primary school teachers for science instruction towards the implementation of the standards-based curriculum in the Kintampo North Municipality.
2. Ascertain the influence of school location on primary school teachers' in-service needs in science towards the implementation of the standards-based curriculum within the Kintampo North Municipality.
3. Determine the gender differences with respect to the in-service needs of primary school teachers in science towards the implementation of the standards-based

curriculum within the Kintampo North Municipality.

4. Examine the differences between primary school teachers' in-service needs in science towards the implementation of the standards-based curriculum in the Kintampo North Municipality with respect to academic background.

1.5 Research Questions

The research question that guided the study is:

1. What are the most prevalent in-service needs of primary school teachers in science towards the implementation of the standards-based curriculum in the Kintampo North Municipality?

1.6 Research hypotheses

The following null hypothesis were formulated and tested in the study:

Ho_1:There is no statistically significant difference between rural and urban-based primary school teachers' in-service needs in science towards the implementation of the standards-based curriculum in the Kintampo North Municipality

Ho_2: There is no statistically significant difference between male and female primary school teachers' in-service needs in science towards the implementation of the standards-based curriculum within the Kintampo North Municipality.

Ho_3: There is no statistically significant difference between Degree and non-Degree primary school teachers' in-service needs in science towards the implementation of the standards-based curriculum in the Kintampo North Municipality.

1.7 Significance of the Study

It is envisaged that the findings of the study will inform the development of effective training programs that meet the in-service needs of primary school teachers in science towards the implementation of the SBC. Policymakers can use the findings to develop targeted training programmes that address specific needs and challenges faced by primary school teachers. The findings of the study will also inform the allocation of resources towards the development of support structures that will assist primary school teachers in the implementation of the SBC in science. Policymakers like MoE and GES can use the findings to allocate resources towards the development of teaching aids, instructional materials, and support systems that will enhance the teaching and learning of science in primary schools in the Kintampo North Municipality.

The findings of the study will contribute to strengthening policy frameworks for STEM education in Ghana. The findings will inform policy decisions aimed at improving the quality of STEM education in Ghana, particularly in primary schools.

The findings of the study will inform policy decisions aimed at enhancing the effectiveness of science teachers in the Kintampo North Municipality. GES can use the findings to develop policies that provide teachers with the necessary support and resources needed to effectively implement the SBC in science.

Scaling up successful practices: The study outcome can serve as a model for scaling up successful practices in other municipalities in Ghana and other countries that have adopted the SBC in science. The findings to replicate successful practices that enhance the teaching and learning of science in primary schools.

Significance for Practices

The findings of the study will inform the development of effective teaching practices that meet the in-service needs of primary school teachers in science towards the implementation of the SBC. Teachers will develop teaching strategies that address specific challenges faced in the teaching of science, such as inadequate training, lack of resources, and limited support.

The findings of the study will also inform practices aimed at improving teacher effectiveness in the teaching of science. Teachers can use the findings to develop their skills and knowledge in science, and to enhance their teaching effectiveness, which will ultimately improve the quality of science education in primary schools.

The findings of the study will contribute to the development of practices that enhance student learning outcomes in science. Teachers can use the findings to develop teaching practices that are student-centered and that meet the learning needs of students. This will ultimately improve the quality of science education in primary schools and help prepare students for future careers in STEM fields.

The findings of the study will promote collaboration among teachers, school leaders, and other stakeholders towards the successful implementation of the SBC in science. Teachers can use the findings to collaborate with other teachers, school leaders, and community members to develop effective teaching practices and support systems that enhance the teaching and learning of science in primary schools

Significance for theory

The findings of the study will contribute to the understanding of STEM education in primary schools. The study will provide theoretical insights into the challenges faced by primary school teachers in the implementation of the SBC in science, which will help to develop theories and models that explain the factors that influence the teaching and learning of science. The study's outcomes will also contribute to the development of theories of teacher professional development in science education. The findings of the study will provide insights into the in-service needs of primary school teachers in science, which will help to develop theories and models that explain the factors that influence teacher professional development in science education. The study's outcomes will also contribute to the development of theories of curriculum implementation. The study will provide insights into the challenges faced by primary school teachers in the implementation of the SBC in science, which will help to develop theories and models that explain the factors that influence the successful implementation of curriculum reforms in science education.

The findings of the study will contribute to the development of theories and models that can be used to enhance the effectiveness of STEM education in primary schools. The study will provide insights into the challenges faced by primary school teachers in the implementation of the SBC in science, which will help to develop theories and models that can be used to improve STEM education in primary schools. The study's outcomes will inform future research in STEM education. The study will provide a basis for future research on the in-service needs of primary school teachers in science, and on the factors that influence the teaching and learning of science in primary schools

The results of the study will give a further boost to the content of teachers' inventory of Needs (STIN) model which was used to guide the study

1.8 Delimitations of the Study

Delimitations are restrictions set by the researcher Simon and Goes, (2011). They provide an idea about the generalizability of the research findings Theofanidis and Fountouki, (2018). In terms of scope, the researcher focused on only basic school teachers who taught classes 1 to 6. Kindergarten and JHS teachers were not involved in the study. In the original version of the instrument for identifying the in-service needs of teachers developed by Zurub et al (1983), the in-service needs of teachers were restricted to seven dimensions including, management of science instruction, diagnosing and evaluating students for science instruction, generic pedagogical knowledge and skills, knowledge and skills in science subjects as well as the medium of instruction. However, in the present study, the medium of instruction used by the primary school teachers during science lessons was not included.

The researcher also restricted himself to the use of only two instruments namely, a questionnaire and an interview protocol for data gathering. Regarding the geographical scope, the study was restricted to primary school teachers within the Kintampo North Municipality of the Bono East region. In determining the influence of qualification of teachers on their in-service needs, focus was placed on the academic rather than professional qualifications of the teachers.

1.9 Organization of the Study

The study is organised under five chapters. Chapter One which is the introductory chapter captures the background to the study, statement of the problem, purpose of the study, objectives of the study, research question, hypotheses, significance of study, delimitations, and organization of the study. Chapter Two deals with the Literature review. Chapter three is the methodology of the study. Chapter Four gives details of the results and discussion. Chapter Five deals with the summary, conclusion, recommendations, and limitations of the study. The chapter Five ends with suggestions for further studies.

CHAPTERTWO

REVIEW OF RELATED LITERATURE

2.0 Overview

This chapter deals with the review of literature that relates to this study. Under this chapter, Theoretical framework is covered. It continues with concepts such as Needs assessment model and Dimensions of Science Teacher inventory of Needs (STIN). Other topics include Gender issues and Professional development programmes in Ghana. The chapter ends by focusing on the Influence of geographic location on the in-service needs of teachers Academic backgrounds.

2.1 Theoretical Framework

A need can be a desire to improve current performance or to correct a deficiency. The individual or group that falls short of the desirable standard is said to be in need (Monetter, 1997), Thus, a needs assessment is one means of determining areas in which the individual desires help (Rossett, 1987). The logic behind identifying educational needs stems from the desire to design and implement relevant educational programmes which are based on measurable and achievable goals and objectives. Over the past decades, there has been a proliferation of models for needs assessment in educational research. Roger Kaufman first developed a model for determining needs and defined need as a gap in results which he called System Model and Organizational Needs Model (Kaufman, 1972). Kaufman argues that an actual need can only be identified independent of premature selection of a solution (wherein processes are defined as means to an end, not an end unto themselves). Therefore, to conduct a quality needs assessment according to Kaufman, you first determine the current results, articulate the desired results, and the distance between results is the actual need. Once a need is identified, then a solution can be selected that is targeted to closing the gap. Kaufman further identified three types, or levels, of needs: Mega, Macro, and Micro. The Mega/outcomes refer to results and their consequences for external clients and society, macro/outputs also refer to the results an organization can or does deliver outside of itself and micro/products is the building-block results that are produced within the organization. These levels of needs are also levels of planning for any organization and it indicates a relationship between the levels. Alignment of objectives at each level is critical to ensure that planning translates into clear organizational operations and ensure that activities at each level add value back up the chain linking measurable to societal value-added (Kaufman, 2006). As a consequence, no level of results is any more important than the others. Rather, it is the alignment of all levels that is critical to achieving desired results.

Borich (1980) also defined a training need as "a discrepancy between an educational goal and trainee performance in relation to this goal". Hence proposing another needs assessment model known as the Borich Needs Assessment Model. This model primarily focuses on four steps (i) underlining the competencies, (ii) surveying the in-service teachers, (iii) ranking competencies, and (iv) comparing high priority competencies with training programme content. The assumption underlying the needs model is that the individual (for example, science teacher) can best judge his or her own performance and, when explicitly asked to do so, can make an objective judgment. This can enhance the credibility of the self-report and provide an additional vantage point from which to judge discrepancies between programme intents and performers (Teachers) performance. Borich survey instrument also allowed one to collect data that can be weighed and ranked in order of priority. By doing so, responses can be linked to a practical decision framework to improve a training programme. The attempt of the model is to determine the congruence between what the educators should be able to do and what the educators can do. Although Borich's (1980) model is widely used in determining the teacher's needs. Witkins (1984) contends that there is no "best" or single universally accepted model of needs assessment in the educational field since its choices, procedures as well as instrument used to gauge the needs would depend on the purpose and context of the assessment study. Therefore, the model for the study would be evaluated against the context of the study.

In 1977, Moore defined in-service need as a conscious drive, or desire on the part of the science teacher which is necessary for the improvement of science teaching. He developed a Teachers in-service need model called Moore Assessment Profile. Moore Assessment Profile ushered in the evolution of teachers need model. Moore's model was further refined by Blakenship and Moore (1977) and Rubba (1981). Eleven years later, Kamariah, Rubba, Tomera and Zurub (1988) established the Science Teacher Inventory of Needs (STIN) out of Moore Assessment Profile as cited by Osman, Halim & Meerah (2006). Since the evolution of teachers need model, the STIN has continuously been refined to assess science teacher's in-service needs in some developed and developing countries over the years to establish empirical evidence and to improve science education. The revised STIN (Osman, Halim & Meerah, 2006) has been used to assess in-service needs of science and mathematics teachers in Malaysia, a developing country like Ghana, was adapted for the study. The instrument may be able to identify some of the professional development needs of the primary school Teachers; majority of who are either non-professional teachers or professional Non-Degree who showed different in-service needs. The variables considered in the study namely; school location, gender and Academic background are implicitly covered in this model. It could be synthesized that from all the needs assessment models highlighted, the major outcome is the identification of contextualized, teachers needs and to establish empirical evidence of the teachers needs in meeting the challenges of science education. These studies therefore served as basis for this study which specifically focused on the identification of the Primary school teachers needs in the Kintampo North Municipality of Ghana.

The prime aim of this study was to ascertain the in-service needs of Primary school Teachers characterized by gender, school location, and area of specialization in the Bono East Region of Ghana.

2.1.1 Need assessment model

Needs are defined, for example, as "the necessity of the organism to gain or, if need be, loose something" (Hartl et al, 1994). An unsatisfied need is sometimes reasoned by the lack of equilibrium, possibly accompanied by emotions: tension, dissatisfaction, fear, 'Anxiety, uncertainty, anger, etc. Needs are not necessarily comprehended, so they can remain unsaturated for a long time. The same can happen with teachers educational needs. According to Encarta (2007) a 'need' is to require something in order to have success or achieve a goal or to indicate that a course of action is desirable or necessary Need assessment is a process for determining and addressing needs, or "gaps" between current conditions and desired conditions, often used for improvement in individuals, education/training, organizations, or communities. The need can be a desire to improve current performance or to correct a deficiency. The idea of needs assessment, as part of the planning process, has been used under different names for a long time. In the past 50 years, it has been an essential element of educational planning. Over the past our decades, there has been a proliferation of models for needs assessment with dozens of 'models to choose from. According to Kamisah et al, (2006), Roger Kaufman who is considered the father of needs assessment developed a model for determining needs. In the same study, the authors stressed that Kaufman argued that an actual need can only be identified independent of premature selection of a solution. They further indicated that to conduct a quality needs assessment according to Kaufman, you first determine the current results, articulate the desired results, and the distance between results is the actual need. Hence, once a need is identified. then a solution can be selected that is targeted to closing the gap. In conclusion, Kaufman's model in particular identifies gaps in needs at the societal level, what Kaufman calls "Mega" planning, along with gaps at the Macro (or organizational) and Micro level (Kamisah et al. 2006).

Analytical scrutiny of needs assessment model used in educational research indicates the availability of a variety of models such as Discrepancy Model (Sweigert & Kase, 1971), System Model and Organizational Needs Model (Kaufman, 1972), and Marketing Model (Kotler, 1982). Based on his conception of training needs as ...a discrepancy between an educational goal and trainees performance in relation to this goal", Borich (1980) proposes another needs assessment model known as the Borich Needs Assessment Model. This model primarily focuses on (i) underlining the competencies, (ii) surveying the in-service teachers, (iii) ranking competencies, and (iv) comparing high priority competencies with training programme content.

Although Borich's (1980) model is widely used in determining the teachers needs. Witkins (1984) contends that there is no "best" or single universally accepted model of needs assessment in the educational field since its choices, procedures as well as instrument used to gauge the needs will depend on the purpose and context of the assessment study.

Reviews on empirical studies on teachers needs and the development of procedures for identifying and categorizing teachers needs have been a major educational agenda since the 1970s. The evolution of teachers needs instrument inaugurated with the development of Moore Assessment Profile (MAP) was further refined by Blakenship and Moore (1977) and Rubba (1981). Eleven years later, Kamariah, Rubba, Tomera and Zurub (1988) established the Science Teacher Inventory of Needs (STIN) which classifies the teachers needs into eight categories. The STIN was widely used primarily in Jordan and in Malaysia. It was further used and contextually refined by Baird and Rowsey (1989) by comprehensively administering the instrument to 1,870 Teachers across Alabama. In 1993, once again STIN was used by Zurub and Rubba in identifying the needs of 1,507 rural Teachers in Arkansas, Illinois, Oklahoma, Kansas, Tennessee and Texas. Until recently, the needs of the Teachers is still a major national agenda as evidenced in Dillion, Osborne, Fairbrother and Kurina (2000) and State of Delaware study (2002). It could be synthesized that from all the needs assessment study highlighted, the STIN's major outcome is the identification of contextualized teacher's needs.

In Malaysia, a needs analysis study was initiated in an effort to establish empirical evidence of the teachers needs in meeting the challenges of science education. Kamariah (2016) first undertook a national needs assessment study to ascertain the needs of Malaysian Teachers five years after the implementation of the New Science Curriculum for Secondary Schools. At the primary level, currently there is only one comprehensive study conducted by Dillion, Osborne, Fairbrother and Kurina, (2000). This literature served as a local point to be used for this study, which specifically focuses on Primary school teachers in-service needs a comparison across gender, school location and area of specialization towards the implementation of the standards-based curriculum in the Bono East Region of Ghana using the Teachers Inventory of Needs (STIN).

2.1.2 Dimensions of Teachers Inventory of Needs (STIN)

A dimension' is a psychological unit for describing a particular learning behavior. More than one dimension constitutes a profile of dimensions (Science Teaching Syllabus, 2019). Since the evolution of Teachers needs model, the STIN has continuously been refined to assess teachers in-service needs in some developed and developing countries to establish empirical evidence and to improve science education (Zurub & Rubba, 1983). The refined STIN used to assess in-service needs of Teachers in some developed and developing countries showed different needs. This served as a direction for this study.

Dillion, Osborne, Fairbrother and Kurina (2000), Strengthened pedagogical research based on these premises could be an important step in improving educational quality, by addressing teacher's needs. The assumption underlying the needs model is that the science teacher can best judge his/her own performance and, when explicitly asked to do so can make an objective judgment.

Some of the dimensions in this study thus include management and delivery of science instruction, diagnosing and evaluating students for science instruction and generic pedagogical knowledge and skills. It further captures knowledge and skills in science subjects, administering science instructional facilities and equipment, as well as planning activities in science instruction. The last dimension is the integration of multimedia technology in science instruction, (Zurub & Rubba, 1983).

2.2 Management and Delivery of Science Instruction

Management according to Encarta (2007) dictionary is the act of controlling or handling something successfully. Also it could be described as the skillful handling or Use of resource. Management of science instruction is primarily the skillful and experience in handling science instruction. According to Nielsen-Marsh et al (2000), effective instruction is not possible without effective management and as most of the Teachers have shown their lack in management skills, consequently, there will be ineffectiveness in delivering science instruction. Sometimes, the role of the science teacher is unique in comparison with that of other teachers in other subjects. Teachers are required to perform many additional management tasks due to the large laboratory component of science lessons. Osborne and Freyberg (1985) indicate that this is due to considerations such as safety which can come into direct conflict with the instinctive desires of an excited student. Doyle, as cited by Conrath (1986) suggests that laboratory activities are more difficult than traditional classroom activities for securing cooperation from a large number of students. It is further suggested by Conrath (1986) that ineffective classroom managers will be reluctant to undertake laboratory activities.

Consequently, ineffective management shown by the studied Teachers may lead to their reluctance in undertaking laboratory activities. Classroom management skills are considered by Lang, Van Goozen, Van de Poll and Sergeant (1994) as by far the most important aspect of a teacher's training and they state that effective classroom management starts with effective lesson preparation. Classroom management is largely concerned with discipline strategies, but other aspects also of vital importance. The definition developed by Conrath (1986) for classroom management includes the organization and planning of students' space, time and materials so that instruction and learning activities can take place effectively.

Alternatively, effective classroom management was divided into four main categories in the studies of Everton, Emmer, Sanford and Clements (1983), These four categories are classroom procedures and rules, student work procedures, managing student behavior and organizing instruction. It is clear from these examples that classroom management is much more than a collection of strategies for discipline and involves many aspects of a teacher's professional expertise.

Teachers' varying approaches to classroom management are reflected in differing levels of effectiveness. For example, a well-prepared teacher has a much greater chance of achieving effective lesson management than an unprepared teacher. From the discussion of Lang, Van Goozen, Van de Poll and Sergeant (1994), different approaches in discipline are said to range from intimidation to total permissiveness. They advised that such extremes should be avoided and in forming these individual approaches, teachers should include monitoring and enforcing reasonable classroom rules, procedures and routines. Effective teaching is more than discipline alone and classroom management has been closely linked to the achievement and engagement of high school science students (McGarity & Butts, 1984). The Ghanaian Primary school science teacher in relation to the discussion of Lang et al. (1994) indicate that teachers' should be equipped in motivated to develop effective classroom management techniques which will have a significant impact on their educational effectiveness. This can be achieved through 'continuous Academic background programme such as professional development.

The focus of this study is to identify the in-service needs of Primary school Teachers to form a database for future in-service programme. Classroom management can take up a considerable amount of a teacher's time.

'This time is generally focused on keeping students on task and ensuring that the task is effective. One reason to this effect is that students' motivations do not match those of the teachers (McGarity & Butts, 1984). A study by Allen, as cited by Lang, Van Goozen, Vande Poll and Sergeant (1994), indicated that students tend to have two major classroom goals to "socialize" and «pass the course". From this it is evident that a student's desire to socialize may lead to disruptive and off task behavior. The findings of Lang et al. (1994) indicate that students will learn best from teachers that combine positive reinforcement with preventative discipline, effective management, and interesting instruction. In light of this, effective management and instruction must allow students to socialize whilst learning interesting content. The amount of time spent on discipline may therefore be minimized with an appropriate form of classroom management.

The use of effective classroom management will be most effective when applied consistently throughout a pupil's schooling and should therefore be implemented school wide, if not system wide. At Balmain High School there has been a school wide approach to classroom management for some time. This approach was implemented through the adoption of the Glasser system. As discussed by Lang et al. (1994), this system is based on the ideas of Dr. William Glasser's "reality therapy". This approach focuses on the present behavior and changing it for the better. Misbehavior is viewed as a result of a bad choice on the part of the student, the teacher provides consequences (positive and negative) to help promote good decision making on the student's part and over time, the student comes to accept responsibility for his/her own behaviour. This system has been studied by Englehardt (1983) and proved effective over previous and competing models when implemented school wide. Not only does it address the behavioral aspects of classroom management, it also provides a general framework for the classroom environment and instructional techniques.

Since classroom management is clearly such a pivotal component of effective instruction it was chosen as one of the dimensions of this study. Due to the practical activities undertaken by the science teacher, more skill is required in some aspects of classroom management and therefore it is of great importance. This is to meet the goals of the dimensions emphasized in the teaching syllabi. This research also explored the role of classroom management in the teaching practice of the science teacher.

Effective teachers command a wide range of generic instructional techniques and use them appropriately. They manage efficiently both the students and the learning environment. Thus, instruction is organized and implemented to allow the schools' goals to students to be met. Educators are able to set the norms for social interaction among students and between students and teachers. Moreover, they understand how to motivate students to learn and how to maintain their interest even when facing temporary failure.

Accomplished teachers can assess the progress of individual students as well as that of the class as a whole. They employ multiple methods for measuring student growth and understanding and can clearly explain student performance to parents.

Science instruction management should reflect the way that science is practiced in the real world. While it isn't always practical or effective to use inquiry as the sole teaching method, inquiry should have a prominent place in every science classroom.

When students are active participants in asking questions, designing procedures, carrying out investigations, and analysing data, they lake responsibility for their own learning, and begin to think like scientists. The issue of class management is one of the most challenging aspects of teaching and Teachers have to endeavour to learn as much as possible in order to improve. It is likely that organisers of in-service programmes consider this profile of dimension as a need for the Primary school Science teacher.

2.3 Diagnosing and Evaluating Students for Science Instruction

Assessment means a broad area of monitoring or taking stock of the performance of students or the impact of programme. The teacher makes total assessment which includes a variety of procedures both quantitative and qualitative. The types of assessment usually considered in teaching are diagnostic, formative and summative.

Diagnostic assessment normally precedes instruction but may be used under special circumstances to discover students learning problems during instruction. It can also provide information to teachers about knowledge, attitudes and skills of students entering a course and can be used as a basis for individual remediation or special instruction.

Formative assessment is carried out during the instructional period to provide feedback to students and teachers on how well the material is being taught and how much of the subject matter the students have mastered in order to help them learn more or help the teacher to improve on-going instruction. Since teaching is a dynamic process formative assessment can provide useful information that can be used to modify instruction and to improve teaching effectiveness for individuals and groups.

Summative assessment is the kind that is used most often by teachers and is primarily aimed toward providing students grades and reports of achievement and/or overall instructional method effectiveness. It is most frequently based upon cognitive gains and rarely takes into consideration other areas of the intellect.

The Ghana Education Service (GES) has evolved various models ol evaluating the performance of pupils and students of all levels of education in the country. At the Primary and second cycle levels, there is a system of continuous assessments by which the actual classroom performance of the student is assessed and computed at the end of every school term. This system of assessment has been replaced by the school based assessment (SBA) (Ministry Of Education Science and Sports [MOESS], 2007). It must be emphasised that both instruction and assessment be based on the profile dimensions of the subject. In developing assessment procedures, the teacher is to select specific objectives in such a way that he/she will be able to assess a representative sample of the syllabi objectives. Each specific objective in the syllabi is considered a criterion to be achieved by the student. When teachers develop a test that consists of items or questions that are based on a representative sample of the specific objectives taught, the test is referred to as 'Criterion- Referenced Test'. In many cases, a teacher cannot test all the objectives taught in a term, academic year etc. The assessment mode used that is class test, homework, projects etc. must be developed in such a way that it will consist of a representative sample of the important objectives taught over a period.

The end of term examination is a summative assessment and should consist of a sample of knowledge and skills students have acquired in the term. For instance the end of term test for third term should be composed of items/questions based on the specific objective studied over the three terms, using u different weighting system such as to reflect the importance of the work done in each term in appropriate proportions. It is important to link knowledge and skills gained in each term to the various end of term test, f his will make students realise that they cannot learn something in the first term and forget about it. Knowledge is always continuous. Linking the end of term tests across the objectives studied in the various terms will bring this important concept home to pupils (Mo, 2007).

The new School Based Assessment (SBA) system is important for raising students' school performance, for this reason, the SBA marks will be scaled to the score of 50 in schools. I he total marks for the end of term test will also be scaled to a score of 50 before adding the SBA marks and end of term examination marks to determine students end of term results. The SBA and end of term results/ will then be combined in equal proportions of 50:50. The equal proportions will affect only assessment in the school system. It will not affect the SBA mark proportion of 30% used by the West African exanimations Council (WAEC) for determining examination results at the end of Primary school. Most Teachers are not conversant with the School Based mode of Assessment, in spite of this there is an utmost need to organise in-service programme in this regard for Teachers (MOKSS, 2007).

2.4 Knowledge and Skills in Science Subjects

Teachers are responsible to help students make sense of the science they are teaching. This is not a new idea, but one shared by scientists, researchers and science educators as cited by Stronge (2007), Coherence in science can be described as a set of ideas that are related to each other and represent a coherent structure with unifying concepts. These include energy transfer, diversity and evolution of living organisms that are hierarchically specified from elementary to high school (Bybee, 2014; National Research Council (NRC). 1996b; Eve, 2013.).

Bybee further clarifies this by stating that "coherence occurs when small number of Primary components are defined in a system, organized in conceptual relationship to each other, and other components are based on or derived from those Primary components (p.350). If this is the understanding of experts, do Teachers have this same understanding of science? If not, the expectation of the Curriculum may never be reached as teachers will not be able to help students understand science as a coherent discipline as outlined by the Curriculum (Bybee, 2003; NRC, 1996b; Eve, 2013). Research on teacher effectiveness has focused primarily on how much science a teacher knows rather than how teachers understand the science they teach in relationship to other ideas in science (Banilower, Pasley, Smith, Weiss & Heck 2003). So many well intentioned science reform efforts focus on improving content knowledge of teachers, however the objectives ends up not achieving its purpose. This situation handicaps the classroom teachers in helping students make conceptual connections in science (Banilower etal, 2003). Literature about teacher knowledge and beliefs indicate that their knowledge and beliefs play a central role in those decisions about what content and how they teach that content (Abd-El-Khalick, Bell & Lederman, 1998). Beginning teachers are characterized by having weaker content preparations and therefore demonstrating a lower quality of classroom discourse between the teacher and student (Bell & Gilbert, 1996), communicating alternative conceptions in science to their students (Eberle, et al 2008- Lee1992), and lacking confidence in their subject area knowledge leading to fragmented and disjointed content (Abd-EI-Khalick, Bell & Lederman, 1998; Lederman, Gess-Newsome & Latz, 1994). Bell and Gilbert (1996) stated that "Teachers' knowledge and beliefs about the content, their role as teachers, how students learn, and the context of school are a part of a web of beliefs that influence one another". Consideration of this evidence as it is related to the selection and interpretation of the content by teachers for their instruction is often neglected in reform efforts. If teachers do not think about accomplishing their learning goals through the selection of appropriate ideas that build to larger concepts, they will contribute to the fragmented, disconnected and incoherent learning experiences by students (Schmidt, et al 1997; Apple, et al 1995). A coherent curriculum is one that has a sense of unity, connectedness, relevance and pertinence. Therefore, the ideas have a sense of a larger purpose (Beane, 1995). Providing instructional experiences that make connections among science ideas within science may offer teachers new ways to help students learn science as stated in the National Science Education Standards (NRC, 1996c). Understanding science requires students to integrate a complex structure of many types of knowledge, including the ideas of science, relationships between ideas, and reason for these relationships (NRC, 1996d).

The depth of knowledge in a science skill is dependent on the era in which it is learned. Trying to apply a science skill to a more advanced era will result in severe penalties due to inadequate knowledge of tools, antiquated theories, and spurious notions. Many of these science skills are interdisciplinary, giving the science teacher and learner some skill in the related sciences. It also appears that knowledge and a skill in science A subject is a perceived need of Teachers. Hence in-service programmes in this regard should focus on this need of Teachers.

2.5 Training of Teachers in Ghana

A sound knowledge base and a repertoire of teaching strategies are fundamental to the challenges of producing an effective teacher (Darling-Hammond, 1996). Currently in Ghana there are levels of teacher training education. The training takes place at the Colleges of Education, University of Education, Winneba and the University of Cape Coast. The Colleges of Education offers a three-year postsecondary certificate "A" diplomas for teachers of basic schools. The University of Education, Winneba and the University of Cape Coast offer diploma certificate, post-diploma certificate and postgraduate certificate for teachers in all levels of education. The University of Education, Winneba and the University of Cape Coast over a decade ago introduced primary education, basic education, sandwich programmes, distances education programme to accelerate the production of trained teachers in basic schools. These programmes also offer professional development for active but untrained teachers to enhance the quality of teaching and for professional upgrading of already trained teachers in basic schools. In the Universities and Colleges of Education, trainees are equipped with basic pedagogical content knowledge, curriculum knowledge, subject content knowledge, knowledge of learners and their characteristics (Anamuah-Mensah & Asabere-Ameyaw, 2004) to teach all the subjects at both the primary and Primary school level (generalist teacher) although there are some specialist teachers. The generalist teachers are professional teachers who are not specialised in science teaching. Often these skills are taught through separated courses, where theory is presented without much connection to practice (Korthagen & Kessels, 1999). That is, methodology is taught without student practising the theories and principles of teaching learnt. Training of generalist teacher is to maximise benefits from the high unit cost of training teachers. The training of generalist provides opportunity to train teachers who can handle all subject areas covered at the basic level.

According to Aboagye (2009) this policy of training a generalist teacher has faced some criticism by some educationist including Principals of training colleges. They are of the view that generalist teachers might possess shallow knowledge in both the content and the methodology of the subjects studied leading to poor lesson delivery whilst some teachers shy away from teaching subjects they are not comfortable with, for example mathematics and science. Again, they argued that the generalist teacher might not bring about the quality teaching and learning for the country's development. Anamuah-

Mensah et al (2004) agreed to this assertion and stated that the basic skills given in science and mathematics to trainees are taught in isolation and with less emphasis placed on the subject content knowledge. Hence, the Ghana Education service (GES) seems to be sacrificing quality at the expense of cost. Again, the three years spent in formal training does not produce the kind of changes expected or necessary for effective teaching (Akyeampong, 2003), more especially when the colleges of education do not attract the best students in terms of academic qualifications. This has implications for developing deep conceptual understanding of school subjects (Akyeampong, 2003). Raising the academic entry qualification may seem like the appropriate action to improve this situation, but this could also threaten enrolment in Colleges of Education. Teaching as a profession in Ghana does not seem to enjoy the prestige attached to other professions like Law and Medicine. Therefore, Colleges of Education are not able to attract best candidates (Anamuah-Mensah & Benneh, 2006).

Furthermore, the college curriculum does not differentiate sufficiently between primary and Primary school methodology (Ministry of Education, 1993). There is overriding evidence that teacher quality in terms of teacher preparation and qualification strongly influence students' level of achievement (Darling-Hammond, Berry & Thoreson, 2001; Hill, Rowan & Ball, 2005). Therefore, there is the need to invest in quality teacher education and professional development programmes to ensure that they have these skills required to realise in the classroom the outlined curriculum. One of such ways of developing teachers professionally is to assess and address their in-service needs to make them competent in their lesson delivery especially, in science instruction.

2.6 Generic Pedagogical Knowledge and Skills

The concept of pedagogical content knowledge is not new. The term gained renewed emphasis with Shulman (1986), a teacher education researcher who was interested in expanding and improving knowledge on teaching and teacher preparation that, in his view, ignored questions dealing with the content of the lessons taught. He argued that developing general pedagogical skills was insufficient for preparing content teachers as was education that stressed only content knowledge (Shulman, 1986).

Shulman (1987) defined pedagogical content knowledge as teachers' interpretations and transformations of subject-matter knowledge in the context of facilitating student learning. He further proposed several key elements of pedagogical content knowledge: (I) knowledge of representations of subject matter (content knowledge); (2) understanding of students' conceptions of the subject and the learning and teaching implications that were associated with the specific subject matter; and (3) general pedagogical knowledge (or teaching strategies). To complete what he called the knowledge base for teaching, he included other elements: (4) curriculum knowledge; (5) knowledge of educational contexts; and (6) knowledge of the purposes of education (Shulman, 1987). To this conception of pedagogical content knowledge, others have contributed valuable insights on the importance and relevance of the linguistic and cultural characteristics of a diverse student population Williams et al, (2018). Pedagogical content knowledge is also known as craft knowledge. It comprises integrated knowledge representing teachers' accumulated wisdom with respect to their teaching practice: pedagogy, students, subject matter, and the curriculum. Pedagogical content knowledge is deeply rooted in a teacher's everyday work. However, it is not opposite to theoretical knowledge. It encompasses both theory learned during teacher preparation as well as experiences gained from on-going schooling activities.

Therefore, the development of pedagogical content knowledge is influenced by factors related to the teacher's personal background and by the context in which he or she works. It is also deeply rooted in the experiences and assets of students, their families and communities. It therefore implies that when teaching subject matter, teachers' actions will be determined to a large extent by the depth of their pedagogical content knowledge, making this an essential component of their on-going learning.

Teachers' poor grasp of the knowledge structure of science acts as a major inhibition to teaching and learning. Strengthening teachers content knowledge should therefore be an essential component of any professional development programme. However, content knowledge is not enough, as indicated by Adler and Reed (2002), who wrote that the issue is how to integrate further learning of the subject with learning about how students in school acquire subject knowledge. They further suggest that teachers need to learn subject knowledge for teaching, echoing the sentiments of veteran educator, Shulman as cited in Ngmam-Wara et al, (2015) who coined the term 'pedagogical content knowledge'. Pedagogical content knowledge research links knowledge on teaching with knowledge about learning, a powerful knowledge base on which to build leaching expertise. Teachers think systematically about their practice and learn from experience.

Darling-Hammond (1999) refers to studies which have correlated teachers courses in subject matter areas and scores on subject matter tests with student achievement. She concludes that the former show positive effects more frequently than the latter. Low variability in test scores is seen as the main reason for low and insignificant associations. Mastery of subject matter is seen as a Primary requirement that is relatively uniformly addressed in initial teacher training. In this sense the explanation of the results in this area is the same as that for overall teacher education effects. Hawk, Coble and Swanson (1985) found that the relation between teachers' training in science and student achievement was greater in higher-level science courses.

Darling-Hammond (1999) lists some ten studies indicating that pedagogical training generally has a stronger effect than subject matter mastery. It should be noted that most of the studies referred to look at teaching methods related to subject matter.

As suggested by Byrne (1983), subject matter mastery is likely to interact positively with knowledge on how to teach the subject. The most frequently used analytical variables when attempting to explain why some teachers are more effective than others are mastery of subject matter and pedagogical knowledge. In the more recent research literature, an interactive construct, combining the two, namely "pedagogical content knowledge" appears to show promising results. The need for professional development in Pedagogical content knowledge is therefore advised.

2.7 Primary school Science Curriculum

The Primary School Science syllabus has undergone amendments in contents, teaching and learning activities to meet the needs of the pupils and to make science and technology relevant to the society. The contents in the Primary school syllabus are organised into five themes namely, Diversity of matter (living and non-living things), Cycles, Systems, Energy and Interactions of matter (living and non-living things). The topics under each theme are similar and related to each other to facilitate teaching and learning. Additionally, new topics have been introduced into the syllabus to meet the challenges of science and technology in the 21st century. For instance, the addition of basic electronics is to equip pupils with skills to understand and to function properly in the Information and Communication Technology (ICT) era.

Concerning instructional approach, the syllabus emphasises inquiry and problem solving methods of teaching to provide opportunity for students to enhance their curiosity and to develop creativity and keenness in them as they explore their environment. These methods are likely to develop in pupils' process skills such as observation, classification, drawing, measurement, interpretation, recording, reporting, and scientific investigation that are necessary to function appropriately in the scientific and technological environment. The role of teachers in the inquiry method is that of a facilitator who provides guided opportunities instead of transmission of knowledge. This approach of teaching orientates students mind in solving problems.

The School Based Assessments (SBA) in the primary school science syllabus is designed to standardize the practice of internal school-based assessment in all schools. The SBA replaces the continuous assessment system and it is based on three profile dimensions (knowledge and Comprehension 20%, application of Knowledge 40% and experimental and it Process Skills 40%). The SBA also spells out the guidelines for constructing assessment items and other assessment tasks, how often teachers are to assess their students as well as the marking and grading system to use. This is to ensure that pupils master the instruction and behaviours implied in the specific objectives of each unit. The SBA consists of 12 assessments in a year instead of the 33 assessments in the previous assessment system. This reduces assessment work load for teachers by 64% compared to the previous continuous assessment system (MoESS, 2007). These 12 specific assessments are administered as individual and group tasks to be assessed monthly and termly. In between these specific tasks are other modes of assessments which include class exercises and home-work used to continually evaluate pupils' performance. Students SBA marks and that of the other modes of assessment make up 30% of the total marks used by West African Examination Council (WAEC) to determine performance of candidates at the Basic Education Certificate Examination (BECE) (MoESS, 2007).

These innovations in the primary school science syllabus place a demand on the teachers' knowledge and skills to teach science effectively. The teachers are expected to master new skills, take on new responsibilities, and to change their classroom practice (Rasku-Puttonen, Etelapelto, Lehtonen, Nummila & Hakkinen, 2004). Such reform-driven expectations would require teachers not only to learn new ways of teaching, but also to be given opportunities to acquire and practice the new knowledge and skills needed to implement these reforms. Guskey and Sparks (2002) described teachers as the key component for change and as such to play their role effectively, they need to acquire the appropriate knowledge and skills to meet the challenges that come with the frequently changed curriculum.

Educators, policy makers and reformers have identified professional development as the vehicle for teachers to acquire growth in knowledge, skills and judgment (Guskey, 2000). It is also to help teachers improve their practices and to bring about the needed change (Shaha, Lewis, O'Donnell & Brown, 2004) and to improve students achievements. There is therefore the need to organise effective professional development for primary school teachers to competently deliver their lessons. For an effective professional development, teacher's in-service needs should be assessed and addressed.

2.8. Professional development, Purpose and Type

In-service education can simply be defined as the relevant courses and activities in which a serving teacher may participate to upgrade his professional knowledge, skills, and competence in the teaching profession. Therefore, it encompasses all forms of education and training given to a teacher who is already on the job of teaching and learning. According to billing (1976) in-service education is staff development which is a deliberate and continuous process involving the identification and discussion of present and anticipated needs of individual staff for furthering their job satisfaction and career prospects and of the institution for supporting its academic work and plans, and implementation of programmes of staff activities designed for the harmonious satisfaction of these needs. Generally, the teachers are regarded as the hub of educational development. Therefore, in-service education is concerned with the activities and courses in which a serving teacher may participate for the purpose of upgrading his professional skills, knowledge and interest, subsequent to initial training. In this case, in-service education is designed to fill the gap of professional inadequacies of a serving teacher. As Fisher (2003) has rightly pointed out the skill appropriate for generation ago might no longer prepare students for the world beyond school. Students are being tasked to be more creative and thoughtful in their daily activities. In-service education is also referred to as continuing education that is designed for the retraining, reskilling and updating the knowledge of manpower. According to UNESCO (2011) continuing education can be regarded as the entire body of educational processes whatever the content level and method, whether formal or otherwise, whether they prolong or replace initial education in schools, colleges and universities as well as in apprenticeship, whereby persons regarded as adults by the society to which they belong develop their abilities, enrich their knowledge, improve their technical or professional qualifications or turn them in a new direction and bring about changes in their attitudes or behaviour in the two fold perspective of full personal development and participation on balance and independent social, economic and cultural development.

Professional development of teachers has generally been considered as the variety of activities and practices, in which teachers become involved in order to enrich their knowledge, improve their skills in teaching and also enable them to become more efficient on the job (GES 2007). Tripathi (1991) considered training as the act of increasing the knowledge and skills of an employee for doing a particular job. He further argued that specific skills are imparted for particular purposes during training. Relating this argument by Tripathi (1991) to professional development of teachers, it is expected that the knowledge and skills of teachers for teaching will increase by professional development. Since it is job related, the content of professional development should be carefully selected to match the needs of the changing knowledge and pedagogy of teaching. This view is in line with Harris' (2000) assertion that training should be structured to meet the changing need of the workplace and the workforce. Such training is necessary to re-orientate teachers to changes in the educational transaction (Conco, 2004). Wight and Buston (2003) and GES (2007) observed that professional development is generally one of the main ways in which teachers continue to acquire knowledge and skills in the course of their jobs. The researcher agrees with the above authors on the definition of professional development but thinks that the professional development should be need based (Conco, 2004).

The importance of professional development, include among others, providing teachers with greater opportunity to share ideas and experiences among themselves. Such cross-fertilisation of ideas and experiences will deepen their content and pedagogical knowledge. GES (2007) and Conco (2004) asserted that professional development helps teachers to expand their knowledge of a subject, develop new knowledge and engage with colleagues at their current school and other schools. Since many teachers enter the profession without having received specific training for curriculum development, in service training become a matter of necessity as argued by Conco (2004).

GES (2007) identified the objectives of professional development as:

a) "Improve and increase teachers' knowledge on the content of academic subjects in order to become more competent
b) Introduce new ideas, policies and new curriculum content to teachers
c) Enable teachers to acquire new teaching methods and materials for specific subject content areas
d) Improve the professional status of teachers and enhance their self-confidence in their lesson practice
e) Train teachers in class management and in school administration
f) Help teachers develop skills in human relations management
g) Encourage team work among teachers" (pp. 3)

It could be deduced from above that professional development has the potential of improving teacher's competencies in the classroom.

In schools, two major types of professional development can be used. These are School-Based (SBI) and Cluster-Based (CBI) professional development. SBI is a type of professional development which is organised at the school level by the teachers in a particular school to resolve some special needs or deficiencies identified in the school (GES, 2007). SBI therefore involves cross fertilisation of ideas, and cooperation among members of staff to find common solutions to problems in their professional development. To enrich the sharing and cross fertilisation of ideas, and expertise, teachers from a number of schools come together once in a while for professional development. This type of professional development is referred to as CBI. Whether the professional development is SBI or CBI, it is necessary to assess the training needs of the teachers which bother around the teacher, the pupil and the teaching content (GES, 2007). These professional developments enhance the professional development of the teacher.

In Ghana, it is observed that past professional development programmes were organised along the lines of CBI professional development, where both experienced and new teachers were trained like teacher trainees regardless of the specific training needs of each individual teacher (GES, 2007). These professional development programmes therefore did not have much impact on the performance of the teachers (GES, 2007). As school curriculum changes, teachers also had to change in terms of pedagogy and subject content knowledge to cope with such changes. Consequently, teachers had to undergo professional development to prepare them to cope with curriculum change, pedagogical skills, and to provide them with the knowledge and skills to improve teaching and learning in the classroom (Guskey & Sparks, 2002). The purpose of professional development therefore is to help in the professional development of teachers.

Although, professional development programmes are valuable and efficient in disseminating information and ideas, there are some barriers that harm professional development programmes. Zimmerman and May (2003) identified some of these as lack of time, money and support for teachers. Also, Bredeson (2002) and Lee (2005) suggested that when professional development is designed and delivered without a clear purpose or consideration of teachers' interests and needs, it most often results in teachers who become resistant, cynical, and frustrated. This shows that, professional development geared towards the teacher's interest would result in the active participation and professional growth of the teacher. These needs of the teacher are mostly in connection with the school curriculum and classroom activities. It is therefore imperative to consider teachers professional development needs for effective professional development programmes. If teachers are to participate and benefit from such programmes.

Professional development that addresses the needs of the classroom teacher brings cooperation and coherence for the implementation of new strategy as it creates the opportunity for teachers to connect curriculum, standards, and activities (Chval, et al 2008; Penuel, et al, 2007). When teachers can see coherence between what they are learning in the programme and their own classrooms and the curriculum it makes the experience more beneficial (Garet, et al, 2001). They are more likely to implement the knowledge and skills they have acquired in their own classrooms. Hence, teacher professional development programmes that are not coherent with the school or curriculum reform and teachers classroom practices are likely to be ineffective

Professional development in the field of science education is considered to be any intentional sustained activity in which teachers engaged for the express purpose of improving their knowledge and skills to teach students science (Banilower, et al 2006). In a study by Boyle, et al (2004), Teachers were the least likely to attend professional development programmes. Because professional development programmes are generalised without consideration of the science teacher's needs. These needs are to be looked at in order to ensure science is being taught effectively in schools. A study by Akerson and Hanuscin, (2007) found that effective professional development programmes increase teachers' understanding of science content and increase their confidence and their ability to teach science in their classrooms. When teachers are confident in the subject matter they teach, it leads to quality instruction, which leads to higher student achievement (Banilower et al, 2007). For Teachers, professional development should be on-going and should relate directly to their field in order to get the most benefit from the material being learned and to keep teachers updated on new teaching strategies and content to improve learner's performance. Concerning the needs of training one area that needs to be discussed is whether it is school location related.

2.9. School Location (Urban and Rural)

Pupil’s academic performance in both internal and external examinations has been used as a measure of teacher’s excellence (Akiri & Ugborugbo, 2009). However, the relationship between school location and student academic achievement in science has been widely reported. Adesoji and Olatunbosun (2008) have reported a significant difference in the academic achievement of students in urban, peri- urban areas. Orji (1997) did not find any significant difference in the urban and peri-urban schools. Adepoju, (2001) found that students in urban schools manifest more brilliant performance than their rural counterparts. This may be because schools in rural areas have unequal access to qualified teachers, textbooks and laboratory materials and equipment for science activities as compared to urban schools. It is argued that lack of these resources has a demoralizing effect on teachers to teach science (Fredua-Kwarteng & Ahia, 2005) hence affecting academic performance of students.

Another school environmental factor is the class size. Generally small class sizes have been associated with rural areas while large class size has been ascribed to schools in the urban areas (Robinson cited in Adesoji & Olatunbosun, 2008). The argument whether large classes perform better than smaller classes have been inconclusive (Robinson cited in Adesoji & Olatunbosun, 2008). He argued that research does not support the expectation that class size will of themselves result in greater academic gains for students. He further argued that the effects of class size on students' learning vary by grade level, pupil characteristics, subject areas, teaching methods and other learning interventions. Afolabi cited in Adesoji and Olatunbosun (2008) did not establish any significant relationship among class size and students learning outcomes. However, Adesoji and Olatunbosun (2008) observed that large class size is not conducive for serious academic work. The researcher believes that since there is association between teachers' professional performance and student academic achievement, the professional development of the teacher through professional development would influence student's academic performance no matter the location of the school and class size.

2.10 Influence of School Location on the Needs of the Primary school Teacher

As countries in Sub-Saharan Africa expand access to education, geographic location influences teachers needs especially in hard-to-reach rural areas. Provision of educational services for these areas presents a series of problems particularly, is the deployment of teachers to rural schools.

2.10.1 Deployment of teachers to rural schools

In many countries, urban areas have qualified teachers who are unemployed, while rural areas have unfilled posts. This pattern of simultaneous surplus and shortage is strong evidence that the problem of finding teachers for rural schools will not be solved simply by producing more teachers. There are quite a few constraints on teacher deployment to rural schools.

The rural-urban disparity in living conditions is the major constraint on attracting leathers to rural areas. Many countries report that teachers express a strong preference for urban postings because living conditions in general are so much better in urban than in rural areas. teachers often express concerns about the quality of accommodations; the working environment, including classroom facilities and school resources; and access to leisure activities and public facilities in rural areas.

Limited opportunities for professional advancement in rural areas also discourage teachers. Urban areas offer teachers easier access to further education and training, while rural areas offer limited opportunities to engage in developmental activities such as national consultations, including those with representative organizations. Teachers in rural areas may even find it more difficult to secure their entitlement to professional development from regional educational administrations and must overcome many obstacles, including corruption by officials.

Diversified local languages and ethnicities can also create barriers for teachers' immersion in rural communities. Deployment is further complicated by the presence of multiple ethnic or linguistic groups within a country. Teachers may be reluctant to locate in an area where the first language is different from their own. For example, in Malawi, student teachers come from various ethnic groups with different first languages, which can pose problems for their deployment in areas with a different dominant language group. Similarly in Ghana, the first language is not a criterion for teacher posting but may be very relevant to the experience of teachers. Where a teacher is not fluent in the language spoken locally, he or she may feel isolated professionally and socially.

Socioeconomic background may also make teachers reluctant to be deployed to less-developed parts of the country. This is particularly the case when the overall access to tertiary education is limited and the majority of higher education students are from the better-off urban families.

There are also specific difficulties of placing female teachers in rural schools. Female teachers may be even less willing to accept a rural posting than their male counterparts, resulting in rural areas having fewer female teachers than urban areas. In some cases, posting single women to unfamiliar areas may cause cultural difficulties and even be unsafe. For an unmarried woman, posting to an isolated rural area may also be seen to limit her marriage prospects. In some countries, single women are not posted to rural areas as a matter of policy. For a married woman, a rural posting may mean separation from her family, as her husband may be unwilling or unable to move for cultural or economic reasons.

The gender distribution of teachers has important implications for gender equity in school enrolment. Across Sub-Saharan Africa, enrolment and retention are lower for girls than for boys. The underrepresentation of girls tends to be greatest in rural areas and the most disadvantaged communities. While a number of measures can be shown to have an impact on the retention of girls in school, one of the important factors is the presence of female teachers. Female teachers can help to make the school environment more supportive and nurturing for girls. Many girls in Africa are forced to drop out of school because school administrators are insensitive to gender issues. In addition, the presence of females in positions of responsibility and leadership in schools is an important factor in creating positive role models for girls. Health and Hiv/Aids concerns also contribute to teachers' unwillingness to work in rural schools. Living in rural areas often involves poor access to health care. The prevalence of HIV in rural areas and the lack of medical facilities have made postings even less attractive to teachers. In some cases; teachers who are ill are posted to urban centres to allow them access to medical services. Although they do little to enhance the teaching in urban areas, their absence from rural areas further enhances the rural -urban divide. In Ghana, poor health is the most common reason given for early transfer from rural areas. When this happens the need for an experienced and professionally degree teacher is lost to an urban area.

Stephens (2003) asserts that, quality is directly related to what occurs in two educational contexts: firstly, in the more focused environment of the classroom; secondly in the wider context of the school system and social context in which the classroom is embedded. Stephens (2003) emphasizes that both environments have a reciprocal relationship with each other.

Paradoxically, a large amount of Ghana's foreign exchange is derived from Gold, Cocoa, Non -Traditional Exports and recently Oil all of which are either found or produced in rural areas. Despite this endowment, rural areas receive very little from the foreign exchange earnings of such export in terms of development and provision of quality social and economic infrastructure and services.

It is significant to note that, there exists a sharp contrast between the rural and urban areas in all the focal areas identified. In terms of numbers of teachers at post, urban districts have enough, best qualified and well experienced. Teaching and Learning materials are hardly kept well and over a long period in rural areas, partly because of lack of good infrastructure that can safely protect the TLMs, hence they waste away causing gaps in the application of these tools.

This is not so with the urban areas, they have good accommodation to store the TLMs. The state of most rural schools' infrastructure, (except the few that have been supported by foreign donors) cannot be accepted to be of any good standard which would promote effective teaching and learning. The gaps in supervision and disparities in social amenities have all pointed to the sharp disparity that exists in the delivery of Primary education between the rural and urban settings, which needs very urgent and appropriate steps to bridge the gap in order to promote quality education for all in Ghana. According to the current educational reforms of 2007, conditions of service of the rural teacher shall be improved.

The Government of Ghana (GoG) is seen demonstrating commitment towards achieving 'Education for All', through its poverty reduction strategy; central to this strategy is the provision of quality education. The Ministry of Education, Science and Sport's four thematic areas (of equitable access, quality of education, educational management, and science and technology) outlined in the Education Sector Performance Report (Ministry of Education Science and Sports [MOESS], 2007), coupled with policies and programmes including Capitation Grant, the Ghana School Feeding Programme, upgrading of Teacher Training Colleges to Diploma awarding institutes are part of GoG's commitment.

Although Government demonstrates its commitment through these programmes, there are un-resolved challenges and inequities associated with the programmes, which translate into issues of exclusion in the educational sector. The quality of education infrastructure in rural areas as well as the quality and quantity of teachers, teaching learning materials and other educational resources is directly reflective of the attention paid to rural education.

2.11. Gender and Science Teaching

Avalos and Haddad (2019) reviewed studies on teacher effectiveness in Africa, India, Latin America, Middle East, Philippines and Thailand and concluded that female teachers were more satisfied with their careers, possessed a better attitude towards their profession, students and school work. They also observed that female teachers exhibited better mental health and suffered less from problems related to their teaching activities.

Wayne and Lawrenz (1982) reported a study involving 273 male Teachers and 72 female Teachers in the USA that female teachers were higher in measures of interest in science and receptive to change than their male counterparts who were rather higher on science knowledge and on their perceptions of the teaching support they received. However, no difference was noticed on the measures of their professional development, development of their perception of teaching effectiveness, curriculum, and workload or facilities. Even though women are interested in science as argued by Wayne and Lawrenz (1982), in many developing countries women find it particularly difficult to participate in science (Alarcon, 2011). This observation may be due to factors such as negative attitude arising from cultural and societal values and persistent use of traditional lecture and memorising of scientific facts methods of teaching science (Alarcon, 2011). The organisation of professional development for Teachers based on the training needs of the teachers can help to remove some of these bottlenecks.

2.12 Training of Primary School Teachers

Parker (2004) and Hill, Rowan and Ball (2005) identified that a good mix of teachers' subject content knowledge, pedagogical content knowledge, curriculum knowledge and assessment skills in their subject areas are acknowledged as strong basis for teacher’s competency and effectiveness in the classroom. The competency of a classroom teacher is an important factor in the success of students. Shulman (1986) argued that subject content knowledge is the comprehension of the subject appropriate to a content specialist in domain and it is one of the factors that make a teacher competent. Concerning content knowledge, Ware (1992) noted that in terms of science, the content knowledge the teacher should know include among others;

a) “the facts and concepts to be taught, and why these facts lead to a formulation of accepted models and theories;

b) how these facts and concepts relate to other important ideas in a given science, as well as to the 'big" ideas in other sciences;

c) which facts and concepts are the most important in science;

d) how knowledge becomes "science" knowledge, and how "accepted" science may be modified based on new data;

e) the laboratory skills necessary to accumulate such data; and,

f) that science is a human construct, developing over time to explain both the universe and the near environment in which we live” (pp. 61).

Ware (1992) further argued that if the teacher has not achieved some level of critical thinking in the discipline, then the teacher is not well prepared to teach that subject. The teacher will use critical thinking to combine these factors in content knowledge to teach effectively.

A teacher who is competent and knowledgeable in his or her subject can teach it well and is more likely to establish a good rapport with students, create a democratic classroom climate, maintain an orderly and learning-focused environment, motivate learners, and provide co-operative interaction by engaging learners in class activities that can maximize teaching and learning (Quan- Baffour, 2007) and lead to higher student achievement (Banilower et al., 2007). However, teachers with inadequate content knowledge go to class without confidence (Akerson & Flanigan, 2000) and this may affect their classroom practice and hence performance of learners. Because, when teachers lack subject content knowledge their teacher's ability to give appropriate and effective science teaching explanations in the classroom may be limited. Competence in the subject matter alone is not sufficient for effective instruction but also teachers' adequate pedagogical knowledge to be able to reach out to the learners. A teacher may have content knowledge, however if he or she is not able to impart this knowledge to the child the teacher may be incompetent. Competency of the teacher therefore calls for pedagogical content knowledge.

Shulman (1986) explained pedagogical content knowledge as:

> *"the most useful form of representation of (topic), the most powerful analogies, illustrations, examples, explanation, and demonstrations-in a word, the way of representing and formulating the subject that makes it comprehensible to others...pedagogical content knowledge also includes an understanding of what makes the learning of specific topics easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons" (pp 9).*

Shulman (1987) again highlighted that pedagogical content knowledge provides teachers with an understanding of how particular subject matter topics, problems, and issues are organized, represented, and adapted to the diverse interests and abilities of learners, and then presented for instruction. Thus, pedagogical content knowledge is an art of teaching in which the teacher adopts unique strategies to make the difficult topics easy and science learning interesting to students (Trowbridge, Bybee & Powel, 2004). Without such transformation, teachers' knowledge and understanding would remain tacit and unavailable for teaching, and hence they would not be able to help students develop the desired understanding of science (Anderson, 1987). Again, the development of pedagogical content knowledge entails the integration of various domains of knowledge such as knowledge of subject matter, pedagogy, student characteristics, and environmental contexts (Cochran, DeRuiter & King, 1993). This clearly indicates that there is a relationship between teacher's subject content knowledge and pedagogical content knowledge. For teachers to effectively understand and implement the methodology stated in the syllabus they must possess some level of curriculum knowledge.

Curricular knowledge is the array of instructional materials, reinforcement devices, and teaching aids and has been classified into lateral and vertical (Shulman, 1986). The teachers knowledge of the curricula include knowledge of the general learning goals of the curriculum as well as the activities and teaching materials to be used in meeting those goals (Magnusson et al, 1999). Hence a science teacher who makes efforts to achieve these goals and objectives using the stated materials and activities in planning lessons will promote understanding of concepts by learners. In order to determine the extent to which students are achieving the target instructional outcomes in the curriculum, they need to be assessed.

Assessment is the only possible means to diagnose learners' problems that hinders their understanding of scientific concepts being taught or meeting the instructional expectations of a teacher. Assessment is "all- activities that a teacher and students undertake to get information that can be used diagnostically to alter teaching and learning" (Black & William, 1998) or to gather information about student performance (Linn & Miller, 2005), either as a group or individually, using a wide range of assessment methods to determine the extent to which students are achieving the target instructional outcomes. Thus, integration of assessment and instruction provides the teacher the unique opportunity to evaluate the teaching and learning. Ngman-Wara (2005) argued that the better the assessment instruments the greater the information available to the teacher for improving his/her teaching.

Furthermore, Teachers should be knowledgeable in the ways that might be used to assess the specific aspects of student learning that are important to a particular unit of study as well as the advantages and disadvantages associated with employing any specific assessment device or technique. Appropriate use of assessment in the science lessons improves teaching, students' learning and maintaining student interest in the science concepts with which they are engaged (Treagust, 2006). Subject content knowledge, pedagogical content knowledge, curriculum knowledge and assessment skills in teacher's subject areas are acknowledged to be their needs for competency and effective classroom instruction. Therefore, any training programme for teacher education should embody the ideas expressed above.

Currently in Ghana, teachers are trained professionally for the basic schools in the Colleges of Education. In 1999/2000 a policy decision was made to adopt an "In-in-out" model of initial training to replace the three-year full-time "In" programme in the Colleges of Education. Under the "In-in-out" model students spend two years in college training, while the whole of the third year is spent learning to teach in a school. The first year is devoted entirely to learning the subject matter. Second and third years focus on curriculum studies and methodology. The introduction of the one year out programme of teaching practice is therefore seen as an opportunity to apply the knowledge of teaching acquired during college training in the classroom. When properly conceptualised, it is expected to narrow the gap between theory (in-college learning of teaching theory and methods) and practice (school-based application of theory). In other words, develop practical knowledge of teaching from a deep understanding of local teaching settings and contexts (Akyeampong, 2003). Thus, teacher trainees would have a fair experience of teaching in the classroom and applying the theory learnt before graduation.

Trainees are therefore, equipped with basic pedagogical content knowledge, curriculum knowledge, subject content knowledge, knowledge of learners and their characteristics through curriculum studies (Anamuah-Mensah & Asabere-Ameyaw, 2004; Ngman-Wara, 2011) to teach all the subjects at both primary and Primary school level. These skills and the one year internship programme may not be enough for teachers to develop the skills to be an experienced teacher. There is therefore the need for professional development for teachers to upgrade their knowledge and skills. Professional development affords the teacher the opportunity to advance professionally. Thus, affording the teacher the opportunity to explain and apply curricular knowledge in the teaching of science. These knowledge and skills discussed above are reflected in the dimensions of the Science Teacher Inventory of Needs (STIN) instrument to be used to assess the in-service needs of the teacher. The researcher belief that since there is association between teachers' competency and student academic achievement (Darling-Hammond et al., 2001; Barton, 2003), the non-science trained teachers will demand more professional development needs as compared to the science trained teachers.

2.13 Administering Science Instructional Facilities and Equipment

In 1995, the government of Ghana established the Science Resource Centres (SRC) project as part of the educational reforms of 1987. The SRCs were established in 110 senior secondary schools spread across Ghana one in each administrative districts. The idea behind this project was to bridge the gap between resourced schools and no resourced schools within a forty kilometre (40km) radius. This project was initiated to help bridge the gap between schools with well-resourced science laboratories (both human and material resources) and those with little or no resources. This was also to ensure equity in students learning across the rural-urban divide.

There are multiple, complex problems that contribute to learners' poor performance. These include poverty, resources, learning cultures, infrastructure of schools and low teacher qualifications which is very common in the rural areas. As a matter of fact some Teachers in the rural areas are non- professionals and ill resourced, this affects their lesson delivery. The non-professionally trained teachers find it challenging to teach the sciences' effectively with regards to administering science instructional facilities and equipment.

Inadequate science resource materials constitute an impediment to inquiry, hands-on and practical science activities in schools. Many classrooms reportedly lack appropriate science resource materials and supplies, which is often exacerbated by poor funding Erinosho (2009). Consequently, teachers face great challenges to provide activity-based instruction (or science by doing) in the context of resource poor and ill-equipped classroom environment. Whilst a few resourceful teachers adopt innovative strategies to get materials to overcome the shortage, many others resort to 'blackboard practical' or 'chalk and talk' teaching that often leads to minimal learning.

There is no doubt that teaching science by 'doing' in a resource poor environment requires dedication and creativity on the part of the teacher. This is because of the heavy reliance of hands-on, inquiry-oriented instruction on supplies and equipment. Essential and sophisticated materials, especially those that require high precision in their design and/or use must be purchased. However, the commonly available materials could be sourced from the immediate locality and resources outside the classroom.

How well a teacher is able to identify and source for local substitute or design prototype depends on his/her ingenuity and ability to use the hands and brain. Teachers must develop skills and competencies to:

a) Conceptualise -bring into focus the original idea underlying the material to be improvised
b) Dismantle- separate into parts all the components
c) Identify parts- separate parts in the system to establish the relationship and interdependence of the parts
d) Source of alternatives- identify substitute or replacement for the parts; and
e) Assemble/ Construct- fabricate or construct substitute of the different parts and assemble them carefully and appropriately.

2.14 Planning Activities in Science Instruction

Planning is a deliberate process that results in teachers being well-prepared prior to walking through the classroom door for the day (Wharton-McDonald, Pressley & Hampston, 1998). Organizing time and preparing materials in advance of instruction have been noted as important aspects of effective teaching. The amount of time students spent engaged in learning experiences, together with the quality of the instruction, is policy associated with student learning (Walberg. 1988). Both the organization of time and preparation of materials are components of the broader practice of planning carefully for instruction. Once the plans are developed, evidence suggests that effective teachers follow the instructional or lesson plan while continuously adjusting it to fit the needs of different students (Wharton-McDonald et al., 1998). Pre-assessments can help gauge students' prior knowledge of the material (Wharton-McDonald et al., 1998). Effective teachers take into account the abilities of their students and the students' strengths and weaknesses as well as their interest levels. A study of teacher expectations revealed that teachers who had high classroom standards also planned in response to individual student performance, which was then linked to student achievement (Wharton-McDonald et al., 1998). Teachers that plan instruction, based on student performance and interest levels meet both the affective and cognitive needs of students.

Novice teachers have more difficulty responding to individual student needs in their planning. They tend to develop a 'one-size-fits-all" approach to planning, whereas more experienced teachers build in differentiation and contingencies at different points during the lesson (Brophy & Good, 1986).

Effective teachers maximize the instructional benefits of resources while minimizing time allocated to less relevant or unnecessary material. They also evaluate resources to use when teaching a unit or lesson. They use criteria such as appropriateness for grade level; alignment to national, state, or local standards; accuracy of information contained within the resource; the time allowed for the lesson or unit; and the learning benefits that come from using the resource (Puttam, 1996). For example, when showing a video on the causes of the illegal mining, the teacher may select only a poignant quote or section from the video, rather than showing the entire segment.

Teachers also recognize that other adults (resource persons) can be a resource for the learning process. They coordinate the participation of adults in order to promote student engagement (Wharton-McDonald et al, 1998). In summary, effective teachers through planning maximize the instructional benefits of resources while minimizing time allocated to less relevant or unnecessary material. Since students learn at different rates, effective teachers plan academic enrichment and remediation opportunities for students. Through the teacher's knowledge of the students, it is possible to offer alternatives to a student or a small group of students who have mastered the material faster than the rest of the class. These students can study the concept on a deeper level or apply the concept in a different way. Students who may lack the prerequisite knowledge or skills need the teacher to give them time to learn the foundational material on which to build the new piece. Providing meaningful experiences for all students to learn is a goal of planning.

By planning a unit, that takes into account the students' prior knowledge and prior performance as well as their learning styles, a teacher can implement effective models for instruction (Wharton-McDonald et al., 1998). Whatever the unit, students benefit if the material can be connected to something they are already familiar with from prior school experiences or real-life situations. Also conscientious planning for student instruction and engagement is a key to connecting the classroom to future success for students. Research indicates that instructional planning for effective teaching includes the following elements as cited in Ngman-wara (2015).

a) Identifying clear lesson and learning objectives while carefully linking activities to them, which is essential for effectiveness
b) Creating quality assignments, which is positively associated with quality instruction and quality student work
c) Planning lessons that have clear goals, are logically structured, and progress through the content step-by-step

d) Using advance organizers, graphic organizers, and outlines to plan for effective instructional delivery
e) Considering student attention spans and learning styles when designing lessons
f) Systematically developing objectives, questions, and activities that reflect higher-level and lower-level cognitive skills as appropriate for the content and the students

It therefore appears that these elements of planning activities in science instruction are needed for Primary school teachers in-service programmes.

2.15 Professional development Programmes in Ghana

Training can also be said to be the process of acquiring specific skills to perform a job better (Jucious, 2020). It helps people to become qualified and proficient in doing some jobs (Gupta et al, 2017). Usually an organization facilitates the employees' learning through training so that their modified behaviour contributes to the attainment of the organization's goals and objectives. Van Dorsal (1962) defined training as the process teaching, informing, or educating people so that (I) they may become as well qualified as possible to do their job, and (2) they become qualified to perform in positions of greater difficulty and responsibility.

Hippo (1961) differentiated between education and training, locating these at the two ends of a continuum of personnel development ranging from a general education to specific training. While training is concerned with those activities which arc designed to improve human performance on the job that employee’s arc at present doing or are being hired to do, education is concerned with increasing general knowledge and understanding of the total environment. Education is the development of the human mind, and it increases the powers of observation, analysis, integration, understanding, decision making, and adjustment to new situations.

Training may broadly be categorized into two types: pre-service training and professional development. Pre-service training is more academic in nature and is offered by formal institutions following definite curricula and syllabuses for a certain duration to offer a formal degree or diploma. Professional development, on the other hand, is offered by the organization from time to time for the development of skills and knowledge of the incumbents (Hippo, 1961).

Professional development is a process of staff development for the purpose of improving the performance of an incumbent holding a position with assigned job responsibilities. It promotes the professional growth of individuals. "It is a program designed to strengthen the competencies of Teachers while they are on the job" (Malone, 1984 p.56). Professional development is a problem-centred, learner-oriented, and time-bound series of activities which provide the opportunity to develop a sense of purpose, broaden perception of the clientele, and increase capacity to gain knowledge and mastery of techniques.

Although teachers play a crucial role in the implementation of new innovative curricula they are not duly informed about the organisation of orientation or professional development courses. The traditional top-down approach is what the central staff of the Curriculum Research Development Division (CRDD) use in which most often teachers arc blamed for the failure of new educational reforms or curriculum innovations. In this regard change is viewed as transmission of ideas from curriculum developers/researchers to teachers (Jucious, 2020).

According to Jucious (2020), Professional development programmes should be designed to result in collaborative programme. This means that teachers, administrators, supervisors, non-teaching staff, students and lay persons should be involved. Such programmes should be grounded on the needs of the participants of the study, thus Primary school teachers. That is, the plan should be developed from an assessment of the needs and interests of the persons to be served.

Once training needs have been identified and training activities have been decided as part of the solution, a needs analysis should be done. This is to determine knowledge, skills, and attitude requirements as well as performance deficiencies. The needs analysis procedure involves breaking down the "training problem" into its Primary parts in different successive phases to identify and understand the important components in each phase. Ultimately it leads to identifying and understanding the training content. The training needs analysis process can be divided into three distinct analytical phases: job analysis, task analysis, and knowledge and skill-gap analysis.

Again, in-service teacher training has more and more been considered as "provision of services", or rather "saturation of needs" of teachers and head-teachers (Joyce, 1993). With regards to teachers educational (and some other kinds of) needs and expectations is one major precondition of a successful educational event, and studies have shown that many teachers call for more respect and more preference to their individual needs (Hustler, 2003). It is important to realize that any trainer needs two separate sets of skills and knowledge. First, they need to know the topic they are teaching (subject matter expertise). And second, they need to know how to efficiently transfer that information to the student (instructional expertise).

2.16 Teachers Educational Background

Subject matter which is an essential component of teacher knowledge is neither a new nor a controversial assertion. After all, if teaching entails helping others learn, then understanding what is to be taught is a central requirement of teaching. The myriad tasks of teaching, such as selecting worthwhile learning activities, giving helpful explanations, asking productive questions, and evaluating students' learning, all depend on the teacher's understanding of what it is that students are to learn.

Although subject matter knowledge is widely acknowledged as a central component of what teachers need to know, some researchers specifically interested in how teachers develop and changes have focused on other aspects of teaching and learning to teach. For example, changes in teachers' role conceptions, their beliefs about their work; their knowledge of students, curriculum, or of teaching strategies. Yet to ignore the development of teachers' subject matter knowledge seems to belie its importance in teaching and in learning to teach. In addition to this, teachers needs vary with regards to their areas of subject specialisation. The need of the biology teacher is different from that of the chemistry, physics, Science and other science related areas. It is more likely that both professionally trained and undegree teachers be given professional development in their subject areas' of specialisation.

2.17 Summary

The success of an educational reform is based on the teachers' effective preparation and active participation. Well prepared and sensitized to teach students, these teachers should gain knowledge and get acquainted with the strategies emphasized by the new curriculum through training sessions and personal readings. Educators agree that the success of any curriculum reform resides in its implementation. Implementing the curriculum in science successfully depends on well trained and motivated teachers; adequate supply of relevant equipment; learner friendly teaching and learning environment; positive attitude to science and development of a scientific culture. In order to play his role, the teacher will adequately prepare for his class by: supporting students' real and active participation during the execution of the learning activities; guiding them individually or collectively so as to follow the scientific process projected in the concept construction phase; leading them while objectively discussing their peers' results; helping them take notes of important ideas; prompting and encouraging them to review the acquired knowledge and skills.

Teachers continually want and need in-service education logically; this need is more pronounced when the teachers are asked to teach new subject matter or subject matter in which they have had little previous training. In developing an in-service education programme, assessing learner needs is an important early step in the process. Involving the learners in the process of planning an in-service education programme increases the likelihood of implementing relevant educational programmes.

In-service opportunities are often orchestrated by teacher educators to meet the needs of teachers. In more recent years, however, teacher educators have begun developing methods to identifying what Teachers perceive to be pertinent to their in-service needs, teachers needs vary depending on years of experience, highest academic qualification held, leadership experience, and levels of pedagogical and technical knowledge. Previous research has identified a cadre of instruction and curricula needs ranging from student behaviour, motivating students to learn, working with special populations and student evaluation. Also implementing new curricula, developing adult programmes, and planning fieldtrips add to research. Experienced teachers rated using computers in classroom teaching, using multimedia equipment in teaching, and teaching record-keeping skills as their top in-service needs.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter provides information on the philosophical assumption of the study, details of the study design, methods used to conduct the research. In particular, it describes the research design, the study population, sampling procedure and the sample size. It further deals with information on the development of the research instrument. Pilot study, data collection procedure, and data analysis.

3.1 Research Paradigm

The philosophical assumption underpinning the study was the pragmatic paradigm. Pragmatism as a research paradigm finds its philosophical foundation in the historical contributions of the philosophy of pragmatism (Maxcy, 2003). As a research paradigm, pragmatism was based on the proposition that researchers should use the philosophical and methodological approach that work best for the particular research problem being investigated (Tashakkori & Teddlic, 2010). It is often associated with mixed-methods or multiple-methods (Bicsta, 2010; Creswell & Clark, 2011), where the focus is on the consequences of research and on the research questions rather than on the methods. It employed both formal and informal rhetoric (Creswell & Clark. 2011).

Pragmatists believed in what works best in any given situation. A major underpinning of pragmatist epistemology was that knowledge was always based on experience. One's perceptions of the world are influenced by his or her social experiences, each persons' knowledge was unique as it created by her/his unique experiences. Pragmatist epistemology did not view knowledge as reality (Feilzer, 2010). Rather, it is constructed with a purpose to manage ones' experiences and to take part in the world (Goldkuhl, 2012).

Nevertheless, much of the knowledge was socially shared as it created from socially shared experiences, therefore all knowledge were social knowledge. Since this study sought to gather data from a wide array of respondents and share the outcomes with concerned stakeholders across the country and beyond, it aligned clearly with the focus of the pragmatist viewpoint.

3.2 Research Approach

Creswell (2014) explained that research approaches were plans and the procedures for research that span the steps from broad assumptions to detailed methods of data collection, analysis, and interpretation. This plan involved several decisions. The overall decision involves agreeing on the approach that should be used to study a topic. The factors that informed the decision to use a given research approach include the philosophical underpinning of the research, procedures of inquiry and specific methods of data collection, analysis, and interpretation. The selection of a research approach is also based on the nature of the research problem or issue being addressed, the researchers' personal experiences, and the audience for the study.

In line with the pragmatist paradigm, the study employed the mixed methods research approach that is, both quantitative and qualitative research approaches.

Burke-Johnson et al. (2007) define mixed methods as:

> *The type of research in which a researcher or team of researchers combine elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration.*

Mixed methods may also be defined as "research in which the investigator collects and analyses data integrates the findings and draws inferences using both qualitative and quantitative approaches in a single study" (Tashakkori & Creswell, 2007, p.4). This means that the researcher employed two different approaches in data collection and analysis which culminate into the findings drawn from the study. Greene (2007) therefore believed that this approach provided researchers with opportunities to compensate for inherent method weaknesses, on inherent method strengths, and offset inevitable method biases. According to Creswell (2014), mixed methods approach has some distinct features including:

i. It involves the collection of both qualitative (open-ended) and quantitative (closed-ended) data in response to research questions or hypotheses. The researcher uses both qualitative and quantitative data instruments to gather information from subjects of the study

ii. It includes the analysis of both forms of data. The researcher who employs this approach ensures the analysis of the two forms of data using different tools.

iii. The procedures for both qualitative and quantitative data collection and analysis need to be conducted rigorously (e.g., adequate sampling, sources of information, data analysis steps).

iv. These procedures can also be informed by a philosophical worldview or a theory.

Some challenges with this approach are that:

i. It is critical that researchers are aware of their skills sets and whether they are able to cope with the demands of utilizing a mixed methods approach (Creswell & Plano Clark, 2011).

ii. Deciding which mixed method research design is most appropriate for your particular study can be very demanding. It will depend upon where you feel your project lies on the continuum of research approaches. The researcher has to decide also whether the approach will be purely mixed which gives equal status to both quantitative and qualitative information or will it be dominated by one approach or the other (Burke-Johnson et al., 2007).

The researcher used this approach because the researcher used both quantitative data collection instrument (Questionnaires) and Qualitative data collection instruments (Interviews) in this research to increase confidence in the findings. The use of this approach offered the researcher "the opportunity to reward for inherent individual approach weaknesses, on inherent approach strengths, and offset inevitable approach biases as pointed out by (Creswell, 2014).

3.3 Research Design

Research design is the framework of research method and techniques chosen by a researcher to ensure that the research is reliable and can always produce clear result (Badr et al 2020). The design allows researchers to hone in a research method that were suitable for the subject matter and set up their studies up for success.

A research design served two main functions, according to Kansal et al (2005), which were the identification or development of procedure required to undertake a study and, also emphasising the importance of the quality of procedure in ensuring their validity, objectivity and accuracy.

The sequential explanatory design is rooted in the pragmatist paradigm, which emphasizes the integration of quantitative and qualitative approaches to gain a comprehensive understanding of complex phenomena. Pragmatism recognizes that different research questions require different methods, and the use of multiple methods can provide a more complete picture of the research topic. By employing the sequential explanatory design, researchers can first establish statistical relationships through quantitative data analysis and then delve deeper into the underlying reasons and meaning behind these relationships through qualitative data analysis.

The study adopted sequential explanatory design; the sequential explanatory design offers several benefits in educational research, making it particularly suited for investigating the in-service needs of primary school teachers in science education. Firstly, it allows for a multimethod approach, enabling researchers to examine a research problem from multiple angles and perspectives. In the context of this study, the sequential explanatory design allows for a comprehensive exploration of the challenges, experiences, and perceptions of teachers, providing a richer understanding of their professional development requirements.

Secondly, by combining quantitative and qualitative methods, the sequential explanatory design capitalizes on the strengths of each approach. Quantitative data analysis provides statistical evidence and generalizability, allowing researchers to identify trends and patterns among a larger sample of teachers. This quantitative analysis can reveal the prevalence of specific needs or gaps in science education. On the other hand, qualitative data analysis offers in-depth insights into the lived experiences of teachers and the contextual factors influencing their professional development needs. Qualitative data can provide rich narratives and contextual information that enhance the understanding of teachers' challenges and perceptions related to science education.

The sequential explanatory design has been successfully applied in various educational research studies. For example, Chen and colleagues (2017), a sequential explanatory design was employed to investigate the impact of a professional development program on teachers' instructional practices and student outcomes in mathematics education. The researchers first collected quantitative data through surveys to examine the program's overall effectiveness. Subsequently, qualitative data, such as interviews and classroom observations, were used to gain deeper insights into teachers' experiences and perceptions.

In the present study on the in-service needs of primary school teachers in science education, the sequential explanatory design has highly relevant and justifiable. Firstly, quantitative data collection was conducted through surveys or questionnaires to assess teachers' content knowledge, pedagogical skills, and access to resources. This quantitative data can provide an overview of the current state of science education and identify potential gaps or areas of improvement. For instance, it can reveal the extent to which teachers feel confident in teaching specific science topics or using hands-on approaches in their classrooms.

Secondly, qualitative data collection, such as interviews or focus groups, was employed to explore teachers' experiences, challenges, and perceptions related to science education. Qualitative data can provide rich narratives and contextual information that enhance the understanding of teachers' professional development needs. Through interviews, researchers can delve deeper into the specific challenges faced by teachers in science instruction and gain insights into their perceptions of effective professional development strategies. This qualitative data can also shed light on the contextual factors that may influence teachers' practices, such as the availability of resources or support from school administrators.

By combining quantitative and qualitative data analysis, the sequential explanatory design allows for a comprehensive understanding of the in-service needs of primary school teachers in science education. The quantitative analysis provides statistical evidence and identifies broader trends, while the qualitative analysis offers nuanced insights into the individual experiences and contextual factors influencing teachers' professional development needs.

3.4 Study Area

Kintampo North Municipal, located in the Bono East Region of Ghana, serves as the study area for this research thesis. This section provides an in-depth exploration of the study area, highlighting its geographical, socio-economic, and educational characteristics. Understanding the context of Kintampo North Municipal is crucial for comprehending the specific challenges and opportunities faced by primary school teachers in science education, as well as the significance of investigating their in-service needs within this particular area.

Kintampo North Municipal encompasses a diverse geographical landscape, featuring both rural and urban areas. It is situated in the central part of the Bono East Region, with Kintampo as its capital town. The municipality is bounded by Kintampo South

District to the south, Techiman North Municipal to the west, and other neighboring districts. The area experiences a tropical climate characterized by two main seasons, namely the rainy season and the dry season.

In terms of population, Kintampo North Municipal has a significant number of residents, with a mix of ethnic groups, including the Bono, Akan, and Gonja. The majority of the population engages in agricultural activities, such as farming and trading, while others are involved in small-scale businesses and services. The socio-economic profile of the area influences the educational landscape and the opportunities available to both teachers and students.

The educational system in Kintampo North Municipal is governed by the Ghana Education Service (GES), which oversees the provision of education from the basic to the tertiary level. The municipality is home to numerous public and private basic schools, including primary schools that cater to the foundational education of children aged 6 to 12 years. These primary schools play a crucial role in shaping students' educational journey and providing them with a strong foundation in various subjects, including science.

Despite the efforts made in education, primary school teachers in Kintampo North Municipal face several challenges in effectively delivering science education. Research conducted in similar regional contexts within Ghana highlights common issues encountered by teachers, which can be extrapolated to the study area. For instance, studies have identified inadequate content knowledge and pedagogical skills among primary school teachers in science education (Dzisi & Anyidoho, 2019). These knowledge gaps can impede teachers' ability to teach science concepts effectively and engage students in meaningful learning experiences.

Furthermore, limited access to resources and teaching materials is another challenge faced by teachers in the area. Science education often requires practical activities, experiments, and hands-on learning experiences to foster students' understanding of scientific concepts. However, the availability of science laboratory equipment, materials, and resources in Kintampo North Municipal may be limited, hindering teachers' ability to provide practical learning opportunities.

Given the challenges faced by primary school teachers in science education, there is a pressing need to address their in-service professional development needs. Professional development programs can provide teachers with the necessary support, subject knowledge, pedagogical skills, and resources to effectively implement the standards-based curriculum and improve science instruction. By identifying and addressing these needs, teachers can enhance their teaching practices, promote student engagement, and improve learning outcomes in science.

3.5 Population

According to Agyedu et al (2011), population in research was the complete set of individuals (subjects), objects or events with common observable features for which a researcher is interested in studying. It is, also, regarded as the larger group from which individuals are selected to participate in a study. A population is also defined as a group of individuals or people with the same characteristics and in whom the researcher is interested. Kusi (2012, p. 80) also defines population as “a group of individuals that the researcher generalizes his/her findings”.

The target population for this study was all primary school teachers in the Kintampo North Municipality. The Kintampo North Municipality has seven circuits. Statistics from the Kintampo North Municipal Education Directorate indicate that there were 78 primary schools in the municipality. Out of this number, 49 were rural-based schools and 31 were urban-based. There were a total of 240 teachers in these schools consisting of 226 males and 14 females. Johnson and Christensen (2012) assert that accessible population consisted of the research participant who was available for participation in a given research. The accessible population for this research consisted of all the 240 primary school teachers within the municipality.

3.6 Sample Size and Sampling Procedure

A sample was a subset of the population of interest. It was the small amount of the population that was given out representative information about the population it was taken from. The study adopted a census sampling technique in selecting respondents for the first phase of the study. In census sampling technique, all the members of the accessible population are used. This technique is often used when data is gathered on every member of the population and reasonably so when the population is small (Kennedy et al, 2011). Though the census technique has its disadvantages such as higher cost and the use of more time, it however has lots of advantages. Some of these advantages are, every member of the population has the opportunity to participate and then also there is better demographic data on the population obtained (Parker, 2011). The researcher for these reasons used all the members in the accessible population which comprised all primary teachers for the first phase of the study. The participants responded to the structured questionnaire designed by the researcher.

Purposive sampling is a non-probability sampling technique that involves selecting participants based on specific characteristics or criteria relevant to the research study. Unlike random sampling, which provides an equal chance for every member of the population to be selected, purposive sampling allows researchers to intentionally choose participants who possess the desired qualities or characteristics. This technique is commonly used when researchers seek to gain in-depth insights from participants who have first-hand experience or expertise related to the research topic (Patton, 2015).

Purposive sampling offers several benefits in research studies. Firstly, it allows researchers to select participants who possess the specific characteristics or qualities necessary to address the research questions or objectives. In this study, the researchers aimed to gather insights into the in-service needs of primary school teachers in science education. The researcher purposively sampled ten respondents, including both males and females, the researcher were able to include a diverse range of perspectives and experiences that could provide comprehensive insights into the research topic (Palinkas et al., 2015).

Additionally, the purposive sample enables the researcher to select participants who are most likely to provide rich and relevant information. In this study, the researcher has chosen participants based on their expertise in science education or their roles as primary school teachers. The researcher selected participants who are with extensive experience in the field; the researchers gather valuable insights and perspectives that contribute to a deeper understanding of the in-service needs of teachers (Creswell & Creswell, 2017).

In this study, the researcher used a purposive sampling technique to select participants for the qualitative phase. The initial sample included ten respondents, comprising 4 females and 6 males. The researchers employed purposive sampling to ensure that the selected participants possessed the necessary characteristics and experiences related to the research topic. However, despite the initial selection of ten respondents, only eight respondents (4 females and 4 males) were available for interviews. This limitation occurred due to various reasons, such as scheduling conflicts or participants' withdrawal from the study.

The use of purposive sampling in this study is justified based on the research objectives and the need to gather insights from primary school teachers who have direct experience in science education. Purposive sampling allowed the researcher to select participants who could provide valuable information and perspectives on the in-service needs of teachers. By including both male and female participants, the researcher aimed to capture a range of experiences and ensure a diverse representation of teachers' perspectives.

While the use of purposive sampling may limit the generalizability of the findings to a larger population, the focus of this study is to gain in-depth insights into the experiences and perceptions of primary school teachers in a specific context, rather than making broad generalizations. Purposive sampling aligns with the qualitative nature of the study and the goal of exploring the unique needs of teachers in science towards the implementation of the standards curriculum (Guest et al., 2020).

3.7 Instrumentation

Two instruments were used in data collection, an interview guide and a questionnaire. Interviews are primarily done in qualitative or mixed methods research, they occur when researchers ask one or more participants questions and record or take notes of their answers. Often audiotapes are utilised to allow for more consistent transcription (Creswell, 2012). The researchers often transcribe and type the data into a computer file, in order to analyze it after interviewing.

Interviews are particularly useful for uncovering the story behind a participant's experiences and pursuing information around a topic. Interviews may be useful with individual respondents after questionnaires, for example, to further investigate their responses (Kothari et al, 2009). A strength of interviews is that a researcher can freely use probes (prompts used to obtain response clarity or additional information).

Questionnaires have many uses, most notably to discover what the masses are thinking. These include market research, political polling, customer service feedback, evaluations, opinion polls, and social science research (O'Leary, 2014).

3.7.1 Questionnaire

The Science Teacher Inventory of Needs (STIN) developed by Osman et al, (2006) to assess science teacher's in-service needs in Malaysia was adapted to collect data for the quantitative data. The STIN developed by Osman et al, (2006) evolved from the original STIN developed by Zurub and Rubba (1983) which was also developed from the Moore Assessment Profile (MAP). Moore (1977) defined teachers' needs as a conscious drive, or desire on the part of the science teacher which are necessary for the improvement of science teaching.

STIN was purposely chosen because it was developed specifically to assess perceived needs of Mathematics and Science Teacher in developing countries to provide the necessary data for the planning of effective in-service activities (Zurub & Rubba, 1983). Also, STIN has been successfully used in a number of developing countries similar to Ghana such as, Malaysia, Jordan, and Lebanon (Abu-Bakar et al, 1988; Jbeily & Barufaldi, 1985; Osman et al, 2006), as well as in a number of studies investigating in-service needs of rural and urban-based Mathematics and Science Teachers in the United States (Baird et al., 1994; Baird et al, 1993).

The STIN instrument developed by Osman, et al., (2006) consists of two sections. Section one comprises 14 items that seek information on the demographic characteristics of the respondents such as, gender, background and years of teaching experience, while section two consists of 72 items pertaining to in-service needs of Teachers. Each item constitutes a statement, which is followed by a five-point Likert type scale with responses ranging from greatly not needed, not needed, uncertain, moderately needed and greatly needed weighted (1, 2, 3, 4 and 5, respectively). The 72 needs-assessment items are distributed among eight dimensions. The eight dimensions with corresponding number of items are, management of science instruction (15), diagnosing and evaluating students for science instruction (11), generic pedagogical knowledge and skills (15), knowledge and skills in science subjects (7), administrating science instructional facilities and equipment (10), planning science instruction (8), integrating multimedia technology in science instruction (4) and use of English language in science instruction (2). A blank page at the end of the questionnaire was provided for teachers to write down in-service needs they considered important which were not included in the instrument.

Initially seven out of the eight dimensions of the STIN were maintained. The dimension, integrating multimedia technology in science instruction was dropped because most public primary schools do not have facilities such as electricity, computers as well as science software to be used. Additionally, the dimension on "use of English language in science instruction" was dropped after the pilot testing because the reliability coefficient values of that dimension was 0.34 which was considerably lower than the other dimensions in the questionnaire. Thus deleting the dimension enhanced the reliability of the overall questionnaire. Some items under the various dimensions of the tool were modified to suit the Ghanaian context and those items which were not related to the Ghanaian context were dropped. For example, *the following subject(s) that you teach and the number of years of teaching the branches of science (chemistry, physics, biology, mathematics)* were replaced with *do you teach Science and how long have you been teaching Science*. This was because Science is taught as a single subject in the Primary school. Again, *managing the budget for science teaching* was deleted because most of the Primary school teachers do not have a fund allocated for science practical and therefore no provision is made for Teachers to present termly or yearly budgets for funds to be allocated. Again, *supervising laboratory assistants in preparing materials / apparatus* and *maintain living organisms for teaching science* were deleted because the public Primary schools do not have science laboratories for that matter laboratory assistants. In addition, the item *updating the knowledge of appropriate requirements for specific title* was deleted because it was not applicable in the Ghanaian context.

Modifications were also made to some of the items; for example, the highest level of education and status of the teachers, were modified to correspond to the levels of education and teachers' status in Ghana. Secondly, the item on *assessing student's laboratory skills* was replaced *with assessing student's process skills* (drawing, observations, manipulative, measuring, classification) because Ghanaian teachers are familiar with the term process skills which is used in the Primary school science curriculum. Thirdly, the item *inculcating spiritual values in science teaching* was modified to read inculcating cultural values in science teaching since one of the objectives of Ghanaian Primary school science curriculum is to acculturate science and technology. The questionnaire was edited for clarity and the items shuffled to avoid trends in teacher's responses. Finally, provision for names of the respondents was avoided on the questionnaire to ensure confidentiality and anonymity so as to enable them to answer the questionnaire with honesty.

The final adapted version of the STIN contains 79 items arranged into two sections. Section one contains 13 items that relate to the biodata of the respondents including details on gender, professional background, years of teaching experience of the respondents and the location of the school. Section two consists of 66 items that sought information pertaining to the in-service needs of the Teachers. Each item constitute a statement, which is followed by a five-point Likert type scale with response ranging from greatly not needed, not needed, uncertain, moderately needed and greatly needed weighted 1, 2, 3, 4 and 5, respectively. The distribution of the items among the dimensions is shown in Table 1.

Table 1: The Distribution of Items for each Dimension of the STIN

Dimensions	No. of Items	Item Distribution
Management of science instruction	15	1, 2, 13, 15, 30, 31, 39, 40, 45, 46, 48, 51, 54, 55, 66
Diagnosing and evaluating students for science instruction	10	3, 4, 14,23, 29, 32, 38, 52, 62, 65
Generic pedagogical knowledge and skills	14	12, 20, 21, 22, 27, 28, 33, 36, 44, 47, 50, 56, 57, 60

Knowledge and skills in science subject	9	5, 6, 19, 25, 26, 37, 41, 49, 53
Administering science instructional facilities and equipment	7	7, 8, 18, 34, 58, 61, 63
Planning activities in science instructions	9	9, 10, 11, 17, 24, 35, 43, 59,64,
Use of English language in science teaching	2	16, 42

3.7.2 Interview

A semi-structured interview guide was used in collecting qualitative data. This instrument was used to gather first-hand information from selected respondents in order to augment data gathered through the use of the questionnaire. A semi-structured interview guide gives the researcher room to seek for explanations and clarifications and the participants, the freedom to express themselves in their own perspective and choice of words (Bryman, 2016). The interview questions were formulated to solicit views of the respondents regarding the influence of school location, gender and academic background of primary school teachers on their in-service needs towards the implementation of the standards-based curriculum. Denscombe (2013) explains that conducting interview helps to reflect emotions and experiences, and explore issues with greater focus. In affirmation on the strength of the interview guide, Denscombe (2013) asserts that conducting interview provides the possibility to direct the process of data collection and offers the possibility to gather specific information required. Thus the use of the interview guide afforded the researcher the opportunity to gain a deeper insight into the science in-service needs of Kintampo North Municipality primary school teachers.

3.8. Validity of the Instrument

Validity of an instrument is concerned with whether it is really measuring what it intends to measure. Research data is considered valid if they provide a measure of what is intended to be measured (Cohen, Manion & Morrison, 2007). Face validity of the modified STIN was enhanced by the supervisors and other senior lecturers in the Department of Basic Education, University of Education, Winneba before the pilot testing. They were satisfied that the items addressed the dimensions of the STIN.

Even though there are different forms of validity the two main types are content validity and construct validity (Sürücü & Maslakçı, 2020).

According to Patra, and Guha, (2018). content validity focuses on the extent to which the instrument makes provisions for capturing information on the phenomenon it is expected to measure. Patra, and Guha, (2018) goes on further to talk about two key requirements for ensuring content validity which are that (1) each item must measure the trait to some extent and (2) all the items combined must measure all aspects of the given trait. Since the items in the questionnaire were developed based on the original version of the STIN, that has been previously validated in terms of the appropriateness of the content for measuring what it is intended for, much more focus was placed on the construct validity.

To establish the construct validity of the confirmatory factor analysis using SPSS version 26.0 was conducted on the data from the pilot study. Construct validity of a measure is directly concerned with the theoretical relationship of a variable with other variables (Larson et al,2011). It refers to the grouping of variables which have something in common.

The two stages used in the Confirmatory factor analysis were factor extraction and factor rotation. The first stage was used to extract factors from a correlated matrix via principal component analysis to filter out the eigenvalues that were greater than 1 using the Kaiser criterion (Cohen et al, 2007). The eigenvalue represents a measure that attaches to the factors and indicates the amount of variance in the pool of original variables that the factors explain. Each construct (factor) was retained if its eigenvalue was equal to or greater than 1 (Cohen et al, 2007). Based on the corresponding Scree plot analysis seven factors were identified (*see Appendix C*). That is, the seven factors shown above the 'bend in the elbow' before the scree levelled off were identified as the factors which accounted for a lot of the variance.

The second step involved a procedure called factor rotation by means of varimax rotation. The Varimax rotation process keeps together variables that are closely interrelated and keeps them apart from variables that are not related. This yielded seven factors accounting for 25.5%, 16.9%, 11.7%, 8.8%, 8.05%, 8.0% and 6.3% of the total variance of 85.2% explained. The factor loadings are presented in (*see Appendix C*). The resulting factor loadings were not satisfactory, that is, with a cut-off point of .3 most of the variables loaded onto factor 1 and 2 instead of loading unto their expected factors. The .3 was used because the Bartlett test of sphericity should be .3 or greater for data to be factored (Cohen et al, 2007). Therefore, regrouping the items would have eliminated face validity of the instrument. The result of factor analysis should not be used alone to determine what item or scale should be included in or excluded from a measure (construct), but in conjunction with what is known about the construct or constructs the items or scales assessed (Larson et al,2011). The construct validity was established in the original STIN, therefore, the modified STIN was used without the support of factor analysis. Moore and Foy (1997) successfully reviewed the Scientific Attitude Inventory (SAI) without considering the factor analysis result.

In testing for the validity of the qualitative instrument, the interview guide was given to colleague master of philosophy students and lecturers at the department of basic education for issues of face validity and content to be addressed. This culminated in the editing of the tool in the form of deletion of some items as well as rewording of others. In order to enhance the content validity of the interview guide, the researcher also ensured the alignment of the interview questions in the guide with the various dimensions of the adapted questionnaire as suggested by Grosse (2002). The researcher's supervisor did also have look at the instrument and help shape the interview guide.

3.9. Item Analysis

The adapted version of the STIN was subjected to item analyses after the pilot test to identify the alpha value of each item. This procedure was employed to identify items whose removal would enhance the internal consistency of the instrument. The items difficulty, discrimination indices and "Corrected Item total-Correlation", were examined using SPSS version 26.0 for windows. Each item correlated well with the overall test performance. The items which least correlated were item 33M, 45K and 66G with correlation of -.106, .016 and .247 respectively (*see Appendix C*. These items were considered negligible because if they were deleted the overall scale would have an alpha value of 0.82 which was not different from the overall alpha value of 0.82 obtained from the analysis. Therefore, this did not necessitate deletion of any of the items.

3.10. Pilot-Testing of Instrument

Pre-testing of instruments helps in identifying the shortcomings in the instrument and also informs the researcher in determining how long the instruments can be completed by respondents. The adapted STIN and the interview guide were pilot tested in Kintampo South Municipal in the Bono East Region of Ghana with 60 Primary school teachers. This was to establish its reliability and validity of the STIN in the Ghanaian context since the instrument was developed and used in the Malaysian context. The pilot sample had similar academic and professional qualifications as the target population. This is because teachers in Ghana are trained from the Colleges and universities of Education with similar curriculum and are employed by the GES. The selection of teachers for the pilot test was based on school location (rural and urban). Thirty teachers each from urban and rural schools were used, this was to ensure equality. Out of the 60 teachers used 11 were female and 49 males.

3.11. Reliability of the Instrument

Reliability measures the stability of an instrument if administered on the same individual on two different occasions (Hong & Easterby-Smith, 2002). For a survey, according to Robson (2002) reliability is more straight forward if all respondents are presented with the same standardized questions. After the pilot test, the modified STIN was analysed using the Statistical Package for Social Science (SPSS) version 26.0 software to determine the internal consistency (Cronbach Alpha reliability coefficient). The overall internal consistency of the instrument was found to be .82 which was sufficiently high. According to Fraenkel and Wallen (2009) a reliability figure should be at .70 and preferably higher and therefore .82 is a good value. The internal consistencies of the seven dimensions of the STIN were also determined. The results are presented in Table 2.

Table 2: The Reliability Coefficients of the Seven Dimensions of the STIN

	Adapted STIN	Original STIN

Dimensions	**No. of Items**	**Cronbach's alpha**	**No. of Items**	**Cronbach's alpha**
Management of science instruction	15	.94	15	.95
Diagnosing and evaluating students for science instruction	10	.94	10	.91
Generic pedagogical knowledge and skills	14	.94	15	.86
Knowledge and skills in science subject	9	.79	7	.90
Administering science instructional facilities and equipment	7	.90	10	.88
Planning activities in science instructions	9	.92	9	.90
Use of English language in science teaching	2	.34	2	.67

The Cronbach alpha values of the adapted STIN are comparable to those of the original except the value for *use of English language in science teaching* which was about half (0.34) of that of its corresponding dimension of the original (0.67). This could be due to the fact that the use *of English language in science teaching* was not a perceived need of the Ghanaian teachers since the language of instruction at the primary school of education in Ghana is determined mainly by the predominant language in the community where the school is located. However, the official language of Malaysia where the instrument was developed is Malay. According to Fraenkel and Wallen (2009) a good reliability figure should be at 0.70 and preferably higher. Except the *use of English language in science teaching* all the other dimensions had alpha values greater than .70 indicating an acceptable range. Consequently, *use of English language in science teaching* was not used in the final analysis of the data. Reliability coefficient estimates, both overall as well as the remaining six dimensions indicated strong internal consistency. Therefore, the adapted STIN was deemed a reliable instrument for identifying the perceived science in-service needs of the Ghanaian Primary school teachers within the Kintampo North Municipality.

3.12. Data Collection Procedure

A letter of introduction was obtained from the Head of the Department of Basic Education of the University of Education, Winneba. This was used to obtain permission from the Municipal Director of Education of the Kintampo Municipal Directorate of the Ghana Education Service (GES). The Municipal directorate in turn provided a letter of introduction to the head teachers of the various public primary schools within the Kintampo North Municipality. Each of the primary schools was visited at least twice. The first was to present the letter of introduction from the Municipal Director to the Head teachers. The visit was also used to interact with and to obtain the consent of the teacher(s) to participate in the study. The purpose of the study was also explained to the respondent(s). The questionnaire was administered if the respondents were ready to complete it on the first visit, if not a convenient time and date were agreed upon to administer the questionnaire. The completed questionnaire was collected on the same day it was administered. This was to ensure that the teachers responded independently to the items and also to clarify issues where necessary. Two hundred and forty questionnaires were distributed all of which were completed and returned, representing a return rate of 100%. One hundred per cent recovery rate was recorded because all the teachers were contacted early and were also eager to participate in the study.

3.13. Data Analysis

Both descriptive and inferential statistics were used to analyse the quantitative data collected to answer the research questions. To determine the prevalent in-service needs of the teachers, respondents were asked to indicate the intensity of their responses to each item on a five-point Likert scale. The responses were categorised into three for easier analysis of the data. The responses 'greatly not needed', 'not needed' and 'uncertain' were merged as 'not needed', hence three categories namely, 'not needed', 'moderately needed' and 'greatly needed' were used for the analysis. This was done to ascertain the variation in the intensities of the in-service needs of the teachers. The items on the questionnaire were coded and entered into the Statistical Package for Social Sciences (SPSS) version 26.0 for windows. The descriptive function of SPSS version 26.0 was used to organise the teacher's response into frequency counts, percentages, mean scores and standard deviation. The frequency counts, percentage frequency, mean score and standard deviation were used to answer research question 1 whilst the mean scores, standard deviation and Chi square analyses were used to answer research question 2, 3, and 4. The teachers' in-service needs were categorised as a priority when the percentage of respondents indicate more than a moderate need. Hence it was then decided that teacher's need would be categorised as a priority when the percentage of respondents indicating a need is 40% or more. Previous studies (Moore & Blakenship 1978; Osman, et al., 2006) have successfully based their cut-off point on 40% when identifying teachers' specific needs as areas for in-service help.

The Chi square test was computed to establish any statistically significant differences in the perceived needs (dimensions) of teachers with regards to school location (urban, rural), gender (male, female) and professional background (degree holder, non-degree holder). The selected teachers' background characteristics (gender, school location and professional background) were the independent variables and the professional development needs (dimensions) were the dependent variable. The independent variables (gender; male and female, school location; urban and rural; degree and non-degree holders) were split and the frequencies computed for each dimension. Chi square statistics were calculated using contingency tables. This inferential statistic was used because the variables were in categories and the observations were measured as frequencies. Again, no more than 20% of the total number of cells contained fewer than five cases. The probability value for all tests of significance was set at 0.05.

The qualitative data was generated based on the questions raised from the analysis of the quantitative data in line the research objectives. The analysis and discussion of the qualitative data was generated into its corresponding quantitative analysis to give further clarification to the quantitative results.

3.14 The Assumptions of the Chi-square

1. The data in the cells should be frequencies, or counts of cases rather than percentages or some other transformation of the data.

2. The levels (or categories) of the variables are mutually exclusive. That is, a particular subject fits into one and only one level of each of the variables.

3. Each subject may contribute data to one and only one cell in the Chi square. If, for example, the same subjects are tested over time such that the comparisons are of the same subjects at Time 1, Time 2, Time 3, etc., then χ^2 may not be used.

4. The study groups must be independent. This means that a different test must be used if the two groups are related. For example, a different test must be used if the researcher's data consists of paired samples, such as in studies in which a parent is paired with his or her child.

5. There are 2 variables, and both are measured as categories, usually at the nominal level. However, data may be ordinal data. Interval or ratio data that

have been collapsed into ordinal categories may also be used. While Chi-square has no rule about limiting the number of cells (by limiting the number of categories for each variable), a very large number of cells (over 20) can make it difficult to meet assumption #6 below, and to interpret the meaning of the results.

6. The value of the cell *expecteds* should be 5 or more in at least 80% of the cells, and no cell should have an expected of less than one. This assumption is most likely to be met if the sample size equals at least the number of cells multiplied by 5. Essentially, this assumption specifies the number of cases (sample size) needed to use the χ^2 for any number of cells in that χ^2. This requirement will be fully explained in the example of the calculation of the statistic in the case study example

3.15 Ethical Considerations

Ethical issues are highly relevant and require serious considerations (Fouka & Mantzorou, 2011). Akaranga and Makau (2016) emphasize that because researchers are professionals, each research team or institution must have a code of ethics for guiding their research activities. Therefore, to create a mutual respect and win-win relationship with the respondents before the commencement of the data collection, a letter was obtained from the Department of Basic Education indicating the purpose of the study and its significance to the teachers and head teachers in the schools, and the Director of Education in the Kintampo North Municipality. In addition, a covering letter was obtained from the Kintampo North Municipal Director of Education to introduce the researcher to the head teachers of the various schools. The head teachers also introduced the researcher to the teachers. Furthermore, each questionnaire had an introductory statement requesting for the respondent's cooperation in providing the required information for the study. The respondents were further assured that the information provided shall be used for academic purposes only (confidentiality).

3.16 Summary of the Chapter

In this chapter researcher considered the philosophical underpinnings, research approach, research designs, populations, the sample and sampling techniques, research instruments, data collection and procedures, validity and reliability of the instruments, Trustworthiness**,** data analysis and ethical considerations.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Overview

This chapter presents the results of the data analysis in two sections. The first section presents descriptive statistics to identify prevalent needs of primary teachers towards the implementation of the standards- based curriculum. The second section presents inferential statistics on whether differences in the perceived needs of teachers with respect to their school location (urban, rural), sex (male, female) or their academic background (professional science trained, professional non-science trained) were significant towards the implementation of the standards- based curriculum.

4.1 Demographics

Figure 1 gives a breakdown on the distribution of the primary school teachers within the Kintampo North Municipal directorate of education based on the school location. One hundred and forty out of the total of 240 primary school teachers involved in the study were based in urban areas. The remaining 100 teachers were rural-based as seen in Figure 1.

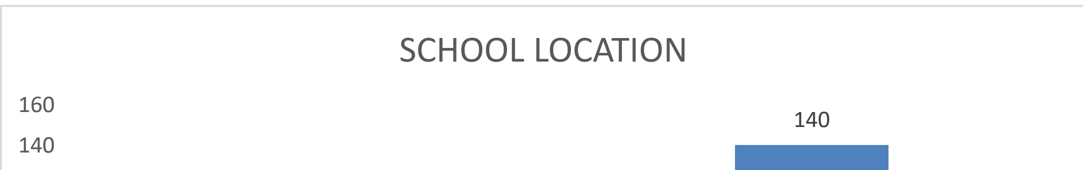

Figure 1: Distribution of Teachers based on Location

From Figure 2, it can be seen that the overwhelming majority of primary school teachers within the municipality were males. Out of the 240 teachers, only 14 were females, with males accounting for as many as 226 of the total number of 240 primary school teachers.

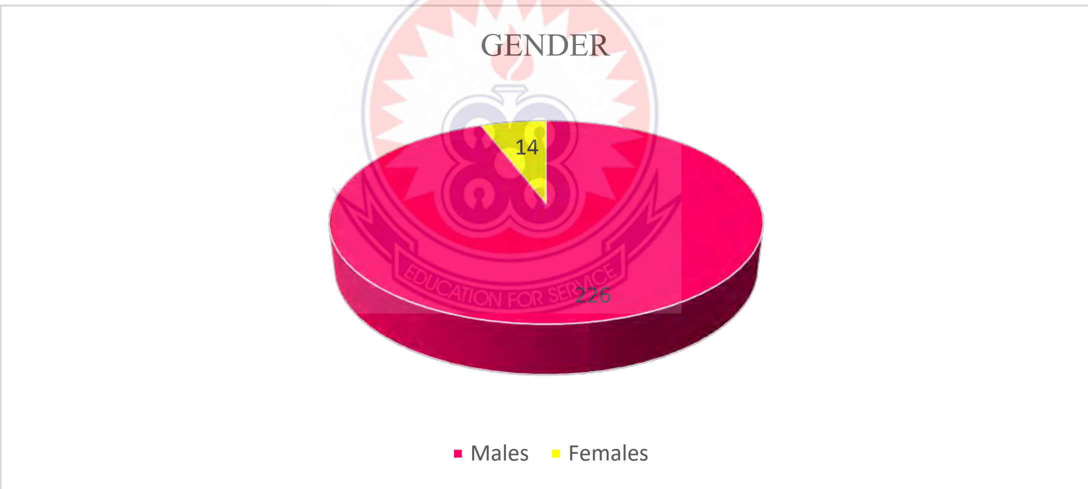

Figure 2: Gender Distribution of Teachers

It can be seen that most of the public teachers in the public primary schools in the Kintampo North Municipality held qualifications which are lower than a first degree. Respondents who did not have a degree made up 166 out of the total of 240. This is shown in Figure 3.

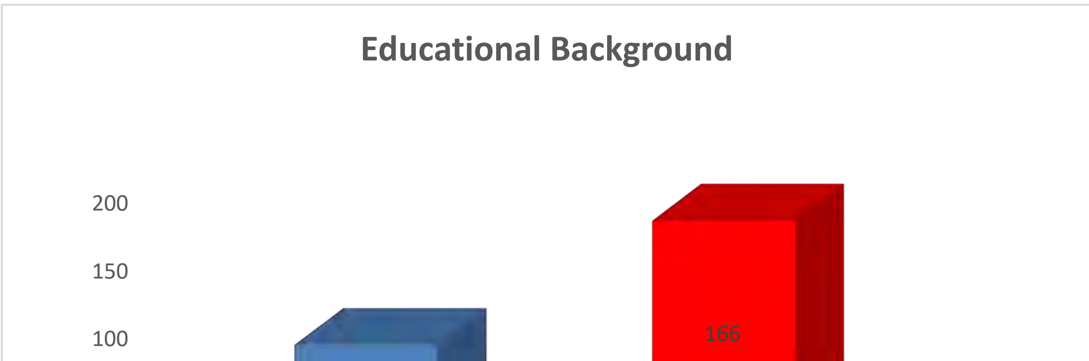

Figure 3: Distribution of Teachers based on Educational Background

4.2 Research Question 1

What are the in-service needs of primary chsool teachers in science towards the implementation of the standards-based curriculum in the Kintampo North Municipality?

Research question one sought to identify the prevalent in-service needs of primary school teachers towards the implementation of the standards-based curriculum in the Kintampo North Municipality. The summary of the result of the teachers with regards to their in-service needs are presented in Table 3.

In Table 3, it is evident that over 60.0% of teachers indicated that they had in-service needs in all of the six dimensions. The percentage scores ranged between 18% and 48.3%. Generic and pedagogical knowledge and skills showed the least and highest percentage scores in the 'not needed' and 'moderately needed' category respectively. The mean score also ranged between 3.4 and 3.7 and the Standard deviation figures ranged between 1.2 and 1.3.

Table 3: Distribution of Responses on levels of In-service Needs in science by Primary school Teachers

Dimensions	Not needed F(%)	Moderately Needed F(%)	Greatly Needed F(%)	M	SD
Management of science instruction	79(32.9)	89(37.1)	72(30)	3.5	1.3
Diagnosing and evaluating students for science instruction	80(33.3)	91(37.9)	69(28.8)	3.4	1.3
Generic and pedagogical knowledge and skills	66(27.5)	94(39.2)	80(33.3)	3.7	1.2
Knowledge and skills in science subject	75(31.3)	93(38.8)	72(30)	3.6	1.3
Administering science instructional facilities and equipment	73(30.4)	89(37.1)	78(32.3)	3.6	1.3
Planning activities in science instruction	68(28.3)	93(38.8)	79(32.7)	3.7	1.2
Mean of Means				3.60	

With regards to management of science instruction, 30% of teachers expressed the view that they greatly needed professional development in this area skill whilst 37.1% of them felt that the skill was moderately needed. However, 32.9% of the teachers felt that the skill was not needed. For diagnosing and evaluating students for science instruction as a skill, 66.6% of the teachers said it was either greatly or moderately needed whereas, 33.3% of them indicated no need for professional development in this dimension. Expressing their views on the issue of acquisition of generic pedagogical knowledge and skills as an professional development need, a total of 72.5% of teachers said it was greatly or moderately needed and the remaining 27.5% said that the skill was not needed.

With reference to knowledge and skills in science subject as an professional development need, 68.8% of the teachers expressed the view that the skill was needed. Concerning administering science instructional facilities and equipment as professional development need, majority (69.4%) of the teachers expressed the view that the skill was greatly or moderately needed. Whereas, 30.4% perceived that they had already acquired the necessary skills in administering science instructional facilities and equipment and therefore did not need that skill. Regarding the issue of planning activities in science instructions, 32.3% of the teachers expressed the view that this skill was greatly needed; whereas 37.1% of the teachers felt that the skill was moderately needed. However, 28.3% of the teachers said the skill was not needed.

The mean score (see Table 3) shows that the most prevalent professional development needs was expressed in the use of generic and pedagogical knowledge and skills (M = 3.7, SD = 1.2) and planning activities in science instruction (M= 3.7, SD = 1.2) by the teachers whereas, diagnosing and evaluating students for science instruction (M = 3.4, SD = 1.3) was identified as their least prevalent professional development need.

Analysis of the responses provided by the interviewees provided more clarification on the in-service needs of primary school teachers in science within the Kintampo North Municipality. Some responses are outline as fellows.

> *In relation to the general and pedagogical knowledge skills in science, I am facing some difficulties comprehending and implementing the suggested pedagogical approaches outlined in the curriculum. It was expected that teachers would be*

> *guided through the curriculum to ensure our proficiency in all aspects of teaching and learning, including the knowledge and skills in science, as well as generic and subject-specific pedagogical knowledge. Unfortunately, since the introduction of the new primary school curriculum in 2019, we have not been provided with sufficient training to adequately address these challenges (T1)*

Other interviewees also corroborated that:

> *As a teacher, my topmost need towards the implementation of the standards-based curriculum is the acquisition of knowledge and skills in science subjects, generic pedagogical knowledge and skills, and planning of science instruction* **(T2).**

> *As a teacher, I am primarily concerned with effectively planning science instruction. To be honest, planning poses a challenge for me as a new science teacher, as I lack significant experience and struggle to determine the best strategies to engage my students in learning science. The curriculum developers are aware of the diverse range of abilities among students, and it is crucial for us to create engaging and captivating lessons, particularly for those with lower skill levels. Given the large size of my class, I am in need of support and guidance regarding the planning of science instruction for my students* **(T6).**

Concerning the teachers' in-service needs in science, the findings of the study were revealing. The primary school teachers call for professional development in all the six dimensions of the STIN, presupposes that, the teachers need to develop professionally in all the major aspects of their profession. Teachers' most required in-service need was the dimension of generic and pedagogical knowledge and skills and planning activities in science instruction. This outcome was expected because trainees in the colleges of education are trained mostly on methodology without any opportunity to undertake practical activities in science Osman, et al., (2006). This teaching approach makes it difficult for teachers after their training to have the requisite skills to plan and teach effective science lessons more especially when teachers are not given regular professional development after their training programme. This finding affirms GES (2007) that teaching in the Colleges of Education focuses mainly on the traditional lecture method which has been found to be ineffective. The primary school teachers being conscious that they lack skills in pedagogical knowledge and skills and planning activities in science instruction is important because it shows how prepared the teachers are to develop their professional skills.

One of the key aims of science at the primary school level is developing individuals to become scientifically literate, good problem solvers with the ability to think creatively and participate fully in the Ghanaian society as responsible citizens (NaCCA, 2019). To realise this goal, teachers have to plan engaging and effective lessons to encourage the active participation of learners in science lessons for the attainment of better learning outcomes. This findings shows that there is the need to have a relook at the practical component of science teacher education at the colleges of education as well as universities that focus on teacher education. Additionally, there is the need for more effective and regular professional development.

Given the current educational climate of "science for all", teachers expressing generic and pedagogical knowledge and skills and planning activities in science instruction as their most prevalent in-service needs seems appropriate. Therefore, professional development programme should be designed to address these demands.

4.3. Hypothesis 1

Ho_1: There is no statistically significant difference between rural and urban-based primary school teachers' in-service needs in science towards the implementation of the standards-based curriculum in the Kintampo North Municipality

Research objective 2 sought to explore the influence of school location on in-service needs of primary school teachers in science within the Kintampo North Municipality.

A questionnaire was used to collect data. Descriptive statistics were used to organise the data into frequency counts, percentage frequency, mean score and Standard deviation, while the Chi square statistics was used to test the hypothesis. Table 4 gives a summary of the results of the teachers and also presents the mean and a summary of Chi square statistics of teachers' responses.

Table 4: Results of Teachers professional development needs in science with Respect to School Location

Dimensions	**School location**	**Not needed F(%)**	**Moderatly Needed F(%)**	**Greatly Needed F(%)**	**M**	**SD**	χ^2
Management of science instruction	Urban	46(32.9)	52(37.1)	42(30)	3.4	1,3	1.560
	Rural	32(32)	37(37)	31(31)	3.5	1.3	
Diagnosing and evaluating students for science instruction	Urban	47(33.6)	51(36.4)	42(30)	3.3	1.3	0.099
	Rural	34(34)	36(36)	30(30)	3.4	1.2	
Generic and pedagogical knowledge and skills	Urban	40(28.6)	56(40)	44(31.4)	3.7	1.2	5.490
	Rural	29(29)	38(38)	33(33)	3.8	1.1	
Knowledge and skills in science subject	Urban	44(31.4)	53(37.9)	43(30.7)	3.4	1.3	*12.42
	Rural	31(31)	35(35)	44(44)	3.7	1.2	
Administering science instructional facilities and equipment	Urban	45(32.1)	54(38.6)	41(29.3)	3.6	1.2	*14.464
	Rural	30(30)	37(37)	33(33)	3.7	1.3	
Planning activities in science instruction	Urban	41(29.3)	56(40)	43(30.7)	3.7	1.2	*10.6
	Rural	31(31)	37(37)	32(32)	3.7	1.2	
Mean of mean					**3.6**		

F=240 $\chi^2_{\text{critical value}} = 5.99$ df= 238 P < 0.05 * Significant

From Table 4, 20.4% of the respondent teachers in the urban schools expressed "not needed" in the generic and pedagogical knowledge and skills dimension whilst majority of them expressed moderately needed in the said skill. The mean score ranged between 3.3 and 3.8 and the Standard deviation also ranged between 1.1 and 1.3. Teachers in the rural schools recorded the highest mean score in the generic and pedagogical knowledge and skills dimension whilst teachers in the urban school had the lower mean score in the dimension, diagnosing and evaluating students for science instruction.

From Table 4, 30% of teachers in the urban schools perceived that they greatly needed professional development in management of science instruction in comparison with 31% of their counterparts in the rural schools. Teachers in the urban and rural schools did not seem to differ in their views regarding the need for professional development in management of science instruction. Similarly, an almost equal percentage of the teachers from urban and rural schools expressed the view that they did not need training in management of science instruction. Table 4 also shows that the rural teachers (M = 3.5; SD = 1.3) needed more professional development in management of science instruction as compared to their colleagues in the urban schools (M = 3.4; SD = 1.3). The Chi-Square statistics however shows no significant difference ($\chi^2 = 1.56$; $p > 0.05$) between rural and urban primary school teachers in relation with their professional development needs in management of science instruction (see Table 4.).

Concerning diagnosing and evaluating students for science instruction as a skill, both urban and rural schools seemed to express equal need for the skill. Again an almost equal percentage of teachers from both urban and rural school expressed the view that they did not need the skill. It could be seen in Table 4 that most teachers in the rural schools (M = 3.4; SD = 1.2) felt they needed to acquire skills in diagnosing and evaluating students for science instruction as compared to their counterparts in the urban schools (M = 3.3; SD = 1.3). However, the Chi-Square statistics in Table 4 shows that the teachers in the urban schools expressing more professional development need for the skill diagnosing and evaluating students for science instruction showed statistically insignificant difference ($\chi^2 = 0.10$; $p > 0.05$).

In the acquisition of generic pedagogical knowledge and skills, Table 4.2 shows that 30% of teachers in the rural school expressed a great need for the skill as opposed to 31.4% of teachers in the urban school. More teachers from the urban schools than those from the rural schools felt that they moderately needed assistance in this aspect (urban = 51.0%; rural =45%). Teachers from both rural schools (M = 3.8; SD = 1.1) and urban schools (M = 3.7; SD = 1.2), felt they needed to acquire more skills in generic pedagogical knowledge and skills. The Chi square analysis in Table 4 however shows that teachers in the rural schools expressing more professional development need for generic pedagogical knowledge and skills was statistically insignificant ($\chi^2 = 5.49$; $p > 0.05$).

With reference to knowledge and skills in the science subject, 44% of teachers from the rural schools expressed the view that the skills was greatly needed, while 30.7% of urban based teachers expressed the opinion that they greatly needed such support. Furthermore, 35% of teachers in the urban schools and 37.9% of teachers in the rural schools moderately needed assistance in this dimension. In contrast, 34% of teachers in the urban schools and 31.4% of teachers in the rural schools felt that acquiring skills in knowledge and skills in science subject is unimportant and therefore did not need that skill. Most teachers (35.0%) in the rural schools (M = 3.8; SD = 1.1) felt they needed to acquire more skills in knowledge and skills in science subject as compared to their colleagues (26.5%) in the urban schools (M = 3.7; SD = 1.2). However, the Chi square analysis in Table 4 shows that teachers in the rural schools expressed the greater desire for professional development need for the knowledge and skills in science subject, which was statistically significant ($\chi^2 = 12.42$; $p < 0.05$) compared to the urban-based teachers.

On the issue of administering science instructional facilities and equipment as a professional development need, 33% of teachers in the rural schools expressed a higher percentage for the category 'greatly needed' for the dimension as opposed to 29.6% of teachers in the urban schools. A higher percentage of teachers in the urban schools (38.6%) held the view that they moderately needed refresher courses in this aspect, whereas 37% perceived that they had acquired the necessary skills in administering science instructional facilities and equipment and therefore did not need that skill. Table 4 also shows that the rural teachers (M = 3.7; SD = 1.2) needed more professional development in administering science instructional facilities and equipment as compared to their colleagues in the urban schools (M = 3.4; SD = 1.3). Table 4 shows that, the view of teachers from urban schools in connection with planning activities in science instruction differed significantly from the views of their counterpart from rural schools expressing more professional development need for the skill administering science instructional facilities and equipment ($\chi^2 = 14.46$; $p < 0.05$).

The Table 4 above shows that 30.7% of teachers in the urban schools and 32% teachers in the rural schools said that they greatly needed support in upgrading their knowledge and skills in planning activities in science instructions. Half of the teachers in the urban schools (40%) felt that they moderately needed refresher courses in this aspect than their counterparts in the rural schools (37%). Table 4 also shows that the rural teachers

(M = 3.7; SD = 1.2) needed about the same professional development in planning activities in science instructions as their colleagues in the urban schools (M = 3.7; SD = 1.2). Table 4 shows that, teachers in rural and urban schools expressing equal professional development need for the skill, planning activities in science instructions was statistically significant ($\chi^2 = 10.65$; $p < 0.05$).

Over 60.0% of teachers in urban and rural schools indicated a need in all the six professional development needs. It could also be noted that the rural school teachers indicated more professional development needs for all the dimensions as compared to their colleagues in the urban schools. Furthermore, significant differences were shown in the areas of knowledge and skills in science subject, administering science instructional facilities and equipment and planning activities in science instructions than their rural counterparts. The null hypothesis stated was rejected therefore; school location has influence on the professional development needs of Primary teachers in the Kintampo North Municipality.

Regarding school location and perceived in-service needs of Primary School Teachers, it appears that the teachers in both schools require professional development in the entire training dimensions.

This finding is expected especially in an era where government is advocating for 60 to 40 ratio of science to humanities students, teachers have to be competent so as to motivate and encourage students to take up science related courses at the Senior High Schools and Tertiary levels after the Primary school. This places huge demand on the teachers to help achieve this goal of the government and the society as the media also regularly publicised the importance of science in every niche of human activities.

It could also be noted that the rural school teachers indicated more professional development needs for all the dimensions except planning activities in science instructions. This finding is expected because urban schools attract teachers who are better qualified academically and professionally than their rural Lavalley,(2018). A comparison of the biodata reveals that 61.8% of teachers in the urban schools are degree holders as opposed to 45.0% of teachers in the rural based schools.

The Chi Square test results on urban and rural-based primary school teacher's in-service needs in science towards the implementation of the standards-based curriculum in the Kintampo North Municipality at p-value of 0.05 and the results are provided in Table 5.

Table 5: Chi Square Test Results on Urban and Rural-Based Primary school Teachers' in-service needs in Science towards the implementation of the Standards- Based Curriculum

Compared Group	N	Mean Score	S.D	χ^2	d.f	p-Value
Urban	140	3.5	1.3	12.42	238	5.99
Rural	100	3.6	1.2	14.46;		

*P> 0.05

The Chi-square test results provide insights into the comparison of in-service needs in science between urban and rural-based primary school teachers for the implementation of the standards-based curriculum. The analysis assesses the statistical significance of any differences observed between the two groups.

In this study, the urban group consisted of 140 primary school teachers, while the rural group included 100 primary school teachers. The mean score for urban teachers' in-service needs was 3.5, with a standard deviation of 1.3. On the other hand, rural teachers had a slightly higher mean score of 3.6, with a lower standard deviation of 1.2.

The chi-square test statistic for the comparison between urban and rural teachers was 12.42 for the urban group and 14.46 for the rural group. The degrees of freedom for the urban group were specified as 238, although the degrees of freedom for the rural group were not provided. The p-value associated with the chi-square test was reported as greater than 0.05, indicating that there was no statistically significant difference in the in-service needs between urban and rural teachers for the implementation of the standards-based curriculum.

These findings suggest that both urban and rural-based primary school teachers share similar in-service needs when it comes to science instruction and the implementation of the standards-based curriculum. The results align with the notion that efforts have been made by the government of Ghana to reduce disparities between rural and urban schools in terms of teacher quality, material distribution, and facility provisions

> *I believe that I require additional professional development just like my colleagues in urban areas. Urban teachers have an advantage when it comes to accessing materials for science instruction. Furthermore, many teachers in rural areas do not possess the same qualifications as those in urban areas.*
>
> *However, it is important to note that the government of Ghana has made a deliberate effort to bridge the gap between rural and urban schools in terms of teacher quality, distribution of materials, and provision of facilities. Therefore, the in-service needs of teachers, both in rural and urban areas, are similar. We all require the same support to enhance our teaching abilities and provide quality education to our students (UT1)*
>
> *Ooh I don't think there's a difference because in Ghana, teachers use the same syllabus and textbooks designed by NaCCA for their instruction* ***(UT2)***

> *We the rural teachers' need greater professional training than our urban counterparts. We lack exposure and experience and we do not acquire relevant information and knowledge in our school-based in-service programmes.* ***(RT1)***
>
> *The urban schools have many support systems and infrastructure and they are located near science resource centres and the District Education Office where it is easy to access information on latest policy implementation in science teaching and learning as well as materials for teaching.* ***(RT2)***

This finding concurred with that of Rakumako and Laugksch (2010) when they assessed the demographic profile and perceived in-service needs of secondary Mathematics teachers in Limpopo province. They indicated that older, more experienced teachers of Mathematics are found in urban schools rather than in township or rural schools.

The rural teachers calling for more professional development could indicate the unpreparedness of teachers to teach science effectively, which ultimately reflects in the poor performance of some pupils in the rural schools in the Basic Education Certificate Examination (BECE) results. This has been a source of concern for teachers in the rural schools as District Directors have challenged them to be more competent in helping to improve student's performance in the BECE results thus, contributing to such feedback (source).

In this study, more urban based teachers believe that have adequate content knowledge to teach science effectively compared to teachers in the rural schools. This finding also concurred with that Rakumako and Laugksch (2010) who reported that in-service programmes should aim at helping rural teachers by specifically upgrading their content knowledge and teaching skills (i.e. their greatest professional need). It is therefore essential that professional development for teachers should aim at upgrading rural teachers' competencies in knowledge and skills in science subject, administering science instructional facilities and equipment and planning activities in science instructions.

4.4 Research Hypothesis 2

Ho_2: There is no statistically significant difference between male and female primary school teachers' in-service needs in science towards the implementation of the standards-based curriculum within the Kintampo North Municipality.

Research objective 3 sought to investigate the influence of gender on the professional development needs of primary school teachers towards the implementation of the standards-based curriculum in the Kintampo North Municipality. A questionnaire was used to collect the data. Descriptive statistics were used to organise the data into frequency counts, percentage, mean score and Standard deviation, while the Chi square statistics was used to test the hypothesis. Table 5 gives a summary of the responses of the teachers and also presents the mean and a summary of Chi square test results on teachers' responses.

Table 6: Mean Score of Teachers professional development Needs with respect to Gender

Dimensions	Male	Not needed F(%)	Moderately Needed F(%)	Greatly Needed F(%)	M	SD	χ^2
Management of science instruction	Male	74(32.7)	82(36.3)	70(31.8)	3.5	1,3	1.22
	Female	5(35.7)	6(42.9)	3(21.4)	3.3	1.4	
Diagnosing and evaluating students for science instruction	Male	75(33.2)	85(38.6)	66(29.2)	3.4	1.3	*6.12
	Female	3(21.4)	6(42.9)	5(35.7)	3.2	1.4	
Generic and pedagogical knowledge and skills	Male	66(29.2)	88(38.9)	73(32.3)	3.8	1.1	0.24
	Female	3(21.4	7(50)	4(28.6)	3.7	1.2	
Knowledge and skills in science subject	Male	73(32.3)	85(38.6)	66(29.2)	3.5	1.3	*11.86
	Female	2(15)	7(50)	5(35.7)	3.9	1.0	
Administering science instructional facilities and equipment	Male	71(31.4)	81(35.8)	74 (32.7)	3.7	1.3	*18.16
	Female	1(7.1)	7(50))	6(42.9)	3.5	1.3	
Planning activities in science instruction	Male	68(30.1)	86(38.1)	72(31.9)	3.7	1.2	*8.13
	Female	2(14.2)	6(42.9)	6(42.9)	3.6	1.3	

F=240 $\chi^2_{\text{critical value}} = 5.99$ df= 2 $P < 0.05$ * Significant

From Table 5 above, the female teachers expressed the least and highest percentage scores (7.1% and 50.0%) in the dimension administering science instructional facilities and equipment. The mean score ranged between 3.2 and 3.9 and the Standard deviation also ranged between 1.0 and 1.4. The female teachers expressed the least mean score in the skills diagnosing and evaluating students for science instruction and highest mean scores in knowledge and skills in science subject.

Female teachers (65%) expressed the view that management of science instruction as a skill was needed whilst, 68.0% of their male counterparts expressed that the skill was needed. However, 35.7% of female teachers felt that the skill was not needed. On the other hand, 32.0% of males indicated no need for the said skills. Most male teachers (M = 3.5; SD = 1.3) felt they needed to acquire skills in management of science instruction as compared to their female counterparts (M = 3.3; SD = 1.4) (see Table 5). However, the Chi square analysis in Table 5 shows that male teachers in expressing more in-service training need for the skill diagnosing difficulties and evaluating student learning was statistically insignificant ($\chi^2 = 1.22$; $p > 0.05$).

The Table 5 above shows that more female teachers (78.6 %) seem to be expressing the need in upgrading their need in the skill diagnosing and evaluating students for science instruction than their male counterparts (67.7%). Table 5 shows that the male teachers (M = 3.4; SD = 1.3) needed more in-service training in diagnosing and evaluating students for science instruction as compared to their female colleagues (M = 3.2; SD = 1.4). Table 5 shows that, male teachers expressing more in-service training need for the skill diagnosing and evaluating students for science instruction was statistically significant ($\chi^2 = 6.12$; $p < 0.05$).

In terms of generic pedagogical knowledge and skills (see Table 5), 78.6% of female teachers expressed greatly and moderately needed whereas, 21.4% perceived that they had acquired the necessary skills and therefore did not need in-service training in the said skill. On the other hand, 78.7% of the male teachers expressed greatly and moderately needed, whilst (21.3%) of them indicated 'no need'. Table 5 again shows that the male teachers (M = 3.8; SD = 1.1) seems to need more in-service training in generic pedagogical knowledge and skills as compared to their female colleagues (M = 3.7; SD = 1.2 and it was statistically insignificant ($\chi^2 = 0.24$; $p > 0.05$).

In terms of knowledge and skills in science (see Table 5), 35.7% of females responded to the greatly needed category. One half of the female teachers (50.0%) also felt that they moderately needed refresher courses in this aspect whereas, 15% perceived that they had acquired the necessary skills in knowledge and skills in science to teach science effectively. On the other hand, 24.0% of the male teachers expressed greatly needed, 45.3% of them expressed moderately needed and 30.7% of them indicated 'no need'. This result indicates that the female teachers (M = 3.9; SD = 1.0) are calling for more in-service training for knowledge and skills as compared to their male colleagues (M = 3.5; SD = 1.3) (see Table 5). Table 5 shows that, female teachers, expressing more in-service training need for knowledge and skills in science than their male counterparts was statistically significant ($\chi^2 = 11.86$; $p < 0.05$).

With reference to administering science instructional facilities and equipment as a skill, 35.7% of the female teachers as compared to their male colleagues (32.7%) in expressing greatly needed for such support. A higher percentage was also displayed by the female teachers when 50.0% of them perceived that such support was moderately needed whilst only 7.1% of them indicated no need. On the other hand, 38.1% of the male teachers demonstrated a moderate need whilst (30.1%) indicated that upgrading their knowledge and skills in administering science instructional facilities and equipment was unimportant (see Table 5). The mean score shows that the male teachers (M = 3.7; SD = 1.3) needed more in-service training in administering science instructional facilities and equipment as compared to their female counterparts (M = 3.5; SD = 1.3) and it was statistically significant ($\chi^2 = 18.16$; $p < 0.05$) (see Table 5).

For the male teachers, 31.9% said they greatly needed skills for planning activities in science instructions. Majority of the male teachers (38.1%) also felt that they moderately needed refresher courses in this aspect whilst 30.1% perceived they have adequate knowledge in the said skill to teach science effectively. On the other hand, equal number of female teachers felt they greatly and moderately needed in-service training for the said skill, whilst (14.2%) perceived that they had acquired the necessary skills in planning activities in science instructions and therefore did not need that skill (see Table 5). The mean score shows that the male teachers (M = 3.7; SD = 1.2) needed more in-service training in planning activities in science instructions as compared to the female colleagues (M = 3.6; SD = 1.3) and it was statistically significant ($\chi^2 = 8.14$; $p < 0.05$) (see Table 5).

The male and female teachers called for in-service training in all the six dimensions. However, the male teachers expressed more in-service training needs in all the dimensions except knowledge and skills in science subject as compared to their female colleagues. Furthermore, there were significant difference in the areas of diagnosing and evaluating students for science instruction, knowledge and skills in science subject, administering science instructional facilities and equipment and planning activities in science instructions. The null hypothesis stated was rejected therefore; Sex has influence on the in-service training needs of Primary teachers in science towards the implementation of the standards based curriculum in the Kintampo North Municipality.

Hypothesis Two

Ho$_2$: There is no statistically significant difference between male and female primary school teachers' in-service needs in science towards the implementation of the standards-based curriculum within the Kintampo North Municipality.

Chi Square test results on male and female primary school teachers' in-service needs in science towards the implementation of the standards-based curriculum was used to test hypothesis 2 at p-value of 0.05 and the results are provided in Table 7.

Table 7: Chi Square Results on Male and Female Science Teachers in-service needs in science towards the implementation of the Standards-Based Curriculum

Compared Group	N	Mean Score	S.D	χ^2	d.f	p-Value
Male	226	3.6	1.3	18.16	238	5.99
Female	14	3.5	1.3	8.14		

*P> 0.05

The chi square results showed that statistically, there was no significant difference between male and female science teachers in-service needs in science towards the implementation of the standards-based curriculum ($\chi^2 = 0.24$, $p>0.05$). Thus the null hypothesis was not rejected.

> "*To my knowledge there is no different between male and female in-services needs towards the implementation of the standard based curriculum because we all interpret the same curriculum or syllabus."(mt1)*
>
> *I needs all the dimensions because the standard based curriculum demand on the teachers the need to be updated on the new contents to be competent to teach science effectively(ft2)*

On the issue of influence of Sex on perceived in-service training needs, the male and female teachers called for in-service training in all the six dimensions. However, the male teachers expressed more in-service training needs in all the dimensions except knowledge and skills in science subject as compared to their female colleagues. This finding was not expected. Some studies have shown that male teachers have greater interest and perform better than females in many aspect of science ((Weinburgh, 1995; Gardner, 1998; Avotri, Owusu-Darko, Eghan, & Ocansey 2000; Anamuah-Mensah, Mereku & Ameyaw-Asabere, 2004). Other studies like Wayne and Lawrenz (1982) established that female teachers were higher in measures of interest in science and receptive to change than their male counterparts who were rather higher on science knowledge and on their perceptions of the teaching support they received.

The male teachers calling for more in-service training needs could be attributed to female teachers adapting well to the current Science syllabus because females more than the males tend to opt for career that enable them to work with human beings and to help other thus they are satisfied with their teaching career. Avalos and Haddad (1981) reviewed studies on teacher effectiveness in Africa, India, Latin America, Middle East, Philippines and Thailand and concluded that female teachers were more satisfied with their careers, possessed a better attitude towards their profession, students and school work.

The female teachers calling for more skills in knowledge and skills in science subject as compared to their male colleagues (see Table 5) seem expected especially with addition of new topics for example, electronics and agricultural science in the current syllabus. This innovations demand on the teachers the need to be updated on the new contents to be competent to teach science effectively. Akerson and Hanuscin (2007) found that if professional development programmes increase teachers' understanding of science content, it could increase their confidence in their ability to teach science in their classrooms. When teachers are confident in the subject matter they teach, it leads to quality instruction, which also leads to higher student achievement (Banilower et al., 2007; Darling-Hammond et al., 2009; Yoon, Duncan, Lee., Scarloss & Shapley, 2007).

4.5 Research Hypothesis 3

Ho$_3$: There is no statistically significant difference between Degree and non-Degree primary school teachers' in-service needs in science towards the implementation of the standards-based curriculum in the Kintampo North Municipality.

Research objective 4 sought to determine the differences in the in-service needs of teachers who hold a minimum qualification of a first degree and those whose qualification is less than first degree, such as Diploma or certificate holders. The responses provided on the questionnaire were used to answer this question. Descriptive statistics were used to organise the data into frequency counts, percentage frequency, mean score and Standard deviation, while the Chi square statistics was used to test the hypothesis. Table 7, gives a summary of the responses of the teachers.

Table 8: Teachers' Responses to professional development needs with respect to Academic Background

Dimensions	Academic background	Not needed	Moderately Needed	Greatly Needed	M	SD	χ^2

		F(%)	F(%)	F(%)			
Management of science instruction	Degree teachers	19(25.7)	34(46)	21(28.4)	3.7	1.2	*7.32
	Non-Degree Teachers	52(30.7)	60(36.1)	54(32.5)	3.3	1.3	
Diagnosing and evaluating students for science instruction	Degree teachers	18(24.3)	36(48.6)	20(27.0)	3.4	1.1	5.23
	Non-Degree Teachers	47(28.3)	60(36.1)	59(35.5)	3.2	1.3	
Generic and pedagogical knowledge and skills	Degree teachers	16(21.6)	37(50)	21(28.4)	3.8	1.1	2.48
	Non-Degree Teachers	45(27.1)	63(38)	58(34.9)	3.7	1.2	
Knowledge and skills in science subject	Degree teachers	20(27)	30(40.5)	24(32.4)	3.5	1.2	*11.47
	Non-Degree Teachers	48(28.9)	68(50)	50(30.1)	3.4	1.3	
Administering science instructional facilities and equipment	Degree teachers	20(27)	30(40.5)	24(32.4)	3.7	1.2	*8.53
	Non-Degree Teachers	50(30.1)	60(36.1)	56(33.7)	3.5	1.3	
Planning activities in science instruction	Degree teachers	17(23)	35(47.2)	22(29.8)	3.7	1.1	4.54
	Non-Degree Teachers	52(31.2)	58(34.9)	56(33.7)	3.6	1.2	

F=240 $\chi^2_{\text{critical value}}$ = 5.99 df= 238 P < 0.05 * Significant

From Table 8, it can be seen that the non-degree teachers attained a lower percentage score (19.2%) in the dimension diagnosing and evaluating students for science instruction whilst the highest (50.0%) was expressed by non-degree teachers in the dimension Knowledge and skills in science subject. The mean score ranged between 3.2 and 3.9 and the Standard deviation also ranged between 1.1 and 1.3. The Degree teachers expressed the highest mean score in the skill generic pedagogical knowledge and skills whilst the non-Degree teachers expressed the least mean score in diagnosing and evaluating students for science instruction.

From Table 6 above, 28.4 % and 46% Degree teachers expressed the view that management of science instruction as a skill was greatly and moderately needed respectively whilst, 32.5% and 36.1% of non-Degree teachers expressed that the skill was greatly and moderately needed respectively. However, 25.7% of degree teachers felt that the skill was not needed. On the other hand, 30.7% of non-degree teachers indicated no need for the said skills. The mean score and Chi square analysis in Table 6 shows that most non-degree teachers (M = 3.7; SD = 1.2) felt they needed to acquire skills in management of science instruction as compared to degree teachers (M = 3.3; SD = 1.3) and was statistically significant ($\chi^2 = 7.32$; $p < 0.05$).

The Table, above shows that more non-degree teachers (71.1 %) seems to be expressing the need in upgrading their need in the skill diagnosing and evaluating students for science instruction than degree teachers (70%). The mean score and Chi square analysis in Table 6, shows that the degree teachers (M = 3.7; SD = 1.1) needed more professional development in diagnosing and evaluating students for science instruction as compared to non-degree teachers (M = 3.2; SD = 1.3). Table 6 shows that, degree teachers expressing more professional development need for the skill diagnosing and evaluating students for science instruction was statistically insignificant ($\chi^2 = 5.23$; $p > 0.05$).

In terms of generic pedagogical knowledge and skills (see Table 6), 87.8% of degree teachers expressed greatly and moderately needed whereas, 12.2% perceived that they had acquired the necessary skills and therefore did not need professional development in the said skill. On the other hand, 72.9% of the non-Degree teachers expressed greatly and moderately needed, whilst (27.1%) of them indicated 'no need'. Table 6 shows that the degree teachers (M = 3.9; SD = 1.1) seem to need more professional development in generic pedagogical knowledge and skills as compared to their non-degree teachers (M = 3.7; SD = 1.2 and it was statistically insignificant ($\chi^2 = 2.48$; $p > 0.05$).

In terms of knowledge and skills in science *(*see Table 6), 32.4% of degree teachers responded to the greatly needed category and 40.5% of them also felt that they moderately needed refresher courses in this aspect whereas, 27% perceived that they had acquired the necessary skills in knowledge and skills in science to teach science effectively. On the other hand, 30.1% of the non-degree teachers expressed greatly needed and 50% of them expressed moderately needed, whilst (28.9%) of them indicated 'no need'. The mean score and Chi square analysis indicates that the degree teachers (M = 3.7; SD = 1.2) are calling for more professional development for knowledge and skills as compared to non-degree teachers (M = 3.4; SD = 1.3) (see Table 6) and was statistically significant ($\chi^2 = 11.47$; $p < 0.05$).

With reference to administering science instructional facilities and equipment as a skill, 29.7% of the degree teachers as compared to Non-degree teachers (33.7%) in expressing greatly needed for such support. A higher percentage was also displayed by the degree teachers when 47.2% of them perceived that such support was moderately needed whilst only 23% of them indicated no need. On the other hand, 34.9% of the Non-degree teachers expressed moderately needed whilst (31.3%) indicated that upgrading their knowledge and skills in administering science instructional facilities and equipment was unimportant. The mean score and Chi square analysis shows that the degree teachers and non-degree teachers indicated about the same need for the said dimension (M = 3.6; SD = 1.2; M = 3.6; SD = 1.3) and it was statistically significant ($\chi^2 = 8.53; p < 0.05$)

For the Non-Degree Teachers, 33.7% said they greatly needed skills for planning activities in science instructions. Majority of the degree teachers (47.2%) also felt that they moderately needed refresher courses in this aspect whilst 23% perceived they have adequate knowledge in the said skill to teach science effectively. On the other hand, 33.7% of Non-degree teachers felt they greatly and moderately needed (34.9%) professional development for the said skill, whilst (31.2%) perceived that they had acquired the necessary skills in planning activities in science instructions and therefore did not need that skill (see Table 6). The mean score and Chi square analysis seems to shows that the degree teachers (M = 3.8; SD = 1.1) needed more professional development in planning activities in science instructions as compared to the Non-degree teachers (M = 3.7; SD = 1.2) and it was statistically insignificant ($\chi^2 = 4.54; p > 0.05$).

The degree teachers and non-degree teachers called for professional development in all the six dimensions. However, the degree teachers expressed more professional development needs in all the dimensions as compared to non-degree teachers. Furthermore, there were significant difference in the areas of management of science instruction, knowledge and skills in science subject and administering science instructional facilities and equipment. The null hypothesis stated was rejected therefore; Academic background has influence on the professional development needs of Primary teachers.

The degree teachers and Non-degree teachers called for professional development in all the six dimensions. However, the degree teachers expressed more professional development needs in all the dimensions as compared to Non-degree teachers. Furthermore, there were statistically significant difference in the areas of management of science instruction, knowledge and skills in science subject and administering science instructional facilities and equipment. The null hypothesis stated was rejected therefore; Academic background has influence on the professional development needs of Primary teachers.

This finding contradicts the assertion that generalist teachers might possess shallow knowledge in the methodology of the subjects studied leading to poor lesson delivery (Aboagye, 2009). The Non-degree teachers requiring more professional development needs than the Non-Non-degree teachers could stem from the fact that these teachers perceived their professional development needs along the line of science teaching and therefore consider professional development in science teaching as part of their professional development. However, the Non-Non-degree teachers perceive professional development in science as not part of their professional development. Furthermore, the professionally Non-degree teachers are aware of their inadequacies in science teaching because of their background training at the university level, whilst the Non-degree teachers do not.

The degree teachers expressed prevalent professional development needs in generic pedagogical knowledge and skill and planning activities in science teaching. This finding was expected because, majority of the degree teachers who participated in the study had more than 3 years teaching experience and were therefore aware of their inadequate pedagogical knowledge and skills and planning activities in science teaching (see Appendix N). Again, the curriculum reform might have created challenges as a result of the introduction of new content and teaching methods in science. For example, the introduction of School Based Assessments (SBA) and the emphasis on differentiated teaching (NaCCA, 2019) required professional development which was inadequate as confirmed when over majority of the respondent indicated that they have not had any professional development (see Appendix N). These findings are in line with the argument made by Fullan (2007) that all innovations bring about some level of incompetence, suppressing acquired competencies and demanding the development of new ones.

The Non-degree teachers expressed prevalent professional development needs in generic pedagogical knowledge and skill and planning activities in science teaching. From the study, majority of the Non-degree teachers had less than 3 years teaching experience and therefore might not have had any professional development to introduce them through the teaching of science they therefore had to depend on pre-service science teaching experience they had from the Colleges of Education. Akyeampong (2003) concurs this when he stated that the three years spent in formal training does not produce the kind of changes expected for effective teaching. In view of the fact that knowledge in science and technology continues to grow exponentially, teachers must be made to undertake regular professional development.

Chi Square test results on in-service needs of primary school Teachers in science with regards to their academic background towards the implementation of the standards-based curriculum in the Kintampo North Municipality was used to test hypothesis 3 at p-value of 0.05 and the results are provided in Table 9

Table 9: Chi Square Results on Male and Female Teachers

Compared Group	N	Mean Score	S.D	χ^2	d.f	p-Value
Degree	226	3.6	1.3	18.16	138	5.99
Non-Degree	14	3.5	1.3	8.14		

*P> 0.05

The Chi Square results showed that statistically, there was no significant difference Degree and Non-degree teachers in-service needs in science towards the implementation of the standards-based curriculum (χ^2 = 0.24, p>0.05). The null hypothesis stated was rejected.

> *As a degree teacher I need more professional development needs than the non-degree teachers because as a Degree teacher my perceive professional development is science teaching and therefore considers professional development in science teaching as part of my professional development so I need all the dimensions towards the implementation of the standard based curriculum.(trt1)*
>
> *,I'm professionally non-degree teacher so any time they organized professional development in science I don't find it important because it not part of my professional development.(nt1)*
>
> *As a professionally Degree teachers am aware of my inadequacies in science teaching because of my background training in teaching from the university as compared to professionally non-Degree teachers(tst2)*

The professionally degree teachers and professionally Non-degree teachers expressed in-service needs in all the dimensions. However, the degree teachers required more professional development in all the dimensions than the non-degree Teachers. This finding contradicts the assertion by Principals of training colleges that generalist teachers might possess shallow knowledge in the methodology of the subjects studied leading to poor lesson delivery (Aboagye, 2009). The degree teachers requiring more professional development needs than the non-degree teachers could be that the science trained teachers perceived their professional development along science teaching and therefore considers professional development in science teaching as part of their professional development. However, professionally non-degree teachers perceive professional development in science as not part of their professional development. Furthermore, the professionally Degree teachers are aware of their inadequacies in science teaching because of their background training in teaching from the Colleges of Education, whilst the professionally non-degree teachers do not.

The degree teachers expressed prevalent professional development needs in generic pedagogical knowledge and skill and planning activities in science teaching. This finding was expected because, majority of teachers who participated in the study had more than 3 years teaching experience and were therefore aware of their inadequate pedagogical knowledge and skills and planning activities in science teaching (see Appendix N). Again, the curriculum reform might have created challenges as a result of the introduction of new content and teaching methods in science. For example, the introduction of School Based Assessments (SBA) and the emphasis on inquiry method of teaching (MoESS, 2007) required professional development which was inadequate as confirmed when over majority of the respondent indicated that they have not had any professional development (see Appendix N). These findings are in line with the argument made by Fullan (2007) that all innovations bring about some level of incompetence, suppressing acquired competencies and demanding the development of new ones.

The non-degree teachers expressed prevalent professional development needs in generic pedagogical knowledge and skill and planning activities in science teaching. From the study, majority of the non-degree teachers had less than 3 years teaching experience and therefore might not have had any professional development to introduce them through the teaching of science they therefore had to depend on pre-service science teaching experience they had from the Colleges of Education. Akyeampong (2003) concurs this when he stated that the three years spent in formal training does not produce the kind of changes expected for effective teaching. In view of the fact that knowledge in science and technology continues to grow exponentially, teachers must be made to undertake regular professional development.

4.6 Summary of Chapter

This chapter focused on the results of data, analysis of the data and discussions of results of data from questionnaire and interview. The quantitative data were analyzed using tables of which frequencies, percentages, mean scores and standard deviation were calculated. The qualitative data were recorded, transcribed and grouped into themes and sub-themes for analysis. After the analysis of the data (quantitative and qualitative), the discussions were subsequently done with reference to the research questions with adequate assistance from relevant literature.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Overview

This chapter presents summary of the findings, recommendation and conclusion of the study.

5.2. Summary of the Study

The study investigated primary school teachers' in-service needs towards the implementation of the standards-based curriculum in science. The entire study was conducted in the Kintampo North Municipality of the Bono East region. The sequential explanatory mixed method was used to collect both quantitative and qualitative data for the study with the aid of a questionnaire and an interview guide. All the primary school science teachers in the public basic schools in the Kintampo north municipality served as the population of the study. The study used census sampling technique to select 240 primary school teachers for the study. The data was analysed using descriptive statistics (frequency, percentages, mean, standard deviation) thematic and inferential statistics (Chi-square test).

5.3 Major finding of the Study

The study, revealed that:

Primary school Science teacher's prevalent professional development needs towards the implementation of the standards- based curriculum were:

- Generic pedagogical knowledge and skills
- Planning activities in science instruction

- School location has some influence on the perceived in-service needs of Primary school teachers towards the implementation of the standards- based curriculum. Teachers in rural schools expressed more need for professional development than their urban school counterparts.
- Gender has some influence on the perceived professional development needs of Primary school teachers towards the implementation of the standards- based. The male teachers expressed a greater need for professional development than their female counterparts.
- Academic background has some influence on the perceived in-service needs of Primary school teachers towards the implementation of the standards- based. degree teachers expressed more need for professional development than the Non-degree teachers.

5.4 Limitations

As this was a human endeavour, it was envisaged that there might be some limits that affected the outcome of the study to some extent. Within the municipality, there were 14 female teachers out of the total number of 240 primary school teachers. This figure translates into 5.8% of the total percentage of primary school teachers. The low number might have affected the findings of the study based on gender to some extent. In spite of the assurances of confidentiality. This could have had an effect on the responses they provided thus the outcome of the study to some extent. Also, some of the respondents were freshly posted teachers or were teachers who had just been transferred from the JHS and Kindergarten to the primary school, thus were not fully abreast with the content of the science curriculum for primary schools. Consequently, their answers to the items might not be based on the true picture on the ground. The culmination of the factors rose above were some of the limitations that might have affected the research findings and consequently the recommendations and suggestions.

5.5. Conclusion

Teachers need to upgrade their skills in all the six professional development needs especially, generic pedagogical knowledge and skills and planning activities in science instructions which was the area identified as the most prevalent so far as professional development needs towards the implementation of the standards- based is concerned. There is the need for a greater emphasis on equipping teachers with generic pedagogical knowledge and skills as well as planning activities in science instructions through regular professional development. It is evident from the study that, the rural-based teachers within the Kintampo North Municipality need to be given more professional development in all the dimensions as compared to their colleagues in the urban schools towards the implementation of the standards- based curriculum. The findings of the study also reveal that within the Municipality, female teachers believe they are more equipped to teach science at the primary school level compared to their male counterparts. It is therefore necessary to encourage a greater male participation in science-based professional development programmes.

Professional development in the field of science is considered to be any intentional sustained activity in which teachers engaged for the express purpose of improving their knowledge and skills to teach students science (Banilower et al, 2006). Although the findings in this study are not representative of all Primary School Teachers in Ghana, they nevertheless provide a useful indication of the demographic profile and prevalent in-service needs of teachers towards the implementation of the standards- based in the Kintampo North Municipality in the Bono East Region.

5.6. Recommendations

From the findings of the study the following recommendations are made:

1. Professional development programmes towards the implementation of the standards-based curriculum for Primary school teachers in the Kintampo North Municipality, must be organised in the areas of generic and pedagogical knowledge and skills and planning activities in science instruction.
2. Rural-based primary school teachers within the Kintampo North Municipality need to receive more professional development in all the dimensions of science teachers' inventory of need as compared to their colleagues in the urban schools, particularly in generic and pedagogical knowledge and skills.
3. Stakeholders such as the MoE, GES and the NTC must come out with initiatives and strategies geared towards addressing the identified in-service needs of male teachers so far as the teaching of science at the primary school level within the Kintampo North Municipality is concerned.
4. Within the GES, the district and municipal STMIE coordinators must make an effort to ensure that the PLC sessions are used to build the capacity of primary school teachers in science lesson delivery.

5.7. Suggestions for Further Research

This descriptive survey has provided information that has set the stage for more extensive investigations into the in-service needs of Teachers in Ghana. Further studies could be done in in the other Municipal/District Assemblies in the region and if possible the entire country to determine prevalent in-service needs of teachers in Primary schools towards the implementation of the standards- based curriculum. In addition to mixed method used, quantitative and qualitative methods such as classroom observation, interview to give a better picture of teachers perceived professional development needs towards the implementation of the standards- based curriculum.

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APPENDIX A

PROFESSIONAL DEVELOPMENT NEEDS FOR PRIMARY SCHOOL TEACHER

This exercise is to find out the in-service needs of teachers in Primary schools in the Kintampo North Municipality.

SECTION 1: RESPONDENT INFORMATION

1. School:

2.School Address:

INSTRUCTIONS: Please tick (√) in the boxes below

3. School location: ☐ Urban ☐ Rural

4. Gender: ☐ Male ☐ Female

5. Age: ☐ 21 to 30 years
☐ 31 to 40 years
☐ 41 to 50 years
☐ More than 50 years

6. How many years of teaching experience do you have? : __________ years

7. Please state your highest level of education:

i. SSSCE certificate ☐

ii. Certificate "A" ☐

iii Post Sec/ Post Middle School Certificate ☐

iv Diploma ☐

v First Degree ☐

vi First Degree with Education. ☐

vii Post graduate (M.ed, M. phil, etc.) ☐

viii Others (Please state) ___________ ☐

If you opt for **I, II, III** or **IV** move to **9a**
If you opt for **V, VI, VII** or **VIII** move to **9b**

Appendix A Continued

8. Please state the academic course you pursued in the institution:

(a) ☐ Science/ Mathematics
☐ General Arts
☐ General
☐ Vocational Skills/ Technology
☐ Other (specify)-------------------

(b) Major

- ☐ Physics
- ☐ Chemistry
- ☐ Mathematics
- ☐ Biology
- ☐ Science
- ☐ Others (Please State) ________

(b) Minor

- ☐ Physics
- ☐ Chemistry
- ☐ Mathematics
- ☐ Biology
- ☐ Science
- ☐ Others (Please State)

9. Please state your highest professional qualification

- ☐ Teacher Certificate "A"
- ☐ Teacher Diploma
- ☐ B. Ed
- ☐ Postgraduate Diploma in Education
- ☐ None
- ☐ Others (Please State) ________

10. Your current status as a teacher

- ☐ Permanent teacher
- ☐ Internship
- ☐ National service
- ☐ Others (Please State) ________

Appendix A continued

11. Please do you teach Science?

- ☐ Yes
- ☐ No

12. Please indicate how long you have been teaching Science.

- ☐ Less than a year
- ☐ 1 to 3 years
- ☐
- ☐
- ☐

4 to 6 years

7 to 9 years

10 years and above

13. Please state the recent Science in-service course(s) that you have attended.

Courses Name	Year/Duration	Sponsored by

SECTION 2: IN SERVICE TRAINING NEEDS FOR TEACHERS

SECTION 2 contains statements related to dimensions of teachers need in teaching and managing science in the classroom. Kindly read the following statements carefully and tick (√) one of the five options given which is applicable to you.

		Strongly not needed	Not needed	Uncertain	Moderately needed	Greatly needed
	I think I need help for:-					
1	Understanding the requirements of the syllabus					
2	Conducting practical lessons in the classroom					
3	Constructing science questions based on teaching objectives					
4	Using test results to identify level of student readiness					
5	Updating your content knowledge in biology					
6	Updating your content knowledge in chemistry					
7	Developing rules of keeping materials /apparatus in science kit box/cupboard					
8	Developing low cost teaching science materials					
9	Preparing various teaching/learning materials					
10	Motivating students to learn science					
11	Using appropriate teaching strategies to treat individuals in teaching science					
12	Obtaining innovative information on teaching science					
13	Relating science subject with daily life activities					
14	Assessing students process skills (drawing, observation, manipulative, measuring, classification)					
15	Using library to support science teaching					
16	Enhancing communication skills in English					
17	Arrangement of teaching and learning science activities					
18	Selecting suitable science equipment for teaching					
19	Updating scientific skills in biology					
20	Taking advantage of further studies in science education					

		Strongly not needed	Not needed	Uncertain	Moderately needed	Greatly needed
	I think I need help for:-					
21	Selecting suitable teaching strategies					
22	Updating knowledge about the use of science in daily life					
23	Using test item bank in science assessment					
24	Using appropriate teaching strategies in class with various skills of students					
25	Improving your basic mathematics in science					
26	Updating your content knowledge in physics					
27	Updating knowledge about career guidance related to science for students					
28	Updating knowledge on cognitive theory, teaching and learning					
29	Using test results to identify student difficulties in learning					
30	Conducting demonstration to facilitate students' understanding of the science concept					
31	Relating daily phenomenon in science teaching					
32	Using scores of test result to keep track of student's enhancement					
33	Being creative in science teaching					
34	Maintaining the science equipment					
35	Using multiple science teaching activities					
36	Enhancing learners thinking skills					
37	Updating scientific skills in chemistry					
38	Using various oral questions to determine students' abilities					
39	Managing time in teaching science subject					
40	Inculcating cultural values in science teaching					
41	Updating your content knowledge in agricultural science					
42	Teaching science using local language words to explain some science concepts					
43	Using "exploratory" strategy in teaching science					
44	Updating knowledge for social issues related to science					

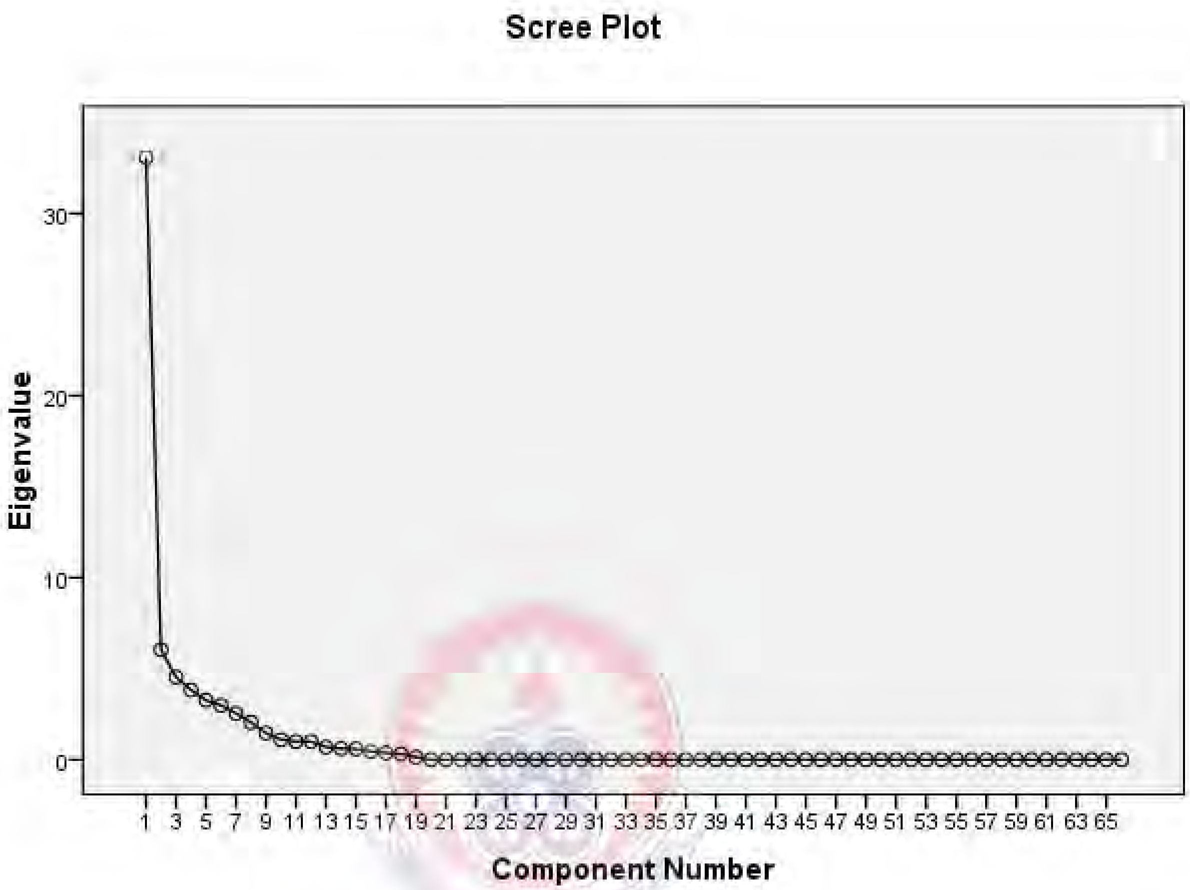
		Strongly not needed	Not	Uncertain	Moderat	Greatly needed
	I think I need help for:-					
45	Integrating thinking skills in science teaching					
46	Preparing safe environment for science learning in the classroom					
47	Enhancing your academic qualifications					
48	Controlling students discipline during teaching science					
49	Updating scientific skills in agriculture science					
50	Updating knowledge on how to be a reflective teacher					
45	Integrating thinking skills in science teaching					
51	Self reflection before, during and after teaching science					
52	Reporting students achievement to parents					
53	Updating scientific skills in physics					
54	Keeping students records to keep track of their achievement					
55	Using" exploratory" technique to gauge students understanding					
56	Enhancing teamwork skills in learners					
57	Enhancing professionalism through short courses					
58	Selecting suitable support materials (books, film, internet) as teaching aid					
59	Using stimulation techniques in teaching science					
60	Enhancing skills to develop action research					
61	Identifying free and cheap resources of science teaching materials					
62	Selecting test questions for diagnosis of student's understanding					
63	Organizing a conducive classroom for learning					
64	Planning science teaching outside classroom (eg: fieldtrips)					
65	Using students readiness information for planning the teaching					
66	Providing questions orally to trace students understanding					
67	State other in-service needs that you wish to be addressed.					

APPENDIX B

INTERVIEW GUIDE

1. How would you rate the following dimensions as your prevalent in-service needs towards the implementation of the standard based curriculum?
2. How different exist by school location of primary science teachers in-service needs towards the implementation of the standard based curriculum (Rural and Urban)?
3. How would you differentiate the in-service needs of primary school science teacher by sex towards the implementation of the student based curriculum?
4. How would you determine the difference in the in-service needs of trained and non-trained primary science teachers towards the implementation of the standard based curriculum?
5. Do you have any other comments based on what we have discussed so far?

APPENDIX C


Scree Plot
Eigenvalue
30
20
10
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65
Component Number

APPENDIX D

Rotated Component Matrix[a]

Item	Component						
	1	2	3	4	5	6	7
20M	.891						
22M	.822						
7D	.815						
41A	.814						
11M	.798						
37A	.791						
6D	.782						
44K	.754						
61G	.727						
29M	.726						
9G	.722						
10P	.714						
53G	.712						
58G	.699						
1D	.667						
56G	.647						
57G	.619						
34D	.617						
60G	.606						
30M	.598						
32M	.598						
23P	.597						
40A	.573						
5D	.541						
62E	.535						
36M	.535						
59G	.520						
43A	.452						
27M		.890					
31M		.854					
13P		.836					
17P		.822					
24M		.739					
26D		.720					
12P		.709					
14P		.625					
28E		.581					

16M		.574					
4D		.561					
50K			.914				
63G			.879				
46K			.778				
64G			.640				
52K			.598				
65G			.571				
42G			.542				
25M			.533				
8D				.856			
47K				.765			
18P				.688			
19P				.630			
35D				.579			
21M					.748		
3D					.633		
2D					.592		
48K					.580		
15P					.515		
49K					.502		
45K						-.925	
33M						-.819	
55G						.638	
51K						.596	
66G						.567	
39A							.827
38A							.762
54G							.411

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 13 iterations.

APPENDIX E

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Item		Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1D	.818	.98	34D		.900	.98
2D	.605	.98	35M		.746	.98
3D	.801	.98	36M		.847	.98
4D	.859	.98	37A		.679	.98
5D	.792	.98	38A		.621	.98
6D	.877	.98	39A		.568	.98
7D	.830	.98	40A		.773	.98
8D	.502	.98	41A		.710	.98
9G	.848	.98	42G		.717	.98
10P	.881	.98	43A		.458	.98
11M	.853	.98	44K		.857	.98
12P	.641	.98	45K		.016	.98
13P	.776	.98	46K		.665	.98
14P	.744	.98	47K		.409	.98
15P	.667	.98	48K		.696	.98
16M	.641	.98	49K		.500	.98
17P	.609	.98	50K		.529	.98
18P	.721	.98	51K		.431	.98
19P	.715	.98	52K		.610	.98
20M	.689	.98	53G		.834	.98
21M	.711	.98	54G		.450	.98
22M	.841	.98	55G		.483	.98
23P	.718	.98	56G		.679	.98
24M	.659	.98	57G		.569	.98
25M	.748	.98	58G		.817	.98
26D	.680	.98	59G		.676	.98
27M	.709	.98	60G		.587	.98
28E	.752	.98	61G		.780	.98
29M	.919	.98	62E		.531	.98
30M	.862	.98	63G		.501	.98
31M	.687	.98	64G		.712	.98
32M	.855	.98	65G		.641	.98
33M	-.106	.98	66G		.247	.98

APPENDIX F

SUMMARY OF DEMOGRAPHIC INFORMATION OF RESPONDENT

	N	Professional Degree teachers	Professional Non-Degree Teachers	In-Service Training		Year of Teaching Science	
				Yes	No	Less than 3yrs	More than 3yrs
Teachers in urban schools	49	30 (61.2%)	19 (38.8%)	13 (26.5%)	36 (73.5%)	26 (53.1%)	23 (46.9%)
Teachers in rural schools	40	18 (45%)	22 (55.0%)	8 (20.0%)	32 (80.0%)	18 (45.0%)	22 (55.0%)
Male teachers	75	32 (42.7%)	43 (57.3%)	17 (22.7%)	58 (77.3%)	39 (52.0%)	36 (48.0%)
Female teachers	15	5 (35.7%)	9 (65%)	4 (28.6%)	10 (71.4%)	5 (35.7)	9 (65%)
Degree teachers	37	37 (41.6%)		9 (25%)	28 (75.7%)	8 (21.6%)	29 (78.4%)
Non-Degree Teachers	52		52 (58.4%)	12 (23.1%)	40 (76.9%)	36 (69.2%)	16 (30.8%)