

UNIVERSITY OF CAPE COAST

AN INVESTIGATION OF PRE-TERTIARY IN-SERVICE SCIENCE
TEACHERS' PERCEPTION OF AND COMPLIANCE WITH THE
NATIONAL TEACHERS' STANDARDS FOR GHANA



LAWRENCE SARPONG

2024



© 2024

Lawrence Sarpong

University of Cape Coast

UNIVERSITY OF CAPE COAST

AN INVESTIGATION OF PRE-TERTIARY IN-SERVICE SCIENCE
TEACHERS' PERCEPTION OF AND COMPLIANCE WITH THE
NATIONAL TEACHERS' STANDARDS FOR GHANA

BY

LAWRENCE SARPONG

Thesis submitted to the Department of Science Education of the College of
Education Studies, University of Cape Coast, in partial fulfilment of the
requirements for the award of Doctor of Philosophy Degree in Science
Education

MARCH 2024

ABSTRACT

This study investigated the perceptions and compliance levels of pre-tertiary in-service science teachers in Ghana with the Ghana National Teachers' Standards (NTS) to inform policy interventions and professional development strategies to enhance educational quality. The study employed qualitative and quantitative methods in an exploratory sequential multi-method design using cross-sectional surveys and interviews. Data was collected through questionnaires, lesson observation guides, and interviews. Proportionate stratified random sampling was used to select 360 pre-tertiary in-service science teachers from public Upper Primary, Junior High, and Senior High Schools across 10 districts in the Greater Accra Region for the study. The quantitative data analysis through descriptive statistics and qualitative data thematic coding and content analysis revealed a significant lack of science teachers' compliance with the NTS, particularly in implementing the science curriculum. The essential competences specified in the NTS were notably absent in the teachers' practices due to teachers' negative perceptions of the document. Teachers' inability to demonstrate the expected competences was because of their difficulty understanding the NTS, inadequate dissemination, insufficient sensitization, and a general lack of understanding among teachers. To address these challenges, this study proposed targeted interventions that recommend comprehensive professional development initiatives facilitated by the National Teaching Council (NTC) and Ghana Education Service (GES). A Continuous Professional Development plan and the use of Professional Learning Communities are suggested to empower teachers with the knowledge and skills required to integrate NTS principles into their teaching and assessment practices.

KEYWORDS

Compliance

Ghana National Teachers' Standards

Policy interventions

Professional development

Teacher perceptions

ACKNOWLEDGEMENTS

My heartfelt thanks go to my supervisors, Professor Joseph Gharthey Ampiah and Dr. Kofi Acheaw Owusu, who provided excellent guidance during this study. Their support and encouragement have made this work more realistic. I am thankful to Prof. Joseph Gharthey Ampiah and Prof. Douglas Darko Agyei, who supported me during my coursework in developing basic research skills to enhance this work. I am grateful to the Department of Science Education, University of Cape Coast, and the staff and students at the schools where this study was conducted. I could not have done so without them. I extend my sincere appreciation to Prof. Theophilus Osei-Anto, whose efforts have helped me. Indeed, I cannot exclude Prof. Eric Nyarko-Sampson, Prof. George Kankam, and the research team, whose tremendous efforts enabled me to complete this work.

Lastly, I express my gratitude to Dr (Mrs.) Evelyn Owusu Oduro; the former Executive Secretary of National Teaching Council, the staff of National Teaching Council, Rev. Thomas Abor; the then president of Ghana Association of Science Teachers (GAST), GAST members in Greater Accra Region, all Educational Directors and the Head of institutions who allowed me to use their respective directorates and schools for the study. I could not have done so without you.

DEDICATION

To my loving family, without whom this journey would not have been possible. I dedicate this thesis to my beautiful wife, Georgina Boateng (Mrs. Sarpong), whose unwavering support, patience, and encouragement have been my driving force throughout this PhD journey. Your selflessness and love have enabled me to pursue my dreams, and I am eternally grateful. To my children, Jedidiah Boateng Sarpong, Jerry Afriyie Sarpong, and Wendy Ama Sarpong, your innocence, curiosity, and smiles have inspired me to work tirelessly towards a brighter future for our family. May this achievement inspire you to chase your own dreams.

I also extend my heartfelt dedication to my mother, Gladys Afriyie Awuah, whose prayers, guidance, and unconditional love have shaped me into the person I am today. To my brothers, Godson Sarpong, Kwabena Sarpong Anning, and Ebenezer Yeboah Sarpong, your brotherly love and support have been a constant source of strength. And to my uncle, Kwadwo Awuah Baffour, your wisdom and counsel have been invaluable. This achievement is a testament to the values and principles instilled in me by our family.

To those who have encouraged and supported me academically and professionally, I express my deepest gratitude. Mr. Samuel Amoh, your mentorship and guidance have been instrumental in shaping my research. Dr. Ntow of the Mathematics Department, University of Cape Coast, your expertise and feedback have enriched my work. Mr. Awuah Afriyie, my colleague former teacher at Odorgonno SHS, your early recognition of my potential sparked a passion for learning. Thank you for believing in me.

TABLE OF CONTENTS

Content	Page
DECLARATION	ii
ABSTRACT	iii
KEYWORDS	iv
ACKNOWLEDGEMENTS	v
DEDICATION	vi
TABLE OF CONTENTS	vii
LIST OF TABLES	xii
LIST OF FIGURES	xiii
LIST OF ABBREVIATIONS	xiv
CHAPTER ONE: INTRODUCTION	
Background to the Study	1
Statement of the Problem	8
Research Questions	15
Significance of the Study	16
Delimitation	17
Limitations	17
Definition of Terms	18
Organisation of the Study	19
CHAPTER TWO: LITERATURE REVIEW	
Theoretical Framework	20
Social Cognitive Theory	20
Implications of Bandura's Social Cognitive theory to the Study	21
The Stimulus-Organism-Response (S-O-R theory)	23

Perception	24
Competences Required of Teachers	31
Teacher Competences and Standards	33
Review of Existing Teachers' Standards at the International Level to align with NTS for Ghana	37
Science Teacher's Reflective Practices	40
Guiding Teachers to Improve Practices	40
Enhancing Science Teachers' Experiences	41
Improving Science Teachers' Professional Knowledge and PCK	41
Teacher Competences in the National Teachers' Standards for Ghana	42
Professional development	42
Community of practice	43
Professional knowledge	44
Knowledge of educational frameworks and curricula	44
Professional practice	46
Managing the learning environment (NTS 3a, b & c)	46
Teaching and learning (NTS 3d, e, f, g, h, i, j, k & l)	47
Assessment (NTS 3m, n, o & p)	49
Science Teachers' Competences in the NTS and Pre-Tertiary Science	
Curriculum	51
Assessment of Science Teachers' Competences	52
In-Service Teachers' Demonstration of Competences in the National Teachers' Standards at Different Grade Levels - Primary, Junior High, and Senior High	55
In-Service Teachers' Perception of the National Teachers' Standards	57

Teacher's Compliance with Standards and Teachers' demonstration of	61
Competences in Standards	61
In-Service Teachers' Non-Compliance with the National Teachers'	
Standards	65
In-Service Teachers' Non-Compliance with the National Teachers'	
Standards at Different Grade Levels	66
Approaches to Ensure In-Service Teachers' Compliance with the National	
Teachers' Standards	69
Sources in Ghana where teachers can access training to enhance their	
competences	73
Chapter Summary	74
CHAPTER THREE: RESEARCH METHODS	
Research Design	78
Study Area	80
Population	82
Sampling Procedure	83
Data Collection Instruments	84
Validity of the Instruments	92
Pilot Testing of the Instruments	93
Reliability of the Research Instruments	96
Data Collection Procedure	98
Ethical Issues	101
Data Processing and Analysis	103
Chapter Summary	106

CHAPTER FOUR: RESULTS AND DISCUSSIONS

Pre-tertiary In-Service Science Teachers' Perception of the NTS	107
Teaching Competences of Pre-tertiary In-Service Science Teachers Based on the National Teaching Standards	111
Teaching competences of Pre-Tertiary Science Teachers by Level of Teaching Based on the National Teaching Standards	114
Pre-tertiary Science Teachers' Non-Compliance with Teaching Competences in the NTS	124
Pre-Tertiary Teachers' Non-Compliance with NTS by the Level of Teaching	127
Approaches to Enhance the Perception of Pre-Tertiary Science Teachers to Ensure Compliance with the NTS	129
Qualitative Data	132
Science teachers' understanding of reflective practice	132
National Teachers' Standards as a guide to teaching	135
National Teachers' Standards contribution to supervision of science teachers	137
NTS contribution to enhanced experience of science teachers	138
NTS contribution to professional knowledge and pedagogical content knowledge	139
Discussion	142
CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS	
Summary of Key Findings	160
Conclusion	161

Recommendations	162
REFERENCES	164
APPENDICES	187
APPENDIX A: SCIENCE TEACHERS' LESSON EVALUATION AND ASSESSMENT TOOL (STLEAT)	187
APPENDIX B: QUESTIONNAIRE ON PRE-TERTIARY IN-SERVICE TEACHERS' PERCEPTION OF THE NTS (QPITPENTS)	202
APPENDIX C: INTERVIEW GUIDE ON PRE-TERTIARY IN-SERVICE SCIENCE TEACHER PERCEPTION OF AND COMPLIANCE WITH NTS (IGOTPACWINTS)	212
APPENDIX D: INTERVIEW GUIDE ON TEACHERS' PERCEPTION OF NTS (IGONTPONTS)	214
APPENDIX E: PRE-TERTIARY IN-SERVICE SCIENCE TEACHER INTERVIEW SCHEDULE	215
APPENDIX F: PRE-TERTIARY IN-SERVICE SCIENCE TEACHER INTERVIEW SCHEDULE	216
APPENDIX G: AN INTRODUCTORY LETTER FROM SUPERVISOR TO GRANT	217

LIST OF TABLES

Table	Page
3 Statistics of Science Teachers in Greater Accra Region	81
4.1 Pre-tertiary Science Teachers' Perception of the National Teaching Standards (NTS) (N=360)	109
4.2 Pre-tertiary Science Teachers Demonstrated Teaching Competences in the National Teachers Standards (N=360)	112
4.3 Primary Science Teachers Demonstrated Teaching Competences in the National Teachers' Standards (N=230)	115
4.4 JHS Science Teachers Demonstrated Teaching Competences in the National Teaching Standards (N=50)	118
4.5 SHS Science Teachers Demonstrated Teaching Competences in the National Teaching Standards (N=80)	121
4.6 Number and respective percentages of Pre-tertiary Science Teachers' Non-Compliance with Teaching Competences in the NTS (N=360)	124
4.7 Pre-Tertiary Teachers' Non-Compliance with NTS by Level of Teaching	128
4.8 Approaches to Promote Pre-Tertiary Science Teachers' Compliance with the NTS	130

LIST OF FIGURES

Figure		Page
1	The Conceptual Framework of the study adapted from the S-O-R Theory (Author's construction, 2023)	25
2	Standards that define competences in NTS (Author's construction, 2020)	50
3	Teacher competences identified in the science curriculum for Ghana (Author's construction, 2020)	51
4	Map of the Greater Accra Region showing 16 districts	81

LIST OF ABBREVIATIONS

NTC	National Teaching Council
NTS	National Teachers' Standards
PTPDM	Pre-tertiary Teacher Professional Development and Management
CPD	Continuous Professional Development
INSET	In-Service Teacher Education and Training

CHAPTER ONE

INTRODUCTION

This chapter introduces the background of the study by presenting efforts made by international organisations and governments to achieve quality education delivery. It also presents a statement of the problem, which delineates the issues that necessitated the research. This chapter also presents the purpose of the study, the research questions, the significance of the study, delimitations, and limitations of the study, the operational definition of terms, and the organisation of the study.

Background to the Study

Many non-governmental and international organisations have supported governments in pursuing quality education and teacher accountability through the implementation of policies and reforms (Harris, 2011; Hopkins, Stringfield, Harris, Stoll, & Mackay, 2014). The rationale for such reforms was often linked to a perceived decline in educational standards and the need to develop better quality education to enable the next generation to be ready for the challenges of a 21st-century globalised economy (Delandshere & Petrosky, 2004; Lanier-Christensen, 2021; Schleicher, 2012). This quest led to the implementation of strategies to improve the quality of education delivery among countries, resulting in initiatives and reforms that focused on using the test to set benchmarks within the education sector. Such reforms and initiatives include the Organization for Economic Co-operation and Development's (OECD's) Programme for International Student Assessment (PISA), Trends in International Mathematics and Science Studies (TIMSS), and Reading Literacy (PIRLS) assessments of the International

Association for the Evaluation of Educational Achievement (IEA) (Tienken, 2013; Mullis & Martin, 2008; Mullis, Martin, Kennedy, & Foy, 2006).

Contrary to the use of test items in setting international benchmarks, other international bodies and organisations have focused on leveraging teachers' assessment practices to improve quality education delivery. Such proponents see classroom assessment as the most prominent teacher-learner activity for improving standards of teaching and learning, and as a more credible means for public accountability (Broadfoot & Black, 2004; Mullis & Martin, 2008; Harrison, Hodgen, Marshall, & Serret, 2011).

Notwithstanding, the International Task Force (ITF) on Teachers, Education for All (EFA) and UNESCO have argued that the use of Teacher Standards can boost education delivery better than existing initiatives (Ingvarson, 2019; Kleinhenz & Ingvarson, 2004). During a stakeholder consultation held in May 2014, UNESCO proposed that entities in all regions shift from other practices to the use of teachers' standards. The focus of stakeholder engagement was to solicit information on teachers' best practices that can yield high learner attainment. Stakeholders included teacher policymakers in the Asia-Pacific region, and experts from international organisations, including the OECD, the World Bank, and the Inter-American Development Bank (Grizzle, Moore, Dezuanni, Asthana, Wilson, Banda, Onumah, et al., 2014). In response to the outcome of stakeholder engagement, a workshop was organised in Rabat (Morocco) around the same year. An abridged version of the teacher policy guide was published, with illustrations of country-specific case examples. The abridged version was intended to guide countries interested in learning more about the topic while using it to develop

a national teacher policy that outlines guidelines for the development of teachers' standards (Sayed & Ahmed, 2015). This initiative was a rapid response to the outcomes of earlier meetings held by the TTF while striving for better and alternative ways of achieving the goals of EFA. The initiative sparked similar meetings in Delhi, where a draft teacher policy was developed to integrate professional values and attributes, professional knowledge, professional practice, and inclusive education (Kleinhenz & Ingvarson, 2004). Kleinhenz and Ingvarson (2004), posited that any approach that aimed to improve quality education was made to consider teachers' professional knowledge, values, and practices because they are critical elements in developing teachers' standards.

Teachers' Standards are referred to as 'flags' or 'banners' that describe what is considered most desirable to achieve in teaching knowledge and practice and as 'measures' of performance (Kleinhenz & Ingvarson, 2004). In a study conducted by Bourgonje and Tromp in 2011, they defined standards as a combination of knowledge and practice with specifications on how the standards are applied to determine performance levels (Bourgonje & Tromp, (2011). Again, Kleinhenz and Ingvarson (2004) iterated that since teachers' standards are developed by teachers, with teachers and for teachers, they can use the standards, to get more influence over decisions that affect teacher quality. This will include:

- (a) who enters teacher preparation courses,
- (b) who trains new teachers,
- (c) who can register and enter the teaching profession,
- (d) what new teachers should know

- (e) what experienced teachers should ‘get better at’ and
- (f) who can be recognised for attaining high standards.

Kleinhenz and Ingvarson (2004), reiterated that the quality assurance role of teachers’ standards has exposed several teacher organisations and employing authorities to the shared responsibility they have for the quality of learning opportunities among teachers and students. The enlightenment of teacher organisations and employing authorities on the assurance role of teachers’ standards have called for swift advocacy on the development and use of teachers’ standards by stakeholders in teacher education (Caena, 2012). Therefore, regulatory bodies are developing and using teachers’ standards to attract, develop, and retain effective teachers to improve students’ learning outcomes. The standards and competences outlined in teachers’ standards have therefore become critical in assessing teacher efficiency and effectiveness in the career progression for reward and retention of effective teachers (Akyeampong, Lussier, Pryor, & Westbrook, 2013).

Researchers, such as Catano and Stronge (2006) and Fullan and Hargareaves (2016), highlighted that professional standards are powerful tools for teachers’ learning and development. According to Sergiovanni and Starrat (2002), professional standards, such as teachers’ standards, are a suitable framework that supports teachers in reflecting on their practice and talking to each other about their professional growth. Evidence-based research has shown that teachers’ standards enhance professional learning because they allow them to play an active role in self-directed enquiries (Darling-Hammond, 2001; Danielson & McGreal, 2000; Pyke & Lynch, 2005).

Even though there is strong advocacy for adopting professional teachers' standards, a study by Kleinhenz and Ingvarson (2004) has indicated that well-documented teachers' standards should focus on behaviour modification of learners that emanates from teaching and learning activities. Consequent to the advocacy of the use of teachers' standards for achieving quality education delivery, TTF and UNESCO have directed their attention to the development of a Teacher Policy Guide intending to help countries develop and promote the use of teachers' standards (Kleinhenz & Ingvarson, 2004).

According to the policy guide, teachers are one of the largest components of a nation's labour force and the most significant single financial component of any education authority's budget (Kleinhenz & Ingvarson, 2004). Consequently, high-quality teachers whose teaching strategies are based on teacher professionalisation and excellence in human resource policies yield the best learning results and reduce educational costs. Aiming to achieve a high-quality teacher workforce that will improve academic standards, the Global Partners' Alliance (GPA) was established in October 2008 at Bettendorf in the United States of America to fill the teacher gap. An initiative that the TTF had already advocated as the surest means of providing enough of enough well-qualified teachers to achieve the goals of Education for All (EFA) (Kleinhenz & Ingvarson, 2004).

Amid the many reforms, Ghana but had already taken different educational reforms initiatives, including Dzobo's reform in 1974, Anfom's educational reform in 1987, and Anamua-Mensah's reform in 2007. Thus, this new move of reforming and restructuring the teacher education system to

develop a national teacher policy in response to the challenges and aspirations of its education system had already begun in Ghana (MoE, 2012). For instance, in Ghana, the Education Act of 2008 (Act 778) established the NTC to develop frameworks around teachers' employment, continuous professional development, and periodic review of professional practice and ethical standards.

In 2012, NTC developed and launched the Pre-Tertiary Teacher Professional Development and Management (PTPDM) policy. The PTPDM policy was to guide the institutionalisation of Continuous Professional Development (CPD) programmes and the setting of minimum standards to enhance teachers' professional values and attitudes, professional knowledge, and professional practice (MoE, 2012). Unfortunately, teachers' standards proposed in the 2012 PTPDM policy focused only on pre-service teachers' standards. In addition, the NTS, 2014 was deficient in its ability to support teachers in applying their standards to demonstrate their credentials in the teaching profession, as propounded by researchers (Acheampong et al., 2013; Bourgonje & Tromp, 2011; Kleinhenz & Ingvarson, 2004).

Given this, there was strong advocacy for the revision of the NTS that had been developed in 2014 for Pre-Service Teachers to include standards for In-Service Teachers (NTC, 2017). To affect the changes in the NTS, the PTPDM policy 2012 had to be revised to include ways of ensuring that teachers are adequately supported, motivated to track the delivery of quality education in Ghana (MoE, 2017). The proposal by the PTPDM Policy 2012 to introduce in-service teachers' standards paved the way for the revision of the NTS for Pre-Service Teachers in 2017 to include in-service teachers'

standards (NTC, 2017a). Even though the PTPDM Policy was developed through a joint effort between the Ghana Education Service (GES) and the NTC, the development and revision of the NTS was the sole responsibility of the NTC, which is the regulatory body of the teaching profession (MoE, 2017).

Until NTS came into force in 2004, the teaching profession in Ghana did not have a common set of standards (regulatory framework) that guided teacher professionalism and practice. The NTS represents the first-ever collectively agreed upon standard to guide teacher training and practice in Ghana (NTC, 2017a). The NTS is a professional tool to guide teacher educators, teachers, student teachers, and other stakeholders in education to identify what teachers clearly and precisely should know and be able to do (NTC, 2014; 2017a). In addition, the NTS prescribes qualities that teachers must possess and the behaviours they are expected to exhibit (Kankam & Westbrook, 2016). It further empowers the NTC to register teachers after they satisfy the appropriate conditions for initial licencing, and issue appropriate licences to teachers. Ghana's NTS is therefore a model of professional standards for teachers that serves as a framework to guide the training and development of teachers. Teachers must demonstrate the minimum requirements of knowledge, conduct, and practice in their workplaces to make them effective and reflective practitioners with a high sense of lifelong learning (MOE, 2017a). The philosophy underpinning the NTS is to ensure the standardisation of teachers' professional values, knowledge, and practices in Ghana. According to the NTC, a professional teacher in Ghana should be considered one who adheres to the NTS (NTC, 2017a).

Although the attempt made by Ghana's NTC is positive in responding to the global movement of teacher professionalism, it is not sufficient. Therefore, the impact and systematic evaluation of policies should be monitored and evaluated. This is key in assessing the success of any reform (Gertler, Martinez, Premand, Rawlings, & Vermeersch, 2016). Such educational impact evaluations typically focus on participants' perceptions and satisfaction, beliefs, performance, and learning (Kreber et al., 2001; Swann, McIntyre, Pell, Hargreaves, Cunningham, et al., 2010; Taylor, 2016).

Teachers' perception of policy and its implementation is crucial because it influences their attitudes and behaviours (Kreber et al, 2001; Swann, McIntyre, Pell, Hargreaves, & Cunningham, 2010; Taylor, 2016). Thus, teachers' perceptions of the NTS can influence how they embrace and implement it, invariably affecting learners' learning attainment. This raises flags on whether there is enough evidence to indicate that information is available on how teachers in Ghana perceive the NTS and the extent to which they implement the document while taking on their roles to perform their responsibilities.

Statement of the Problem

A study of the relationship between teachers' professional standards and work output showed that teachers' standards can enhance teacher quality and improve professional practice (Guskey & Sparks, 2004). Therefore, the NTS guidelines for Ghana were developed with the belief that teachers with good knowledge are more likely to demonstrate the competences thereof. A study by MaCaughtry, Martin, Kulinna, and Cothran (2006) indicated that teachers' standards improve professional knowledge, skills and dispositions,

and broaden their horizon of effective strategies in teaching and learning. The available evidence of the effectiveness of teachers' standards in improving their competences has therefore necessitated a call for professional teachers in Ghana to adhere to the NTS (NTC, 2017b). Teachers were not directly involved in developing standards, although their representatives at the national level might have been involved. This situation could create a problem for teachers to accept and willingly use standards. It must be noted that if teachers do not accept or use these standards, judging the viability of the NTS will be difficult. Hence, there is a need to gauge teachers' perceptions of professional standards (NTS) and how they comply with these standards. This is because teachers' perceptions are believed to influence the implementation of national policies, which require their involvement and effort (Adu & Olatundun, 2007; Call, 2018; Omah, 2002; Palenzuela, 2004).

The NTS, like any other professional standard, is considered an effective tool for quality teacher development and accountability worldwide (Cochran-Smith & Zeichner, 2009; Darling-Hammond et. al., 2001). However, the implementation of NTS can be influenced by teachers' perceptions and compliance (Omah, 2002; Call, 2018; Palenzuela, 2004). Teachers who are the pivots within learners' talent development hold views and experiences which are likely to influence their compliance with policy initiatives (Margot & Kettler, 2019). The NTS was introduced as a compliance tool for teachers to demonstrate proficiency in professional knowledge, values and attitudes, and practices in quality education delivery (NTC, 2017a). Therefore, the NTS for Ghanaian teachers in pre-tertiary education institutions is expected to comply with this in their practice to ascertain high proficiency levels among teachers

(Ananga, 2021). According to Darling-Hammond (2001) and Hattie (2012), high-quality teaching strongly correlates with improved student outcomes.

Hattie (2012) indicated that while students have the highest impact on their learning, teachers play the next most significant role. Similarly, Ingvarson et al. (2007) argued that investing in teacher quality and professionalism is essential for improving outcomes. Notwithstanding, research points out that calls for implementing professionalism and measures to demonstrate quality performance cannot be achieved without tracking how teachers embrace and implement professional standards (Delandshere & Ingvarson, 2007; Delandshere & Petrosky, 2004).

Again, although the NTS for Ghana is designed to help teachers demonstrate professionalism and improve the quality of lesson delivery, and also guide against professional misconduct, such as absenteeism, drinking and drug use, indecent dressing, unhealthy relationships with students of the opposite sex, corporal punishment, and teacher hostility towards students have recently been recorded as significant factors in students' indiscipline in the school (Antwi-Danso, Kusi, & Annang (2018).

The use of corporal punishment in schools, coupled with historical precedents and the legacy of power-oriented teacher education, appears to be a direct result of Ghanaian society's beliefs, values, and norms (Act 29, Sec. 31[i], 1995). For example, Section 31(i) of Act 29 provides that force, or harm may be justified on the grounds of the authority to correct a child, servant, or other similar people for misconduct (Act 29, Sec. 31[i], 1995). Unfortunately, such actions are considered non-inclusive measures that compel learners to be passive rather than active in a learning environment (NTC, 2017b). The result

of such oppressive and aversive strategies used by teachers is the absence of a conducive and inclusive learning environment in which learners can freely explore and express their thoughts through learning-by-doing in a democratic learning environment (GES, 2011). Teachers assume that aggressive strategies encourage students to learn. Unfortunately, learners tend to lose interest in school, which adversely affects their academic performance (GES, 2017). Such measures do not conform to NTS 2f and 3c.

Apart from physical assault and creating unfriendly learning environments, some teachers do not see the need to improve themselves. Such teachers are likely to teach incorrect concepts to learners using incorrect conceptual approaches, which may result in misunderstanding of ideas, poor concept formation, and misconstruction of knowledge among learners (Ameyaw & Sarpong, 2011). This situation could contribute to low standards of education (Mabena, Mokgosi, & Ramapela, 2021).

Therefore, for a regulatory agency such as the NTC to introduce NTS in Ghana, it is important to understand teachers' beliefs and perceptions about NTS. For instance, it is expected that when the NTS, like any other professional standard, complies with it, teachers would appreciate the need for lifelong learning. They will be able to create a conducive learning environment, exhibit professionalism, and relate well with learners to improve learning outcomes (Kember, McNaught, Chong, Lam, & Cheng, 2010; NTC, 2017a).

Thus, teachers' standards which embody a different set of competences expected to be demonstrated by teachers are believed to improve quality education delivery should teachers demonstrate such competences. Literature,

therefore, suggests that teachers' ability to comply with standards is related to how they perceive those standards (Palenzuela et al., 2002). Bourke (2011) and Taylor (2016) explored teachers' perceptions of professional standards in Australia and the United States, respectively, while Opfer, Kaufman, and Thompson (2016) outlined what has been done in California in terms of teachers' perception of professional standards.

Bourke's work which investigated the impact of professional standards as the mechanism to enhance professionalism and teacher quality in the teaching force within Australia reported that using teachers' standards to regulate teachers has been resisted by teachers who considered it as inappropriate means of regulating them. According to Bourke (2011), teachers were sidelining and potentially disregarding the use of standards to ensure professionalism in Queensland, mainly because they were not exposed to the content of the standards. Similarly, a survey conducted by the General Teaching Council for England revealed that teachers did not comply with teachers' standards. The interview results from the General Teaching Council survey attributed teachers' non-compliance with professional standards to the fact that more than half of the teachers interviewed were not aware of the standards or their purpose (Poet, Rudd, & Smith, 2010). In a related studies in the UK, Evans (2011), McCulloch, Helsby, and Knight (2000) reported that perhaps teachers refused to comply to the standards since they were forced on them rather than involving them in the various levels of development of the standards and its implementation phases.

Tylor's (2016) study extended the research on professional standards to include practitioners' experiences which had been missing in most recent

studies on teachers' standards. Focusing on teachers' experiences of the Australian Professional Standards for Teachers, Tylor (2016) reported that teachers perceived the quality assurance role of the teachers' standards as heavily outweighing the discourse of quality improvement, and so did not comply with the standards. Again, Tylor (2016) reported that professional standards were perceived as focusing on what teachers should know and be able to do, rather than the ontological dimension of the human person that teachers become. These perceptions generally provide unhealthy grounds to measure the impact of standards on teachers' professionalism and performance.

In Ghana, the NTS, which is the contextualised professional standard for teachers, spells out the competences to be demonstrated by teachers to meet learners' needs and support them in improving their learning attainment (Ananga, 2021). The NTS has been designed around 27 competences that teachers must exhibit to help them satisfy the criteria (NTC, 2017a). Although the NTS serves as a regulatory instrument to guide the conduct and instructional practices of teachers in Ghana, no empirical studies have been conducted on how teachers perceive and comply with the in-service part of the NTS in Ghana since its introduction in 2017. This raises the question of whether in-service teachers are familiar with what they are expected to know, evaluate, and do and whether they appreciate the role of the NTS in their professional practice (Bourke, 2011) Evans, (2011); Tylor (2016).

This is critical because before the introduction of the NTS guidelines for Ghana, Teacher Education Institutions had their pre-service teachers' training standards (Akyeampong, 2018; GES, 2017; Ofori, 2015), with in-

service teachers having a professional code of ethics to guide their professionalism (NTC, 2018). Therefore, additional standards in both pre-and in-service training from the NTS are likely to face teacher resistance since change is difficult to embrace. Moreover, it is uncertain whether teachers have been sensitised to using the NTS guidelines for Ghana since there is no available information on this effect.

As an intervention in teacher development, investigating how pre-tertiary in-service science teachers perceive and comply with the NTS is critical since teacher quality is strongly correlated with their compliance with professional teacher standards (Ananga, 2021; Musset, 2010; NTC, 2017a).

The absence of such a study in Ghana at the time of this study makes it possible to determine how teachers perceive NTS and the extent to which their perceptions influence their compliance and NTS. Thus, the absence of a sufficient study on pre-tertiary in-service teachers' perception of the NTS in Ghana and the extent of their compliance with the NTS makes it difficult to tell how teachers demonstrate competences in the NTS guidelines for teachers in Ghana, which is worrisome. When the NTS for Ghana outlines the minimum competences to be exhibited by all teachers in Ghana, irrespective of their specialised areas, there is a need to investigate how teachers perceive and work with the NTS (Pulungan & Nasution 2021). Again, the absence or lack of sufficient study on the impact of NTS on the professional practices of pre-tertiary in-service science teachers in Ghana leaves no evidence to justify the realisation of the rationale for introducing NTS in Ghana. Moreover, the absence of such research makes it difficult to measure the relationship

between teachers' perceptions of the NTS and their compliance with standards.

Therefore, this study investigated, and documented records on how science teachers in Ghana perceive NTS and the extent to which they comply with NTS in their professional practice concerning lesson preparation, delivery, management of the learning environment, and reflective practice.

Purpose of Study

The study investigated Pre-Tertiary In-Service Science Teachers' perception of and compliance with the National Teachers' Standards for Ghana.

Research Questions

The following research questions and hypotheses guided this study.

1. What is pre-tertiary in-service science teachers' perception of the National Teachers' Standards?
2. a. What teaching competences are demonstrated by pre-tertiary in-service science teachers based on the National Teaching Standards?

2b. What teaching competences based on the National Teaching Standards are demonstrated by primary, JHS and SHS science teacher?
3. 3a. What proportion of pre-tertiary in-service science teachers do not comply with the standards in the national teachers' standards?

3b. What proportion of pre-tertiary in-service science teachers at the primary, JHS, and SHS levels do not comply with the standards in the NTS?

4. What approaches enhance the perception of pre-tertiary science teachers to ensure compliance with national standards?

Significance of the Study

This study is significant for decision makers such as the National Teaching Council, Ghana Education Service, and the National Inspectorate Board to regulate, manage, and monitor science teachers' activities to improve learners' attainment in science. The study's outcome also provides a clear indication to science teachers of the need to be familiar with the importance of the minimum level of competences expected of science teachers in the job market to help develop them towards such expectations.

This study on science teachers' perceptions of and compliance with the NTS serves as a basis for conducting similar studies on teachers in other subject areas. The results would serve as a reference for academia, particularly regarding further research on science teachers' standards. Furthermore, the study findings could serve as a springboard for key stakeholders, such as the NTC, GES, Continuous Professional Development service providers, and GAST, to monitor the extent to which science teachers are living up to prescribed standards and provide support where necessary. In addition, the study results provided a reflective tool for science teachers to measure their practical effectiveness and efficiency. Again, the study results provide a basis for stakeholders to monitor and assess science teachers' effectiveness and efficiency in providing support to meet their professional needs of science teachers.

Finally, the results of the study provide appropriate strategies to enhance pre-tertiary science teachers' perceptions of the NTS to enhance their compliance with national standards.

Delimitation

Evidence indicates that many factors influence the implementation of teachers' standards. However, this study is limited to teachers' perceptions and the extent of their compliance with professional standards for teachers in Ghana. This study sought to investigate pre-tertiary in-service science teachers' perceptions of and compliance with the NTS guidelines for teachers in ten education directorates within the Greater Accra Region of Ghana.

Limitations

Although this study advances the understanding of how pre-tertiary science teachers perceive and comply with the NTS guidelines for Ghana, it is still limited to some factors which are likely to influence its generalisation, accurate representation of other populations, and the authenticity of the data gathered. For instance, the study was restricted to pre-tertiary science teachers in 10 educational directorates within the Greater Accra Region. Therefore, the sample under investigation may not accurately represent the entire Ghanaian teacher population.

In addition, this study has limitations related to its methodology. For instance, the main data regarding teachers' perceptions of the NTS were gathered using a self-report questionnaire (self-report) which did not allow the respondents to express themselves. For any data gathered from the questionnaire, the researcher runs the risk of gathering inaccurate data because some respondents may not be honest in their responses. Pre-tertiary In-service

science teachers are likely to report what ought to be desirable, and not what reflects their thoughts.

Moreover, since the lesson observation tool has some degree of subjectivity, observers' ratings with the tool are likely to be influenced by their discretion and not by the reality of teachers' practice. Different curricular goals (objective- and standard-based curricula) are implemented at different grade levels.

Finally, the results of this study should be interpreted with caution as the study was prediction oriented. It is not sufficient to say that teachers' perceptions are the only factor likely to influence their compliance with the NTS. There may be other factors, such as motivation, compliance enforcement, supervision, and issues regarding promotions which can drag teachers to comply with the NTS, as well as teachers' unwillingness to stay in the profession which can result in non-compliance.

Definition of Terms

The following operational definitions were used in this study:

Compliance: the act of conforming to laid down principles

Standards: something considered by an authority or general consent as a basis of comparison or accepted as an approved model.

Competences: They are the basis of any proficient working behaviour that represents a summary of key professional and personal skills/talents as well as behavioural patterns of individuals.

Perception: The way in which something is regarded, understood, or interpreted.

Domain: A well-defined competency variable; professional competences: skills, knowledge, and attributes that are valued explicitly by professional associations, organisations, and bodies connected to a career.

Organisation of the Study

Chapter Two focuses on the conceptual and theoretical framework and related literature that responds to issues related to the research questions. Chapter Three presents the research methods employed in this study. It describes the research design, study area, population, and sampling procedure. It further discusses the data collection instruments, procedures, data processing and analysis, and provides a chapter summary. Chapter Four presents the results and a discussion. Chapter five consists of a summary, conclusions, and recommendations.

CHAPTER TWO

LITERATURE REVIEW

This chapter presents a review of related literature. It includes the work of recognised authorities and research conducted by other researchers. The chapter covers the following themes: the theoretical framework of the study, which is underpinned by Constructivism and Stimulus Response Theory based on perceptual processes; a conceptual framework of the study; basic competences required to teach science; teacher competences and standards; and the National Teachers' Standards in Ghana. It also reviews the literature related to the research questions, such as teachers' perceptions of the use of teachers' standards, demonstration of teachers' competences in teachers' standards, teachers' compliance with professional standards, and approaches to ensure teachers comply with standards.

Theoretical Framework

This study is underpinned by the social cognitive theory propounded by Albert Bandura and the Stimulus-Organism-Response (S-O-R) theory by Albert Mehrabian and James A. Russel in 1974. The two theories and their relationships with this study are discussed in the next session.

Social Cognitive Theory

This study is grounded in social cognitive theory developed by Albert Bandura (Hulings, 2024). The theory posits that individuals are influenced by themselves, their environment, and their behavior. It emphasises the importance of reciprocal interactions among personal, behavioral, and environmental determinants in understanding human behaviour (Bandura, 1986). The social cognitive theory shows that as individuals interact with their

surroundings, they process information and construct a mental representation of their environment. This mental model then shapes their expectations for outcomes, their belief in their abilities (self-efficacy), and their responses to their behavior.

Implications of Bandura's Social Cognitive theory to the Study

Social cognitive theory is particularly relevant in the context of investigating science teachers' perception of and compliance with the National Teachers' Standards (Bandura, 1986). By considering the social, cognitive, and environmental factors that shape teachers' beliefs and behaviors, researchers can gain valuable insights into the challenges and opportunities related to adherence to professional standards in the field of science education (Hulings, 2024). .

For instance, the theory emphasises the role of self-efficacy, which refers to individuals' beliefs in their capabilities to organize and execute courses of action required to attain specific performance levels (Bandura, 1977). In the context of science teachers' compliance with national standards, self-efficacy beliefs play a central role in determining the extent to which teachers feel capable of meeting the prescribed expectations. Researchers could base on Bandura's theory to investigate how science teachers' self-efficacy beliefs influence their perceptions of the NTS and their willingness to engage in professional development activities aimed at meeting these standards.

Furthermore, Bandura's concept of observational learning, or modeling, suggests that individuals acquire new behaviors and attitudes by observing the actions and outcomes of others (Bandura, 1986). Applied to the

context of science teachers' compliance with national standards, this aspect of the theory suggests that teachers' perceptions and behaviors may be influenced by the examples set by their colleagues, school leaders, and the broader educational community (Tsai. 2002). Research guided by Bandura's theory could explore how observational learning processes shape science teachers' understanding of the National Teachers' Standards and their willingness to align their pedagogical practices with these standards(Tsai. 2002).

Finally, Bandura's social cognitive theory emphasizes the reciprocal interactions between personal, behavioral, and environmental factors in shaping human behavior (Bandura, 1986).In the context of science teachers' compliance with national standards, this perspective highlights the need to consider the influence of contextual factors such as school leadership, resources, and professional norms on teachers' perceptions and adherence to the standards. Research informed by Bandura's theory could illuminate the complex interplay between individual beliefs, classroom practices, and structural conditions in determining science teachers' compliance with the National Teachers' Standards.

Thus, Albert Bandura's social cognitive theory provides a valuable framework for investigating science teachers' perception of and compliance with the National Teachers' Standards. By considering the influence of self-efficacy beliefs, observational learning processes, and environmental determinants on teachers' behaviors, researchers can gain a comprehensive understanding of the factors that shape teachers' engagement with professional standards in the field of science education (Tsai. 2002).

The Stimulus-Organism-Response (S-O-R theory)

The S-O-R propounded by Mehrabian Russell in 1974 (Hochreiter, Benedetto & Loesch, 2022). is an extension of stimulus–response theory developed by Pavlov in 1902 (Aslam & Luna, 2021). A stimulus is defined as the factor which causes organismic response processes in an individual (Eroglu, Machleit, & Davis, 2003). An internal component of an organism manages a stimulus, which finally leads to the elicitation of certain behaviours. Thus, in S-O-R theory, an organism mediates the impact of stimuli on responses. The significance of SOR theory has been noticed in modern technology, where stimuli such as visual and auditory cues are presented to an organism in either offline or online modes to elicit specific responses (Kumar & Kim, 2014; Richard, 2005).

The S-O-R theory has also been used to analyse customers' responses to social media networks such as Facebook and Instagram, where brand publications regarded by researchers as stimuli were used to activate organisms' (users') perceptions to drive their responses (Casalo et al., 2021; Islam & Rahman, 2017; Kim & Johnson, 2016). Thus, proponents of the applications of the S-O-R theory are of the view that many systematic interactions occur within an organism, causing the organism to elicit a response (Casalo, flavin, & Ibanes-Sanchez, 2021; Eroglu, Machleit, & Davis, 2001; Islam & Rahman, 2017; Kim & Johnson, 2016; Kumar & Kim, 2014; Richard, 2005). These systematic interactions, which cause an organism to elicit a response, have been described by various researchers as perceptions. (Eysenck & Keane, 2020; Ries, 2009).

Perception

Perception involves selecting a stimulus from the environment to organise and interpret as information (Andrej, 2013; Ries, 2009). The perceptual process includes the selection of stimuli that pass through our perceptual filters, organising them into existing structures and patterns, and interpreting them based on experiences. Thus, perception is a cognitive and psychological process which speculates that how we perceive things around us affects communication (Ries, 2009). It can therefore be surmised that perceptual processes begin when sensory receptors (eyes, ears, tongue, nose, and skin) encounter sensory stimuli (sight, sound, taste, odour, and textures) around us (Lemetyinen, 2012).

Therefore, in determining a theory that underpins this study; *“Investigating Science Teachers’ Perception of the National Teachers’ Standards and the Extent of their Compliance with the Standards”*, the S-O-R theory, becomes relevant since it is a foundational model that explores the connection between an external stimulus, internal mental processes, and an individual's response behavior (Mehrabian, 1976). In the context of a study aiming to investigate science teachers' perception of and compliance with the National Teachers' Standards for Ghana, the S-O-R theory can provide a framework for understanding how external factors such as the standards themselves (stimulus) influence teachers' attitudes and beliefs (internal processes) leading to their actions and behaviors (response). By applying the S-O-R theory, the study will help to analyze how science teachers in Ghana perceive the National Teachers' Standards and to what extent their perceptions shape their compliance with the standards. This approach enables a

comprehensive examination of the cognitive processes and behavioral outcomes that underlie teachers' adherence to national standards, contributing valuable insights to educational policy and practice in Ghana (Ajayi, Kwaansa-Ansah, & Laryea, 2019). As a result, S-O-R theory was considered the basis for the design of the Conceptual Framework which is presented in Figure 1.

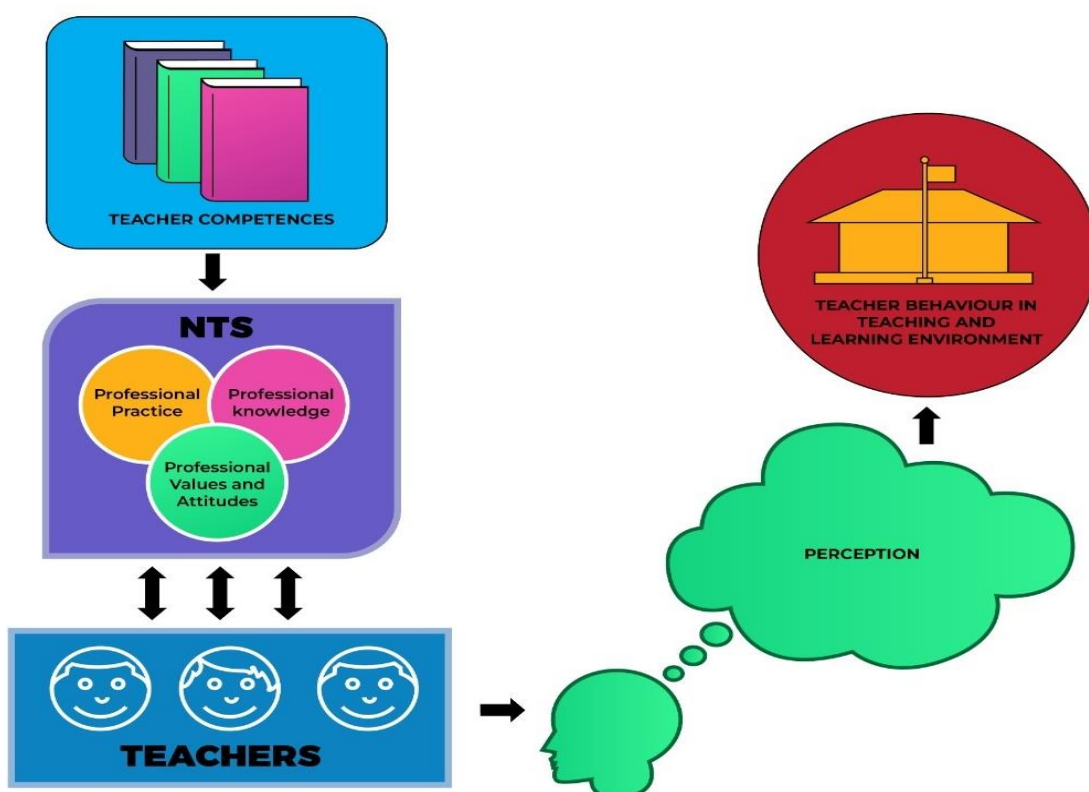


Figure 1: The Conceptual Framework of the study adapted from the S-O-R Theory (Author's construction, 2023).

In the framework of Figure 1, the arrows between the teacher competences and the NTS indicate that the NTS is imbued with some competences whereas the three arrows between the NTS block and the teachers' block illustrate that interactions exist between teachers and the NTS. The third arrow moves from left to right as one moves from the teachers' block depicting the result of the interactions between the teacher and the

standards and this result is labeled as perception. The next arrow after the perception block points to the consequence (s) of teachers' perceptions that emanate from their interaction with the NTS. Thus, the arrow indicates that teachers' behaviour is influenced by their perceptions which are products of their interactions with their environment which is referred as NTS in Figure 1.

Assumptions and Justification for the use of the Conceptual Framework

In this study, Section two of the National Teachers' Standards (NTS) was used to determine in-service science teachers' perceptions of the standards and their effects on teacher behaviour during teaching. In-service Teachers referred to teachers who were in active service before the NTS was developed in 2017 (NTC, 2017b). Thus, it was assumed that in-service teachers with a good perception of the NTS are more likely to demonstrate competences (standards of action) in the NTS during teaching.

According to Guskey and Sparks (2004), standard-based professional learning maximises potential change, improves professional practice, and increases learners' achievement. It also brings about changes in professional knowledge, skills, and dispositions, and broadens the repertoire of effective strategies to meet performance expectations and students' learning needs. Moreover, a study conducted in the midwestern urban district of the United States of America by McCaughtry, Barnard, Martin, Shen and Kulinna (2006) on the influence of 71 physical education teachers' emotional understanding of their challenges and their implications on their teaching, revealed that teachers' understanding, and interpretation of school systems influence their practices.

Researchers who used interpretive methodology multiple times over the years to interview physical education teachers indicated that when educators' practices improved and professionalism was enhanced, students were more likely to achieve results (McCaughtry & Rovegno, 2003). Since professionalism and teacher practice are linked with teachers' standards, it is without doubt that teachers' standards have the ultimate impact of improving learners' attainment (McCaughtry, Barnard, Martin, Shen & Kulinna, 2006) . Some policymakers and educators have also indicated that one of the most important policy strategies for improving teaching and learning is the recent development of standards by teachers themselves; therefore, teachers should take professional standard setting as a critical means for teachers to make good on the promise of competence that professions make to the public, and must also comply with these standards and expectations (Carnegie Forum, 1986; Holmes & Group, 1986; Imig, 1992).

It has also been reported in Darling-Hammond's analysis of the policies of 50 states, where information from a 50-state survey of policies, state case study analyses, the 1993–1994 Schools and Staffing Surveys (SASS), and the National Assessment of Educational Progress (NAEP) were used to examine the connections between teacher credentials, teacher standards, and other school inputs and student achievement across states that teachers' standards are directly correlated with learners' learning (Darling-Hammond, 2000).

Moreover, in his 2021 study on the implementation of National Teachers' standards for Ghana, Ananga indicated that teachers' standards have the potential to improve quality education for learners. This study used 368

college tutors and 3,600 students in Ghana as research subjects (Ananga, 2021). It is therefore expected that the NTS, when complied with by science teachers and students learning attainment in science, would improve as teachers involve learners in lessons through learner-centred pedagogies.

However, the extent of compliance with these standards largely depends on how teachers perceive NTS (Guskey & Sparks, 2004), although there may be other factors. This is because teachers will not abide by the directives of the standards should they have bad perception about the standards. For instance, if the in-service teachers perceive the standards as a document that is imposed on them or something that has been introduced to assess their performance rather than a benchmark that is supporting them to exhibit professionalism. That is, if teachers perceive NTS only as regulatory standards or standards for certification and control without considering the other aspect as developmental standards, standards for quality improvements, and standards for professional learning, they may be demotivated to comply with it (Mahony & Hextall, 2000; Mayer & Bell, 2005; Sachs, 2003).

The way teachers interact with the NTS influences their perception, which determines their behaviour in the teaching and learning environment, as illustrated by the study's conceptual framework. The assumption behind the construct of the framework is that if teachers apply competences in the NTS during teaching, their behaviour in the teaching and learning environment will be positively enhanced. Improving teachers' behaviour positively enhances learners' learning attainment. To determine teachers' perceptions and whether they are complying with the NTS, compliance and perception tools were

developed to ascertain such information, since the NTC has not produced any assessment tool to measure compliance with the NTS (NTC, 2021).

The framework in Figure 1 projects the NTS with its three domains (Professional Values; PV, Professional Knowledge and Professional Practice; PP) as the reservoir of competences (stimuli) that influence teachers' behaviour in the teaching and learning environment. Teachers' competence is a vital instrument in teaching and learning (Copriady, 2015). Therefore, the extent to which teachers perceive an NTS that contains specific competences for professionalism determines how effective and efficient teachers will be in their lessons (from preparation through delivery to the evaluation stages of the lessons). This is likely one of the reasons why Khatoon, Alam, Bukhari, and Mushqud, 2014 reiterate that the ability to plan, organise, and conduct various investigations involving students is certainly one of the most important competences that should be acquired by a teacher (Sanchez, 2001).

According to Sanchez, (2001), science teachers' competence is the embodiment of knowledge gained, developed abilities, and formed value-based orientations. Science teachers' competence is the knowledge put into action. A competent science teacher understands how to guide students in performing experiments and implementing practical activities (Copriady, 2015). To be an effective science teacher, one should have the knowledge, skills, attitudes, and abilities required to modify the behaviour of science students to attain holistic personal development and national aspirations (Copriady, 2015). This confirms that science teachers should possess scientific competence (cognitive) and manipulative skills associated with psychomotor orientation (Acar & Aktamis, 2010). Science teachers should be able to

modify learners' behaviour in a more appropriate direction and demonstrate the minimum competences required to facilitate science lessons.

To improve the quality of teaching and learning of science and to augment science teachers' professional practice, science teachers are required to demonstrate competences in the NTS which include, but are not limited to, the skills to use the equipment in the laboratory and laboratory management skills, as well as the ability to demonstrate the spirit of strong will and motivation to apply practical methods in teaching and learning science (Copriady, 2015). Teachers' abilities and wisdom in handling learning activities have a direct impact on students' active involvement in learning activities. Consequently, science teachers are expected to have professional and educational competences to facilitate science lessons, which are the tenets of all teacher standards (Datnow & Hubbard, 2020).

Teachers' attitudes (*responsive behaviour*) define their cognitive, affective, and behavioural responses, which are organised based on the experience and knowledge of the individual or event around the environment (Kasapoğlu, 2010). This is in line with S-O-R theory, since Kasapoğlu's finding can be interpreted to mean that teachers' behaviour is influenced by how they perceive their environment (stimuli). Other scholars define competence as a predisposition to respond in a favourable or unfavourable manner with respect to a given attitudinal objective (Oskamp & Schultz, 2005). Moreover, scholars such as Abudu and Gbadamosi (2014) have explained attitude as a hypothetical construct that predicts individuals' likes and dislikes. According to them, attitude is an approach, temperament,

sensation, situation, or inclination of one's mind towards or away from a person, a thing, or a course.

Competences Required of Teachers

Blašková (2011) defines competence as key professional and personal Skills/talents as well as behavioural patterns that should be demonstrated by individuals to accomplish targeted goals as they perform professional tasks, duties, and responsibilities. Gibb (2008) defines professional competence as the capability of superior performers. Thus, competence reflects all human efforts within an organisation. For example, Plamínek and Fišer (2005) view competence as a summary of the achieved performance and generated potential and argued that if one of these components is missing, competence is also missing (Blašková & Blaško, 2012; DEQUA, 2012; Plamínek & Fišer, 2005).

In their study on teacher competence classification, Valica and Rohn (2018) initially categorised teacher competence into two main groups: pedagogical competence and professional competence. Pedagogical competence referred to teachers' knowledge and skills related to instructional practices, classroom management, and student engagement, while professional competence encompassed teachers' ability to collaborate with colleagues, engage in continuous professional development, and adhere to ethical standards in education.

However, in subsequent research by Valica and Rohn (2020), this classification was modified to include a third category: cultural competence. Cultural competence was introduced to highlight the importance of teachers' awareness and understanding of diverse cultural backgrounds in the

classroom, as well as their ability to create inclusive learning environments that respect and value students' identities and experiences.

The rationale for this modification was grounded in the recognition that cultural competence plays a crucial role in effective teaching and learning, particularly in increasingly diverse educational settings (Valica and Rohn, 2020). By acknowledging and addressing cultural diversity, teachers can enhance student engagement, promote positive intergroup relations, and improve academic outcomes for all learners.

Therefore, the updated classification by Valica and Rohn (2020) now includes three key dimensions of teacher competence: pedagogical competence, professional competence, and cultural competence. Each of these classifications represents distinct yet interrelated aspects of teachers' knowledge, skills, and dispositions that contribute to their effectiveness in the classroom and their ability to support the learning needs of all learners.

The four set of categorisation of teacher competence described by Plamínek and Fišer, (2005), Blašková Blaško and Kucharčíková (2014) and Valica and Rohn (2018; 2020) presents different ways to determine the expectations of science teachers to function effectively in the classroom. It can therefore be summarised from these four categorisations of competences represent a summary of key professional and personal skills/talents, as well as the behavioural patterns of the teacher. Thus, teachers' competences form the basis of proficient working behaviour, and their maturity level is crucial for the successful performance of science teachers. Aghaie (2006) believes that the most important competences of a teacher are familiarity with different thinking skills and applying them; familiarity with new learning and teaching

methods and using them; class management and specific skills of communicating with students; familiarity with communication and information technologies; and being capable of employing them in teaching, research skills, and skilful in evaluating academic achievements. Shabani (2006) and Taghipourzahir (2010) classified teacher competences into specific categories after outlining the competences required by teachers to function effectively.

Likewise, Mensah, Appiah, and Angbin (2017) suggest that teachers' competency to facilitate effective lessons can be deduced from the preparation made by the teacher before the facilitation of the lesson, how the lesson is facilitated by the teacher, and how the teacher assesses the learning progress of the learners. Fathivajargah (2003) proposed that, when employing teachers, the employer should hire those who have cognitive emotional), and practical competences Seif, 2003). The views expressed by Fathivajargah (2003) and, Mensah et al., (2017) are expressed in the domains and subdomains of National Teachers' Standards for Ghana upon which the identified competences are defined as standards.

Teacher Competences and Standards

'Teacher Competence models' and 'Teacher Standards' are popular terms and relevant issues regarding educational systems in some countries and states such as the United State of America, Australia, and German-speaking countries (Weinert, 2001). As indicated earlier, 'teacher competence' has been variously defined by different scholars in the broadness of conceptions. For instance, Weinert emphasizes the importance of teachers' competences as a combination of knowledge, skills, and attitudes necessary for effective

teaching. This definition encompasses not only subject matter knowledge but also pedagogical knowledge, interpersonal skills, and the ability to create supportive learning environments (Weinert, 2001).

Ferrari in 2012, extends the definition of teachers' competences to include traditional academic skills and socio-emotional skills. This definition perceives teachers' competences as the ability to foster positive relationships with students, empathize with their needs, and create inclusive and culturally responsive learning environments (Ferrari, 2012).

In addition to Weinert's and Ferrari's definitions, Bertschy, Kunzli, and Lehmann focus on the dynamic nature of teachers' competences in the context of educational reforms and societal changes. They emphasize the importance of adaptability, continuous professional development, and the ability to integrate new technologies and pedagogical approaches into teaching practices. (Bertschy, Kunzli, & Lehmann, 2013).

Thus, while all three definitions highlight the multifaceted nature of teachers' competences, they vary in their emphasis on specific aspects such as socio-emotional skills, adaptability, and the evolving demands of teaching in contemporary society.

Usually, teacher competences are viewed in a very general way, including social competences, learning-to-learn, or key competences (Ferrari, 2012). However, researchers like Hargreaves and Fullan (2012) have emphasized the importance of teacher competences in a specific subject area. Hargreaves and Fullan argue that effective teaching requires not only pedagogical skills but also deep subject knowledge. They suggest that teachers should possess a strong understanding of the content they are teaching to

facilitate student learning effectively. Similarly, Shulman (1986) introduced the concept of pedagogical content knowledge (PCK), which highlights the intersection of subject matter expertise and pedagogical skill. This perspective underscores the significance of teachers having both knowledge of the subject matter and the ability to teach it effectively. By narrowing teacher competences to focus on knowledge and skills in a specific field or subject, researchers like Hargreaves, Fullan, and Shulman emphasize the importance of subject mastery in enhancing teaching effectiveness and student outcomes.

Others define teacher competence as the cognitive abilities and skills required to solve specific problems associated with motivational, vocational, and social dispositions in various situations (Weinert, 2001). For instance, researchers like Hargreaves and Fullan (2012) have emphasized the importance of teacher competences in a specific subject area. Hargreaves and Fullan argue that effective teaching requires not only pedagogical skills but also deep subject knowledge. They suggest that teachers should possess a strong understanding of the content they are teaching to facilitate student learning effectively (Hargreaves & Fullan (2012). Similarly, Shulman (1986) introduced the concept of pedagogical content knowledge (PCK), which highlights the intersection of subject matter expertise and pedagogical skill.

This perspective underscores the significance of teachers having both knowledge of the subject matter and the ability to teach it effectively (Shulman, 1986). By narrowing teacher competences to focus on knowledge and skills in a specific field or subject, researchers like Hargreaves, Fullan, and Shulman emphasize the importance of subject mastery in enhancing teaching effectiveness and student outcomes. Despite the variations in

definition, the teacher competence models for science subjects, such as the Curriculum, Sustainable Development, Competences, Teacher Training (CSCT) model) used in Germany and Switzerland, and the Competences in Education for Sustainable Development (ECE) model used in Austria, are similar (Bertschy, Künzli, & Lehmann, 2013). They were codified (standardised) to align themselves in three dimensions to include content, levels, and skills to easily assess teachers' competences. Large-scale assessments take advantage of standards established for assessment purposes (Ferrari, 2012). The definition of standards should allow objective comparisons of different abilities. Standards can be expressed as minimal, regular, or maximal. Minimal standards define the minimum requirements that must be met by an individual regarding an assigned task (Ferrari, 2012).

If teachers' achievement scores are low, it usually has consequences on their practices (Shulman, 1986). Although it might be easier to achieve and agree upon minimal standards, this could encourage teachers to be satisfied when this minimal goal is reached. Many countries, including Switzerland, have adopted minimal standards, whereas Germany and Australia have operated under both minimal and regular standards (Labudde, 2007). Despite variations in the two (minimal and regular standards), both indicate what the average teacher should exhibit in content and performance. Standards provide a solid basis for describing and measuring teachers' competences in teaching and learning (Schecker 2012).

Review of Existing Teachers' Standards at the International Level to align with NTS for Ghana

This review focuses on teachers' standards developed for the recognition of ongoing teacher professional learning and development (professional certification). That is, teachers' standards are used as benchmarks to ensure their practices and certify that they meet the national minimum standards that allow them to practice as professional teachers. In most professions, the purpose of quality assurance is assigned to statutory agencies and professional bodies in public services. For instance, in Ghana, the National Teaching Council is the agency responsible for teacher certification and therefore uses the National Teachers' Standards Guidelines for Ghana to certify teachers' learning and practice (NTC, 2017a). In Nigeria, the Teachers' Registration Council of Nigeria (TRCN), as a responsible agency for teacher registration and certification, uses Nigerian Teachers' Standards to train teachers and guide their practice (TRCN, 2010).

Therefore, for teachers to demonstrate their credentials as professionals, they and their associations in several countries are undertaking the responsibility of developing professional standards (Gallie & Keevy, 2014). For instance, in the 1980s, the National Council of Teachers of Mathematics (NCTM) in the United States developed teaching standards emulated by other professional associations in the United States and Australia. Focusing on the development and use of teachers' standards to ensure quality in teacher training and practice has become necessary for several reasons, including protecting and enhancing the quality of teaching and learning. One of the reasons for developing standards for NCTM was to control for the

harmful effects of trends in mathematics textbooks and testing in 1980 on the quality of mathematics teaching.

Moreover, there was rigorous pressure from teacher and principal associations in Australia to establish the National Institute for Quality Teaching and Professional Leadership. The quest was to enable teachers and principals to play a stronger role in the professional development of their members and to recognise those who attained high professional standards (Australian Institute for Teaching and School Leadership, 2012). Thus, in Australia, teacher associations are taken more seriously in policy arenas due to the initiatives made by English, Mathematics, and Science subject associations to develop subject-based standards for others to emulate (Australian Institute for Teaching and School Leadership, 2014).

While all countries adopted common teaching standards to benchmark UNESCO's nine dimensions for professionalising teaching (teachers' standards and professionalism, teacher education and continuous professional development, teacher recruitment and retention, teacher deployment and management, teacher career structure and progression, teacher working conditions, teacher recognition and reward systems, teacher accountability, and school governance), Ghana appeared to have different standards at different training institutions (MoE, 2012). For Ghana to align itself with the UNESCO standards of professionalism to make its teachers to be generally recognised at the international level, it became critical to identify the kind of teacher Ghana needed. The defining professional teachers of Ghana require documentation in NTS for Ghana (NTC, 2014). The NTS has therefore been designed to hinge on three main domains upon which teachers' competences

enshrined. These domains are professional values, attitudes, and practices (NTC, 2014). These domains were identified as the basis of most of the reviewed standards. For instance, samples of teaching standards and their applications from Australia, New Zealand, the United Kingdom, Scotland, Denmark, and the United States had at least two of the three domains identified in the NTS for Ghana.

These samples were arranged into four categories that broadly corresponded to teacher career stages: 'graduation, full registration, experienced, and 'accomplished practice. In each of the standards studied, various models were noted to have been discussed in terms of their purpose, structure, assessment arrangements, and the incentives they provide for teachers to undertake the professional learning required for their achievement (Fletcher, Walker, & Boniface, 2013). However, most of them were generic standards like those of the NTS for Ghana, except for Australia, the United States, Canada, and Alaskan which had specific standards for specific subject teachers. Essential differences between 'generic' and subject/year level/specialist standards are that while generic standards have value as statements of overall principles about what is valued, they are limited in their capacity to 'capture' what good teachers know and do (Kleinhenz & Ingvarson, 2007).

The importance of teacher standards in improving teaching and learning has been demonstrated in Ghana (Ananga, 2021). Almost all Teacher Education Institutions (TEIs) seem to have curricula underpinned by the National Curriculum Framework (National Teacher Education Curriculum Framework-NTECF), an offshoot of the NTS. Similarly, Ghana's pre-tertiary

teacher professional development framework is underpinned by the In-Service Teachers' Standards for Ghana. (NTC, 2018). Thus, the National Teachers' Standards developed by the National Teaching Council of Ghana assist in both teacher preparation and development, although other institutions are yet to comply (NTC, 2017). This indicates that the NTS was recognised in Ghana. Although the NTS is generic rather than subject-specific, it focuses on supporting in-service teachers in developing essential competences for effective and efficient discharge of duties as professionals.

Science Teacher's Reflective Practices

One of the key roles of the NTS is to encourage all teachers including those teaching science to engage in reflective practices, which involve critically analysing their own teaching methods, instructional strategies, and classroom dynamics to improve student learning outcomes. According to Allen and Wright (2014), the NTS provides a framework that prompts science teachers to regularly reflect on their teaching practices and make informed decisions to enhance their pedagogy. Furthermore, Garet et al. (2013) found that NTS actively promotes self-reflection among science teachers by identifying specific teaching dimensions that need to be examined and improved, such as content knowledge, instructional delivery, and assessment.

Guiding Teachers to Improve Practices

NTS serves as a guiding tool for science teachers to identify areas for improvement and to pursue professional development opportunities. Research conducted by Darling-Hammond and Richardson (2009) highlighted the significance of NTS in providing a clear roadmap for science teachers to enhance their instructional strategies, content knowledge, and classroom

management skills. By aligning professional development initiatives with the NTS, educational institutions can help science teachers navigate their growth trajectories. Additionally, Miles and Darling-Hammond (2017) emphasised the importance of ongoing support and coaching in helping science teachers effectively implement the strategies outlined in the NTS.

Enhancing Science Teachers' Experiences

NTS contributes to enhancing science teachers' experience by promoting a positive and supportive teaching environment. According to Trujillo and King (2018), the NTS provides guidelines for creating a collaborative culture among science teachers that fosters the sharing of best practices, peer mentoring, and professional dialogue. This collaborative approach empowers science teachers and creates opportunities for continuous improvement through shared experience and knowledge exchange. Furthermore, research by Gravel et al. (2014) suggests that NTS encourages the involvement of science teachers in professional learning communities and other collaborative networks, which positively impacts their job satisfaction and overall experience in the field.

Improving Science Teachers' Professional Knowledge and PCK

NTS is instrumental in improving science teachers' professional knowledge and pedagogical content knowledge (PCK), enabling them to deliver more effective science instruction. Song et al. (2019) state that NTS serve as a foundation for implementing high-quality professional development programmes that target specific aspects of science teaching, such as inquiry-based instruction, classroom discourse, and assessment practices. The study conducted by Windschitl et al. (2012) supported the notion that aligning

professional development with NTS is essential for promoting science teachers' acquisition of deep subject matter knowledge and developing their ability to effectively integrate content knowledge with pedagogy.

Teacher Competences in the National Teachers' Standards for Ghana

The NTS for Ghana defines competences in terms of standards and sometimes uses them interchangeably, even though there are specific competences (sub-standards) under each standard. The NTS, therefore, defines standards (competences) as clear expectations of skills and knowledge that teachers should be able to demonstrate (NTC, 2014).

The NTS is organised in the form of domains divided into three subdivisions. The NTS domains were as follows:

1. Professional values and attitudes
2. Professional knowledge
3. Professional practice

Each domain has been further developed into subdomains for instance, there are two subdomains under professional values and attitudes which include professional development and community of practice.

Professional development

According to Ghana's NTC (2017), by way of demonstrating expected competences in the NTS, teachers should;

- critically and collectively reflect to improve teaching and learning. (NTS 1a).
- improve their personal and professional development through lifelong learning and Continuous Professional Development (CPD). This can be done by identifying gaps in knowledge,

carrying out self-directed study by accessing libraries, the internet and from CPD programmes (NTS 1b).

- demonstrate effective leadership qualities in the classroom and in the wider school.

This can be done by delegating roles to females and males learners equally, volunteering to work on students' leadership and making meaningful contributions in meetings (NTS 1c),

Community of practice

The teacher was expected to display the following competences:

- Demonstrate legal and ethical codes of conduct in practice
- Show high levels of attendance and punctuality.
- Work within the policies of the Ministry of Education and the Ghana Education Service as well as the schools in which they teach. (NTS 1d).
- Engage positively with colleagues, students, parents, the School Management Committee (SMC), the Parent Teacher Association (PTA), and the wider public as part of a community of practice. This means that the teacher should attend and contribute to school meetings, parent-teacher consultations, and SMC and PTA meetings as appropriate (NTS, 1e).
- Develop a positive teacher identity and acts as a good role model for learners as well as agent of change. This means that teachers should express their own philosophy of what it means to be teachers, and show pride in their profession.

- Transform the school, community, and country to meet societal goals and must understand the role that education plays in the lives of the local community (NTS 1f & g). In this regard, it is also expected that the teacher will positively support initiatives that bring about changes or improvements in the school, such as the innovative use of local materials or facilitating access and social inclusion (NTC, 2017).

Professional knowledge

The identified substandards were as follows:

- i. knowledge of educational frameworks and curriculum
- ii. knowledge of learners.

Knowledge of educational frameworks and curricula

The teacher is expected to display the following competences based on knowledge of the educational frameworks and curriculum:

- Demonstrate familiarity with the education system and the key policies guiding it. (NTS 2a).
- Exhibit comprehensive knowledge of the official school curriculum, including learning outcomes and must be able to reference the curriculum (NTS 2b).
- Demonstrate knowledge of what learners should have learned in previous years and across the curriculum.
- Discuss issues in the implementation and covering of the curriculum, particularly for more vulnerable groups, and consider how to support learners in attaining the expected curricular outcomes.

- Demonstrate adequate knowledge and understanding of content knowledge, pedagogical knowledge, and pedagogical content knowledge.
- Demonstrate adequate subject knowledge beyond what is contained within the curriculum and textbooks.
- Identify and address gaps in their subject knowledge through self-study and must also be able to articulate high standards of literacy and the correct use of oral and written language (NTS 2c).
- Demonstrate competences in a wide variety of ways of organising learning and recognising the advantages and disadvantages of teacher- and learner-centredness as well as gender-responsive pedagogies.
- Demonstrate adequate knowledge of the curriculum for the years appropriate for multi-grade classes and must have good knowledge of how to teach beginning reading and numeracy, speaking, listening, reading, and writing of at least one Ghanaian language for instruction (NTS 2d).

Knowledge of learners:

- Describe how children develop and learn in diverse contexts, and apply this to their teaching. Thus, lesson notes and plans should show a variety of teaching and learning strategies appropriate for learners at different developmental stages (NTS 2e).

- Analyse and respect learners' cultural, linguistic, socio-economic, and educational backgrounds in their planning and teaching. In this regard, it is expected that the teacher will investigate and take notes of each learner's background, acknowledging where they may have gaps in their education.

Professional practice

There were three themes: managing the learning environment, teaching and learning, and assessment (NTS 3a–3p).

Managing the learning environment (NTS 3a, b & c)

- Plan and deliver varied and challenging lessons that show clear grasp of the intended outcomes of their teaching. This means that teachers should have long-term (weekly, termly) objectives of what and how learners should learn and should make sure that the lesson objectives are clear to learners at the beginning of lessons and their progress towards these is monitored (NTS 3a).
- Carry out small-scale action research to improve practice. In this case, the teacher should identify one area to improve each term in the academic year (NTS 3b).
- Expected to create a safe, encouraging learning environment and should be warm, friendly, and fair, offer praise and encouragement, and should withhold any form of corporal punishment or any threatening behaviour (NTS 3c). Thus, the teacher should be able to manage behaviour and learning with small and large classes and should demonstrate the ability to

use group and pair work to overcome the challenges of large classrooms. This means that the teacher should be friendly, but firm in matters related to discipline.

Teaching and learning (NTS 3d, e, f, g, h, i, j, k & l)

Under teaching and learning, teachers are expected to display the following competences:

- Employ a variety of instructional strategies that encourage learner participation and critical thinking. The teacher should demonstrate the ability to use whole-class dialogue (discussion), questioning, group/peer work (collaborative learning), demonstrations, explanations, experimentation, project/enquiry-based learning, different learner groupings, peer teaching/support, manipulative/modeling, field trips, games, role-play, songs, storytelling, and ICT in their lessons (NTS 3d).
- Demonstrate skills in paying attention to all learners, especially girls and learners with Special Educational Needs (SEN), while ensuring their progress (NTS 3e). The teacher must ensure that quiet or non-participating learners contribute and learn, and must employ differentiation by varying questions or learners' work to cater to diversities in the class.
- Provide resources appropriate to learners' needs, such as plates to teach geometry to visually impaired learners or Braille, or adapt ICT accordingly (NTS 3f).

- Employ instructional strategies appropriate for mixed-ability, multilingual, and multiage classes (NTS 3g). This means that instructional strategies are differentiated to target different grades of learning within the classroom, organising the classroom to support multi-grade learning through seating. Overage learners are acknowledged, and instructional strategies and tasks are differentiated to consider levels of maturation.
- Set meaningful tasks that encourage learner collaboration and lead to purposeful learning. Learners are expected to work together purposefully on carefully designed tasks that require them to share, talk, and debate (NTS 3h).
- Explain concepts clearly using examples familiar to learners, drawings, diagrams, demonstrations, teaching and learning resources, ICT, analogy, metaphor, and representation to obtain new concepts in a variety of ways so that learners can understand (NTS 3i).
- Produce and use a variety of teaching and learning resources that enhance learning, including ICT. Resources that are made from local materials where possible and in sufficient numbers for all learners to handle, such as charts, simple story books, flash cards, bottle tops, stones, sticks, and pens.
- Employ ICT's in teaching as much as possible (NTS 3j).
- Demonstrate competences in the integration of various assessment modes into lesson facilitation to enhance learners' learning attainment (NTS 3k).

- Demonstrate listening skills by providing different opportunities for learners to express themselves without interruptions or entertaining fears of intimidation. In this case, it is expected that teachers will take time to listen to learners and interpret their understanding to give constructed feedback to learners (NTS 3l).

Assessment (NTS 3m, n, o & p)

The competences expected to be developed and demonstrated under assessment include the teachers' ability to integrate a variety of assessment modes into teaching to support learning. In this case, the assessment modes were integrated into the daily practice. They include learners' verbal and written responses such as drawings, maps, diagrams, stories, descriptions, accounts, experiments, local research, and handicrafts. Again, the teacher should be able to listen to learners and give constructive and/or formative feedback to individual female and male learners, and must demonstrate the ability to motivate learners to talk or respond without interruption, in extended speech modes in whole-class or group scenarios. Moreover, the teacher should be able to identify and remediate learners' difficulties or misconceptions by referring to learners whose needs lie outside the teacher's competency (NTS 3m). Again, the teacher must demonstrate competences in meaningful records and keep and communicate student progress regularly to the learners and parents. The teacher should be able to keep regular, detailed, and legible records of learners' assessments, both ongoing, formative, and summative, analyse any disparities between females and males, and use these to inform planning and teaching daily (NTS 3n). Teachers should also demonstrate

awareness of learners' national and school levels of attainment. The teacher maintains high expectations for all learners, acknowledging gaps between learners' expectations from the curriculum and the reality of low learning outcomes for many learners, notes school performance over the years, and works with colleagues to improve attainment levels. (NTS 3o).

Finally, the teacher should use objective criteria referencing to assess learners. Teachers should assess learners fairly, use predetermined criteria, and not compare learners. At Junior and Senior High School, teachers should demonstrate the ability to use published marking schemes for Basic Education Certificate Examination (BECE) and West African Senior (WASSCE)

In summary, the competences outlined above have been categorised into 7 thematic areas within the NTS as indicated in Fig. 5.

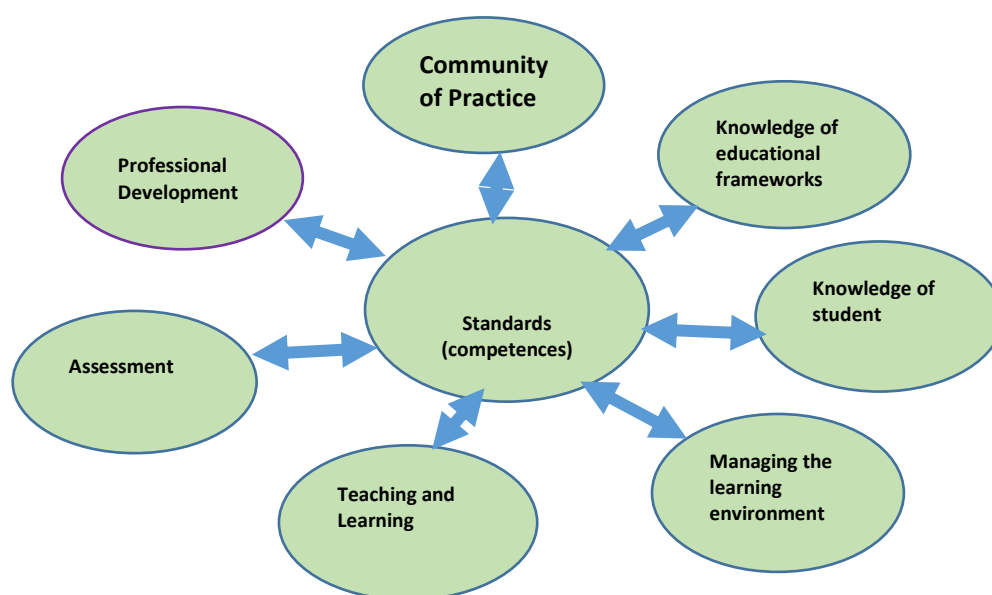


Figure 2: Standards that define competences in NTS (Author's construction, 2020)

Furthermore, the science curriculum at the pre-tertiary level in Ghana espouses skills, knowledge, and attitudes that are expected to be imbibed in the teaching and learning process to prepare the learner to be enculturated in

the identified strands were categorised under four broad headings: lesson planning and subject matter knowledge (instruction planning skills), action systems and content delivery skills, classroom organisation and management skills, and reflective practice for improvement (NTC, 2017a). These strands form the basis of teachers' behaviour in the teaching and learning environment, as stated in the conceptual framework. As a result, the relationship between science teachers' perception of the NTS and the extent to which science teachers comply with the standards in the NTS is key to this study and is given special attention in the next subsection.

Assessment of Science Teachers' Competences

The European standards for higher education recognise teachers as the most valuable and key source of information for learners (ENQA, 2009). The teacher is a professional who is well-informed and equipped with a theoretically profound and critical analysis of educational phenomena and processes in teaching a study subject. Consequently, teachers can design instructional activities that guide learners to achieve their national goals and aspirations (Soanes & Stevenson, 2003; Valica & Rohn, 2013). Teachers' work has a significant impact on the development of knowledge and cognition in each society. It is a demanding task that requires professional competences, the continual enhancement of professional knowledge, social competence, and the ability to develop acquired skills. It also requires the ability to conduct scientific research and connect research results to classroom work to unearth and build the potential of learners (Kravčáková, Lukášová, & Búgelová, 2011).

Since teachers play a major role in the developing the potentials of students, it is very important to investigate teachers' successes in terms of their competences and capacity (Hartley, Hilsdon, Keenan, Sinfield, & Verity, 2011). A teacher is in direct and permanent contact with students, providing them with information and knowledge, helping them acquire and improve their skills, and developing their competences. In addition, the teacher objectively assesses students' knowledge growth to direct their future (often lifelong) development efforts, so that they can build themselves properly to maintain their professional authority and qualifications.

The main motive for investigating teacher knowledge is to improve student outcomes (Schecker, 2012). Therefore, how to recognise a competent (expert) teacher, what teacher professionalism involves, and what is defined as an appreciable teacher's knowledge are key factors in teacher professionalism. The literature highlights many features that characterise a competent (expert) teacher, including pedagogical content knowledge, problem-solving strategies, adaptation for diverse learners, decision-making strategies, insight into classroom events, sensitivity to context, and respect for students (Kleinhenz & Ingvarson, 2004). Although teacher knowledge is undoubtedly a component of teacher professionalism, professional competence also involves more than just knowledge. skills, attitudes, and motivational variables also contribute to the mastery of teaching and learning (Kleinhenz & Ingvarson. 2004).

Blömeke and Delaney (2012) proposed a model that identifies cognitive abilities and affective-motivational characteristics as the two main components of teachers' professional competence. According to them, conceptualising teacher knowledge is a complex issue that involves

understanding key underlying phenomena, such as the process of teaching and learning, the concept of knowledge, and how teachers' knowledge is put into action in the classroom (Blömeke & Delaney, 2012). Several existing models capture the complex process of teaching and learning; however, current models propose that assessment of teachers' knowledge should include learners' knowledge and the learning process, rather than focusing only on knowledge of content and classroom management. Such models view student factors as part of and are interdependent with the teaching-learning process (Blömeke & Delaney, 2012).

Other models have also considered how teachers make decisions regarding teaching and learning as a crucial aspect of assessing teachers' competence. Such models describe teachers' decision-making to include factors influencing teachers' decisions as antecedent conditions, such as students, the nature of the instructional task, the classroom, and the school environment, which combine with teachers' characteristics and cognitive processes to impact pedagogical decisions (Schecker, 2012).

According to Labudde (2007), several studies investigating how teacher knowledge is used in decision-making suggest that, to make informed pedagogical decisions, teachers must be able to analyse and evaluate specific learning episodes, in addition to contextual and situational factors. In line with Labudde (2007), Blömeke and Delaney (2012) stressed that teachers must connect the results of analysis from specific learning episodes to their specialist knowledge of the teaching-learning process to direct subsequent teaching actions. These opinions have informed many stakeholders in the teaching industry to develop assessment tools that assess teachers'

competences at both Pre-Service and In-Service levels. For instance, through the Teacher Education Division, Ghana Education Service developed a Lesson Observation tool to assess In-Service Teachers' competences (Ghana Education Service, 2008).

Similarly, interactions with the leadership of Teacher Training Institutions (TTIs) in Ghana (Universities and Colleges responsible for training teachers) revealed that all TTIs have developed assessment tools to assess the competences of teacher trainees during out-segment teaching practice. Unfortunately, it appears that both the Pre-Service and In-Service assessment tools for teachers' lesson observation were developed before the development of the NTS for Ghana, and so there is a need to ensure that they resonate with each other. Therefore, this study envisaged the need to develop a comprehensive assessment tool (Lesson Evaluation and Assessment Tool for Science Teachers' Performance) that will help measure teachers' competences associated with sub-domains of the NTS for Ghana to determine how science teachers comply with the NTS.

In-Service Teachers' Demonstration of Competences in the National Teachers' Standards at Different Grade Levels - Primary, Junior High, and Senior High

In an evolving educational landscape, in-service teachers play a crucial role in effective implementation of national standards. Teachers' standards serve as a framework that outlines the expectations of professional competences and behaviours for in-service teachers. It defines a range of competences across different domains, including pedagogy, subject knowledge, assessment, planning, behavior management, and professional

development (Hammond, Kamler, & Cunningham, 2014). Although these standards vary between countries and are regularly revised to meet the evolving demands of education systems, the expectation is that in-service teachers will be proficient in each domain to ensure optimal teaching and learning experiences for their students (Department of Education, 2013).

Research suggests that in-service teachers' demonstration of competences aligned with their standards has a significant impact on effective and efficient demonstration of professionalism (Hattie, 2012). Thus, when teachers exhibit these competences, they positively influence their professionalism and professional growth.

By examining relevant research, several challenges have been reported in the literature regarding in-service teachers' demonstration of competences aligned with the NTS at different grade levels. A common challenge is the lack of opportunities for professional development focused on NTS (Johnson, 2018). This challenge of not having professional development opportunities to study the NTS inhibits teachers' ability to acquire the necessary skills and knowledge to effectively implement standards. Additionally, Aslan et al. (2021) highlighted the challenges of time constraints and heavy workload, which often prevent in-service teachers from fully engaging in continuous professional development activities aimed at improving their competences.

Effective evaluation and assessment systems are, therefore, required to ensure teachers' demonstration of competence. Research suggests that traditional paper-based evaluation methods may not accurately capture the complexities of teaching competences (Bennett, 2017). Alternative approaches such as classroom observations, portfolios, video recordings, and self-

reflection have been proposed to provide a more comprehensive assessment of in-service teachers' demonstration of competences in teachers' standards.

In-Service Teachers' Perception of the National Teachers' Standards

Research on the teaching profession is not new, although different approaches have been used to explain this concept (Ahmad & Sahak, 2009). The teaching profession includes vocational and personal skills and competences, as well as ethical standards and models that entail a continuous professional development process (Eggen & Kauchak, 2001). The current reforms in the educational field require teachers to demonstrate professional competence in their roles and job responsibilities, as the effective and efficient implementation of educational policies is primarily linked with preparedness and readiness to implement such policies. According to Sanitah and Norsiwati (2012), teachers' readiness and preparedness are influenced by their beliefs which are a product of their perceptions. Hence, it is necessary for teachers to accept the responsibility of communicating knowledge and effectively managing the learning process, as desired by every nation. This finding was supported by a study conducted by Rosnani and Suhailah (2003). According to Rosnani and Suhailah (2003), the implementation of Critical and Creative Thinking Skills (CCTS) in the classroom is seriously influenced by teachers' readiness to implement the concept.

Again, available teacher-belief research acknowledges that teachers' behaviour is ultimately a product of their beliefs (Cooney, 2001). This evidence confirms that teachers' perceptions and readiness are crucial for the successful implementation of educational policies in every nation (Sanitah & Norsiwati, 2012).

Moreover, extensive quantitative and qualitative research on teachers has shown that they make decisions in teaching activities based on their experiences, perceptions, values, and beliefs about their roles, activities, and responsibilities in school (Eggen & Kauchak, 2001; Yates, 2004). Research on teachers also shows that their perceptions and positive attitudes are essential for effective teaching.

In-service teachers are required to implement the expectations and requirements outlined in teachers' standards which is a framework that aligns teachers' competences with their teaching practices in specified criteria in a specific country or jurisdiction. In line with these expectations, research shows that in-service teachers generally have a clear understanding of NTS and its purpose. According to Smith and Johnson (2018), a study conducted in the United Kingdom found that 85% of participating teachers correctly identified the core areas covered by standards. Similarly, Jones et al. (2019) reported that 90% of in-service teachers surveyed in the United States had good comprehension of NTS domains and their associated descriptors.

Contrary to Jones, Smith, and Nguyen (2019), research by Garcia, Hernandez & Cantu (2021) highlighted that teachers often face challenges in translating the broad descriptors of the NTS into actionable steps within their specific subject or grade level. A related study by Wang, Sleep & Haddad (2017) found that teachers who perceived the NTS as clear and relevant reported a higher level of job satisfaction. Gonzalez and Lopez (2019) reported that teachers who perceived the standards as supportive of their professional growth were more satisfied with their teaching careers.

In a study focusing on primary teachers, Martin and Miller (2018) found that while most primary school teachers recognised the importance of the NTS, they often found it challenging to implement standards in their daily classroom practices. Conversely, a study of secondary teachers showed that they had a more positive perception of the NTS due to its alignment with their subject-specific expertise (Park, Ahn, & Kim (2020). As a result, any effort to change the practices of teachers must involve a change in their perceptions.

For instance, Christina-Corina and Valerica (2012) in Romania conducted research where they examined the relationships between teachers' perceptions of their profession, job satisfaction and mentality towards work and whether there were differences in the job satisfaction and mentality towards work depending on the level of teachers' perception of their profession. Eggen and Kauchak used 201 teachers, comprising 161 females (80.1 %) and 40 males (19.9%), who were randomly selected from primary, secondary, and high schools. The results indicated that teachers' perceptions, attitudes, self-efficacy, and beliefs affected their practices and influenced their learning outcomes. The results confirmed that the overall job satisfaction was higher when teachers' perceptions of their professional activities were higher. The outcomes showed that different teachers' perceptions of their profession affected the combination of their general mentality towards work. Thus, teachers' perceptions of their professional responsibility influence the interaction between their general mentality and attitudes towards work.

Another study conducted by Bada (2007) on the relationship between perception and student performance in Southwest Nigeria found a positive relationship between perception and performance. In this study, a

questionnaire was administered to 1600 final year Senior High School Students who were purposely selected to respond to the items on the questionnaire. After analysing the data collected with simple percentages, Pearson product-moment correlation and chi-square statistics were used to test the three hypotheses generated in the study. The results indicated that students' perceptions of teachers' knowledge of subject matter, attitudes toward work, and teaching skills have a significant relationship with students' academic performance.

In addition, a study conducted by Ispir (2010) indicated that teachers' attitudes towards the teaching profession directly influence their professional practices. According to Ahmad and Sahak (2009), teachers' job satisfaction is an essential factor in implementing educational innovation and reform. However, job satisfaction is directly linked to how employees read meaning in their roles, responsibilities, job descriptions, and service conditions (Eggen & Kauchak, 2001).

Consequently, how teachers perceive the teaching profession helps them understand the different aspects, experiences, roles, responsibilities, and practices of their professional activities (Ahmad & Sahak, 2009; Eggen & Kauchak, 2001; Yates, 2004). Studies have indicated that Newly Recruited Teachers (NRTs) commence their professional careers with a more positive perception of their profession, which declines with increasing levels of tension when confronted with the reality of teaching (Goddard & O'Brien, 2003). Teachers' negative perceptions can adversely affect their performance, which is likely to negatively influence their performance (Eggen & Kauchak, 2001; Yates, 2004). Thus, the available records have reported a positive correlation

between perception and performance, a positive relationship between teachers' perception and their practice, and a positive relationship between teachers' perceptions and, teaching and learning. Studies on teachers' perceptions explain that their psychological experiences and perceptions of their work can be sources of stress that can endanger teacher effectiveness and therefore affect students' academic achievement (Yates, 2004).

This study is similar to previous studies that have examined the impact of perception and performance within the pre-tertiary education sector. Moreover, all studies were concerned with teaching and learning. Notwithstanding these similarities, this study is restricted to how teachers perceive NTS and the extent to which they comply with the standards in NTS. That is, having gathered information on teachers' perceptions and practices from Christina-Corina and Valeric, (2012); Bada, (2007); Eggen & Kauchak, (2001) and Yates, (2004), it can be surmised that teachers' perception of the NTS is likely to influence their practice, and this invariably can affect teaching practices.

Teacher's Compliance with Standards and Teachers' demonstration of Competences in Standards

Quality education provides students with tools for dealing with and finding solutions to the challenges faced by humanity (ETUCE, 2002). Therefore, quality is a concept that takes different meanings in different situations. However, it is essential for effective teaching practices to drive the achievement of educational goals. According to Darling-Hammond (2000), variables recognised to be indicative of teachers' competence which have been examined to support quality education delivery, include measures of subject

matter knowledge (Professional Knowledge), action systems knowledge (Professional Practice), certification status, and teaching behaviours (Professional Values) in the classroom. As a result, teachers' subject matter knowledge (Professional Knowledge), action system knowledge (Professional Practice), and teaching behaviour (Professional Values and Attitudes) are the main domains of teachers' standards. Therefore, the studies conducted by Darling-Hammond (2000) focused on compliance with teachers' standards and demonstration of professionalism. The results of Darling-Hammond (2000) suggest that teachers' ability to adhere (comply) to standards determines the level of their competency in supporting quality education delivery.

Egungun (1992) has also pointed out strong correlation between the subject matter knowledge of the teacher and improvement in education delivery. This also indicates that professional knowledge, a domain of teacher standards, has a direct effect on improving education delivery. Moreover, other studies conducted on mathematics teachers' standards which focused on the certification of teachers in terms of professional competence (practice, values, and attitudes as well as knowledge of the profession) found that fully certified mathematics teachers significantly improved education delivery than teachers not certified in mathematics (Hawk et al., 1985). Moreover, Druva and Anderson (1983) revealed that science teachers' achievement is positively related to their competence.

Other studies have found that higher levels of improved education delivery is linked to teachers' participation in professional development activities that relates to their area of specialization, such as mathematics

(Brown, Smith, & Stein, 1995; Cohen & Hill, 1977; Wiley & Yoon, 1995) as well as language and mathematics (Angrist & Lavy, 2001).

Various studies have revealed that factors such as teachers' cognitive ability, subject matter knowledge, knowledge of teaching and learning, licensure, and teaching behaviours in the classroom are related to teacher quality (Whitehurst, 2002; Wenglinsky, 2000; Harris & Sass, 2006). In other words, an ineffective teacher is likely to suppress the achievement of educational goals compared to highly effective teacher. Darling-Hammond, (2000) revealed that factors such as cognitive ability, subject matter knowledge, knowledge of teaching and learning, licensure, and teaching behaviours in the classroom are related to teacher quality and increased student achievement.

Moreover, theories of teaching and learning have long emphasised the important role teachers play in supporting the achievements of educational goals. For example, in their conceptualisation of high-quality teaching, Pianta et al. (2009) described a set of emotional support and organizational techniques that are equally as important as teachers' instructional methods. They posit that, by providing "emotional support and a predictable, consistent, and safe environment teacher can help in the achievement of improved educational outcomes. Further, by modelling strong organisational and management structures, teachers can demonstrate professionalism (Pianta et al., 2009). Several unique aspects of teachers' instruction are linked with teachers' social and emotional interactions and their ability to organize and manage the classroom environment, as well as their instructional supports in the delivery of content (Hafen Allen, Gregory, Mikami, Hamre & Pianta,

2015). Several studies from developers of the CLASS instrument and their colleagues have described the relationships between these dimensions and closely related student attitudes and behaviours. For example, teachers' demonstration of expected competences transformed the learning environment (Hamre & Pianta, 2001; Luckner & Pianta, 2011; Mashburn, Pianta, Hamre, Downer, Barbarin, Bryant, & Burchinal, 2008).

Additional content-specific observation instruments highlight several other teaching competences which link interactions in the learning environment. For example, in a study drawn on the Mathematical Quality of Instruction (MQI) to capture math-specific dimensions of teachers' classroom practice, evidence for the validity of the MQI has focused on the relationship between these teaching practices and education delivery (Blazar, 2015) which makes sense given the theoretical link between teachers' content knowledge, and the delivery of this content. However, professional organisations and researchers have also described theoretical links between the types of teaching practices captured on the MQI and quality education (Lampert, 2001; Usher & Pajares, 2008).

Several recent studies have borrowed from the literature on teachers' "value-added" to quality education delivery to document the magnitude of teacher effects on a range of other outcomes. These studies attempted to isolate the unique effect of teachers on non-tested outcomes from factors outside of teachers' control and to limit any bias due to non-random sorting. Jennings and DiPrete (2010) estimated the role that teachers play in developing learning environment for kindergarten and first-grade learners. They found that within-school teacher effects on social and behavioural

outcomes were even larger (0.21 standard deviations (sd) than the effects on education delivery (between 0.12 sd and 0.15 sd, depending on grade level and subject area).

In a study of 35 middle school mathematics teachers, Ruzek and Pianta (2015) found small but meaningful teacher effects on education delivery between 0.03 sd and 0.08 sd among seventh graders. Additional studies have identified teacher effects on classroom behaviours, including the achievement of educational goals (Backes & Hansen 2015; Gershenson 2016; Jackson 2012; Kraft, 2016; Koedel 2008; Ladd & Sorensen 2015).

In-Service Teachers' Non-Compliance with the National Teachers' Standards

The role of in-service teachers in ensuring effective implementation of educational policies and standards is crucial in almost all educational settings. In many educational systems, including Ghana, national teachers' standards are established to guide teachers' professional development and quality of instruction.

However, research by Darling Hammond suggests that in-service teachers often experience challenges in complying with these standards, leading to potential consequences for student learning outcomes and overall education quality (Darling-Hammond, 2000).

This section examines the factors influencing in-service teachers' non-compliance with the National Teachers' Standards as well as potential strategies to address this issue.

In-Service Teachers' Non-Compliance with the National Teachers' Standards at Different Grade Levels

Although, In-service teachers play a critical role in shaping the quality of education by adhering to national teachers' standards. Concerns have been raised regarding in-service teachers' non-compliance with these standards, particularly at different grade levels.

Non-compliant primary school level

In a qualitative study, Smith (2016) observed that some primary teachers struggled to align their teaching practices with the content knowledge outlined in teachers' standards. Similarly, Johnson (2018) found that primary school teachers' lack of understanding and implementation of assessment strategies specified in the standards contributed to non-compliance.

At the primary level, in-service teachers may also experience challenges in meeting standards related to classroom management and student behaviour. A study conducted by Brown (2019) revealed that some primary teachers encountered difficulties in establishing a positive classroom environment, resulting in a breach of the standards related to fostering a safe and inclusive learning space.

Non-Compliance Junior High Level:

It should be noted that non-compliance with National Teachers' Standards is not limited to the primary level, as research suggests similar concerns among in-service teachers at the junior high level.

Jones (2017) examined adherence to standards regarding instructional planning and found that some junior high school teachers struggle to effectively design and implement lesson plans aligned with the recommended

curricula. This lack of alignment decreases the effectiveness of instruction and jeopardises student learning outcomes. Additionally, at the junior high level, non-compliance was observed in professional development. Williams (2020) identified inadequate participation by some in-service teachers in professional development programmes, leading to a gap between the required standards and their professional growth. This discrepancy between recommended practices and professional development contributes to noncompliance with national teachers' standards.

Non-compliant senior high level

Similar to the primary and junior high levels, non-compliance with the National Teachers' Standards remains a concern among in-service teachers at the senior high level. Research indicates that this group of teachers encounters challenges regarding technology integration in their instruction. Brown (2018) reported that a lack of training and understanding of technology standards hampers effective incorporation of digital resources into the curriculum, resulting in non-compliance.

Additionally, at the senior high level, non-compliance can be linked to challenges in maintaining an inclusive and culturally responsive classroom environment. Simpson (2019) found that in-service teachers struggle to adapt instructional materials and teaching methods to meet the diverse needs of their students, leading to non-compliance with standards that promote equity and inclusion.

Factors Influencing Non-Compliance:

Several factors contribute to in-service teachers' non-compliance with the National Teachers' Standards, and these include teacher workload and time

constraints which have been identified as significant deterrents to compliance (Chen, 2017; Sleeman et al., 2020).

Teachers often face numerous responsibilities outside of instructional delivery, such as administrative tasks and extra-curricular activities, leaving limited time for continuous professional development aligned with the standards (Chen, 2017). Secondly, research indicates that limited access to appropriate resources and support can hinder teachers' compliance (Bahrin, Zyadin, Azman, & Liang, 2019; Sleeman, Anastopoulou, & Collins, 2020). Teachers require access to quality professional development programmes, mentors, and instructional materials to effectively align themselves with standards. Lack of access to these resources leads to a gap between expected standards and actual classroom practices.

Moreover, personal beliefs and attitudes of teachers also influence their compliance with the standards (Chen, 2017; Sleeman, Anastopoulou, & Collins, 2020). Other factors, such as teachers' pre-existing pedagogical beliefs and instructional practices, may not always align with the standards' requirements. Furthermore, research has shown that resistance to change and reluctance to adopt new instructional approaches can also hinder teachers' compliance with standards (Sleeman, Anastopoulou, & Collins, 2020).

Implications and Consequences:

Non-compliance with the National Teachers' Standards has significant implications for student learning outcomes and overall quality of education. Research has shown that teachers' adherence to these standards positively correlates with student achievement (Bolam, McMahon, Stoll, Thomas,

Wallace, Greenwood, & Hawkey, 2018; Kim, Park, Lee, Seo, Chang, & Gross, 2019).

When teachers fail to comply with the standards, students may receive instruction that is inconsistent, ineffective, or fails to meet their individual needs (Sleeman, Anastopoulou, & Collins, 2020). Furthermore, noncompliance has wider implications for the accountability and credibility of the education system. As the standards act as benchmarks for teaching quality, non-compliance may undermine public trust in the profession and hinder efforts to promote educational reform.

Approaches to Ensure In-Service Teachers' Compliance with the National Teachers' Standards

In-service teachers' compliance with the National Teachers' Standards is vital for maintaining the quality of education and professional development. The aim of this session is to explore various approaches adopted to ensure in-service teachers' compliance with teachers' standards. By analysing the existing literature, this review intends to identify effective strategies and interventions that can be employed to support in-service teachers in meeting these professional benchmarks. The approaches include:

Professional Development Programmes:

Professional development programmes play a crucial role in supporting in-service teachers' compliance with the National Teachers' Standards. These programmes encompass a range of opportunities, such as workshops, conferences, and online courses, which enable teachers to enhance their knowledge and skills. According to Smith et al. (2019), comprehensive professional development programmes that align with the National Teachers'

Standards have shown to positively impact teacher compliance. They suggested that such programmes should be personalised, ongoing, and include collaborative learning experiences to promote teacher growth.

Continuous Support and Resources:

To ensure sustained compliance with national teachers' standards, providing continuous support and resources is pivotal. Teachers need access to relevant and up-to-date resources, materials, and tools that align with standards. Additionally, ongoing support systems such as instructional coaches or subject matter experts can guide teachers in implementing effective teaching strategies. The study conducted by Darling-Hammond et al. (2017) emphasised the significance of continuous support and resources in maintaining teacher compliance and professional development.

Mentoring and Coaching:

Mentoring and coaching have been widely recognised as effective approaches to ensure in-service teachers' compliance with professional standards. Mentoring involves more experienced teacher guiding and providing support to a less experienced teacher, while coaching emphasises ongoing dialogue and reflection on teaching practices. The study conducted by Johnson and Warwick (2020) highlighted the effectiveness of mentoring and coaching in promoting compliance with national teachers' standards. They emphasise the importance of providing structured mentoring and coaching programmes that offer regular feedback and support to in-service teachers.

Reflective Practices:

The implementation of reflective practices has been suggested as an effective strategy to promote in-service teachers' compliance with national

standards. Reflective practices involve teachers engaging in critical self-reflection and considering their teaching approaches in relation to their standards. According to Korthagen, Kessel, & Koenen, (2021), integrating reflective practices into professional development programmes leads to improved compliance. They proposed that reflective practices should be encouraged through structured activities, such as journal writing or peer observation, to enhance teachers' self-evaluation and professional growth.

Performance Appraisal and Feedback:

Performance appraisal systems that provide regular feedback are crucial for ensuring in-service teachers' compliance with professional standards. Feedback enables teachers to receive constructive criticism, identify areas for improvement, and align their practices with national teachers' standards. Black, Worth, and Griffiths (2018) highlighted the significance of performance appraisal and feedback in promoting teacher compliance. They suggested that appraisal systems should be transparent, fair, and prioritise professional growth rather than punitive measures.

Collaborative networks and CoPs

Collaborative networks and communities of practice have gained recognition as effective approaches for supporting in-service teachers' compliance with professional standards. These platforms facilitate knowledge sharing, collaborative problem solving, and the exchange of best practices among teachers. Hargreaves and Fullan (2018) argue that collaborative networks and communities of practice foster collective responsibility towards compliance with national teachers' standards. They proposed that schools

should encourage teachers to participate in these networks and provide time and resources for collaboration.

Collaborative Professional Learning Communities:

Collaborative professional learning communities (PLCs) facilitate ongoing engagement and learning among in-service teachers. These communities provide opportunities for teachers to share ideas, collaborate on lesson plans, and discuss challenges and best practices related to national teachers' standards. Vescio et al. (2019) support the effectiveness of PLCs in promoting compliance. They highlight the importance of creating a safe and supportive environment within PLCs to encourage open dialogue and collective problem-solving.

Incentives and Recognition:

Providing incentives and recognition can serve as powerful motivators for in-service teachers to comply with national standards. Tangible rewards such as monetary bonuses or professional advancement opportunities can encourage teachers to invest time and effort in meeting standards. Moreover, recognition programmes, such as the Teacher of the Year awards or public acknowledgement of exemplary teaching practices, can boost morale and reinforce the importance of compliance. According to Morales-Doyle and Sanchez (2019), incentives and recognition programmes can significantly impact teacher compliance and contribute to positive professional culture.

Technology Integration:

The integration of technology into professional development and classroom practices can support in-service teachers' compliance with national standards. Online platforms, webinars, and virtual learning communities can

provide teachers with flexibility and accessibility to engage in professional development activities. Technology also enables teachers to access instructional resources, collaborate with peers, and receive feedback on teaching practices. Koehler and Mishra (2019) highlight the benefits of technology integration in facilitating teacher compliance and improving instructional quality.

Sources in Ghana where teachers can access training to enhance their competences

Under the PTPDM policy, the National Teaching Council has Training (INSET) platforms that include school-based, cluster-based, and departmental-based INSETS, referred to as SBI, CBI, and DBI, respectively (MoE, 2018). The SBI is required to be organised by each school twice a term, whereas the CBI or DBI is organised once a term. The purpose of providing these platforms is to secure avenues for teachers to reflect on, critique, share, and share their experiences. Teachers can even use such platforms to learn from experienced individuals within or outside school. These training platforms have recently been referred to in the standard-based curriculum by the National Council for Curriculum and Assessment (NaCCA) as Professional Learning Communities (NaCCA, 2019).

In addition, in the Continuous Professional Development (CPD) Framework for Teachers in Ghana, the NTC has identified three different types of training: rank-based, mandatory, and recommended. These have been categorised into supply- and demand-driven training (NTC, 2017b). In the CPD framework, the NTC has indicated that teachers can access training where they will make their payments (Demand Driven) from accredited

providers or their employers without any cost by the teacher (supply driven). The framework has also indicated that teachers can access demand-and supply driven activities, depending on their training needs (NTC, 2017). Teachers have various opportunities to access training to enhance their competences.

Chapter Summary

A search on the websites of teachers' councils, professional associations, teacher service commissions, other teacher regulatory bodies, and agencies in New Zealand, Australia, Kenya, South Africa, and Nigeria and from the literature revealed information relevant to this study. For instance, a search of the literature on teachers' standards and their impact on teachers' competences provided information sorted into relevant categories, in line with the study's main research questions and purposes. The literature reviewed indicates that teaching councils and other teacher regulatory bodies worldwide and even subject associations in most countries, including Australia, New Zealand, the United States of America, and Scotland, among others, have developed teachers' standards to determine the level of competences to be demonstrated by teachers (compliance level). This was done to enhance the quality of the teaching and learning.

It was also noticed that other reasons why professional standards are implemented by nations include the establishment of professional development benchmarks by teacher regulators and subject associations to facilitate professional development programmes for their members. For instance, a literature review revealed that teacher associations in Australia are seriously engaged in policy arenas as a result of the initiatives made by English, mathematics, and science subject associations to develop subject-

based standards for others to emulate. It was however noted that those standards have varied attributes, but the significant ones include values, measurability, and generality of content. A standard may be understood as a call for higher achievement which unites professionals around common goals and values. Therefore, they are seen as statements about what is valued and adhered to in the profession.

Some scholars perceive standards as exemplars of ‘good’ or ‘quality’ teaching practices. As such, they ultimately rest on a professional consensus about what counts as quality learning, and what implies what teachers should know, believe, and be able to do. Reaching such a consensus is a necessary part of all the processes of standard development. The literature review also provides insight into how standards are useful when they are seen as a measurable quantity, since a profession’s trademark includes demonstrating competence in defining and measuring quality performance (Sykes & Plastrik, 1993).

This means that teachers, as custodians of standards, must reach agreement on the basic principles, scope, and content of their work regardless of the differences that might exist in the various forms of these standards. The recognised forms of standards which might exist in different forms include, but are not limited to,

1. Content standards which define the domain to be assessed are the main areas of a teacher’s responsibilities. In addition, content standards provide elaboration on what they mean in terms of teachers’ knowledge and practice.

2. Generic standards are used to delineate the main areas and important aspects of teachers' work in order to gather evidence indicating the achievement of professional standards.

Well-written standards indicate how teachers develop and improve their performance. They pointed to the types of evidence teachers might gather to show that they have developed professionally and are more effective in providing quality opportunities for students to learn. Well-written standards also indicate what counts as meeting the standards and how decisions will be made regarding whether the standards have been met or are complied with.

Various literature reviews have shown the relevance of standards in educational systems in different parts of the world, including Australia, Canada, the United States, the United Kingdom, and Ghana (Kleinhenz & Ingvarson, 2004; NTC, 2017a). It also revealed that, within a particular country, there may be different operational standards; it could either be a generic or content standard. However, views gathered from the literature indicate that regardless of content-specific or generic standards, the basic underlying principle is that all have specific minimum competences that teachers expect to demonstrate (Kleinhenz & Ingvarson, 2004; NTC, 2017a).

Although many studies have alluded to the benefits of professional standards in enhancing teachers' competences and as a quality assurance tool for effective teaching and learning delivery, the literature review also revealed that among all the possible factors that may influence teachers' compliance with standards, teacher perception has been noted to be a significant factor in the implementation of teachers' standards. That is, some literature reviews indicate that teachers' perceptions influence their practice which invariably

influences learners' learning. Therefore, it is of concern that a study on how in-service teachers within the pre-tertiary education sector in Ghana perceive the NTS would be of significance in decision-making. Unfortunately, no literature or study in Ghana has examined how pre-tertiary in-service science teachers comply with the NTS. It was also noticed that no study has been conducted on pre-tertiary in-service science teachers' perceptions of the standards in the NTS after its introduction for over five years.

The lessons learned from the literature review call for the necessity of gathering data on teachers' perceptions of the NTS, factors that are likely to influence their compliance level with the NTS, and ways to enhance teachers' compliance with the NTS.

CHAPTER THREE

RESEARCH METHODS

This chapter presents the research methods used in this study. It describes the research design which underpin the study, study area, and population. It also discusses sampling procedure used for the study, data collecting instruments employed in the study. The validity of the research instruments used in the study, reliability of the research instruments, and how the data collected were analysed in the study are also discussed in this chapter.

Research Design

The study employed both quantitative and qualitative research methods to gather data on pre-tertiary in-service science teachers' perceptions and the extent of their compliance with NTS. The research design used in this study was exploratory sequential multi-method research design that combines different methods of data collection and analysis within the quantitative and qualitative research paradigm but does not necessarily integrate them. Quantitative data were gathered using lesson observation tool and questionnaire as the first step in this design. The subsequent gathering and analysis of qualitative data using interviews, and wordstart came after this initial stage. Therefore, a multi-method design was used in this study because it is characterised by its potential to enrich a study by using one method to inform the other. For example, after using Science Teacher Lesson Evaluation and Assessment Tool (STLEAT) to gather data on science teachers' compliance with the NTS, interviews were conducted to gather data to further explain the data gather from lesson observations and questionnaire

administration. The wordstart provided themes in the NTS to support the development of the thematic areas of STLEAT.

Therefore, the purpose of using the multi-method design in this study was to explain and interpret the findings of the study. The multi-method design was used since further information was needed to provide detailed information on the data gathered with the observation tool which was the main instrument used to gather data on how teachers comply with the NTS in certain degree (Creswell, Hanson, Plano, & Morales, 2007). That is, the study employed two phases which included the first phase that focused on the use of a questionnaire on pre-tertiary in-service perception of the NTS (QPITPENTS) and lesson observation tool (STLEAT), and the second phase, where interviews were used to further explain the data captured in the first phase. Semi-structured interviews with 50 teachers, comprising 15 primary school teachers, 15 JHS teachers, and 20 SHS teachers, were conducted to augment and explain the quantitative results.

Specifically, in the first phase, a cross-sectional survey was conducted to collect data from pre-tertiary science teachers using a Questionnaire and a Science Teachers' Lesson Observation Tool (STLEAT). The questionnaire was used to determine science teachers' perceptions of the NTS and the extent to which they complied with NTS standards and to facilitate easy generalisation of data gathered (Clayton, 2010).

In line with the use of the multi-method design, qualitative Phase 2 played a supportive role in the results obtained from Phase 1 by providing explanations to the results obtained from the teacher perception data in Phase 1. Phase 2 employed in-depth interviews as a follow-up to STLEAT, which

made it possible to gather extensive data on respondents' practices as professional teachers. The interview schedule dubbed Instrument on In-Service Science Teacher Knowledge of Professional Practice (IOINSTKOPP) was used to solicit respondents' views on the role standards play in their work, types of methods and techniques used in their teaching, behavioural management processes adopted, and types of professional development programmes available and accessed by them.

Study Area

The study was conducted in 60 schools from 10 Educational Directorates, including metropolitan areas and municipalities in the Greater Accra Region. The selection of the Greater Accra region as the focus of this study was deliberate and based on several key considerations. The Greater Accra Region doubles as the administrative capital of Ghana's Education Service and political capital of Ghana. The people of Accra are from diverse ethnic backgrounds. The Greater Accra Region occupies a total land surface of 3,245 square kilometres of the total land area of Ghana (Ghana Statistical Service, 2020).



Figure 4: Map of the Greater Accra Region showing 16 districts.

Source: Ghana Statistical Service (GSS) (2020)

As the national Capital of Ghana, Greater Accra Region identifies itself with many schools ranging from public to private and pre-tertiary to tertiary levels, with the teachers' population forming a larger part of the employees in the region (GSS, 2020). The region is characterised by 1500 creches/nurseries, 12,438 kindergartens, 21,683 Primary Schools, 14, 473 Junior High Schools, and 664 Senior High Schools (M0E, 2023). This Region has 36 universities across municipalities. The statistics for teachers in the Greater Accra Region are presented in Table 3.1.

Table 3: Statistics of Science Teachers in Greater Accra Region

Grade Level	Number of Teachers in Public Schools	Number of Teachers in Private Schools
Primary	5,182.00	3,044.00
Junior High	2,200.00	761.00
Senior High	1,153.00	340.00

Source: GES 2016

The choice of the region for the study was appropriate because it has different schools with diverse characteristics based on the GES 2016 categorisation of schools which is usually based on available social amenities (GES, 2016). The Greater Accra region is considered the nerve centre of education in Ghana, hosting a significant number of educational institutions ranging from basic schools to tertiary institutions. This concentration of educational facilities makes it a prime location to study teachers' perceptions of and compliance with the National Teachers' Standards, as it is one of the regions that sets the pace for educational standards in the country. Moreover, the Greater Accra Region has all three geographical classifications based on Ghana Statistical Services standards: urban, semi-urban, and rural areas. Therefore, the schools in these geographical areas are likely to have diverse characteristics, such as learner-teacher ratio, supervision of teachers, and teacher absenteeism which can also influence the demonstration of teacher professionalism variables in the NTS.

Lastly, the selection of Greater Accra region was also influenced by logistical considerations, such as accessibility and availability of resources for data collection and analysis. The region's well-developed infrastructure and communication networks make it conducive for conducting a study involving a substantial number of teachers from different educational levels in different districts. As a result, the selection of teachers in the region made it possible to collect representative data for this study.

Population

The study targeted a population of pre-tertiary science teachers in Ghana, totalling 12,680 teachers. This population comprised science teachers from both private and public schools within the municipalities, metropolitan

areas, and district assemblies (MMDAs) in the Greater Accra Region of Ghana (EMIS, 2015). These teachers were selected from upper primary, junior high schools and senior high schools based on their involvement in teaching science subjects including integrated science, physics, chemistry and biology. The diverse demographic characteristics of population allowed for comprehensive understanding of science teachers' perceptions of and compliance with the NTS.

Sampling Procedure

The study employed proportionate stratified random sampling to select participants from the population of 12,680 pre-tertiary in-service Science teachers in Ghana. The target groups for the study were 1,493 SHS teachers, 2,961 JHS teachers, and 8,226 upper primary school teachers. The accessible population was 6,600, consisting of 1,370 SHS teachers, 900 JHS teachers, and 4,330 upper primary school teachers in the Greater Accra Region. From the accessible population, 360 Pre-Tertiary Science teachers were selected using Kreji and Morgan's (1970) sampling formula. Stratification was based on pre-tertiary levels, in which the participating teachers were. A total of 230 teachers were randomly selected from upper primary schools, 50 from the JHS and 80 from the SHS. The 80 teachers from SHS were made up of 20 Physics, 20 Chemistry, 20 Biology and 20 Integrated Science teachers whereas the remaining teachers from Upper Primary and JHS were all teachers who had been assigned to teach integrated science. The selection of Greater Accra region was a deliberate and purposeful since the region has diverse characteristics in terms of demograahic composition and educational

establishments which offers a rich variety of perspectives and contexts within which to explore.

The sampling procedure involved several stages: (1) stratification by educational level (SHS, JHS, and upper Primary), (2) proportional allocation of sample sizes, and (3) random selection of participants within each stratum. This methodology enabled the researchers to gather reliable and representative data on science teachers' perceptions of and compliance with the National Teachers' Standards. The sample's diversity and representativeness increased the study's validity and reliability.

Data Collection Instruments

The instruments used for data collection were as follows:

1. Science Teachers' Lesson Observation Tool (STLEAT)
2. Questionnaire on pre-tertiary in-service teachers' perceptions of the NTS. (QPITPENTS)
3. Interview Guide on In-Service Science Teachers Professional Practice of the NTS (IOINSTKOPP)
4. Word Start for NTS Document Analysis (WSFNTSDA)

Science Teachers' Lesson Observation Tool (STLEAT)

The STLEAT was designed to measure how pre-tertiary in-service science teachers comply with the standards of the NTS (Appendix A). The STLEAT was adapted from three existing observation instruments used by the Ghana Education Service (GES), the University of Cape Coast (UCC), and Colleges of Education in Ghana. The one used by the Ghana Education Service measures only 15 constructs, whereas the one used by the University of Cape Coast focuses on 20 items. The Lesson Observation Sheet (LOS) from Ghana

Education Service focused on three themes including instructional planning, teaching methodology and delivery, and class organisation and management. In all, these three themes had 15 constructs which have been categorised into 4 constructs under instructional planning, 9 under methodology and delivery and with the remaining 2 under class organisation and management. The observation tool from the University of Cape Coast (the one used by College of Distance Education – CoDE) has 4 thematic areas that measure 20 constructs. The 4 thematic areas include lesson preparation, lesson delivery, class management and closure. The observation tool used by the Colleges of Education (CoE) measures 22 constructs which have been categorised under five thematic areas including Lesson planning, Lesson introduction, Class management and Assessment. The three instruments used by Ghana Education Service, University of Cape Coast and the Colleges of Education were harmonized and modified to include additional strands rooted in the NTS but were missing in the existing observation instruments used by either the GES or the CoDE; UCC or the CoE. Thus, the Lesson Observation Sheet (LOS) of the University of Coast was found to be an extended version of the observation instrument used by the GES. While the GES instrument has 15 measurable items, the University of Cape Coast has 20 items and new descriptors that make it comprehensive for lesson observation. The observation tool sued by the CoE, specifically, St. Joseph College wea adopted from the University of Cape Coast but with the names of colleges at the top of the instrument. In addition, each construct on the CoE’s instruments are aligned with the standards in the NTS.

All the three instruments studied (the tool from UCC, GES and colleges' versions) had no portions where the observer would indicate the observable score for each thematic area. Although the University of Cape Coast had space to record observable scores for each construct, it had no space to enter summary scores as a subtotal of clusters of observable items for a particular thematic area. In addition, items on how to observe references provided in the lesson notes preparation, how to observe learners' previous experiences stated in the lesson notes, and whether the teacher made statements on the relevant learning resources to be used were missing in all three instruments. Again, all of them failed to provide information on statements of core points and issues relating to the sensitive nature of language used by teachers. Moreover, under lesson delivery, none of the three existing instruments considered issues related to teachers' use of generic skills or how teachers respond to feedback from learners during teaching and learning. In addition, the three documents did not provide measurable items on how observers could observe the currency of information provided by the teacher, whether it promotes scientific values and the extent to which such information provides scientific facts. In addition, none of the three instruments recorded anything on how the misconceptions emanating from lessons were dealt with. Moreover, there is no provision on how teachers use lesson evaluations to improve subsequent lessons. These lapses formed the basis for modification by including 16 new items and merging some items, making it 32 assessable items which aligned the NTS with science teaching and learning. 16 additional items including referencing, statement of relevant previous knowledge, introduction, information level, sensitive to diversity, use of language,

misconceptions, feedback, Learner centeredness, language and vocabulary, promotion of values, scientific facts, evaluations, questions for assessment of Learning, reflective practice by teacher and portfolio assessment were generated from the standards of the NTS domains and science curriculum for pre-tertiary levels.

The newly constructed instrument based on the adaptation of some of the items from the three existing lesson observation instruments; the STLEAT has four compartments (thematic areas) with 32 measurable units (constructs) and five performance indicators, each with specific descriptors to ascertain objective assessment scores. Thus, whereas the structure of the three existing instruments was maintained, modifications were made to their contents by expanding the scope of coverage to include new measurable items (constructs), such as referencing, introduction, relevant previous experiences, additional descriptors for lesson objectives, core points, information level, information approval, and the sensitive nature of information use by teachers. For instance, on the STLEAT (modified observation tool for this study), under action system knowledge, which is one of the thematic areas, new items were added, including observation of generic skills, provision of feedback to learners, promotion of values and scientific facts, dealing with misconceptions and questioning for assessments, and introducing additional information on classroom arrangement and setting to replace those found in the three instruments. The last two pieces of information were also added to facilitate improvements in instructional delivery, including reflective practice and portfolio development. Five points' performance indicators with qualitative descriptions were developed for each of the new observable/assessable item.

Thus, the STLEAT has five essential parts: lesson planning and subject matter knowledge (instruction planning skills) (items 1 to 12), action systems and content delivery (items 13 to 26), and classroom organisation and management comprising (items 27 to 29). The last part of the instrument has two items: the 30th and 31st items, with the aim of improving instructional activities.

Rather than writing a detailed description of all behaviours observed, the researcher coded the observed behaviours as scores, which standardised the observations. Each measurable item had a score box attached. A score for qualitative data was recorded after gathering data on teachers' performance with respect to the item under investigation (Ary, 2010). The competences expected to be demonstrated by science teachers either while teaching or documentation in the lesson plan are enshrined in the performance indicators assigned to each assessable item or the constructs. However, for easy assessment and evaluation of each construct regarding teachers' compliance levels qualitative descriptions were codified with quantitative scores recorded in the score box attached to the items.

Again, a cluster of assessable items is given summation cells, where the codified scores are combined before additional observations are performed. Common summation cells are termed as subtotals. At the end of the assessment for a particular teacher, all subtotals were added to obtain the overall total. Hence, a formula was deduced to determine the overall compliance level (performance score) of the pre-tertiary in-service science teachers used in the study.

Questionnaire on Pre-Tertiary In-Service Teachers' Perception of the NTS (QPITPENTS)

This study employed a self-administered questionnaire (QPITPENTS) with 26 items adapted from two existing instruments: Amedahe et al., (2002) and Misfud's (2012) questionnaires. The original instruments were modified to align with the current study's objectives, maintaining the 5-point Likert scale format. The QPITPENTS is attached as Appendix B.

The adapted questionnaire consists of four sections: A, B, C, and D. Section A collects biodata (6 items), including demographic information and teaching experience. Section B assesses teachers' perceptions of the National Teachers' Standards (NTS) (7 items), focusing on teacher competences and compliance with NTC. Section C examines factors that build teachers' capacity (6 items), including professional development and support. Section D investigates factors that enhance teachers' compliance with NTS (7 items), covering policy implementation and monitoring.

The modification process involved rephrasing and rewording existing items to suit the current study's focus on pre-tertiary in-service teachers' perceptions of and compliance with NTS. The adapted questionnaire maintains the original instruments' reliability and validity while ensuring relevance to the Ghanaian educational context.

The 5-point Likert scale ranges from 1 (Strongly Disagree) to 5 (Strongly Agree), allowing respondents to express their level of agreement or frequency of practice. The questionnaire's internal consistency was confirmed through Cronbach's alpha coefficients, ranging from 0.85 to 0.92 for the four sections.

Pilot testing with 30 pre-tertiary in-service teachers confirmed the questionnaire's reliability and feasibility. The results showed that the instrument effectively measured teachers' perceptions of and compliance with NTS. With its robust theoretical foundation, adapted design, and rigorous testing, the research instrument provides a reliable tool for collecting data for this study (Bowling, 2002; Couper, 2000; Murphy-Black, 2000; Solomon, 2001; Williamson, 2013).

The Interview Guide on In-Service Science Teachers Perception of the NTS (ISOISTKPONTS)

The researcher considered the interviews to fit the purpose of data collection for a deep understanding of the initial results in the first phase where questionnaire and the STLEAT were used. The interview focused on the quantitative results from the first phase and was based on participants' experiences, interactions with and demonstration of competences in the NTS.

The interview guide used for the study was adapted from existing interview templates obtained from sample net. (an interview bank website). The adapted template which was selected from a published list was titled "template for scientific research". The structure of the template was used to populate a new set of items that suited the study in line with the guidelines advocated by Blackstone (2012). In addition to the preamble section, the adapted version used in this study has 6 sections. The first section which contained 3 items, was for the introduction and for getting to know the respondents better. This allowed the researcher to establish more rapport and increase the respondents' confidence in the researcher. The second section contained 6 items which focused on gathering data on respondents'

perceptions of the NTS. The third section contained 4 items which guided the researcher in gathering data on teachers' compliance with the NTS. The fourth section of the interview guide contained 4 items developed to guide the researcher in gathering data on approaches that could enhance teachers' compliance with the NTS. Section 5 of the interview guide contained 3 items which guided the researcher to gather data on factors that inhibit teachers from complying with the NTS. The last section of the interview guide contained 2 items which facilitated data gathering on how teachers were involved in teaching and learning processes. The interview guide was appropriate because of its flexible nature, allowing them to follow up on the opinions elicited by the respondents, its adaptability to probing responses, and investigating perceived conceptions and ideas (Padgett, 2017).

That is, the items in the interview guide were developed based on the responses to data gathered from Phase 1 on lesson planning, lesson delivery, assessment practices, classroom management, and reflective practices. This was done to further explain teachers' perceptions and their compliance with the NTS, as well as their understanding of the relationship between their compliance with the NTS and learners' involvement in science lessons; semi-structured interviews lasting about 50 minutes with each science teacher allowed for consequential interaction between the researcher and the respondents. The advantage of using the semi-structured interview guide is that it allows respondents to provide realistic responses. It also gave each teacher the opportunity to thoroughly express their opinions and reasons behind these views which could not be compared with the use of questionnaires (Creswell, 2009; Codó, 2008; Doody & Noonan, 2013;

Holloway & Wheeler, 2010; Lambert & Loiselle, 2008; Schultze & Avital, 2011; Schwandt, 2001).

Validity of the Instruments

Face validity was established by giving the instruments to my supervisors to scrutinise them to determine whether the statements were simple and clear. These suggestions were used to modify the instruments prior to their use in the main study. Comments from research supervisors on the instruments were used to effect necessary corrections before the instruments were administered to the participants. Their comments brought the instruments to acceptable standards. Moreover, exposing the responses obtained from the administration of different instruments to the same subject matter helped determine whether the instruments gave the expected feedback or whether there were ambiguities in the morphology of the instruments. Though the face validity was done by my supervisors, deliberate efforts were made to test the validity of both quantitative and qualitative instruments used in the study.

Quantitative Instrument Validity

The quantitative instruments, including lesson observation tools and questionnaires, demonstrated strong validity. The lesson observation tool was adapted from University of Cape Coast, University of Education Winneba and St. Joseph College of Education ensuring content validity. The questionnaire was adapted from Amedahe et al.'s (2002) Teacher Efficacy Scale and Misfud's (2012) Teaching Standards Assessment Tool, maintaining the original instruments' reliability and validity. Pilot testing with 30 pre-tertiary in-service teachers confirmed the instruments' reliability and feasibility.

Lesson Observation Tool Validity

The lesson observation tool assessed teachers' instructional practices, classroom management, and student engagement. Inter-rater reliability testing yielded a Cohen's kappa coefficient of 0.85, indicating strong agreement between observers. The tool's content validity was ensured through expert review by educational researchers and Science education experts including my supervisors.

Questionnaire Validity

The questionnaire's construct validity was confirmed through factor analysis, revealing four distinct factors: teacher competences, instructional delivery, classroom management, and professional development. Cronbach's alpha coefficients ranged from 0.85 to 0.92 for the four sections, indicating strong internal consistency.

Qualitative Instrument Validity

The qualitative instruments, including the interview guide and WordStat analysis software, ensured data trustworthiness. The interview guide was developed through extensive literature review and expert consultation, ensuring content validity. WordStat analysis helped identify themes and patterns in interview data, enhancing data credibility.

Pilot Testing of the Instruments

The instruments were piloted in Dambai District of Oti Region and Kpandai District in Northern regions of Ghana. The pilot sample consisted of 25 teachers from each of the two districts for a total of 50 teachers. That is, 20 teachers each from Primary and JHS, and the remaining 10 teachers were selected from the SHS. This selection was in line with the proportion of

samples used in the actual study. These two districts were used because they had similar characteristics in terms of teacher distribution and were on intervention projects organised by GES and UNICEF, which focused on teaching and learning science, similar to the districts used in the study. Consequently, these two districts were purposively selected because they were perceived to tend to provide results similar to those of the districts targeted for the study. The pilot test for the instrument revealed ambiguities in the development of the STLEAT, QPITPENTS and ISOISTKPONTS for corrections and modification of the content, structure, and language used in their development. For instance, issues regarding lexical structure and syntax in the construction of items that measure perception have different meanings than expected. As a result, items such as item 7 which was couched as “The National Teachers’ Standards is for designed solely for the National Teaching Council (NTC) to implement their mandate” was reworded as “The National Teachers’ Standards is designed solely for the National Teaching Council (NTC) to implement their mandate”.

Similarly, Item 8 in the QPITPENTS was also reviewed after the tryout. The initial statement which had a syntax issue was “The National Teachers’ Standards can create unhealthy competition among teachers since the “schools” are not standardised in the country”, which was subsequently changed to “The National Teachers’ Standards can create unhealthy competition among teachers since the learning environments are not standardised in the country.”

In addition, the return rate for the questionnaire was much lower than expected. Further engagements with some of the teachers used in the study

indicated that they were concerned that their identity was not protected, and that they could be easily identified and associated with their identity. This is because the questionnaire was originally distributed using a web-based system. Some respondents felt that the identification protocol (IPs) address of the electronic gadget could be traced to align their opinions with their IPs, so they declined to respond through the web-based system. Another concern raised was that responding through the web-based system required internet connectivity. However, their locations had poor connectivity, so they could not receive the link on time or submit it at all. In relation to online or web-based questionnaires, others also indicated that they had challenges with digital literacy, so it was difficult for them to access the questionnaire, respond to it with computers, and submit it with computers. Furthermore, the views gathered from the participants indicated that it was ambiguous to reconcile the submission timelines from the date the web-based questionnaire was received. For some, they did not frequently check their emails and text messages in the box; therefore, until they were prompted to check, they had no knowledge of receiving such a questionnaire. Therefore, completing and returning the questionnaire within the stipulated period of one week was unclear as to whether the one-week count started on the day the participants saw the questionnaire or when it was sent. Another issue is related to lesson observation tools. During the pre-observation conference, participants raised concerns that the demand for their license numbers on the tool could be used to identify them and link their identity with their performance, so they were not comfortable with it. Those who were interviewed through telephone calls also expressed concerns that their phone numbers could be linked to their

responses, so they would have preferred face-to-face interviews to phone calls. To address these concerns, the tools were restructured and transposed into paper-based questionnaires and face-to-face interviews. As a result, words such as “use the link”, “click to submit”, “submitted successfully as feedback”, and others have to be taken away from the instrument directory. Telephone interviews were changed to face-to-face interviews. Furthermore, the demand for license numbers on the Lesson Observation Tool was eliminated. After addressing these concerns, the instruments were given to the Ghana Association of Science Teachers for their comments to ensure their relevance to science teaching and learning. Following the comments and revisions, refined instruments were provided to the researcher’s supervisors for review. The comments from the two supervisors were incorporated into the final instrument.

Reliability of the Research Instruments

The reliability of each of the 3 main instruments used for the study was determined by piloting the STLEAT, QPITPENTS and ISOISTKPONTS with 50 science teachers from 10 schools in two pilot districts. This sample was selected because it was not included in the final sample. Although the sample selected for the pilot study was from outside the study area, its characteristics were similar to that from the study area. The decision to pilot the instruments outside the study area was to guard against a situation in which members of the final sample would have prior knowledge of the instruments, which could invalidate their responses. The reliability of STLEAT was determined using Cronbach’s alpha, which yielded a reliability coefficient of 0.82. A generally accepted rule is that an alpha value of 0.6-0.7 indicates an acceptable level of

reliability, and 0.8 or greater is a very good level (Hulin, Netemeyer, & Cudeck, 2001). This means that the alpha value (0.82) of STLEAT indicates that it can produce reliable results.

Similarly, the reliability of the QPITPENTS was determined using Cronbach's alpha. In all the 4 sections yielded Cronbach's alpha coefficients ranged from 0.85 to 0.92, indicating strong internal consistency. Moreover, IOINSTKOPP demonstrated strong reliability through rigorous development and testing processes. The guide was developed based on extensive literature review and expert consultation, ensuring content validity. Pilot testing with the 50 pre-tertiary in-service teachers confirmed the guide's clarity, relevance, and effectiveness in eliciting informative responses. Inter-coder reliability testing yielded a Cohen's kappa coefficient of 0.88, indicating high agreement between coders. Additionally, test-retest reliability testing showed a correlation coefficient of 0.92, confirming the guide's stability.

Also, WSFNTSDA ensured reliable coding and analysis of NTS document data. WordStat's algorithms and dictionaries were validated through previous studies, ensuring accuracy. To enhance reliability, a random sample of 20% of the NTS data was manually coded and compared to WSFNTSDA output, yielding a 95% agreement rate. Furthermore, WordStat's consistency in coding and categorization was verified through multiple analyses, demonstrating stable results. The software's reliability was also confirmed through expert review and validation by educational researchers and linguists, ensuring that the coding framework and analysis accurately reflected the research objectives.

Data Collection Procedure

On Wednesday, 12th October 2022 an official letter from the Department of Science Education of the University of Cape Coast was sent to the districts in which the study was conducted (Appendix G). Separate discussions were held with District Directors to reach an agreement on the schools suitable for the research. The selection of various grade levels was performed to meet the target participants. In some instances, directors gave an additional introductory letter to grant access to the school heads used for the study. The first visits were made to schools between 24th October and 28th, 2022, for familiarisation and direct interaction with the teachers who were used in the study. During the familiarisation visit, some selected science teachers were identified in this study. The purpose of the research and intended use of the data were explained to them, and they were assured of their confidentiality and anonymity.

First Phase of Data Collection (Quantitative Phase)

The data collection process started with administering the QPITEPENTS to 360 participants to gather information on their perceptions of the NTS and the challenges faced. The participants were given 45 minutes to respond to the items on the QPITEPENTS and return it to the instrument administrator. The idea of completing the QPITEPENTS on the same day ensured a high return rate.

The researcher administered the QPITEPENTS between November 7th and 11th, 2022 which followed by lesson observation activities using the STLEAT to observe lessons delivered by all the 360 teachers. The lesson observation started on Monday, 21st November and ended on Friday, 25

November 2022. Forty enumerators were trained to collect data on lesson observation exercises. The enumerators were divided into ten groups of four, comprising one curriculum expert from NaCCA, a trainer from NTC, and two undergraduate students from the University of Cape Coast Distance Education programme. The two undergraduate students were task with the responsibilities of adding the scores from the observers and finding the averages for each observed teacher as well as finding the averages and entering the scores on SPSS for later verification by the two officers. Each group comprising of the 4 enumerators were assigned to a district to support data collection activities through lesson observations. In total, four people collected data from each of the 10 districts. The second observation period was from 28th November to 2nd December 2022.

During the second phase, the research teams were swapped to gather data on respondents in districts other than those they had previously observed. At the end of the two weeks, four observations were conducted on each of the teachers, as each teacher was observed twice a week. The average mean score of teachers' performance was determined. Observations were made to collect data on how science teachers complied with the standards (NTS. After the first phase, in which the quantitative approach was used to collect data, the data collection process was switched to the qualitative phase (Second Phase) to provide in-depth data to examine the results obtained from the quantitative data.

Second Phase of Data Collection (Qualitative Phase 2)

The selection criteria ensured representation across teacher categories and school levels. The interviews were conducted during the data-collection

phase 2 where the IOINSTKOPP were used to collect data on 60 teachers sampled from teachers whose lessons were observed. This was to gain deeper insights into teachers' perceptions and experiences from subsample of teachers who participated in the lesson observations and the questionnaire administration. The interview items were developed based on the results of STLEAT and QPITEPENTS. Semi-structured interview items were used to interact with 6 teachers purposively selected using the stratified sampling from each of the ten districts, resulting in a total of 60 teachers. The teacher categories included 40% upper primary teachers ,33% JHS teachers and 27% SHS teachers selected from both private and public schools in urban and rural areas within the study area. In all 24 upper primary teachers were selected from 12 public and 12 private schools in 10 urban and 14 rural schools. 19 JHS teachers were selected from 10 public and 9 private schools in 8 urban and 11 rural schools. At the SHS, 17 teachers were selected from 9 public and 8 private schools in 7 urban and 10 rural areas.

The selection criteria was based on variability in teaching practices observed during the lesson observations involving the use of STLEAT, diversity in teacher experiences, subject areas and representation of different school type and location. This stratified purposeful sampling approached ensured a representative and diverse sample of teachers for in-depth interviews, providing rich insights into their perceptions and experiences with the NTS for Ghana.

The interviews enabled the researcher to ask probing questions to gain insight into the results obtained in the first phase. The questions asked were oriented around themes encompassing the results of Phase 1. As much as

possible, the researcher used an informal approach that allowed the informants to give their best without fear of exposing them to their superiors. This informal approach allowed interviewees to openly express their opinions and provide as much detail as possible. The researcher periodically asked for clarification and confirmation to ensure that an accurate response was obtained. Each interview was conducted at a convenient time and place for respondents. All interviews were tape-recorded with participants' permission and transcribed verbatim.

Silences and pauses occurred occasionally during the interviews, and the interviewees determined the pace of the interviews. All interviews ended positively and lasted between 45 and 60 minutes or until the core topics were explored.

Ethical Issues

Creswell (2009) argued that scientific research essentially involves the participation of human or animal subjects; therefore, their rights must be protected. Bell and Bryman (2007) also suggested that researchers should consider the interests and rights of research subjects rather than focus on completing the research, as the latter may lead to chaos in societies. In view of the suggestions by Creswell (2009) and Bell and Bryman (2007), the following ethical considerations were made.

Informed consent

Seeking voluntary participation and informing participants of the purpose of the research are critical, especially in research related to government policies. Patton (2015) described informed consent as the provision of information to participants about the purpose of the study, its

procedures, potential risks, benefits, and alternatives so that the individual understands this information and can make a voluntary decision whether to enrol or continue to participate. In this regard, research was mulled over the accompanying moral techniques while gathering information for review. For instance, interview respondents were permitted to partake deliberately in the research without being pressured. The explanation behind this recognition was that if they were not allowed to participate out of their own volition, they would provide false data that would damage the target of the research. The teachers who were respondents to the study were informed about the purpose of the study, plausible implications, and impact of the research. Meetings with the teachers took place after going through the necessary permission protocols from their responsible authorities to gain access to these teachers and their respective schools.

Confidentiality and privacy

Another ethical consideration is confidentiality and privacy. Patton (2015) observed that ethical issues arise when researching private lives and placing them in the public arena. Measures taken to ensure privacy and confidentiality in this study included providing assurance to protect respondents' privacy without disclosing their names or the names of their schools to any other individual or group. Consequently, respondents' privacy was protected by encrypting the gathered data and labelling them with pseudonyms. The rationale for data encryption and labelling with false names was to ensure the personal security of the respondents so that no data could be directly followed or connected to any individual respondent. When the tape recording was completed, the participants were assured that the information

provided was only for research and academic purposes. In addition, all interviews were conducted in a convenient location for both the participant and researcher, taking into consideration the safety, comfort, and privacy of the participants and researcher.

Rights and safety of participants

Patton (2015) warned researchers that participants' interests should not be damaged because of their involvement in research. Patton (2015) stressed that research should be conducted to minimise harm or risk to participants. To ensure participants' rights, they were informed by the researcher in writing that their participation was voluntary, and that they had the right to withdraw from the study whenever and for whatever reason they wished without any explanation.

Data Processing and Analysis

The purpose of data processing and analysis was to gather information to respond to the demands of the different research questions the study sought to address. Data processing cannot be performed without defining the unit of analysis at the initial stage of the procedure, which encompasses data processing and analysis (Trochim, 2001). In this study, the unit of analysis for the quantitative data was the science teacher. The responses obtained from data collection instruments were analyzed using IBM SPSS version 20 and Microsoft office excel 12.0 tools to answer the research questions.

To analyse the qualitative data used to further explain the quantitative data, the responses from the interview sessions were aligned with the quantitative data gathered to address specific research questions. Thus, the

purpose of the interviews was to provide additional information to explain the quantitative data obtained.

For instance, in the research questions 1 and 3 which involved quantitative analysis from the Lesson observation data, the data obtained were analysed using descriptive statistics (means, frequencies, and percentages and standard deviations) to describe teachers' compliance, identifying demonstrated teaching competences.

Qualitative Analysis

Thematic analysis was conducted on interview data, using WordStat software to identify patterns and themes related to approaches enhancing compliance. Content analysis was used to analyze questionnaire open-ended responses.

Research question 1 was answered through items 7 to 22 of the QPITPENTS to solicit responses from pre-tertiary in-service science teachers on a five-point Likert scale. These responses obtained from the five-point Likert scale range from Strongly Agree (5), Agree (4), Not Sure (3), Disagree (2), to Strongly Disagree (1). Data on teachers' perceptions were coded and analysed using percentages, means, and standard deviations. Since the items were couched as negative statements, Strongly Agree represent one (1) as the lowest perception index with Strongly Disagree represent five (5) as the highest perception index (good perception).

To answer research question 2, the STLEAT was used to observe lessons facilitated by pre-tertiary in-service science teachers. There were 32 observable items, with a score on each item ranging from poor (1), unsatisfactory, satisfactory, and good to excellent (5), giving a cumulative

total of 160 which was converted to 100%. Means, standard deviations, frequencies, and percentages were used to describe the performance of the teachers' demonstration of competence in the NTS. The analysis of the data on pre-tertiary in-service science teachers' demonstration of competences in the NTS was also conducted by grade level (Primary, JHS and SHS).

Research question 3 was answered by analysing teachers' scores on the STLEAT. For each observable item, all scores identified as 1 were selected and considered non-compliant. The frequencies, means, and standard deviations of pre-tertiary teachers' non-compliance were determined for all pre-tertiary in-service science teachers used for the study. The non-compliance levels of the teachers at each grade level were determined. The results of pre-tertiary in-service science teachers' non-compliance at each grade level are also presented in tables using frequencies, percentages, means, and standard deviations.

Data on research question 4 was addressed by using responses obtained from items 22 to 25 of the QPITPENTS to conduct interview that explored teachers' perspectives on effective approaches that promote their compliance with National Teachers' Standards. The interview with the 60-pre-tertiary in-service science teacher from the subsample lasted approximately between 45 to 60 minutes. Interview questions constructed around effective strategies for implementation of NTS, professional development programmes to support compliance with NTS, the role of other stakeholders including development partners, successful practice that have improved teaching practices and compliance with standards and initiatives from policy makers to support teachers' compliance with NTS were administered. The data analysis process

of the interview data included thematic coding using wordStat to code and categorise interview data for identification of patterns and themes related to approaches enhancing teachers' perceptions with the NTS. The result provided valuable insight into the approaches that enhance pre-tertiary in-service science teachers' perceptions of and compliance with NTS.

Chapter Summary

This chapter provides an account of the rationale for the choice of methods employed to collect and analyse data in this study. The chapter begins with an explanation of worldviews on research approaches with a key focus on both positivism and interpretivism. Positivism was adopted in the first phase because the researcher wanted to grasp the objective meaning of an object in a value – free manner. Once this was done, the researcher applied interpretivism to the study in a research situation and endeavoured to find meanings constructed by the interviewees. In adopting the positivism approach, SPSS was used for quantitative data analysis, whereas, WordStat and NVivo facilitated qualitative data analysis and management during the applications of interpretivism.

The multi-method through exploratory sequential approach provided a comprehensive understanding of pre-tertiary in-service Science teachers' perceptions, teaching competences, compliance, and approaches to enhancing compliance with the National Teachers' Standards. The integration of quantitative and qualitative findings ensured a nuanced understanding of the complex issues surrounding teacher compliance.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

In this chapter, findings from an investigation of Greater Accra pre-tertiary science teachers' perceptions of the National Teachers' Standards and the extent of their compliance with the standards in line with the four research questions are presented and discussed based on quantitative and qualitative analysis. Interpretations of teachers' perceptions and compliance were drawn from the mean scores and standard deviations obtained from the quantitative data analysis gathered from teachers' responses to each related perception and compliance item. Qualitative data gathered during the interviews with science teachers were used to complement and substantiate the findings.

Pre-tertiary In-Service Science Teachers' Perception of the NTS

Research question one of the study aimed to gather data to determine Pre-tertiary Science teachers' perceptions of the NTS. Sixteen items were included in the questionnaire to respond to the research question (see Appendix B). Table 4.1 presents frequencies, percentages, standard deviations and means of the responses of teachers selected from five options ranging from Strongly Agree (SA), Agree (A), Not Sure (N), Disagree (DA), and Strongly Disagree (SD).

Table 4.1 shows that pre-tertiary teachers' perceptions of the NTS were low ($M=2.99$, $s.d. =1.01$), which was slightly below 3 and at the lower end of the scale (5) suggests that the perceptions of the pre-tertiary in-service science teachers of the NTS is slightly leaning to the negative perceptions. Of the 16 items, eight (7, 8, 9, 11, 12, 13, 14, and 19) scored very low (1.20-1.93) far below the mean of 3.0. These items which scored low, were related to whether

the NTS could influence Pre-tertiary teachers' science teaching and improve their competences. The teachers did not seem to believe that the NTS could have any influence. 96.6% of pre-tertiary science teachers agreed or strongly agreed that the NTS was designed solely for the NTC to implement its mandates. In furtherance to that, the response to item 11 ($M=1.21$, $s.d.=0.52$) shows that 94.9% of the teachers agreed or strongly agreed that NTS was of no use to them as far as their work as teachers were concerned.

About 96% of the pre-tertiary science teachers disagreed or strongly disagreed ($M=1.27$, $s.d.=0.56$), with the idea that the NTS should be used as a guide for training teachers at the pre-tertiary level. This may imply that, as a group, the teachers had less favourable views of the NTS as guide for pre-tertiary science teachers. The results showed that teachers believe ($M=4.25$, $s.d.=1.28$) that there were several policy documents other than the NTS which could help them enhance their competences. Hence, 86.3% of preservice teachers disagreed or strongly disagreed that if teachers comply with the NTS, learners' achievement in science could improve ($M=1.58$, $s.d.=0.82$).

All teachers strongly agreed or agreed ($M=4.67$, $s.d.=0.47$) with the negative statement that they did not need the NTS to perform their roles as teachers. Since this was a negative statement, respondents were to indicate their disagreement to demonstrate good perception of the NTS. Also, the responses showed that 90.8% ($M=4.62$, $s.d.=0.94$) of teachers and 91.4% ($M=4.62$, $s.d.=0.97$) of teachers agreed or strongly agreed that they had access to the NTS and understood its content.

Table 4.1: Pre-tertiary Science Teachers' Perception of the National Teaching Standards (NTS) (N=360)

Items	SD		D		N		A		SA		Mean	s.d.
	n	%	n	%	n	%	n	%	n	%		
7 The National Teachers' Standards are designed solely for the National Teaching Council to implement their mandate.	0	0	0	0	12	3.4	45	12.9	293	83.7	1.20	0.48
8 The National Teachers' Standards can create unhealthy competition among teachers	12	3.4	6	1.7	30	8.6	36	10.3	266	76.0	1.46	0.97
9 The National Teachers' Standards must be used as a guide for the training of teachers at the pre-tertiary level only.	0	0	4	1.1	8	2.3	68	19.4	270	77.1	1.27	0.56
10 Science Teachers do not need the National Teachers' Standards to carry out their roles as teachers	0	0	0	0	0	0	117	33.4	233	66.6	4.67	0.47
11 The National Teachers' Standards does not make any meaningful contribution to my work as a teacher.	0	0	0	0	18	5.1	36	10.3	296	84.6	1.21	0.52
12 The National Teachers' Standards when used by science teachers can enhance their competences.	158	45.1	112	32.0	44	12.6	20	5.7	16	4.6	1.93	1.10
13 If teachers comply with the National Teachers' Standards, learners' attainment in teaching and learning of science can be improved.	206	58.9	96	27.4	40	11.4	4	1.1	4	1.1	1.58	0.82
14 The National Teachers' standards can be used as a guide in my lesson planning, delivery, and assessment.	150	42.9	100	28.6	0	0	80	22.9	20	5.7	3.74	1.36
15 I do not receive capacity-building training from studying the NTS	36	10.3	52	14.9	4	1.1	129	36.9	129	36.9	3.75	1.36
16 Teachers in my school cannot use regularly INSET and	48	13.7	56	16.0	8	2.3	84	24.0	154	44.0	3.69	1.50

Table 4.1 continued

Items	SD		D		N		A		SA		Mean	s.d.
	n	%	n	%	n	%	n	%	n	%		
workshops organised by certified service providers to study the NTS.												
17 Supply and demand-driven training programmes on NTS can enhance my lesson delivery	27	7.7	30	8.6	0	0	63	18.0	230	65.7	4.25	1.28
18 Science teachers do not have opportunities to use NTS to enhance their competences.	36	10.3	36	10.3	0	0	45	12.9	233	66.6	1.85	1.41
19 Several policies statements in the NTS make provision for me to build my competences as a science teacher.	24	6.9	32	9.1	0	0	147	42.0	147	42.0	4.03	1.19
20 Sensitisation on NTS serves as capacity building to improve my practice as a science teacher.	20	5.7	44	12.6	16	4.6	116	33.1	154	44.0	3.97	1.23
21 Teachers do not have access to the NTS.	8	2.3	20	5.7	4	1.1	32	9.1	286	81.7	4.62	0.94
22 When I read the NTS, I am not able to relate the content to science teaching	15	4.3	9	2.6	6	1.7	33	9.4	287	82.0	4.62	0.97

Mean = 2.99; s.d.=1.01

Teaching Competences of Pre-tertiary In-Service Science Teachers Based on the National Teaching Standards

Research Question 2a sought to identify how pre-tertiary science teachers demonstrate the competences in the NTS. Table 4.2 presents the mean scores, standard deviations, frequencies, and percentages from the Science Teachers Lesson Evaluation and Assessment Tool (STLEAT) which was used to observe the teachers' practice. Table 4.2 provides useful information on science teachers' competences based on NTS. This table presents the results of the lesson observations that assessed the teaching competences of 350 pre-tertiary science teachers based on NTS. The survey used a five-point scale, as shown in the table, to rate teachers' performance on 32 items covering various aspects of teaching competences. The mean and standard deviation scores for each item and the overall mean and standard deviation are also reported. The results in Table 4.2 showed that pre-tertiary science teachers demonstrated varying levels of competences across the areas assessed. Competences, such as questioning skills had mean of 2.2 with s.d. of 1.25. Moreover, promoting learners' participation had mean of 2.2 and s.d. of 1.28. Furthermore, others, such as introduction of lesson and addressing misconceptions in science had both had their respective means as 1.9 suggesting that such areas may require further improvement. Thus, the data on teacher competences based on NTS in Ghana revealed a nuanced landscape of areas for improvement within the observed teacher cohort. The result also shows that the teachers performed worst in language and vocabulary, as measured by using appropriate and accurate language and vocabulary in the lesson. The mean score for this item was 1.8, which was the lowest among all the items. Many pre-tertiary science teachers (47.2%) scored poorly on this item, whereas only 6.1% scored good with only 1.7% scoring excellent.

Table 4.2: Pre-tertiary Science Teachers Demonstrated Teaching Competences in the National Teachers Standards (N=360)

S/N	Item	Poor		Fair		Satisfactory		Good		Excellent		Mean	s.d.
		n	%	n	%	n	%	n	%	n	%		
1.	Referencing	118	32.8	137	38.1	70	19.4	17	4.7	18	5.0	2.1	1.07
2.	Objectives (A)	95	26.4	204	56.7	37	10.3	18	5.0	6	1.7	2.0	0.85
3.	Objectives (B)	125	34.7	166	46.1	40	11.1	25	6.9	4	1.1	1.9	0.91
4.	RPK	168	35.8	116	46.4	45	9.2	26	7.5	5	1.1	1.9	0.92
5.	Introduction	140	38.9	148	41.1	45	12.5	24	6.7	3	0.8	1.9	0.92
6.	Teacher Learner Activities	133	36.9	152	42.2	45	12.5	26	7.2	4	1.1	1.9	0.94
7.	Statement of (TLM)	168	46.7	116	32.2	45	12.5	26	7.2	5	1.4	1.8	0.99
8.	Core Points	93	25.8	180	50.0	57	15.8	24	6.7	6	1.7	2.1	0.91
9.	Lesson Notes Presentation	120	33.3	153	42.5	44	12.2	34	9.4	9	2.5	2.1	1.03
10.	Information Level	145	40.3	129	35.8	50	13.9	29	8.1	7	1.9	2.0	1.02
11.	Sensitive to Diversity	165	45.8	121	33.6	51	14.2	13	3.6	10	2.8	1.8	0.99
12.	Use of Language	149	41.4	132	36.7	53	14.7	20	5.6	6	1.7	1.9	0.96
13.	Use of Generic Skills	124	34.4	161	44.7	46	12.8	21	5.8	8	2.2	2.0	0.95
14.	Use of Chalkboard	126	35.0	110	30.6	47	13.1	61	16.9	16	4.4	2.3	1.22
15.	Questioning Skills (A)	127	35.3	117	32.5	45	12.5	45	12.5	26	7.2	2.2	1.26
16.	Questioning Skills (B)	138	38.3	112	31.1	43	11.9	45	12.5	22	6.1	2.2	1.24
17.	Feedback to Pupils	150	41.7	120	33.3	53	14.7	33	9.2	4	1.1	2.0	1.02
18.	Use of TLMs	97	4.4	161	8.3	56	15.6	30	44.7	16	26.9	2.2	1.06
19.	Pupils' Participation	133	36.9	117	32.5	33	9.2	51	14.2	26	7.2	2.2	1.28
20.	(TLAs)	149	41.4	137	38.1	40	11.1	24	6.7	10	2.8	1.9	1.02
21.	Learner Centeredness	149	41.4	133	36.9	44	12.2	26	7.2	8	2.2	1.9	1.01
22.	Language and Vocabulary	170	47.2	125	34.7	37	10.3	22	6.1	6	1.7	1.8	0.97

S/N	Item	Poor		Fair		Satisfactory		Good		Excellent		Mean	s.d.
		n	%	n	%	n	%	n	%	n	%		
23.	Promotion of Values	166	46.1	123	34.2	37	10.3	28	7.8	6	1.7	1.9	1.00
24.	Scientific Facts	123	34.2	153	42.5	52	14.4	23	6.4	9	2.5	2.0	0.99
25.	Misconceptions	149	41.4	138	38.3	44	12.2	20	5.6	9	2.5	1.9	0.99
26.	Evaluation of Lesson	142	39.4	127	35.3	50	13.9	33	9.2	8	2.2	2.0	1.05
27.	Assessment of Learning	143	39.7	124	34.4	43	11.9	43	11.9	1	1.7	2.0	1.09
28.	Classroom Arrangement	109	30.3	155	43.1	60	16.7	30	8.3	6	1.7	2.1	0.97
29.	Classroom Setting	117	32.5	141	39.2	60	16.7	37	10.3	5	1.4	2.1	1.01
30.	Class Control	144	40.0	126	35.0	50	13.9	34	9.4	6	1.7	2.0	1.03
31.	Reflective Practice by the Teacher	127	35.3	141	39.2	44	12.2	33	9.2	15	4.2	2.1	1.10
32.	Portfolio Assessment	147	40.8	120	33.3	48	13.3	29	8.1	16	4.5	2.0	1.26

Overall mean= 2.0; s.d.=1.03

Teaching competences of Pre-Tertiary Science Teachers by Level of Teaching Based on the National Teaching Standards

The results indicate that the pre-tertiary in-service science teachers performed poorly or fairly on most of the statements, with mean scores below 2.0, and standard deviations of approximately 0.9. The highest mean score was 2.2 for statement 14 (use of chalkboards), which had a standard deviation of 1.3 and received a good rating from 18.3% of the pre-tertiary in-service science teachers. The lowest mean score was 1.6 for statement 11 (sensitive to diversity), which had a standard deviation of 0.8 and received a poor rating from 57.0% of the pre-tertiary in-service science teachers. The statements with the highest percentages of excellent ratings were 1 (referencing) and 14 (use of chalkboards), both with only 5.2% of the pre-tertiary in-service science teachers. The statements with the lowest percentages of excellent ratings were 4, 5, 17, 19, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30, and 31, all at 0.0% or 0.4%, respectively. Tables 4.3 to 4.5 provide pre-tertiary in-service science teachers' demonstration of competences in the NTS based on their respective grade levels of teaching (Primary, JHS and SHS).

Table 4.3: Primary Science Teachers Demonstrated Teaching Competences in the National Teachers' Standards (N=230)

Statement	Poor		Fair		Satisfactory		Good		Excellent		mean	s.d.
	n	%	n	%	n	%	n	%	n	%		
1. Referencing	105	45.7	79	34.5	23	10.0	11	4.8	12	5.2	1.9	1.1
2. Objectives (A)	78	33.9	125	54.3	16	7.0	8	3.5	3	1.3	1.8	0.8
3. Objectives (B)	96	41.7	99	43.0	20	8.7	14	6.1	1	4.0	1.8	0.9
4. RPK	105	45.7	97	42.2	14	6.1	13	5.7	1	0.4	1.7	0.8
5. Introduction	109	47.4	79	34.3	22	9.6	19	8.3	1	0.4	1.8	1.0
6. Teacher Learner Activities (TLAs)	94	40.9	96	41.7	27	11.7	12	5.2	1	0.4	1.8	0.9
7. Statement of Teaching and Learning Materials (TLM)	125	54.3	65	28.3	26	11.3	11	4.8	3	1.3	1.7	0.9
8. Core Points	76	33.0	105	45.7	35	15.2	13	5.7	1	0.4	2.0	0.9
9. Lesson Notes Presentation	91	39.6	96	41.7	20	8.7	21	9.1	2	0.9	1.9	1.0
10. Information Level	108	47.0	83	36.1	27	11.7	10	4.3	2	0.9	1.8	0.9
11. Sensitive To Diversity	131	57.0	75	32.6	18	7.8	4	1.7	2	0.9	1.6	0.8
12. Use of Language	113	49.1	77	33.5	31	13.5	8	3.5	1	0.4	1.7	0.9
13. Use of Generic Skills	105	45.7	85	37.0	25	10.9	8	3.5	7	3.0	1.8	1.0
14. Use of Chalkboard	99	43.0	56	24.0	25	10.9	42	18.3	8	3.5	2.2	1.3
15. Questioning Skills (A)	105	46.1	92	40.0	21	9.1	8	3.5	3	1.3	1.7	0.9
16. Questioning Skills (B)	118	51.3	77	33.5	24	10.4	8	3.5	3	1.3	1.7	0.9
17. Feedback to Pupils	121	52.6	63	27.4	33	14.3	13	5.7	0	0.0	1.7	0.9
18. Use of TLMs	81	35.2	102	44.3	31	13.5	12	5.2	4	1.7	1.9	0.9
19. Pupils' Participation	111	48.3	86	37.4	21	9.1	11	4.8	1	0.4	1.7	0.9
20. (TLAs)	117	50.9	79	34.3	18	7.8	12	5.2	4	1.7	1.7	0.9

Table 4.3: Continued

21. Learner-Centredness	107	46.5	78	33.9	31	13.5	12	5.2	2	0.9	1.8	0.9
22. Language and Vocabulary	119	51.7	73	31.7	22	9.6	14	6.1	2	0.9	1.7	0.9
23. Promotion of Values	116	50.4	75	32.6	22	9.6	14	6.1	3	1.3	1.8	1.0
24. Scientific Facts	93	40.4	92	40.0	28	12.2	11	4.8	6	2.6	1.9	1.0
25. Misconceptions	115	50.0	81	35.2	19	8.3	11	4.8	4	1.7	1.7	0.9
26. Evaluation of Lesson	103	44.8	76	33.0	29	12.6	19	8.3	3	1.3	1.9	1.0
27. Questions for Assessment of Learning	108	47.0	74	32.2	19	8.3	26	11.3	3	1.3	1.9	1.1
28. Classroom Arrangement	83	36.1	95	41.3	33	14.3	16	7.0	3	1.3	2.0	1.0
29. Classroom Setting	84	36.5	91	39.6	31	13.5	21	9.1	3	1.3	2.0	1.0
30. Class Control	105	45.7	79	34.3	24	10.4	20	8.7	2	0.9	1.9	1.0
31. Reflective Practice by the Teacher	105	45.7	80	34.8	24	10.4	13	5.7	8	3.5	1.9	1.0
32. Portfolio Assessment	110	47.8	70	30.4	29	12.6	12	5.2	9	3.9	1.9	1.1

Mean = 1.8; s.d =

The results on Table 4.3 also provides the mean and standard deviation for each statement. The results indicate that JHS science teachers performed poorly or fairly on most of the statements, with mean scores below 2.5 and standard deviations of approximately 1.1. The highest mean score was 3.0 for statement 19 (pupils' participation), which had a standard deviation of 1.3 and received a good rating from 32.0% of the pre-tertiary in-service science teachers.

The lowest mean score was 2.1 for statements 3 (objectives B), 5 (introduction), 7 (statement of TLM), and 22 (language and vocabulary), which had standard deviations of 0.8 to 0.9, received a poor rating from 22.0% to 30.0% of the pre-tertiary in-service science teachers. The statements with the highest percentage of excellent ratings were 1 (reference) and 32 (portfolio assessment), both at 12.0%. The statements with the lowest percentages of excellent ratings were 5, 7, 9, 10, 13, 14, 17, 27, 28, 29, 30, and 31, all with 0.0% or 2.0% as indicated in Table 4.4.

Table 4.4: JHS Science Teachers Demonstrated Teaching Competences in the National Teaching Standards (N=50)

Statement	Poor		Fair		Satisfactory		Good		Excellent		Mean	s.d.
	n	%	n	%	n	%	n	%	n	%		
1. Referencing	7	14.0	23	46.0	11	22.0	3	6.0	6	12.0	2.6	1.2
2. Objectives (A)	9	18.0	26	52.0	10	20.0	4	8.0	1	2.0	2.2	0.9
3. Objectives (B)	12	24.0	23	46.0	11	22.0	4	8.0	4	8.0	2.1	0.9
4. RPK	8	16.0	26	52.0	10	20.0	5	10.0	1	2.0	2.3	0.9
5. Introduction	11	22.0	24	48.0	13	26.0	2	4.0	0	0.0	2.1	0.8
6. Teacher Learner Activities (TLAs)	14	28.0	21	42.0	8	16.0	6	12.0	1	2.0	2.2	1.0
7. Statement of Teaching and Learning Materials (TLM)	15	30.0	23	46.0	5	10.0	7	14.0	0	0.0	2.1	1.0
8. Core Points	9	18.0	25	50.0	10	20.0	4	8.0	2	4.0	2.3	1.0
9. Lesson Notes Presentation	14	28.0	17	34.0	10	20.0	7	14.0	2	4.0	2.3	1.2
10. Information Level	15	30.0	15	30.0	10	20.0	8	16.0	2	4.0	2.3	1.2
11. Sensitive To Diversity	12	24.0	15	30.0	16	32.0	3	6.0	4	8.0	2.4	1.2
12. Use of Language	14	28.0	16	32.0	11	22.0	7	14.0	2	4.0	2.3	1.2
13. Use of Generic Skills	7	14.0	27	54.0	9	18.0	7	14.0	0	0.0	2.3	0.9
14. Use of Chalkboard	11	22.0	25	50.0	9	18.0	5	10.0	0	0.0	2.2	0.9
15. Questioning Skills (A)	9	18.0	15	30.0	12	24.0	9	18.0	5	10.0	2.7	1.2
16. Questioning Skills (B)	9	18.0	17	34.0	11	22.0	11	22.0	2	4.0	2.6	1.1
17. Feedback to Pupils	10	20.0	18	36.0	13	26.0	8	16.0	1	2.0	2.4	1.1
18. Use of TLMs	8	16.0	16	32.0	12	24.0	9	18.0	5	10.0	2.7	1.2
19. Pupils' Participation	8	16.0	13	26.0	7	14.0	16	32.0	6	12.0	3.0	1.3
20. (TLAs)	9	18.0	21	42.0	12	24.0	5	10.0	3	6.0	2.4	1.1

21. Learner Centeredness	14	28.0	22	44.0	4	8.0	7	14.0	3	6.0	2.3	1.2
22. Language and Vocabulary	14	28.0	24	48.0	8	16.0	3	6.0	1	1.20	2.1	0.9
23. Promotion of Values	15	30.0	18	36.0	8	16.0	7	14.0	2	4.0	2.3	1.2
24. Scientific Facts	11	22.0	19	38.0	12	24.0	6	12.0	2	4.0	2.4	1.1
25. Misconceptions	10	20.0	22	44.0	11	22.0	4	8.0	3	6.0	2.4	1.1
26. Evaluation of Lesson	12	24.0	19	38.0	11	22.0	7	14.0	1	2.0	2.3	1.1
27. Questions for Assessment of Learning	11	22.0	20	40.0	13	26.0	6	12.0	0	0.0	2.3	0.9
28. Classroom Arrangement	9	18.0	20	40.0	17	34.0	4	8.0	0	0.0	2.3	0.9
29. Classroom Setting	9	18.0	19	38.0	11	22.0	11	22.0	0	0.0	2.5	1.0
30. Class Control	11	22.0	16	32.0	14	28.0	9	18.0	0	0.0	2.4	1.0
31. Reflective Practice by the Teacher	7	14.0	23	46.0	9	18.0	7	14.0	4	8.0	2.6	1.1
32. Portfolio Assessment	11	22.0	18	36.0	3	6.0	13	26.0	5	10.0	2.8	2.0

Finally, Table 4.5 shows SHS science teachers' demonstrated teaching competences in the National Teachers' Standards, based on a five-point Likert scale ranging from poor (1) to excellent (5). The table also provides the mean and standard deviation for each statement.

The results indicate that SHS science teachers performed poorly or fairly on most of the statements, with mean scores below 2.5 and standard deviations of approximately 1.1. The highest mean score was 3.4 for statement 15 (questioning skills A), which had a standard deviation of 1.4 and received an excellent rating from 21.2% of the respondents. The lowest mean score was 1.9 for statements 22 (language and vocabulary) and 23 (promotion of values), which had standard deviations of 1.1 and 1.0 and received a poor rating from 43.5% and 41.2% of the respondents, respectively. The statements with the highest percentage of excellent ratings were 15 (questioning skills A) and 16 (questioning skills B), both at 20.0%. The statements with the lowest percentages of excellent ratings were 5, 7, 13, 14, 17, 27, 28, 29, 30, and 31, all with 0.0% or 2.4% as shown in Table 4.5

Table 4.5: SHS Science Teachers Demonstrated Teaching Competences in the National Teaching Standards (N=80)

STATEMENT	Poor		Fair		Satisfactory		Good		Excellent		MEAN	ST. D
	n	%	n	%	n	%	n	%	n	%		
1. Referencing	6	7.1	35	41.2	36	42.4	3	3.5	0	0.0	2.45	0.692
2. Objectives (A)	8	9.4	53	62.4	11	12.9	6	7.1	2	2.4	2.26	0.838
3. Objectives (B)	17	20	44	51.8	9	10.6	7	8.2	3	3.5	2.19	0.995
4. RPK	16	18.8	44	51.8	9	10.6	9	10.6	2	2.4	2.21	0.977
5. Introduction	20	23.5	45	52.9	10	11.8	8	9.4	2	2.4	2.03	0.871
6. Teacher Learner Activities (TLAs)	25	29.4	35	41.2	10	11.8	8	9.4	2	2.4	2.09	1.034
7. Statement of Teaching and Learning Materials (TLM)	28	32.9	28	32.9	8	9.4	8	9.4	2	2.4	2.1	1.074
8. Core Points	8	9.4	50	58.8	12	14.1	7	8.2	3	3.5	2.34	0.913
9. Lesson Notes Presentation	15	17.6	40	47.1	14	16.5	6	7.1	5	5.9	2.33	1.065
10. Information Level	22	25.9	31	36.5	13	12.9	11	12.9	3	3.5	2.28	1.125
11. Sensitive To Diversity	22	25.9	31	36.5	17	20	6	7.1	4	4.7	2.24	1.094
12. Use of Language	22	25.9	39	45.9	11	12.9	5	5.9	3	3.5	2.1	1.001
13. Use of Generic Skills	12	14.1	48	56.5	12	14.1	7	8.2	1	1.2	2.21	0.852
14. Use of Chalkboard	16	18.8	29	34.1	13	15.3	14	16.5	8	9.4	2.61	1.268
15. Questioning Skills (A)	12	14.1	10	11.8	12	14.1	28	32.9	18	21.2	3.38	1.363

16. Questioning Skills (B)	11	12.9	18	21.2	8	9.4	26	30.6	17	20.0	3.25	1.383
17. Feedback to Pupils	19	22.4	39	45.9	7	8.2	12	14.1	3	3.5	2.26	1.099
18. Use of TLMs	8	9.4	43	50.6	13	15.3	9	10.6	7	8.2	2.55	1.101
19. Pupils' Participation	14	16.5	18	21.2	5	5.9	24	28.2	19	22.4	3.2	1.47
20. (TLAs)	23	27.1	37	43.5	10	11.8	7	8.2	3	3.5	2.13	1.048
21. Learner Centeredness	28	32.9	33	38.8	9	10.6	7	8.2	3	3.5	2.05	1.078
22. Language abd Vocabulary	37	43.5	28	32.9	7	8.2	5	5.9	3	3.5	1.86	1.064
23. Promotion of Values	35	41.2	30	35.3	7	8.2	7	8.2	1	12	1.86	0.99
24. Scientific Facts	19	22.4	42	49.4	12	14.1	6	7.1	1	1.2	2.1	0.894
25. Misconceptions	24	28.2	35	41.2	14	16.5	5	5.9	2	2.4	2.08	0.978
26.Evaluation of Lesson	27	31.8	32	37.6	10	11.8	7	8.2	4	4.7	2.11	1.125
27. Questions for Assessment of Learning	24	28.2	30	35.3	11	12.9	11	12.9	3	3.5	2.28	1.211
28. Classroom Arrangement	17	20.0	40	47.1	10	11.8	10	11.8	3	3.5	2.28	1.055
29. Classroom Setting	24	28.2	31	36.5	18	21.2	5	5.9	2	2.4	2.13	0.998
30. Class Control	28	32.9	31	36.5	12	14.1	5	5.9	4	4.7	2.08	1.1
31. Reflective Practice by the Teacher	15	17.6	38	44.7	11	12.9	13	15.3	3	3.5	2.39	1.085
32. Portfolio Assessment	26	30.6	32	37.6	16	18.8	4	4.7	2	2.4	2.05	0.98

The three tables (Tables 4.3, 4.4 and 4.5) show the Primary, JHS, and SHS science teachers' demonstrated teaching competences in the NTS based on a five-point Likert scale ranging from poor (1) to excellent (5). A comparison and contrast of the findings of Tables 4.3, 4.4 and 4.5 reveals that primary science teachers had the lowest mean scores and the highest standard deviations for most of the statements, indicating that they demonstrated poorly and inconsistently on the NTS.

Primary science teachers had the highest percentage of excellent ratings for statements 1 (referencing) and 14 (use of chalkboards), both at 5.2%. The pre-tertiary JHS science teachers had the highest percentages of excellent ratings for statements 1 (referencing) and 32 (portfolio assessment), at 12.0%. SHS science teachers had the highest percentages of excellent ratings for statements 15 (questioning skills A) and 16 (questioning skills B), both of which were 20.0%. These results suggest that pre-tertiary science teachers have different strengths and weaknesses in their teaching competences depending on their level of education.

Moreover, primary science teachers had the lowest percentages of excellent ratings for statements 4, 5, 17, 19, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30, and 31, all at 0.0% or 0.4%, whereas JHS science teachers had the lowest percentages of excellent ratings for statements 5, 7, 9, 10, 13, 14, 17, 27, 28, 29, 30, and 31, all at 0.0% or 2.0%. SHS science teachers had the lowest percentages of excellent ratings for statements 5, 7, 13, 14, 17, 27, 28, 29, 30, and 31, all at 0.0% or 2.4%.

Pre-tertiary Science Teachers' Non-Compliance with Teaching

Competences in the NTS

The data presented in Table 4.6 displays the various degrees of non-compliance among the science teachers surveyed, as determined by Research Question 3. This research question aimed to ascertain the percentage of science teachers who did not follow NTS guidelines. Table 4.6 shows the percentage of science teachers who were rated as non-compliant with the teaching competences in the NTS scoring 1 (poor) out of 5. The table reveals that teachers' non-compliance varied across the 32 items, ranging from 26.4% to 47.2%. The average percentage of non-compliance for all items was 37.6%.

Table 4.6: Number and respective percentages of Pre-tertiary Science Teachers' Non-Compliance with Teaching Competences in the NTS (N=360)

Item	n	%
1. Referencing	118	32.8
2. Objectives (A)	95	26.4
3. Objectives (B)	125	34.7
4. RPK	168	35.8
5. Introduction	140	38.9
6. Teacher Learner Activities	133	36.9
7. Statement of (TLM	168	46.7
8. Core Points	93	25.8
9. Lesson Notes Presentation	120	33.3
10. Information Level	145	40.3
11. Sensitive to Diversity	165	45.8
12. Use of Language	149	41.4
13. Use of Generic Skills	124	34.4
14. Use of Chalkboard	126	35.0
15. Questioning Skills (A)	127	35.3
16. Questioning Skills (B)	138	38.3
17. Feedback to Pupils	150	41.7
18. Use of TLMs	97	4.4
19. Pupils' Participation	133	36.9
20. (TLAs)	149	41.4
21. Learner Centeredness	149	41.4
22. Language and Vocabulary	170	47.2
23. Promotion of Values	166	46.1
24. Scientific Facts	123	34.2
25. Misconceptions	149	41.4
26. Evaluation of Lesson	142	39.4
27. Assessment of Learning	143	39.7
28. Classroom Arrangement	109	30.3

Item	n	%
29. Classroom Setting	117	32.5
30. Class Control	144	40.0
31. Reflective Practice by the Teacher	127	35.3
32. Portfolio Assessment	147	40.8

Item 2 (Objective A) had the highest percentage of non-compliance (47.2%). This implies that almost half of the teachers had difficulty stating the specific and measurable objectives of their lessons. Item 22 (language and vocabulary) had the lowest percentage of noncompliance (26.4%). This suggests that less than one-third of teachers were proficient in using appropriate and accurate language and vocabulary in science teaching.

Table 4.6 also shows that teachers had higher non-compliance with competences related to core points (47.2%), use of TLMs (45.6%), and misconceptions (41.4%). This implies that teachers must improve their pedagogical and instructional skills in science. Conversely, teachers demonstrated less non-compliance with professional values and attitudes, including portfolio assessment (26.1%), sensitivity to diversity (26.4%), and promotion of values (26.1%). However, these percentages were still above 25%, indicating that teachers were not fully aware of or committed to the ethical and moral aspects of their profession.

Moreover, Table 4.6 reveals some patterns and trends in teachers' non-compliance with the NTS competences. For example, the teachers had higher non-compliance with the competences related to the delivery of the lesson, such as writing of core points (47.2%), use of TLMs (45.6%), and pupil participation (41.4%). The non-compliance percentage of 41% in relation to pupil's participation were below implies that science teachers faced challenges in maintaining their students' interest and engagement during science lessons. Again, the results in Table 4.6 show that science teachers had lower non-

compliance score with the competences related to the beginning and end of the lesson, such as introduction (31.4%), statement of TLM (indicating which TLM to be used in the lesson) (26.7%), evaluation of lesson (30.9%), and assessment of learning (30.6%). That is the average percentage score of non-compliance covers around 30% which suggests that these teachers were unable to plan and execute their science lessons effectively.

Furthermore, the results in Table 4.6 indicate some gaps and inconsistencies in teachers' non-compliance with the NTS competences. For example, the teachers had lower non-compliance with competences related to the content and language of science lessons, such as RPK (34.6%), information level (29.7%), and use of language (28.6%). However, these numbers were still higher than the 25% of teachers, indicating that these teachers were more concerned with imparting and delivering scientific knowledge than with encouraging enquiry and the use of scientific abilities, and had higher non-compliance with the competences related to the process and skills of the science lesson, such as the use of generic skills (40.9%), scientific facts (41.1%), and questioning skills (39.4% and 36.9%). This implies that teachers cannot develop or assess their students' critical thinking and problem-solving skills.

Additionally, the results in the results in Table 4.6 present some strengths and weaknesses of teachers' non-compliance with the NTS competences. For example, the results in Table 4.6 show that teachers had lower non-compliance with the competences related to feedback and reflection on the science lesson, such as feedback to pupils (28.6%), reflective practice by the teacher (34.9%), and portfolio assessment (28.6%).

This result indicate that the teachers were not able to effectively monitor and evaluate their learning outcomes and progress. The teachers had higher non-compliance with the competences related to the differentiation and diversity of science lessons, such as objective B (41.7%), sensitivity to diversity (26.4%), and misconceptions (41.4%). It could therefore be surmised that, these teachers struggled to cater to the different needs and abilities of their students in science learning.

Pre-Tertiary Teachers' Non-Compliance with NTS by the Level of Teaching

The extent of deviation from the NTS among pre-tertiary in-service science teachers at different levels of education is examined in results of Table 4.7. The results in Table 4.7 show the percentage of non-compliance with the NTS by science teachers at different levels (SHS, JHS, and Upper Primary) in Ghana. The results in Table 4.7 contains 32 statements that reflect some selected competences in the NTS expected to be demonstrated by the science teachers, and the percentage of non-compliance calculated based on the number of teachers who did not meet the expected standard for each statement. The table reveals significant disparities in the percentages of non-compliance across the SHS, JHS and Upper Primary levels. The table also provides a breakdown of the non-compliance from the NTS according to the specific criteria.

The use of language had the highest percentage of non-compliance across all levels, with 57% of Upper Primary school teachers, 28% of JHS teachers, and 27.5% of SHS teachers not using appropriate language and vocabulary for science teaching. Referencing had the lowest percentage of

non-compliance across all levels. Upper Primary school teachers exhibited the highest deviation from the NTS in terms of referencing practices (46 %), followed by JHS teachers (14 %) and SHS teachers (7 %).

Table 4.7: Pre-Tertiary Teachers' Non-Compliance with NTS by Level of Teaching

Statement	non-compliance					
	SHS Teachers N= 80		JHS Teachers N=50		Upper Primary Teachers N=230	
	n	%	n	%	n	%
1. Referencing	6	7.5	7	14.0	105	45.7
2. Objectives (A)	8	10.0	9	18.0	78	33.9
3. Objectives (B)	17	21.3	12	24.0	96	41.7
4. RPK	16	20.0	8	16.0	105	45.7
5. Introduction	20	25.0	11	22.0	109	47.4
6. Teacher Learner Activities (TLAs)	25	31.3	14	28.0	94	40.9
7. Statement of TLM	28	35.0	15	30.0	125	54.3
8. Core Points	8	10.0	9	18.0	76	33.0
9. Lesson Notes Presentation	15	18.8	14	28.0	76	33.0
10. Information Level	22	27.5	15	30.0	91	39.6
11. Sensitive to Diversity	22	27.5	12	24.0	108	47.0
12. Use of Language	22	27.5	14	28.0	131	57.0
13. Use of Generic Skills	12	15.0	7	14.0	113	49.1
14. Use of Chalkboard	16	20.0	11	22.0	105	45.7
15. Questioning Skills (A)	12	15.0	9	18.0	99	43.0
16. Questioning Skills (B)	11	13.8	9	18.0	105	45.7
17. Feedback to Pupils	19	23.8	10	20.0	118	51.3
18. Use of TLMs	8	10.0	8	16.0	121	52.6
19. Pupils' Participation	14	17.5	8	16.0	81	35.2
20. TLAs	23	28.8	9	18.0	111	48.3
21. Learner Centeredness	28	35.0	14	28.0	117	50.9
22. Language and Vocabulary	37	46.3	14	28.0	107	46.5
23. Promotion of Values	35	43.8	15	30.0	119	51.7
24. Scientific Facts	19	23.8	11	22.0	116	50.4
25. Misconceptions	24	30.0	10	20.0	93	40.4
26. Evaluation of Lesson	27	33.8	12	24.0	115	50.0
27. Questions for Assessment of Learning	24	30.0	11	22.0	103	44.8
28. Classroom Arrangement	17	21.3	9	18.0	108	47.0
29. Classroom Setting	24	30.0	9	18.0	83	36.1
30. Class Control	28	35.0	11	22.0	84	36.5
31. Reflective Practice by the Teacher	15	18.8	7	14.0	105	45.7
32. Portfolio Assessment	26	32.5	11	22.0	105	45.7

Similarly, the Table 4.7 compares the deviation from the NTS among the teachers at the three levels about "Setting Objectives for Lessons". The percentages show that Upper Primary school teachers had the highest deviation

(34 %), followed by JHS teachers (18 %), and SHS teachers (9 %). This reflects a higher degree of non-compliance among JHS and Upper Primary school teachers, indicating the importance of emphasising objective setting during teacher education and professional development programmes.

Moreover, since page 53 of NTS requires teachers to link previous lessons to subsequent lesson, Table 4.7 presents a comparison of how teachers at various levels focus on using learners' Relevant Previous Knowledge (RPK) in their lessons. The result on the table shows that the non-compliance from the NTS requirements in this regard is in the descending order of Upper Primary school teachers: 46%, SHS teachers: 19%, and JHS teachers: 16%.

teachers, the non-compliance was found to be high among primary school teachers.

Approaches to Enhance the Perception of Pre-Tertiary Science Teachers to Ensure Compliance with the NTS

Table 4.8 summarises the results of the survey on approaches to ensuring compliance with professional standards for pre-tertiary science teachers. Table 4.8 displays the frequencies, percentages, means, and standard deviations of the responses to each statement, which were rated on a five-point Likert scale ranging from strongly agree (SA) to strongly disagree (SD).

The results in Table 4.8 show that most of the pre-tertiary in-service science teachers (65.3%) agreed or strongly agreed that they received capacity-building training from their employers through various platforms (S/N22), with a high mean score of 4.1 and standard deviation of 1.45. Only 23.1% of respondents disagreed or strongly disagreed with this statement, whereas 0.6% were neutral.

Table 4.8: Approaches to Promote Pre-Tertiary Science Teachers' Compliance with the NTS

S/N	Statements	SA		A		N		D		SD		Mean	s.d.
		n	%	n	%	n	%	n	%	n	%		
22	I receive capacity-building training from my employers through at least two of the following platforms: SBI, CBI, PLC, and sensitisation workshop	235	65.3	40	11.1	2	0.6	46	12.8	37	10.3	4.1	1.45
23	Teachers in my school regularly attend INSET and workshops organised by certified service providers	58	16.1	139	38.6	2	0.6	91	28.1	60	16.7	3.1	1.41
24	I am familiar with where to access supply and demand-driven training programmes in case, I want to enhance my competences	23.2	64.4	34	9.4	2	0.6	64	18.3	28	7.2	4.06	1.427
25	Science teachers do not have opportunities to enhance their competences since the government has not made any provision for the capacity building of teachers.	50	13.9	60	16.7	10	2.8	99	27.5	141	39.2	2.39	1.481

On the other hand, the results in Table 4.8 reveal that the respondents were less positive about the availability and quality of the external training programmes offered by certified service providers (S/N 23), with a low mean score of 3.1 and a high standard deviation of 1.41. Only 54% of the teachers agreed or strongly agreed with this statement, 44.8% disagreed or strongly disagreed, and 0.6% were neutral. This suggests that the science teachers have diverse opinions about the effectiveness and accessibility of INSET and workshops organised by other institutions, and that they may encounter some difficulties or obstacles in attending them.

The science were also mostly in agreement that they were familiar with where to access supply and demand-driven training programmes in case they wanted to enhance their competences (S/N 24), with a high mean score of 4.06 and a standard deviation of 1.427. Majority of the respondents (73.8%) agreed or strongly agreed with the statement, that they were familiar with where to access supply and demand-driven training programmes in case they wanted to enhance their competences while only 25.5% disagreed or strongly disagreed and 0.6% were neutral. This implies that the respondents were knowledgeable about the various options and opportunities for self-directed learning and professional growth, and this could be an opportunity for teachers to study and comprehend why they have to apply the standards to their practice.

Finally, the results demonstrate that most of the teachers (66.7%) disagreed or strongly disagreed that science teachers do not have opportunities to enhance their competences since the government has not made any provision for capacity building of teachers (S/N 4), with a low mean score of

2.39 and a high standard deviation of 1.481. Only 30.6% of the teachers agreed or strongly agreed with this statement, whereas 2.8% were neutral.

Qualitative Data

To better understand the responses given to the questionnaire and the lesson observations scores, particularly, the results in Tables 4.1 and 4.2, an interview was conducted to further explain the quantitative results. Twenty-five teachers (10 from both primary school and JHS and five from SHS) were interviewed. However, they were given identifications that would hide their identity rather than using real names which might have infringed on the data protection and rights of secrecy.

Science teachers' understanding of reflective practice

Reflective practice enables educators to engage in self-assessment and improvement by critically examining their instructional strategies and outcomes. Through this approach, teachers can identify their strengths and weaknesses, gain valuable insights from their experiences, and develop innovative teaching approaches and techniques. While conducting the interviews, enquiries were posed to the teachers regarding their engagement in reflective practices. The teachers' answers revealed a misunderstanding of the fundamental nature of reflective practice. Subsequently, the teachers held the belief that achieving reflective practice using the National Teachers' Standard (NTS) was unattainable, ineffective utilisation of In-Service Teachers' time, and that supervision was a more efficient alternative to reflective practice, which would prove advantageous for teachers. The other six teachers claimed that they believed in expert reviews but could not link them to reflective practice among teachers.

Based on the findings derived from the interview data, it was evident that science teachers had two distinct interpretations of the concept of reflective practice. Even though science teachers explained it as either self-reflection or critiquing one's work, they argued that it is not possible to reflect on one's work, as no one may want to condemn what they have done, as seen in this response.

Sir, we know of expert reviews which include vetting by Heads of Institutions and departments and peer reviews which are very effective ways of helping teachers improve their practices. I do not think reflection on my own work will make a difference. (MT6)

Some teachers believe the following:

reflective practice is for those in teacher training institutions where their supervisors observe their lessons and give them comments to reflect upon. Sir, you are aware that in the field, every teacher is a master of his or her own class and area, so you do what you think is right and that is all. I don't think we have to do reflective practice like they do in the colleges(MT21)

While 12 out of the 25 science teachers saw reflective practice as virtually impossible because, according to them, one cannot be a referee and player at the same time, seven of them described reflective practice as a waste of time and would not encourage such practice, where teachers will look back on what they have done to improve their work. This view of reflective practice is captured in the following quote:

I think teachers will waste time if this reflective practice is introduced.

I reflect to put out my best to prepare, deliver and assess my lessons.

What else can I do if there is no one to observe and provide feedback?

Sir, how can one person teach and observe himself or how many teachers can buy a recorder to video their lessons and watch? Hmm, me, I don't like these theories that are not practicable. There are so many policies in the system which are wasting teachers' time. (MT3)

Some teachers also believed that teacher training institutions (Colleges of Education) are those that practice reflective practice, and not in-service science teachers who are qualified teachers with experience. One JHS science teacher shared the following:

I think reflective practice is for those in teacher training institutions where their supervisors observe their lessons and give them comments to reflect upon. Sir, you are aware that in the field, every teacher is a master of his or her own class and area, so you do what you think is right and that is all. I don't think we have to do reflective practice like they do in the colleges (MT21)

The qualitative data gathered in Phase 2 provided detailed explanations of why respondents believed that a teacher could not undertake self-reflection to improve teaching and learning. Most interviewees described self-reflection as inappropriate because they could not prepare for their work and scrutinised it to address shortfalls. For some, it is appropriate to employ experts or use peer reviews rather than critique their work. Respondents expressed that these reviews are always conducted by supervisors, so teachers can revise their work to suit the factor comments from supervisors or experts. Others even felt that reflective practice in teachers' work is a waste of time since no one can reflect on their work to improve. Interestingly, those who accepted the

implementation of reflective practice indicated that it should be done at the pre-service level, because in-service teachers have rich practical experience.

The view of the science teachers interviewed revealed that reflective practice occurs among teachers and colleagues, and for that matter cannot be undertaken by one person, contradicts a study conducted in education by Habib (2017). Therefore, it is surprising for some respondents to think that a teacher who critiques their work may be biased so that one teacher cannot undertake reflective practice which is the first standard in the NTS. If a teacher relies solely on comments from colleagues for improvement, this may hinder their analytical skills.

National Teachers' Standards as a guide to teaching

The science teachers were asked about the contributions of the NTS to serve as a guide to teaching. All 25 science teachers were of the view that the NTS aims to set benchmarks to increase teachers' workload, and that the NTS compels teachers to provide unnecessary evidence which may bring competition among teachers, since supervisors may be looking for who is demonstrating what is in the NTS and not what seems appropriate within a space of time. They felt that acquiring experience from the field is different from acquiring book knowledge, so they would not spend time on something that does not apply to their learners' learning needs. They claimed that teachers who have practiced for more years can exhibit competences that address their learners' needs regardless of how weak their content knowledge is. They further indicated that teachers already exhibit secure pedagogies and attitudes that are responsive to their learners' needs. They also indicated that all they need is the curriculum and textbooks, since learners will be assessed

on curriculum content and not the NTS which cannot even change the attitude and behaviour of teachers. They further explained that teachers who have taught the same subject or class for more than three years can address their learners' learning needs without adhering to any standards. Another response from primary school level is summarised in the following statement:

Sir, I don't think the NTS will bring any good thing oh, teachers will stay in the office and produce documents to meet the standards without doing the actual work. After all, sir, we all want to be recognised as teachers who are following the NTS. Why can't they leave us to do our work than to bring this standard for teachers to compete among ourselves? If teachers feel that they are not secure when doing the practical work, they will all turn to produce the documents for the top people so that such teachers can be appraised well. (FT7)

The teachers stressed supervision by heads of department and circuit supervisors to guide them instead of resorting to the NTS, as captured by this quote:

Hmm, sir, I think I will hardly do what I know will help the learners if they demand that all teachers follow the standards. Sir, this NTS has nothing in it oh. What is needed is supervision because if my supervisors spend time with me, always available in the school to support teachers to deliver, teachers will sit up and do the right thing. (MT6)

All the 60 teachers said that they had personal philosophies and standards which may be influenced by the NTS, which they do not like. 23 out of the 60 teachers interviewed felt that the NTS as teacher-training material undermined the culture of Teacher Education Institutions (TEI), as each TEI

has its own culture and standards. They stressed that training teachers to adhere to the NTS could negatively influence their autonomy. Comments from science teachers were captured by what a teacher at the primary school level said:

I have read about the NTS which was published by the National Teaching Council, but you see, before the NTC, teachers were trained by training colleges, the University of Education, Winneba, and the University of Cape Coast. How were they training teachers who were even better than those coming out today? Sir, do you know that I was trained as a teacher in those days without any NTS, and yet won the best teacher in my district and at the regional level? So many of my friends from Cape Coast also won either regional or national best teacher award. (FT7)

National Teachers' Standards contribution to supervision of science teachers

Science teachers at all levels stressed that the strengthening of instructional leadership is a key factor, and not the introduction of a new policy called NTS. Teachers insisted that the code of ethics and conduct did not outlive their supervisory roles, which would warrant a new standard. Therefore, the teachers saw the NTS as competing with supervisors rather than complementing their efforts. There was also a view that the NTS would only introduce rules and sanctions instead of providing support for teachers to do their work. The stress on the work of supervisors was captured by the following comments:

I know that supervisors monitor teachers' work and provide feedback for improvement. That to me, is enough. The NTS has nothing in it. I

have gone through it but didn't see anything in it. Let's give logistics to supervisors to do their work well rather than focusing on policies that cannot be used in Africa. In our environment, teachers understand supervision more than any other thing. Supervision will put teachers on their toes. (FT4)

You see that the in-service teachers have a code of ethics and professional conduct, so I think the standards are there already, and we obey them. Why should they introduce the NTS? Sometimes, I don't get our leaders, you pay supervisors to monitor our work, my HOD, Assistant Head Academic, the Headmistress and sometimes regional office supervisors go around to supervise teachers' work. Please, don't they go to monitor the best practices? How can they do that if there are no standards? Personally, I think it is all about supervision and not the NTS. That is my view. (MT6)

NTS contribution to enhanced experience of science teachers

During the interviews, science teachers were asked how NTS contributed to the enhanced teaching experience of teachers at all levels. Teachers did not agree that NTS contributed in any way to the enhanced teaching experience. From the perspective of science teachers, using NTS cannot improve teachers' practices, rather they can gain experience in the job. Rather, they indicated that interactions with stakeholders provided a better experience for teachers than reading standard documents. They felt that teachers who stayed longer in the profession performed better and gained more experience that could not be provided by the NTS. Comments from a

JHS science teacher and a primary school teacher captured the views of science teachers:

I think the levels of support that teachers need to enhance their competences come from supervision, workshops, and motivations and not compliance to NTS. As for the NTS, it is a book oh, and nobody will have time to read it all the time. My brother, anything about policy has its time oh. The best thing is to train the teacher to understand what must be done in the classroom in different situations. Compliance with standards is a different thing altogether. (MT8)

I think you are aware that practice makes people perfect. Teachers need more exposure, so reshuffling from one class to the other and giving teachers more challenging situations to handle can enhance their competences rather than forcing them to obey some laws. Even those who will enforce the laws may be more corrupt than the teachers. As for me, I disagree that compliance will enhance teachers' competences, it is rather the experience on the field. (FT3)

NTS contribution to professional knowledge and pedagogical content knowledge

Science teachers were asked how the NTS contributed to PCK and teachers' professional knowledge. Some teachers saw professional knowledge as being the same as their knowledge of the profession. The teachers did not appreciate the difference between their professional knowledge and their knowledge of their profession; professional knowledge refers to the specific skills and expertise required to teach a particular subject or grade level,

whereas knowledge of the profession refers to a broader understanding of the field of education.

Teachers' responses showed that the effectiveness and efficiency of teachers rest in their in-depth knowledge of the subject area in which they specialised. They categorically stated that PCK is required to improve learning outcomes which NTS cannot. The teachers did not see any relationship between PCK and the NTS or between teachers' professional knowledge and PCK, as seen in the following quotes:

Subject matter knowledge and pedagogical content knowledge determine who a professional teacher is and not knowing about the profession. After all, anybody can also read about the one's profession. I think, what makes the difference is the skills to deliver so teachers should be equipped with skills on how to deliver lessons effectively. Workshops can be organised for teachers from time to time, and some teachers can also be sponsored to learn more about their subject areas. After all, private school teachers who are not professionals can meet their targets because they have mastery of their subject areas. (FT2)

Performance of school in WASSCE or BECE is an indication of how the teachers are conversant with the content and pedagogy rather than professional knowledge. I think as a nation, we should rather help teachers to have mastery of their content knowledge and how they can use different strategies to address learners' learning needs rather than any other thing which comes about because of the long service. I think capacity building for teachers in their subject areas will minimise their low performance in schools. (MT5)

I understand that knowledge of the subject matter and various lesson delivery strategies are the key to supporting learners to perform. If you know about curriculum frameworks as a teacher, how can that help you to deliver when you are not the one developing the curriculum? Also, there are individual differences so no teacher can understand learners' behaviour completely from the NTS. You will understand them and support them as you interact with them. Sir, behaviour can change at any time, but the subject matter stays longer. We don't have to waste time on teachers' professional knowledge which can be handled by teacher unions and employers. Let's help teachers understand the content and the teaching methodologies. (FT1)

Finally, a probe to determine why teachers feel that complying with the NTS would not necessarily improve learners' learning attainment revealed that teachers believe that, if there is a lack of cooperation and parental support in their wards, it would be difficult for learners to improve their learning. The responses provided by the teachers indicated that the teachers were cynical about the effectiveness of NTS in improving the teaching and learning of science because poor parental support and other sociocultural issues can adversely affect learners' learning, irrespective of the high level of compliance with the teachers' standards.

This study showed that teachers had might have had challenges understanding the standards and were not adequately trained on how to use them. The findings of this study support those of Agbor et. al., (2016). Additionally, some studies have found that standards can create unhealthy competition among teachers which is supported by this study's findings.

Overall, the findings of this study suggest that some teachers have a poor understanding of the national teachers' standards in Ghana and do not see it as a useful guideline for their work.

Discussion

Science Teachers' Perception of the NTS

The items that were used to solicit data on science teachers' perceptions of the NTS were expressed under eight key areas revolving around reflective studies, the role of NTS in teaching and learning, the use of NTS as a guideline for training teachers, comparison between compliance with NTS and acquisition of subject knowledge and how compliance with NTS enhances teachers' competences for quality delivery and among others.

The quality of education in any country is highly dependent on the quality of teachers and their adherence to teaching standards. The teaching standards are a set of guidelines that provide a framework for teachers to develop their teaching practices, reflective practice, lesson note preparation, and classroom management and among others. The standards are designed to promote the development of effective teaching practices and improve student learning outcomes.

However, despite the importance of teaching standards, pre-tertiary science teachers have been found to have a poor perception of teachers' standards under reflective practice, lesson notes preparation, and classroom management as well as teaching practices and professional development and this is in line with a study conducted in Nigeria (Chukwuebuka & Okeke, 2020).

The analyses of the results obtained from the items as expressed in perceptions 1 to 8 in this study indicates that respondents had poor perception of the NTS. The results gathered from the various data collection phases demonstrated that teachers' perception was against the national expectations and the rationale for developing the NTS. For instance, under professional development where the NTS expects teachers to reflect critically and collectively to improve teaching and learning, respondents could not agree that individual teachers could reflect without the inputs from their colleagues. The implication of their views is that reflective practice cannot be undertaken by individual teachers so they would not reflect on their own practice.

The qualitative data gathered in phase 2 provided detailed explanations to why respondents thought a teacher cannot undertake self-reflection to improve teaching and learning. Majority of the interviewees described self-reflection as inappropriate because they cannot prepare their own work and scrutinize it to come out with shortfalls. For some, it is appropriate practice to employ expert or peer review than to critique one's own work. Respondents expressed that those reviews are always done by supervisors so teachers can revise their work better than what their supervisors or the experts would do. Others even felt that reflective practice on teachers' own work is a waste of time since no one can reflect on his or her own work to improve. Interestingly, those who accepted the implementation of reflective practice indicated that it should be done at the pre-service level since in-service teachers have rich experience to practice.

The perception that reflective practice occurs among teachers and colleagues, and for that matter cannot be undertaken by one person contradicts

a study conducted in the education by Habib in 2017 which projects reflective practice as the process of the educator studying his or her own teaching methods and determining what works best for the students (Habib, 2017). Teachers learn from their own lessons each time they teach and evaluate what they do through self-critical evaluations. Reflective practice has also found to be useful in other studies where the researchers indicated teachers who reflect on their own works learn how question clichés that have learned during their formative years to develop more informed practice and self-capacity building strategies (Akbari, 2007; Sellars, 2012).

It therefore leaves a gap if the science teachers think that a teacher who critique own work may be biased and so one teacher cannot undertake reflective practice which is the first standard in the NTS. If a teacher solely relies on comments from colleagues or supervisors for improvements, it may hinder the analytical skills of such teacher. It could also be that the word “collectively” as used in the standards as *teacher(s) collectively reflects to improve teaching and learning* is misleading the teachers since it connotes the idea of reflecting together where breakfast meetings and critical friends are used to initiate reflective studies (Habib, 2017). Though that is correct, it should be noted that even if it is so, sharing together starts with personal reflection on what works and what did not work. Therefore, it is awkward for a teacher to perceive that reflective practice cannot be undertaken by individuals. It calls for intensive sensitisation to cure this poor perception.

Similarly, science teachers’ perception that the NTS would create unhealthy competition among teachers since there are disparities in the learning environment is explained by the interview. A response from the

interview shows that the respondents perceived the NTS as a tool to judge their performance. This thought seems to align with studies conducted by researchers Kleinhenz and Ingvarson, (2004) who defined standards as a measure of performance or Bourgonje and Tromp where standards had been explained as specifications for determining levels of performance (Bourgonje & Tromp, 2011). Unfortunately, perceiving the NTS from this perspective may be a myopic thought since in the works of either Kleinhenz and Ingvarson, (2004) or Bourgonje and Tromp, (2011), the explanations given goes beyond standards as a tool for determining performances. Though, the learning environment may not be standardised, the NTS is not cast in stones. It allows for flexibility and adaptations. Again, if teachers see standards as that which may cause unhealthy competition rather than collegiality then it surmises that either there are misconceptions surrounding the use of the NTS or education had not gone down well. Moreover, if teachers opted for workshops that will build their capacity in teaching pedagogies and content knowledge rather than working with the NTS, it could be interpreted that the teachers could not identify the role NTS play in enhancing their pedagogies and content knowledge. This is also an indication that the perceived knowledge of the NTS is misconception that needs to be worked on.

The responses from the data gathered have established science teachers had poor perception of the NTS. These expressed perceived views of teachers towards NTS is worrisome because there is extensive research which indicate that teachers make decisions in teaching activity based on their experiences, perceptions, values and beliefs about their roles, activities, and responsibilities in schools (Eggen & Kauchak, 2001; Yates, 2004). It is also evidenced by

research on teachers that teachers' perceptions and positive attitudes are essential to effective teaching. The teachers' poor perception of the NTS therefore suggest that efforts should be made to correct these poor perceptions to improve teachers' applications of the standards in NTS in their practices. Any inertia towards this need for change may have the tendency to affect students' learning outcome (Eggen & Kauchak, 2001). In view of the poor perception of teachers toward teacher professional standards which is emerging in the study, it is becoming critical to examine how teachers in other subject areas also relate to the NTS since teachers' perception of the NTS is likely to have direct influence on their compliance and learners' learning (Ispir's (2010; Ahmad & Sahak; 2009). The specific perceptions that emanated are: teachers cannot critique and reflect on their own work, the NTS can promote unhealthy competition among teachers, Teacher Education Institutions have been operating with their own standards over the decades so there is no need to introduce the NTS, the In-service teachers are supervised by both internal and external monitors so there is no need for NTS, NTS does not make any meaningful contributions to teachers work, professional knowledge is not relevant compared to subject matter and action system knowledge.

These specific persons outline in the study align with studies conducted in Kenya and other African countries as well as China and Turkey. For instance, one study conducted by Oduol (2014) in Kenya found that many teachers had a poor perception of the National Teachers' standards. The study revealed that teachers saw the standards as "impractical, irrelevant, and

unattainable." Teachers complained that the standards were not tailored to their specific needs and were not sensitive to the local context.

Similarly, a study conducted by Agbor (2016) in Cameroon found that teachers did not see the standards as useful guidelines for their work. Additionally, a study in China have found that the standards can create unhealthy competition among teachers (Li and Liu, 2020). Just as in this study, some of the science teachers argue that they do not need standards to carry out their roles, a study in Turkey reported same (Kucuk & Sahin, 2017)

The research reveals that some teachers have a poor perception of the National Teachers' standards of Ghana and do not see it as useful guidelines for their work. Some teachers also believe that the NTS for Ghana can create unhealthy competition among colleagues and that they do not need standards to carry out their roles.

Science Teachers Demonstration of Competences in the NTS

The findings of this study reveal interesting insights into the demonstration of competences among science teachers in relation to the National Teachers' Standards. The mean scores obtained by the different groups of teachers – 80 SHS science teachers, 50 JHS teachers, and 230 primary school teachers – provide a basis for understanding the level of competence demonstrated across different educational levels. For instance the findings on the competences demonstrated by the 80 SHS science teachers suggest a moderate level of competence in meeting the selected items of the NTS. This finding is consistent with previous research indicating that high school science teachers often possess a solid understanding of subject matter content and pedagogical techniques (Smith & Neale, 2017). However, it also

highlights areas where further improvement may be necessary to fully align with the standards.

Contrastingly, the findings on the competences demonstrated by the 50 JHS teachers depict a slightly higher level of competence compared to their counterparts in senior high schools. This may be attributed to the emphasis on foundational teaching skills and pedagogical approaches in junior high school education (Kim & Park, 2019). The findings suggest that JHS teachers are relatively proficient in meeting the specified competences outlined in the NTS.

In comparison, the findings on the competences of the 230 primary school teachers indicates a lower level of competence relative to their counterparts in secondary education. This finding underscores the need for targeted professional development initiatives aimed at enhancing the skills and knowledge of primary school teachers, particularly in science education (Hobson & Malderez, 2013). It is imperative to provide primary school teachers with adequate support and resources to effectively implement the National Teachers' Standards in their classrooms.

Overall, the variations in mean scores across different groups of teachers underscore the importance of considering the unique context and educational levels when assessing teacher competences. Future research could delve deeper into the specific factors influencing teacher competence and explore strategies for enhancing professional development opportunities tailored to the needs of different teacher cohorts.

Science Teachers non-compliance with the NTS

The findings of the study presented significant levels of teachers' non-compliance with the NTS which is quite alarming since teachers' compliance

with teachers' standards has been found to influence teachers' practice (Kleinhenz, & Ingvarson 2004; Khaola and Mokhele, 2019).

Though compliance with Teaching Standards has been found to have a significant influence on teacher competences (Darling-Hammond et al., 2017), low compliance with the NTS has been documented in this study which resonates with the results of similar studies conducted in Africa and beyond. For instance, one study conducted by Ndirangu and Wambugu (2018) in Kenya found that only 81.5% of teachers surveyed were non-compliant with the National Teachers' Standards. Another study conducted by Adedokun (2014) in Nigeria found that only 72.5% of teachers surveyed were non-compliant with the National Teachers' Standards.

Though several factors may account for teachers' non-compliance with standards, in this study, teachers' non-compliance with standards was largely attributed to their reluctance to comply with the NTS which probably emanated from their inability to decipher the rationale for the development of the standards. Teachers' reluctance to comply with the NTS aligns with a similar study conducted in Turkey (Kucuk & Sahin, 2017).

The perception data indicated that teachers have a poor perception of the NTS, it is therefore not surprising that a significant percentage of teachers were recorded as non-compliant. A study in Uganda also found that similar result where large numbers of teachers were non-compliant with teachers' standards (Sang et al., 2019)

Khaola and Mokhele (2019) revealed that teachers who complied with teaching standards had higher levels of teaching competences compared to teachers who did not comply with the standards. Similarly, in this study, the

compliance level of the pre-tertiary science teachers on the use of the NTS is extremely low with low competences demonstration. For instance, teachers in the SHS hardly prepare lesson plans because they felt they had been trained as professionals who have specialized in their subject areas and have even acquired extensive experience after long years of service. Therefore, they teach without a lesson plan. Some indicated that they read test books and explain to their students. Others indicated that they rather prepare teaching notes instead of lesson notes. These arguments of having a specialty in teaching subjects and so teaching without lesson notes preparation are brought to bear in instances where teachers argue that teacher autonomy must be respected. For instance, in a study conducted by Ryan and Deci (2000), it was found that teachers who felt they had autonomy and control over their teaching were not interested in complying with standards such as preparation of lesson plans, specific strategies to manage behavior, and ensuring classroom management. Instead, they dealt with issues in the ways that deemed fit. Some teachers argued that the Heads of schools cannot even comprehend contents in their fields of study since the Heads might have different specialties so there was no need to prepare a lesson plan for Heads to supervise as this may violate their autonomy and control (Ryan & Deci, 2000).

The SHS teachers who prepared their lesson did so because they had foreknowledge of the lesson observation part of the interaction, otherwise, they would not have prepared as it is not their practice to prepare lesson plans. This could contribute to why the teachers had low scores in lesson planning. Another reason that confirms low scores in lesson planning could be attributed to the lack or poor supervision of lesson plans by supervisors. Some of the

participants indicated that they only had to fill all the fields in the lesson plan book and that alone is enough. Moreover, the way some of the respondents were very emotional about lesson plan preparation indicated that were not ready to comply with the NTS. This indicates that respondents have issues with their role as teachers. It is strange for teachers to perceive that asking them to prepare a lesson plan is infringing on their rights. If teachers are not satisfied with what they do, especially with their working environment, it is likely to influence their performance (Eggen & Kauchak, 2001). For instance, this behaviour of not preparing a lesson plan or preparing of scanty lesson plan is likely to adversely influence the outcome of teaching and learning (Mensah & Appiah, 2017). The NTS 2f requires teachers to take account of and respect learners' cultural, linguistic, socio-economic, and educational backgrounds in planning and teaching (NTC, 2017). Therefore, teachers' non-compliance with NTS means that learners are not likely to benefit from the lessons as their background may not be considered.

Teachers indicating that lesson planning is not part of their work is evidence of not recognising themselves as professionals. Every profession has its identification and one of the things that distinguish other professionals from teachers is the lesson planning, NTS 2f and 1f (NTC, 2017). Thus, teachers indicating that they do not prepare lesson plans is a serious non-compliant that has serious implications on their performance.

Also, it was confirmed from the interviews that some of the teachers had difficulties in managing their large class sizes without caning students. If the science teachers claim that their class sizes are large so without canning, it would be difficult to control learners' behavior and manage the learning

environment, it questions their competences demonstration of the NTS standards in NTS 3d (NTC, 2017). Meanwhile, lots of studies have shown that class control or behavior control strategies and class management are crucial in improving learners' learning attainment (Aghaie, 2006; Valica & Rohn, 2013). Aghaie (2006) posits that the most important competences of a teacher is but not limited to familiarity with new learning and teaching methods and using them, Class management, and specific skills of communicating with the students, Therefore for a teacher to indicate that since they are not allowed to cane the learners it is difficult to manage the class or the class size restrict them from managing and controlling behavior is central to the classroom management and behavior control standards prescribed by the NTS (NTC, 2017) and by Aghaie (2006).

In all, it is evident in the compliance data that teachers' reluctance to comply with the NTS is largely due to their perception and it is also not limited to Ghana but Kenya, Nigeria, Uganda, and Turkey. The data gathered also indicates that teachers' non-compliance to NTS has the potential to badly affect their performance since non-compliance adversely affects teachers' competences.

The results from both qualitative and quantitative data indicate that teachers at JHS demonstrated high levels of compliance compared to those in the primary and Senior High school (JHS) levels. The quantitative results showed that the non-compliance level among primary school teachers were higher than that of the JHS and SHS teachers. It also shows that percentage non-compliance among the JHS teachers is lower than that of SHS. It was expected that the SHS teachers would have had low percentage score of non-

compliance (SHS teachers should have had high compliance percentage scores), but the reverse was recorded. This expectation was linked to the fact that research has indicated that at the SHS, teachers are more experienced and specialised in the subject areas. In addition, they are likely to have access to more resources compared with their counterpart in the primary and JHS (Kamat et al., 2020). The result obtained contradicts the study conducted by Kamat et al., (2020) which shows that Senior High School teachers comply with teachers' standards better than their colleagues at primary and Junior High Schools.

The high non-compliance among primary school teachers is not alarming than that of the Senior High School teachers who are mostly subject specialists compared to those of Junior High School teachers because Research has indicated that specialised teachers are more knowledgeable and experienced in their subject area, so they are better equipped to adhere to standards (Gelman & Stevens, 2016). Furthermore, research shows that teachers with the higher the level of education, are more likely to comply with standards as they are better informed about professional requirements (Levin et al., 2018; Johnson & Smith, 2020). The propositions of Levin et al., (2018) and, Johnson and Smith, 2020 are an indication that specialisation of teachers in specific subject areas can lead to higher levels of compliance with standards. Ironically, the results on science teachers' compliance with National Teachers Standards of Ghana in this study has shown otherwise.

The results on comparison of compliance among JHS and SHS teachers in this study also disagree with propositions by Brown and Davis

(2018) and Smith et al. (2019) which posit that teachers who teach mature learners often face higher levels of accountability due to their ambition.

Upon a reflection on the highest non-compliance percentage of the SHS teachers compared with the two other cohorts, it is tempted to say that SHS teachers might feel that lots of research goes into their preparations, or they have specialised in their area, so they do not need any standards to guide their practice (Brown & Davis, 2018). Meanwhile, there is a saying that self-complacency can be an enemy to progression. If teachers repose because they believe in their ability, the tendency, and the desire to look for new ideas may be minimised or diminished. Some teachers at the SHS even indicated that they have been training basic schoolteachers on teaching and learning of science and so they (SHS science teachers) are confident in their subject areas. Though this is a positive sign on the part of the SHS teachers, if care is not taken it may also undermine the integrity of the science teachers at the upper primary and JHS once their colleagues at the SHS have classified them as not leaving up to expectation. Moreover, for the primary school and JHS teachers to also admit that teaching and learning of science at those levels do not require any intensive effort can also affect how science is taught at these levels which are likely to adversely influence learners' attainment in teaching and learning of science at the basic school levels.

The ability of teachers to comply with teachers' standards is influenced by various factors, including their professional competence, motivation, and support systems. However, when teachers face downgrades or negative evaluations as commented by the SHS teachers in this study, the compliance of JHS and Primary school teachers with teachers' standards may be

compromised. Downgrades or negative evaluations can have a significant impact on teachers' confidence and motivation, leading to a decreased ability to comply with teachers' standards. A study by Anderson and Johnson (2017), Davis and Thompson (2018), and Brown (2019) confirms downgrades from colleagues can affect compliance with Standards.

In all, existing research confirms that senior high school teachers tend to comply with teachers' standards more than their colleagues in primary and junior levels. This higher compliance rate has been attributed to factors such as greater subject expertise, increased accountability, and maturity level of SHS students as well as the higher qualification possessed by SHS teachers. Paradoxically, the result of this study indicate that Senior High School Teachers have the highest non-compliance rate compare with the JHS and Primary School teachers. The results also shows that JHS teachers has the least non-compliance percentage score; meaning JHS teachers comply with the NTS more than Primary and SHS teachers.

Approaches to enhance Science Teachers Compliance with the NTS

The science teachers demonstrated positive attitude towards several approaches that can be harnessed to positively improve their competences. These approaches were identified to include Professional Learning Communities (PLCs) such as School-Based INSET (SBI) and Cluster-Based INSET (CBI). The findings also showed that teachers are familiar with the activities of professional development service providers and patronise their programmes with payments from teachers' professional development allowance. Other source indicated by the science teachers as an avenue for

their capacity building was the programmes organised by Development Partners (DPs).

Findings from the interview confirmed that the teachers knew of the approaches used to build their capacity and indicated a positive attitude towards capacity-building workshops such as INSET which is used to discuss challenging topics. The findings also revealed that some districts get support from donors to organise trainer-of-trainer workshops which is normally cascaded to teachers in the districts. It was also evidence in the interviews that in some districts there are a structured number of school and district-based training organised in a term. For some others, Parent Teacher Association sponsor them to attend training programmes organised by certified individuals or groups of people. Others also indicated that the teacher unions and associations organise training programmes for their members, so they take advantage of such training since members are not charged to pay any training cost. Others also indicated that they normally pay to attend some of the trainings, especially, those relating to promotion examinations.

The approaches to enhancing teachers' perception of compliance with teachers' standards identified by the science teachers are supported by previous studies conducted (Karanja & Mungai, 2017). It is evident in this study that Professional Learning Communities (PLCs) can be used to strengthen teachers' engagement in professional development and to increase their commitment to their profession. PLCs as a collaborative professional learning activity allow teachers to share their experiences, discuss common challenges, and develop strategies for addressing them. Moreover, the SBIs and CBIs are evidenced in this study as effective approaches for improving science teachers'

knowledge and skills and this aligns with Kilimani, (2017). It is therefore one of the appropriate and effective ways that can be used to enhance teachers' perception of the standards. Furthermore, engaging development partners, NGOs, CPD service providers and providing incentives to teachers for CPD attendance have been found in this study as effective approaches that can help to boost teacher perceptions of compliance with the standards. This result aligns with a study conducted by Hall et al., (2020).

The positive attitude shown by respondents towards the various approaches used to build their capacity in dealing with professional issues suggests that the same platforms or styles (approaches) can be used to introduce them to the content of the NTS to change their negative orientations (poor perceptions) towards the NTS. That is, some of the SBIs, CBIs, and DBIs can be dedicated to the study of the NTS. Moreover, service providers and DPs can integrate the study of the NTS into their activities to promote a proper understanding of the NTS. Even, the feedback from the respondents indicated that they pay money to access training towards their promotions, this is also reported by Hall et al., (2020) in a similar study. This therefore means that some of the promotion exams when dedicated to teachers' knowledge of the NTS, may motivate them to study the NTS which will probably give them a proper understanding of the NTS.

Using the identified approaches to build teachers' capacity is likely to shape their beliefs and perspectives in a way that promotes their professional growth and improves instructional delivery and classroom management (Sikora & Alexander, 2004). It is also critical to strengthen the various approaches used to build teachers' capacity since the pre-service training

programmes are not enough to prepare teachers to function effectively (Guskey, 2003; Lindberg & Olofsson, 2010). Since the respondents have a positive attitude towards PLCs, SBIs, and INSET, they are likely to be used as good strategies or approaches to orient teachers to function effectively to enhance their professional knowledge, attitude, and practices (Feiman-Nemser, 2001)

It can therefore be suggested from the findings of the research question four that activities from SBI, CBI, DBI, INSET providers, and Donor partners as well as content prescriptions from promotion examinations can be used to positively enhance teachers' perception for compliance to the NTS.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter highlights the most important findings and offers some generalisations that draw stakeholders' attention to critical issues relating to compliance with Ghana's National Teachers' Standards. It is anticipated that science teachers, GES and the NTC will hark the concerns raised and use them to monitor pre-tertiary in-service science teachers to develop positive attitudes towards the NTS and comply with it.

This study investigated how pre-tertiary in-service science teachers perceived and complied with national teachers' standards in Ghana. This was done by providing descriptive and explanatory information on teachers' perceptions of the standards and their demonstrated competences in the NTS of Ghana. The sample consisted of 360 pre-tertiary in-service science teachers from public Upper Primary, Junior High, and Senior High Schools across 10 districts in the Greater Accra Region.

The research design used in this study was a multi-method design that combined different methods of data collection and analysis within the both quantitative and qualitative research paradigm but does not necessarily integrate them in a meaningful way. Quantitative data were gathered using a survey and analysed as the first step in this design. The subsequent gathering and analysis of qualitative data using interviews came after this initial stage.

Phase one involved a quantitative study that highlighted the means of perceptions, competences, and compliance variables of pre-tertiary in-service teachers in public and private schools in the Greater Accra Region of Ghana. The first phase also presents the identified approaches to enhance pre-tertiary

science teachers' perceptions of NTS. This was achieved through the questionnaire and lesson observations. After the macro-level analysis of the data generated in phase one, phase two of the study used interviews to gather to further explain issues regarding teacher compliance with the NTS for generalisation.

Summary of Key Findings

Pre-Tertiary In-Service Science Teachers' Perception of the National Teachers' Standards

The study revealed that most pre-tertiary science teachers harbor poor perceptions of the NTS. Teachers view NTS as theoretical and irrelevant to their practical teaching experiences. The reasons for this perception might be due to their belief that the NTS is meant for the National Teaching Council to implement its mandate and that some teachers question its applicability to science educators. These perceptions are likely to impact teachers' attitudes toward incorporating NTS into their teaching practices.

Pre-Tertiary In-Service Science Teachers Demonstrated Competences in the National Teachers' Standards

This study assessed the competences of pre-tertiary in-service science teachers based on the NTS. The overall mean score of the competency demonstration was relatively low for all the grade levels. At different grade levels, primary science teachers exhibited notably deficient competences, particularly in assessment and evaluation domains. By contrast, Junior High School teachers, while performing better in assessment and evaluation, showed weaknesses in effectively using teaching materials and preparing to engage in teaching activities. Senior High School teachers (SHS) not only had

low mean scores but also considerable variability in competences. Additionally, the study found that a low percentage of SHS teachers achieved good or excellent competency levels, indicating a notable gap between the expected standards outlined in the NTS and the actual proficiency levels of this group.

Approaches to improve Teachers' compliance with NTS

The findings of the study indicate that several effective approaches can be employed to improve teachers' compliance with the National Teachers' Standards (NTS). These include the use of PLCs, SBIs, DBIs platforms to educate the teachers on the rationale for the introduction of the NTS. It also came up that Development partners and service providers can integrate education on NTS into their programmes to raise awareness of teachers on the need to comply with the NTS.

Conclusion

This thesis delved into the perceptions and compliance levels of pre-tertiary in-service science teachers with Ghana NTS. The findings revealed an overarching poor perception among teachers coupled with a significant shortfall in their demonstration of competences aligned with the NTS. Moreover, their compliance with the standards was consistently low across various levels, posing a challenge to the intended regulatory framework aimed at guiding teachers' practice and professionalism. The root cause of this low compliance appears to be the teachers' poor understanding of the NTS, as some respondents identified the document as difficult to comprehend. This deficiency in perception and understanding, in turn, leads to reluctance or inability to adhere to the prescribed standards.

In terms of implications for teacher education and policy implementation, this study underscores the need for continuous impact assessments of NTS implementation by the National Teaching Council. These findings emphasise the importance of follow-up measures, including monitoring, evaluation, and feedback, to ensure successful realisation of policy objectives.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. The study revealed that most of the respondents had a poor perception of the NTS. Therefore, to eradicate or reduce the poor perception of NTS among pre-tertiary in-service science teachers, the Ghana National Teaching Council should collaborate with the following:
 - i. Employers and regulators (E.g GES, GVET, NTS, NaCCA) of teachers to embark on nationwide sensitisation of the NTS, its benefits, and how it can be used to guide teachers' work.
 - ii. development partners such as Right To Play, UNICEF, USAID Learning to integrate relevant contents of the NTS in their activities,
 - iii. employers of teachers to use PLC aspects to study NTS.
 - iv. certified service providers to train teachers in NTS during demand-driven training.

2. The results from the lesson observations using STLEAT indicated that the majority of teachers did not comply with the NTS and, as a result, exhibited poor demonstration of competences in the NTS. To ensure that teachers comply with the NTS, the Ghana National Teaching Council should:
 - i. Collaborate with relevant stakeholders to use compliance with the NTS as a condition for licencing renewal and promotion.
 - ii. Develop and use a compliance tool to measure the extent of compliance with appropriate reinforcement.
3. The study also revealed that pre-tertiary in-service science teachers recognised the training opportunities offered by their employers, service providers, development partners, and school-based activities. It is therefore recommended that platforms such as PLC, SBIs, and CBIs, as well as other platforms that are recognised and cherished by teachers, should be used to educate teachers on policy initiatives and implementations, including the implementation of NTS.

REFERENCES

- Abudu, K. A., & Gbadamosi, M. R. (2014). Relationship between teacher's attitude and student's academic achievement in senior secondary school chemistry. A case study of Ijebu-Ode and Odogbolu Local Government Area of Ogun state. *Wudpecker Journal of Educational Research*, 3(3), 035-043.
- Acar, E., & Aktamış, H. (2010). The relationship between self-regulation strategies and prospective elementary school teachers' academic achievement in mathematics teaching course. *Procedia - Social and Behavioral Sciences*, 2(2), 5539–5543.
- Adedokun, O. A. (2014). Compliance of teachers with national teaching standards in Nigeria. *European Journal of Educational Research*, 3(2), 71-77.
- Adu, E. O., & Olatundun, S. O. (2007). Teachers' perception of teaching as correlates of students' academic performance in Oyo state, Nigeria. *Essays in education*, 20(1), 6.
- Agbor, E. (2016). Teachers' perception of the Cameroon National Teachers' Standards. *Educational Research and Reviews*, 11(10), 920–926.
- Aghaie, A. (2006). Recognition of personal and professional features of future teachers. MA thesis, Tehran: Shahed University.
- Ahmad, A. & Sahak, R. (2009). Teacher-student attachment and teachers' attitudes towards work. *Journal Pendidikan dan Pendidikan*, 24, 55–71.
- Akbari, R. (2007). Reflections on reflection: A critical appraisal of reflective practices in L2 teacher education. *System*, 35(2), 192-207.

- Akyeampong, K. (2018). Teacher Education in Ghana; Past, present and future. *Journal of Education and Human Development*, 7(1), 1-12
- Akyeampong, K., Lussier, K., Pryor, J., & Westbrook, J. (2013). Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? *International journal of educational development*, 33(3), 272-282.
- Amedahe, F. K., Ahiatrogah, P. D., & Etsey, Y. K. A. (2002). The impact of supervision and mentorship practices on perceived competence of teacher-trainees and beginning teachers in Ghana. *IFE Psychologia: An International Journal*, 10(2), 119-135.
- Ameyaw, Y., & Sarpong, L. (2011). Integrating ICT in the pedagogical skills of teachers in some basic schools in the Ga South District in the Greater-Accra Region of Ghana. *Journal of Education*, 1(1), 1.
- Ananga, E. D. (2021). Teachers' Standards in Ghana's Initial Teacher Education Programme: Some Implementation Issues and Challenges. *Journal of Educational Issues*, 7(1), 376-391.
- Andrej, 2013 Perception Theories. Slovakia: Kraków.
- Angrist, J. & Lavy, V. (2001). Does Teacher Training Affect Pupil Learning? Evidence from Matched Comparisons in Jerusalem Public Schools. *Journal of Labor Economics*, 19 (2), 243-369.
- Antwi-Danso, Kusi & Annang (2018): Teacher Behaviour and Student Indiscipline at Teteku Senior High School in Ghana. *Journal of Education and Practice* 9 (23).
- Ary, D., Jacobs, L. C., Irvine, C. K. S., & Walker, D. (2018). *Introduction to research in education*. Cengage Learning.

- Aslam, W., & Luna, I. R. D. (2021). The relationship between brand Facebook page characteristics, perceived value, and customer engagement behavior: An application of Stimulus-Organism-Response (SOR). *Revista Brasileira de Gestão de Negócios*, 23, 43-62.
- Australian Institute for Teaching and School Leadership (AITSL). (2014). Australian professional standards for teachers. Retrieved from <http://www.aitsl.edu.au/australian-professionalstandards-for-teachers>.
- Backes, B., & Hansen, M. (2015). Teach for America impact estimates on nontested student outcomes. Working Paper 146. Washington, D C: National Center for Analysis of Longitudinal in Education Research
- Bada, T. (2007). Perception of teachers' knowledge, attitude and teaching skills as predictor of academic performance in Nigerian secondary schools. *Educational Research and Reviews*, 2(7), 165-171.
- Bell, E., & Bryman, A. (2007). The ethics of management research: an exploratory content analysis. *British Journal of Management*, 18(1), 63-77.
- Bertschy, F., Künzli, C., & Lehmann, M. (2013). Teachers' competences for the implementation of educational offers in the field of education for sustainable development. *Sustainability*, 5(12), 5067-5080.
- Black, P., Harrison, C., Hodgen, J., Marshall, B., & Serret, N. (2010). Validity in teachers' summative assessments. *Assessment in Education: Principles, Policy & Practice*, 17(2), 215-232.
- Blair, J. (2000). Certification found valid for teachers. *Education Week*. XX (8), 1, 24-25.

- Blašková, M. & Blaško, R. (2012). *Dimenzie a atribúty kvality vysokoškolského učiteľa*. Human Potential Management in a Company. Banská Bystrica: University of Matej Bel, 32-43.
- Blašková, M., Blaško, R., & Kucharčíková, A. (2014). Competences and competence model of university teachers. *Procedia-Social and Behavioral Sciences*, 159, 457-467.
- Blazar, D. (2015). Effective teaching in elementary mathematics: Identifying classroom practices that support student achievement. *Economics of Education Review*, 48, 16-29.
- Blazkova, H. (2011). Telling tales of professional competence: Narrative in 60-second business networking speeches. *The Journal of Business Communication* (1973), 48(4), 446-463.
- Blömeke, S. & Delaney, S. (2012). Assessment of teacher knowledge across countries: *A Review of the State of Research*, *ZDM* 44(3), 223-247.
- Bourgonje, P., & Tromp, R. (2011). *Quality educators: An international study of teacher competences and standards*. Oxfam Novib
- Bourke, T. (2011) Teacher Professional Standards: Mirage or Miracle Cure. An Archaeology of Professionalism in Education. Queensland University of Technology. Australia
- Bowling, A. (2002). *Investigating health and health services*. Open University Press.
- Brewer, J., & Hunter, A. (2006). *Foundations of multimethod research: Synthesizing styles*. Sage.

- Broadfoot, P., & Black, P. (2004). Redefining assessment? The first ten years of assessment in education. *Assessment in Education: Principles, Policy & Practice*, 11(1), 7-26.
- Brown, C. A., Smith, M. S. & Stein, M. K. (1995). *Linking teacher support to enhanced classroom instruction*. Paper presented at the AERA Conference, New York
- Bryman, A. (2008). *Social research methods* (3rd ed.). New York: Oxford.
- Bryman, A. (2015). *Social research methods*: Oxford University Press.
- Caena, F. (2014). Initial teacher education in Europe: an overview of policy issues. European Commission. ET2020 Working Group of Schools Policy. Consultado en http://ec.europa.eu/education/policy/strategic-framework/expert-groups/documents/initial-teacher-education_en.pdf.
- Call, K. (2018). Professional teaching standards: A comparative analysis of their history, implementation and efficacy. *Australian Journal of Teacher Education*, 43(3), 93-108. Cambridge University Press.
- Casaló, L. V., Flavián, C., & Ibáñez-Sánchez, S. (2021). Be creative, my friend! Engaging users on Instagram by promoting positive emotions. *Journal of Business Research*, 130, 416-425.
- Catano, N., & Stronge, J. H. (2006). What are principals expected to do? Congruence between principal evaluation and performance standards. *NASSP bulletin*, 90(3), 221-237.
- Clayton, J. (2010). *Handbook of research methods*. Jaipur, India: Global Media

- Cochran-Smith, M., & Zeichner, K. M. (Eds.). (2009). *Studying teacher education: The report of the AERA panel on research and teacher education*. Routledge.
- Codó, E. (2008). Interviews and questionnaires. *The Blackwell guide to research methods in bilingualism and multilingualism*, 158-176.
- Cohen, D. K. & Hill, H. (1977). Instructional policy and classroom performance. The mathematics reform in /California. *Paper presented at the AERA*, Chicago, IL. Books Inc. Competences. *Journal of Human Resources*.
- Cole, M., & Wertsch, J. V. (2004). Beyond the individual-social antinomy in discussions of Piaget and Vygotsky. *Human development*, 39(5), 250-256.
- Copriady, J. (2015). Self-motivation as a Mediator for Teachers' Readiness in Applying ICT in Teaching and Learning. *Procedia - Social and Behavioral Sciences*. 176 (10). 699-708.
- Couper, M. P. (2000). Web surveys: A review of issues and approaches. *The Public Opinion Quarterly*, 64(4), 464-494.
- Creswell, J. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches*. (3rd ed.). Los Angeles: Sage Publications.
- Creswell, J. W. (2013). *Research design: qualitative, quantitative and mixed methods approach* (4th ed.). Thousand Oaks, CA: Sage.
- Creswell, J. W., Hanson, W. E., Clark Plano, V. L., & Morales, A. (2007). Qualitative research designs: Selection and implementation. *The counseling psychologist*, 35(2), 236-264

- Creswell, R. (2014). *Research design: qualitative, quantitative, and mixed methods approach*. USA: SAGE Publications.
- Dalati, S., & Marx Gómez, J. (2018). Surveys and questionnaires. In *Modernizing the Academic Teaching and Research Environment* (pp. 175-186). Springer, Cham.
- Danielson, C., & McGreal, T. L. (2000). *Teacher evaluation to enhance professional practice*. Ascd.
- Darling-Hammond, L. (2001). The challenge of staffing our schools. *Educational leadership*, 58(8), 12-17.
- Darling-Hammond, L., Berry, B., & Thoreson, A. (2001). Does teacher certification matter? Evaluating the evidence. *Educational evaluation and policy analysis*, 23(1), 57-77.
- Datnow, A., & Hubbard, L. (2016). Teacher capacity for and beliefs about data-driven decision making: A literature review of international research. *Journal of Educational Change*, 17(1), 7-28.
- Deakin University (2008). Undergraduate Studies Handbook. McPherson's Printing Group. Australia.
- Delandshere, G., & Petrosky, A. (2004). Political rationales and ideological stances of the standards-based reform of teacher education in the US. *Teaching and teacher education*, 20(1), 1-15.
- DEQUA. (2012). *Improving quality of university teachers. Evidence from Development*, 72, 625-638
- Doody, O., & Noonan, M. (2013). Preparing and conducting interviews to collect data. *Nurse researcher*, 20(5).

- Druva, C.A. & Anderson, R. D. (1983). Science teacher characteristics by teacher behaviour *Economics*, 19 (10). 343-69.
- Eggen, P. D. & Kauchak, D. P. (2001). *Strategies for teachers: Teaching content and thinking skills* (4th ed.). Boston: Allyn and Bacon.
- Egungun, N. V. (1992). Human resource development and utilization in Nigerian private enterprises. In Yahaya, A.D. & Akinyele, A. (Eds.). *Human resource development and utilization, policies and issues*. Badagry: Administration Staff College of Nigeria.
- ENQA. (2009). Standards and guidelines for quality assurance in the European Higher Education Area. Helsinki: *European Association for Quality Assurance in Higher Education*.
- Eroglu, S. A., Machleit, K. A., & Davis, L. M. (2001). Atmospheric qualities of online retailing: A conceptual model and implications. *Journal of Business research*, 54(2), 177-184.
- Eroglu, S. A., Machleit, K. A., & Davis, L. M. (2003). Empirical testing of a model of online store atmospherics and shopper responses. *Psychology & marketing*, 20(2), 139-150.
- Evans, L. (2011). The 'shape' of teacher professionalism in England: Professional standards, performance management, professional development and the changes proposed in the 2010 White Paper. *British Educational Research Journal*, 37(5), 851-870
- Eysenck, M. W., & Keane, M. T. (2020). *Cognitive psychology: A student's handbook*. Psychology press.
- Fathivajargah, K. (2003). Standard School. (7th. ed). Tehran: Fakher

- Fautley, M., & Savage, J. (2008). *Assessment for learning and teaching in secondary schools*. Learning Matters.
- Ferrari, A. (2012). *Digital Competence in practice: An analysis of frameworks*. Seville: JRC-IPTS
- Fišer, R., & Plamínek, J. (2005). *Řízení podle kompetencí*.
- Fletcher, M., Walker, L. & Boniface, R. (2013). Summary of practice relating to the development, specification and use of professional standards for teachers across the UK and in selected other Countries. Preston, UK: Research & Consultancy Unit.
- Fox, R. (2001). Constructivism Examined. *Oxford Review of Education*, 27 (1), 23-35.
- Fullan, M., & Hargreaves, A. (2016). *Bringing the profession back in. Learning Forward*,
- Gallie, M. & Keevy, J. (2014). *Framework for teachers and school leaders*. London: Commonwealth Secretariat.
- Gergen, K. J. (1985). The social constructionist movement in modern psychology. *American Psychologist*, 40 (3), 266-175.
- Gershenson, S. (2016). Linking teacher quality, student attendance, and student achievement. *Education Finance and Policy*, 11(2), 125-149.
- Gertler, P. J., Martinez, S., Premand, P., Rawlings, L. B., & Vermeersch, C. M. (2016). *Difference-in-differences*.
- Ghana Education Service. (2017). *Teacher Education in Ghana: A policy framework*. Accra: Ghana Education Service.
- Ghana Education Service Act. (1995). Section 31[i]. Republic of Ghana.

- Ghana Statistical Service. (2020). 2019 Population and Housing Census: Report on housing and population characteristics of Ghana. Accra: Ghana Statistical Service.
- Gibb, S. (2008). Human Resource Development. Process, Practices and Perspectives. Second Edition. New York: Palgrave MacMillan.
- Grizzle, A., Moore, P., Dezuanni, M., Asthana, S., Wilson, C., Banda, F., & Onumah, C. (2014). *Media and information literacy: policy and strategy guidelines*. Unesco
- Guskey, T. R., & Sparks, D. (2004). Linking professional development to improvements in student learning. *Research linking teacher preparation and student performance*, 12(11).
- Guskey, T. R., & Sparks, D. (2004). Linking professional development to improvements in student learning. In E. Guyton (Ed.), *Teacher education yearbook: Vol. 12. Research linking teacher preparation and student performance*. Westmark Drive Dubuque (Iowa): Kendall/Hunt Publishing Company
- Habib, H. (2017). A study of reflective practice and its role for teachers. *International Journal of Creative Research Thoughts (IJCRT)*, 5(4), 944-947.
- Hafen, C. A., Allen, J. P., Gregory, A., Mikami, A.Y., Hamre, B. & Pianta, R. C. (2015). The pivotal role of autonomy in secondary school classrooms. *Journal of Youth and Adolescence*, 2015, 41:245–255.
- Hafen, C. A., Allen, J. P., Gregory, A., Mikami, A.Y., Hamre, B. & Pianta, R. C. (2015). The pivotal role of autonomy in secondary school classrooms. *Journal of Youth and Adolescence*, 2015, 41:245–255.

- Hamre, B. K., & Pianta, R. C. (2001). Early teacher–child relationships and the trajectory of children's school outcomes through eighth grade. *Child development*, 72(2), 625-638.
- Harris, A. (2011). Reforming systems: Realizing the fourth way. *Journal of educational change*, 12, 159-171.
- Harris, J. R. (2011). *The nurture assumption: Why children turn out the way they do*. Simon and Schuster.
- Harris, O. & Sass, T. R. (2006). Value – added models and the measurement of teacher quality. *Unpublished manuscript*.
- Hartley, P., Hilsdon, J., Keenan, C. H., Sinfield, S. & Verity, M. (2011). *Learning development in higher education*. London: Palgrave Macmillan.
- Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning*. Routledge.
- Hawk, P. P., Coble, C. R., & Swanson, M. (1985). Certification: It does matter. *Journal of teacher education*, 36(3), 13-15.
- Hobson, A. J., & Malderez, A. (2013). The importance of subject expertise for teacher effectiveness in secondary schools: A cross-sectional study of the association between subject and pedagogic knowledge and student outcomes. *Learning and Instruction*, 23, 23-32.
- Hochreiter, V., Benedetto, C., & Loesch, M. (2022). The Stimulus-Organism-Response (SOR) Paradigm as a Guiding Principle in Environmental Psychology: Comparison of Its Usage in Consumer Behavior and Organizational Culture and Leadership Theory. In *Global Business Conference 2022 Proceedings* (p. 42).

- Holloway, I. & Wheeler, S (2010). *Qualitative Research in Nursing and Healthcare*. Third edition. Wiley-Blackwell. Oxford.
- Hopkins, D., Stringfield, S., Harris, A., Stoll, L., & Mackay, T. (2014). School and system improvement: a narrative state-of-the-art review. *School Effectiveness and School Improvement*, 25(2), 257-281.
- Horner, C. & Westacott, E. (2000). *Thinking through Philosophy: An Introduction*.
- Hulin, C., Netemeyer, R., & Cudeck, R. (2001). Can a Reliability Coefficient Be Too High? *Journal of Consumer Psychology*, Vol. 10, Nr. 1, 55-58.
- in the implementation of the Primary School Standard Curriculum (KSSR) in Kluang district. *Journal of Science and Mathematics Education*, 6, 26-38.
- Hulings, M. (2024). Self-efficacy in Elementary Science: What Impact Do Field Experiences Have on Preservice Teachers? *The Electronic Journal for Research in Science & Mathematics Education*, 27(4), 1-17.
- Ingvarson, L. (2019). Teaching standards and the promotion of quality teaching. *European Journal of Education*, 54(3), 337-355.
- Ingvarson, L., Beavis, A., & Kleinhenz, E. (2007). Factor affecting the impact of teacher education programmes on teacher preparedness: implications for accreditation policy. *European Journal of Teacher Education*, 30(4), 351-381.

- Islam, J. U., & Rahman, Z. (2017). The impact of online brand community characteristics on customer engagement: An application of Stimulus-Organism-Response paradigm. *Telematics and Informatics*, 34(4), 96-109.
- Jackson, J. (2012). Education abroad. In *The Routledge handbook of language and intercultural communication* (pp. 456-470). Routledge.
- Jennings, J.L. & DiPrete, T.A. (2010). Teacher effects on social and behavioral skills in early *Journal of Educational Change*, 17 (1), pp.7–28.
- Kankam, G & Westbrook, J. (2016). Teachers’ Standards for Ghana.
- Kember, D., McNaught, C., Chong, F. C., Lam, P., & Cheng, K. F. (2010). Understanding the ways in which design features of educational websites impact upon student learning outcomes in blended learning environments. *Computers & Education*, 55(3), 1183-1192.
- Khatoon, Z., Alam, M.T., Bukhari, M. A., & Mushtaq, M. (2014). In-service Teachers' Perception about their Competences in Delivery of Biology Lessons. *International Journal of Asian Social Science*, 4(7), 820- 834.
- Kim, A. J., & Johnson, K. K. (2016). Power of consumers using social media: Examining the influences of brand-related user-generated content on Facebook. *Computers in Human Behavior*, 58, 98-108.
- Kim, H. (2014). Involvement of the dorsal and ventral attention networks in oddball stimulus processing: A meta-analysis. *Human brain mapping*, 35(5), 2265-2284.

- Kim, Y., & Park, J. (2019). A comparative study of science teacher competences in middle and high schools: A focus on pedagogical content knowledge. *Asia-Pacific Education Researcher*, 28(4), 289-299.
- Kleinhenz, E., & Ingvarson, L. (2004). Teacher accountability in Australia: Current policies and practices and their relation to the improvement of teaching and learning. *Research papers in education*, 19(1), 31-49.
- Koedel, C. (2008). An empirical analysis of teacher spillover effects in secondary school. *Economics of Education Review*, 28, 682-692.
- Kravčáková, G., Lukáčová, J., & Búgelová, T. (2011). *Práca a kariéra vysokoškolského učiteľa* *work and career of the university teacher*. Košice: Pavol Jozef Šafárik University in Košice.
- Kreber, C., Brook, P., & Policy, E. (2001). Impact evaluation of educational development programmes. *International Journal for Academic Development*, 6(2), 96-108.
- Kucuk, S., & Sahin, M. (2017). Teachers' views on the national teacher standards in Turkey. *Educational Research and Reviews*, 12(5), 290–297.
- Kumar, A & Kim, Y.A. (2014). The store-as-a-brand strategy: The effect of store environment on customer responses. *Journal of Retailing and Consumer services*, 21 (5), 685-695.
- Labudde, P. (2007). How to develop, implement and assess standards in science education? 12 challenges from a Swiss perspective. *Making it comparable: Standards in science education*, 277-301.

- Ladd, H. F. & Sorensen, L. C. (2015). *Do master's degrees matter? Advanced degrees, career paths, and the effectiveness of teachers*. Washington, DC: CALDER.
- Lambert, S. D., & Loiselle, C. G. (2008). Combining individual interviews and focus groups to enhance data richness. *Journal of advanced nursing*, 62(2), 228-237.
- Lampert, M. (2001). *Teaching problems and the problems of teaching*. New Haven, CT: Yale University Press,
- Lanier-Christensen, C. (2021). Creating regulatory harmony: the participatory politics of OECD chemical testing standards in the making. *Science, Technology, & Human Values*, 46(5), 925-952.
- Lemetyinen, H. (2012). Language Acquisition. Retrieved on December, 2021 from Simply Psychology: [https:// www.simplypsychology.org/language.htm](https://www.simplypsychology.org/language.htm).
- Li, L., & Liu, C. (2020). Teachers' perceptions of the national teacher standards in China. *Asia Pacific Education Review*, 21(3), 345–354.
- Luckner, A. E., & Pianta, R. C. (2011). Teacher–student interactions in fifth grade classrooms: Relations with children's peer behavior. *Journal of Applied Developmental Psychology*, 32(5), 257-266.
- Luszczynska, A., & Schwarzer, R. (2020). Changing behavior using social cognitive theory. *The handbook of behavior change*, 2, 32-45.
- Mabena, N., Mokgosi, P. N., & Ramapela, S. S. (2021). Factors Contributing To Poor Learner Performance In Mathematics: A Case Of Selected Schools In Mpumalanga Province, South Africa. *Problems of Education in the 21st Century*, 79(3), 451.

- Mahony, P., & Hextall, I. (2000). *Reconstructing teaching: Standards, performance and accountability*. London: RoutledgeFalmer.
- Margot, K. C., & Kettler, T. (2019). Teachers' perception of STEM integration and education: a systematic literature review. *International Journal of STEM education*, 6(1), 1-16.
- Martin, M. O., Mullis, I. V., & Foy, P. (2011). Age distribution and reading achievement configurations among fourth-grade students in PIRLS 2006. *IERI Monographic Series: Issues and Methodologies in Large-Scale Assessments*, 4, 9-33.
- Martin, M., Mullis, I. V., & Foy, P. (2008). Interrelationships among reading achievement, grade level, and age in PIRLS 2006. IEA International Research Conference, Taipei, Chinese Taipei
- Mashburn, A. J., Pianta, R. C., Hamre, B. K., Downer, J. T., Barbarin, O. A., Bryant, D., & Burchinal, M. (2008). Measures of classroom quality in pre-kindergarten and children's development of academic, language, and social skills. *Child Development*, 79(3), 732–749.
- Mayer, D., Mitchell, J., Macdonald, D., & Bell, R. (2005). Professional standards for teachers: A case study of professional learning. *Asia-Pacific Journal of Teacher Education*, 33(2), 159-179.
- McCaughtry, N., & Rovegno, I. (2003). Development of pedagogical content knowledge:
- McCaughtry, N., Barnard, S., Martin, J., Shen, B., & Kulinna, P. H. (2006). Teachers' perspectives on the challenges of teaching physical education in urban schools: The student emotional filter. *Research quarterly for exercise and sport*, 77(4), 486-497.

- McCulloch, G., Helsby, G., & Knight, P. (2000). The politics of professionalism: Teachers and the curriculum. London: Continuum.
- Mensah F., Appiah, J. Y., & Angbin, H. (2017) Environmental Studies. University printing press, Cape Coast. Moving from blaming students to predicting skillfulness, recognizing motor development, and understanding emotion. *Journal of Teaching in Physical education*, 22(4), 355-368.
- Murphy-Black, T (2000). Questionnaire. In Comack D (Ed.). *Research Processing in Nursing*. Blackwell Science, Edinburg 302-313.
- Musset, P. (2010). Initial teacher education and continuing training policies in a comparative perspective: Current practices in OECD countries and a literature review on potential effects
- National Teaching Council. (2018). National Teachers' Standards for Ghana. Accra: National Teaching Council.
- Ndirangu, M. W., & Wambugu, P. W. (2018). Compliance with the National Teacher Standards among secondary school teachers in Kajiado County, Kenya. *Journal of Education and Practice*, 9(12), 109-115.
- Oduol, J. O. (2014). Teachers' perception of the effectiveness of the National Teachers' Standards in enhancing quality education in Kenya. *Journal of Education and Practice*, 5(28), 90–97.
- Ofori, K. (2015). Teacher Training in Ghana: An examination of teachers. *Journal of Teacher Education and Development*, 3(1) 23-40.
- Omah, P. (2002). The Neutral Teacher, In: C.S.Brown (ed) *Philosopher Discuss Education*, Banisngstoke.Macmillan,

- Opfer, V. D., Kaufman, J. H., & Thompson, L. E. (2016). Implementation of K–12 state standards for mathematics and English language arts and literacy. *Santa Monica, CA: RAND*.
- Oskamp, S., & Schultz, P. W. (2005). *Attitudes and opinions*. Psychology Press. Other. Science, 328 (10). 459-63. New York, N.Y. *Oxford, OH*.
- Padgett, D. K. (2016). Qualitative methods in social work research (Vol. 36). Sage Publications.
- Pajares, F., & Usher, E. L. (2008). Self-efficacy, motivation, and achievement in school from the perspective of reciprocal determinism. *Advances in motivation and achievement, 15*, 391-423.
- Palenzuela, S. M. (2004). Measuring pre-kindergarten teachers' perceptions: Compliance with the high/scope programme. *Journal of Research in Childhood Education, 18*(4), 321-333.
- Patto n, M. Q. (2015). Qualitative research and evaluation methods (4th ed.). Thousand Oaks, CA: Sage.
- Pianta, R. C., La Paro, K. & Hamre, B. K. (2009). *Classroom Assessment Scoring System (CLASS)*. Dimensions Overview. Paul H. Brookes Publishing Co., Inc. London
- Poet, H., Rudd, P., & Smith, R. (2010). How teachers approach practice improvement. London: General Teaching Council for England. Professionalism in Education. Queensland University of Technology. Australia.

- Pulungan, M. S., & Nasution, D. (2021, March). The effect of scientific inquiry learning model and scientific attitude on students' science process skills. In *Journal of Physics: Conference Series* 1811 (1), . IOP Publishing.
- Pyke, C. L., & Lynch, S. (2005). Mathematics and science teachers' preparation for National Board of Professional Teaching Standards certification. *School Science and Mathematics*, 105(1), 25-35.
- Richard, M. O. (2005). Modeling the impact of internet atmospherics on surfer behavior. *Journal of business research*, 58(12), 1632-1642.
- Ries, L., (2009). *In the Boardroom: Why Left-Brained Management and Right-Brain Marketing Don't See Eye-to-Eye*. New York: HarperCollins.
- Roller, M. R., & Lavrakas, P. J. (2015). *Applied qualitative research design: A total quality framework approach*. Guilford Publications.
- Rosnani H., & Suhailah, H. (2003). The teaching of thinking in Malaysia. Kuala Lumpur : International Islamic University Malaysia.
- Ruzek, E. A. & Pianta, R. C. (2015). The value of using observational and student report methodologies in classroom research. In: Rubie-Davies CM, Stephens JM, Watson P, editors. *The Routledge international handbook of social psychology of the classroom*. New York, NY: Routledge; 2015. pp. 231–241.
- Sachs, J. (2003). The activist teaching profession. Buckingham: Open University Press.

- Sang, D., Oduor, A., & Simatwa, E. (2019). Teachers' compliance with the national teacher professional standards in Uganda. *Journal of Education and Practice*, 10(21), 1-13
- Sanitah. M. Y., & Norsiwati, I. (2012). Teacher readiness among first year mathematic teachers'
- Sayed, Y., & Ahmed, R. (2015). Education quality, and teaching and learning in the post-2015 education agenda. *International Journal of Educational Development*, 40, 330-338.
- Schecker, H. (2012). Standards, competences and outcomes. A critical view. In S. Bernholt, K. Neumann, & P. Nentwig (Eds.), *Making it tangible: learning outcomes in science education* (pp 219–234). Münster: Waxmann. (PDF) *Students Explaining Science - Assessment of Science Communication Competence*.
- Schleicher, A. (2012). *Preparing teachers and developing school leaders for the 21st century: Lessons from around the world*. OECD Publishing. 2, rue Andre Pascal, F-75775 Paris Cedex 16, France
- Schultze, U., & Avital, M. (2011). Designing interviews to generate rich data for information systems research. *Information and organization*, 21(1), 1-16.
- Schunk, D. H., & Usher, E. L. (2012). Social cognitive theory and motivation. *The Oxford handbook of human motivation*, 2, 11-26.
- Schwandt, T. A. (2001). Dictionary of qualitative inquiry. In *Dictionary of qualitative inquiry* (pp. xxxiv-281).
- Seif, A. A. (2003). *Educational Psychology*. Tehran: Agah.

- Sergiovanni, T. J., & Starratt, R. J. (2002). *Supervision: A redefinition* (7th ed.). New York: McGraw-Hill.
- Shabani, H. (2006). *Educational skills*. Tehran: Samt
- Simplinotes, M. (2019). Perceptual Process. Webcustoms.
- Smith, & Firth, J. (2011). Qualitative data analysis: application of the framework approach. *Nurse Researcher*, 18(2), 52-62.
- Smith, J. K., & Neale, D. C. (2017). High school science teachers' perceptions of competences needed for effectively teaching higher order thinking: A national survey. *Journal of Science Teacher Education*, 28(5), 463-482
- Smith, R., & Peterson, A. (2019). The Role of Clarity in Policy Implementation: A Study of Teacher Standards. *Educational Policy*, 33(3), 389-415.
- Snape, D., & Spencer, L. (2003). The foundations of qualitative research In J. Richie & J. Lewis (Eds.), *Qualitative Research Practice* (pp. 1-23). Los Angeles: Sage.
- Soanes, C. & Stevenson, A. (2003). *Oxford dictionary of English*. Second Edition. Oxford. Oxford University Press.
- Solomon, D. J. (2000). Conducting web-based surveys. *Practical Assessment, Research, and Evaluation*, 7(1), 19.
- Swann, M., McIntyre, D., Pell, T., Hargreaves, L., & Cunningham, M. (2010). Teachers' conceptions of teacher professionalism in England in 2003 and 2006. *British educational research journal*, 36(4), 549-571

- Sykes, G., & Plastrik, P. (1993). *Standard setting as educational reform. (Trends and Issues Paper no. 8)*. Washington, DC: ERIC Clearinghouse on Teacher Education and American Association of Colleges for Teacher Education. ED 358 068.
- Tang, S. Y. F., Cheng, M. M. H., & So, W. W. M. (2006). Supporting student teachers' professional learning with standards-referenced assessment. *Asia-Pacific Journal of Teacher Education*, 34(2), 223-244.
- Taylor, S. (2016) UK Professional Standards Framework (UKPSF) Dimensions of the Framework for Doctoral Supervisors. Higher Education Academy. Retrieved https://www.heacademy.ac.uk/sites/default/files/downloads/ukpsf_dof_doctoral_supervisors_150416_final_0.pdf Accessed 17th December 2021
- Tienken, C. H. (2013). Conclusions from PISA and TIMSS testing. *Kappa Delta Pi Record*, 49(2), 56-58.
- Trochim, W. M. K. (2001). *Research methods knowledge base*. Cincinnati, OH: Atomic Dog Pub.
- Tsai, C.C. (2002). Nested epistemologies: Science teachers' beliefs of teaching, learning, and science, *International Journal of Science Education*, 24(8), 771-783.
- Usher, E. L. & Pajares, F. (2008). Sources of self-efficacy in school: Critical review of the literature and future directions. *Review of Educational Research*, 78, 751–796

- Valica, M. & Rohn, T. (2013). Development of the professional competence in the ethics teachers. 4th international conference on new horizons in education. *Procedia–Social and Behavioral Sciences*, 106(2013), 865–872. Wiley & Sons: New York.
- Weinert, F. E. (2001). Concept of competence: a conceptual clarification. In D. S. Rychen & L. H. Salganik (Eds.), *Defining and selecting key competences* (pp. 1–10). Dordrecht: Kluwer.
- Wenglinsky, H. (2000). *How teaching matters: bringing the classroom back into discussion of teacher quality policy*. Princeton, NJ: Educational Testing Services.
- Whitehurst, G. J. (2002). Raising student achievement: the evidence of high-quality teaching. *Remarks presented at the Standards-based Teacher Education Project 2002 Summer Conference*.
- Wiley, D. E., & Yoon, B. (1995). Teacher reports on opportunity to learn: Analyses of the 1993 California Learning Assessment System (CLAS). *Educational Evaluation and Policy Analysis*, 17(3), 355-370
- Williamson, C. (2013). Questionnaires, individual interviews and focus groups. In *Research methods: Information, systems, and contexts* (pp. 349-372). Tilde University Press
- Williamson, C. (2013). Questionnaires, individual interviews and focus groups. In *Research methods: Information, systems, and contexts* (pp. 349-372). Tilde University Press.
- Woolfolk, A. (2001). *Educational Psychology* (8th ed.). Allyn and Bacon.
- Yates, J. S. (2004). *Doing social science research*. London: Sage Publications in association with the Open University Press.

APPENDICES**APPENDIX A****SCIENCE TEACHERS' LESSON EVALUATION AND ASSESSMENT****TOOL (STLEAT)****INSTRUCTIONAL MANUAL****NAME OF INSTITUTION:****1. INTRODUCTION AND JUSTIFICATION**

Observing a lesson and providing feedback in the spirit of support is the best means to help teachers improve their teaching skills. Lesson observations tools are generally used to assess the strengths and weaknesses of the teaching skills of teachers. Using evaluation and assessment tool is the best practice to assess the Pre-tertiary science teacher's performance since it takes into consideration what Ghana Education Service has approved as the best curriculum evaluation and assessment practices (Ghana Education Service, 2008). However, the curriculum evaluation and assessment tool for Ghana Education Service (GES) did not consider observing science lessons as different practice from assessing other subjects like English and Ghanaian language and others. Besides, the GES Lesson Observation Sheet (LOS) considers only fifteen items and these does not include introduction, RPK, and other quantum of areas that are deemed necessary to science lessons. As a result, the STLEAT is an innovation and an improved product of the LOS designed and used by Ghana Education Service for school and cluster Based in-service training. The GES provided "LESSON OBSERVATION SHEET" as a tool for observing lessons in the INSET Sourcebook Module 3 (3rd edition) published in 2008. Based on the feedback from both district level

users and school level users of the LOS, I have upgraded LOS and named it as ***“SCIENCE TEACHERS LESSON EVALUATION AND ASSESSMENT TOOL (SLEAT)”***. The STLEAT is a tool for anyone who observes science lessons at primary and second cycle institutions in Ghanaian schools (DTO, CS, DMT, DTST, Head teachers, Teachers, etc) to assess the lesson easily and to provide feedback (comments/ advice) appropriately to science teachers so that they can improve their subject matter and action system knowledge. This booklet is a guide on how to use the SLEAT.

2. **FEATURES**

The STLEAT has unique characteristics as follows:

A. High Reliability of Lesson Evaluation

Some may rate a lesson excellent, while others rate it poor. Some may stress the importance of lesson plans while others may not. To make lesson evaluation have higher reliability, ratings from evaluator(s) must be the same or at least similar so that everyone can accept the rating. For this purpose, the STLEAT provides a clear definition of teaching skills and levels as follows.

30 Observation Items in 3 categories

The STLEAT provides 30 observation items so that each evaluator uses the same observation points. These are classified into three categories:

- I) Instruction Planning Skills and Subject Matter Knowledge (Lesson Plan),
- II) Action systems and content delivery and
- III) Classroom Organization and Management.

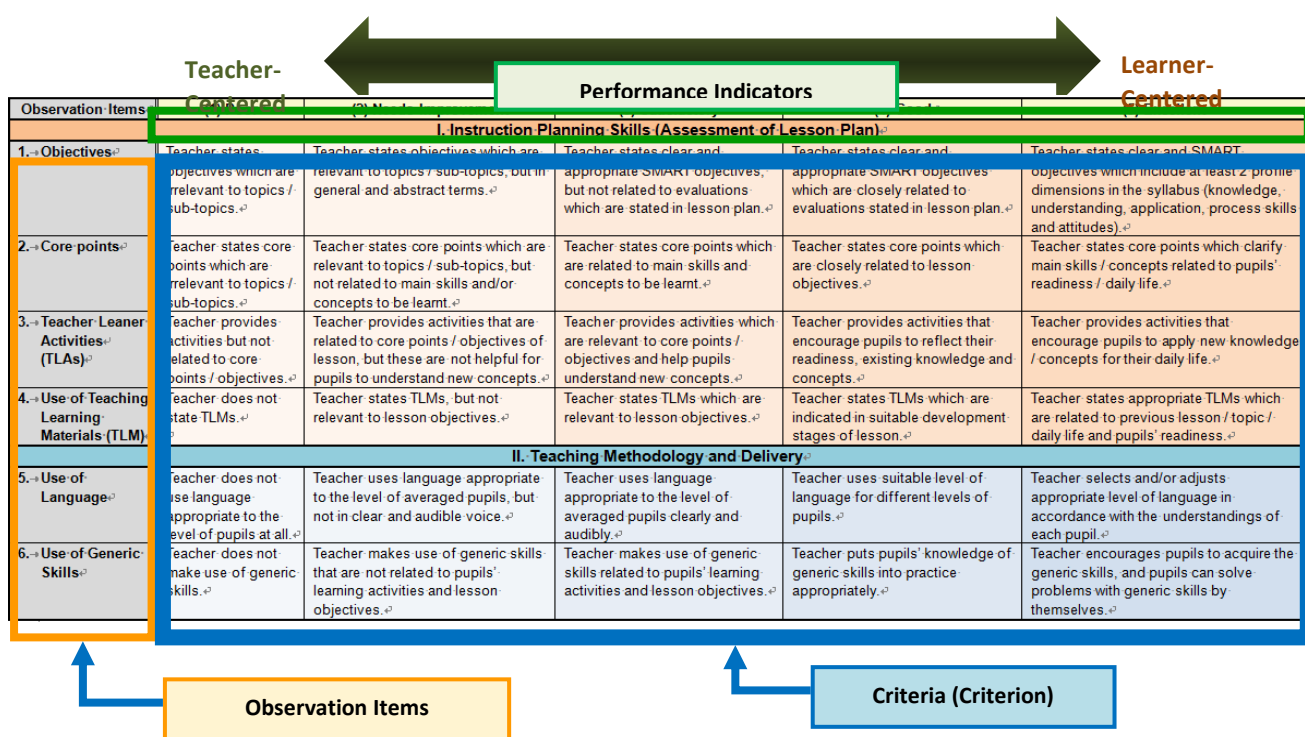
The 30 observation items in 3 categories are shown in the table to the right.

5-Scale Performance Indicators with Clear Definition (Criterion) of Each Observation Item

Each observation item will be rated by performance indicators on a scale from 1 to 5: “(1) Poor”, “(2) Needs Improvement”, “(3) Satisfactory”, “(4) Good” and “(5) Excellent”. As the scale increases, the lesson/teaching skills tend to be more Learner-centered. For example; “(1) Poor” implies a typical “*Teacher-centered*” lesson whereas “(5) Excellent” implies a typical “*Learner-centered*” lesson. Each observation item has specific “*Criteria*”. “*Criteria*” is a kind of standard for judging the level of teaching skills. The criterion of each performance indicator defines the specific state of teaching skills which help users to measure the level of teaching skills *objectively* and *reliably* when lessons are evaluated.

B. Systematic Structure

The STLEAT has systematic structures such as “observation items”, “performance indicators” and “criteria” as shown in the diagram below.



This structure helps evaluators to find observation points easily, assess teaching skills objectively and identify the teacher's level reliably. For instance, when you want to evaluate teachers' generic skills, you would first find it in the observation item list in the left column. Then you will see the 5 levels of criterion for each of the performance indicators as follows.

C. Empowerment Evaluation for Teachers

Observation Items	(1) Poor	(2) Improvement	(3) Needs Satisfactory	(4) Good	(5) Excellent
6. Use of Generic Skills	Teacher does not make use of generic skills.	Teacher makes use of generic skills that are not related to pupils' learning activities and lesson objectives.	Teacher makes use of generic skills related to pupils' learning activities and lesson objectives.	Teacher puts pupils' knowledge of generic skills into practice appropriately.	Teacher encourages pupils to acquire the generic skills, and pupils can solve problems with generic skills by themselves.

“Empowerment Evaluation” is an evaluation approach designed to help teachers to evaluate their own performance and accomplish their goals of teaching. Therefore, applying the idea of “Empowerment Evaluation” to lesson evaluation will help teachers to evaluate their current teaching level and improve their teaching skills to reach the next level based on the SLEAT. An evaluator, who facilitates the process and steps of empowerment evaluation, is required to evaluate teacher's current teaching level and provide supportive comments and necessary advice to help teachers to improve their skills (**Support and Encouragement Approach**). Advice should be provided based on the criterion of the next level in the STLEAT: for example, if the teacher's current level is “(1) Poor”, the evaluator should give advice based on the

criterion of “(2) Needs Improvement”. This is called a **Step-by-Step Approach**. This step-by-step approach will help teachers to improve their teaching skills steadily with confidence and motivation (**Self-Confidence & Motivation Approach**). Hence, these 3 approaches provide empowerment to teachers for effective teaching.

The next section elaborates on how to use the STLEAT for empowerment evaluation.

3. PROCEDURE TO USE THE STLEAT FOR EMPOWERMENT EVALUATION

When you evaluate a lesson with the STLEAT for empowerment, follow these three steps.

STEP 1: Evaluate Teacher’s Current Teaching Skills

Identifying the teacher’s current teaching skills properly on each observation points of the SLEAT is imperative when you evaluate a lesson. The comments and advice in the next two steps will be provided based on the identified skills in this step. When you observe a teacher’s lesson on a certain observation item (you will evaluate a single observation item when you are a beginner at using the STLEAT, but you will be able to evaluate multiple items at once when you acquire more proficiency), compare the observed skill of teachers with the criterion using “**(1) Poor**” of the observation item on the STLEAT. If the observed skill is better than the criterion of “**(1) Poor**”, check the criterion at the next level of “**(2) Needs Improvement**” and continue to find the best described criterion which is suitable for the teacher’s teaching skill. Write the value of the best described criterion in the box provided at the respective item column. In principle, you would evaluate all observation items, quantify them

and write the respective figure of the applicable criterion in the boxes provided at the item column.

Evaluate all observation items and write their respective values in all the boxes provided

Observation Items	(1) Poor	(2) Needs Improvement	(3) Satisfactory	(4) Good	(5) Excellent
I. Instruction Planning Skills (Assessment of Lesson Plan)					
1. Objectives	Teacher states objectives which are irrelevant to sub-topics. 3	Teacher states objectives which are relevant to topics / sub-topics, but in general and abstract terms.	Teacher states clear and appropriate SMART objectives, but not related to evaluations which are stated in lesson plan.	Teacher states clear and appropriate SMART objectives which are closely related to evaluations stated in lesson plan.	Teacher states clear and SMART objectives which include at least 2 profile dimensions in the syllabus (knowledge, understanding, application, process skills and attitudes).
2. Core points	Teacher states core points which are irrelevant to sub-topics. 2	Teacher states core points which are relevant to topics / sub-topics, but not related to main skills and/or concepts to be learnt.	Teacher states core points which are related to main skills and concepts to be learnt.	Teacher states core points which are closely related to lesson objectives.	Teacher states core points which clarify main skills / concepts related to pupils' readiness / daily life.
3. Teacher Learner Activities (TLAs)	Teacher provides activities but not related to core points / objectives.	Teacher provides activities that are related to core points / objectives of lesson, but these are not helpful for pupils to understand new concepts.	Teacher provides activities which are relevant to core points / objectives and help pupils understand new concepts.	Teacher provides activities that encourage pupils to reflect their readiness, existing knowledge and concepts.	Teacher provides activities that encourage pupils to apply new knowledge / concepts for their daily life.
4. Use of Teaching Learning Materials (TLM)	Teacher does not state TLMs.	Teacher states TLMs, but not relevant to lesson objectives.	Teacher states TLMs which are relevant to lesson objectives.	Teacher states TLMs which are indicated in suitable development stages of lesson.	Teacher states appropriate TLMs which are related to previous lesson / topic / daily life and pupils' readiness.
II. Teaching Methodology and Delivery					
5. Use of Language	Teacher does not use language appropriate to the level of pupils at all.	Teacher uses language appropriate to the level of averaged pupils, but not in clear and audible voice.	Teacher uses language appropriate to the level of averaged pupils clearly and audibly.	Teacher uses suitable level of language for different levels of pupils.	Teacher selects and/or adjusts appropriate level of language in accordance with the understandings of each pupil.
6. Use of Generic Skills 5	Teacher does not make use of generic skills.	Teacher makes use of generic skills that are not related to pupils' learning activities and lesson objectives.	Teacher makes use of generic skills related to pupils' learning activities and lesson objectives.	Teacher puts pupils' knowledge of generic skills into practice appropriately.	Teacher encourages pupils to acquire the generic skills, and pupils can solve problems with generic skills by themselves.

Based on the identified level of teacher's skill of each observation item you scored, give comments on the teacher's current state of teaching performance. If you do not have enough time to provide feedback, select a few observation items for comments in which the teacher needs to improve the most.

STEP 3: Provide Advice to Attain the Next Level

The prime purpose of lesson observation is to improve teachers' teaching skills, and therefore providing advice on how to improve their teaching skills is more crucial than giving comments in the process of "Empowerment Evaluation". Based on the criterion in the next level of identified teachers' skills, provide teachers with advice on how to achieve the next level of their teaching skills.

When you give comments/advice

1. Give **clear and specific** comments/advice to teachers.
2. Give **supportive and encouraging** comments/advice which help teachers to improve their teaching skills to reach the next level.
3. ***Don't criticize teachers and their lessons!***

4. WHEN TO USE THE SLEAT

The following are the typical occasions of STLEAT usage in the 3 stages of PRE-TERTIARY:

However, teachers can also use the SLEAT for themselves in any of their routine activities such as when preparing lessons, evaluating lessons and reflecting on lesson or teaching skills. A copy of the SLEAT which is an improved form of GES LOS can be found in the next page.

Date:

Time:

School:

Class:





Observer:

SCIENCE LESSON EVALUATION AND ASSESSMENT TOOL

Objective (s):

Instruction: - This Lesson Observation Sheet is designed to help teachers identify ways to improve their teaching skills through assessment of 30 items.

- Each observation item has performance indicators arranged from the lowest to the highest level.
- Always start from the statement in "(1) Poor" for each item. If the lesson meets the statement, move to the statement of the next level, and keep going.
- If the lesson does not meet the statement of a certain level, for example "(4) Good", the level of lesson is assessed as "(3) Satisfactory".
- For each observation item, write the performance indicator which appropriately describes the teacher's level of performance in the box provided under the respective observation item.
- The one using this sheet is expected to advise the demonstrator/teacher on how he/she can step up to the next level in post-delivery session.

Observation Items	(1) Non-compliance	(2) unsatisfactory	(3) Satisfactory	(4) Good	(5) Excellent
I. ASSESSMENT OF LESSON PLAN AND SUBJECT MATTER KNOWLEDGE (INSTRUCTION PLANNING SKILLS)					
1. Referencing 	Not stated	Stated but does not specify the author, year of publication, title of the reference material, place of publication and publishing company	Author's name stated with appropriate names and initials but NO titles of materials, year of publication, place of publication and company	Author's name well stated with appropriate year and titles, place of publication and publishing company	Author's name well stated with year of publication, title, edition, place of publication and publishing company
2. Objectives (A) 	Teacher states objectives which are irrelevant to topics / sub-topics / sub-topics.	Teacher states objectives which are relevant to topics / sub-topics, but in general and abstract terms	Teacher states clear and appropriate SMART objectives, but not related to evaluations which are stated in the lesson plan.	Teacher states clear and appropriate SMART objectives which are closely related to evaluations stated in the lesson plan.	Teacher states clear and SMART objectives which include at least 2 profile dimensions in the syllabus. (knowledge, understanding, application, process skills and attitudes)
 3. Objectives (B)	The percentage weight of profile dimension is not factored in Los at all	Some of the profile dimensions captured do not merit the percentage weights given	All profile dimensions captured have their respective percentage weight captured as well	Profile dimension well weighted and promotes at least two domains of learning	Profile dimension well weighted and promotes all the three domains of learning
4. R.P.K 	Never stated	Stated but not appropriate to the new topic and was not reviewed in the introduction	Stated but not appropriate to the new topic even though reviewed in the introduction	RPK stated and appropriate to the new topic but was not reviewed in the introduction	RPK Stated, appropriate to the new concept and was reviewed
5. Introduction	Not stated in the planning	Stated in the plan but has no link with the RPK	Stated in the plan and has a link with the RPK but it is not captivating	As stated in the plan, linked with RPK and captivating	As stated in the plan, linked with RPK, captivating and stimulating learners' interest

					for further learning
6. Teacher Learner Activities (TLAs) <input type="checkbox"/>	Teacher provides activities not related to core points/objectives.	Teacher provides activities that are related to the core points/objectives of the lesson, but these are not helpful for pupils to understand new concepts.	Teacher provides activities which are relevant to core points/objectives and help pupils understand new concepts.	Teacher provides activities that encourage pupils to reflect on their readiness, existing knowledge and concepts.	Teacher provides activities that encourage pupils to apply new knowledge/concepts in their daily lives.
7. Statement of Teaching Learning Materials (TLM) <input type="checkbox"/>	Teacher does not state TLMs.	Teacher states TLMs, but not relevant to lesson objectives.	Teacher states TLMs which are relevant to lesson objectives.	Teacher states TLMs which are indicated in suitable development stages of the lesson.	Teacher states appropriate TLMs which are related to the previous lesson/topic/daily life and promotes learner's readiness at each developmental stages of the lesson.
8. Core points <input type="checkbox"/>	Teacher states core points which are irrelevant to topics/sub-topics.	Teacher states core points which are relevant to topics / sub-topics, but not related to the main skills and/or concepts to be learnt.	Teacher states core points related to the main skills and concepts to be learnt.	Teacher states core points which are closely related to lesson objectives.	Teacher states core points which clarify the main skills/concepts/lesson's objective at each stage and relate to pupils' readiness/daily life.
9. Lesson Notes Presentation <input type="checkbox"/>	Steps are clearly stated but not in logical and systematic terms	Provides clear, systematic, and logical steps for delivery	Provides clear, systematic, and logical steps for delivery with given examples	Provides clear, systematic, and logical steps for delivery with examples and also specifies what the teacher and learner do at each stage	In addition to point 4, it suggests that the teacher has mastery of the subject matter
10. Information Level <input type="checkbox"/>	Provides current and up-to-date information	Content places learning in context	Content is made meaningful by linking laws, principles and themes to applications	Sensitive to diversity such as gender, religion and culture	Content selected and the information given are appropriate for the level

11. Sensitive To Diversity <input type="checkbox"/>	Lesson presents offensive information	Lesson presents offensive information	Lesson presents a natural representation of sex, culture and religion	Lesson presents a positive representation of either gender, cultural or religion	Lesson presents a positive representation of all (gender, cultural and religion)
12. Use of Language <input type="checkbox"/>	Teacher does not use language appropriate to the level of pupils at all.	Teacher uses language appropriate to the level of averaged pupils, but not in a clear and audible voice.	Teacher uses language appropriate to the level of averaged pupils in clearly and audible voice/intonation.	Teacher uses a suitable level of language for different levels of pupils.	Teacher selects and/or adjusts the appropriate level of language to the understanding of each pupil.
SUB TOTAL:					
ITEMS AND CONTENT DELIVERY					
Observation Items	(1) Poor	(2) Needs Improvement	(3) Satisfactory	(4) Good	(5) Excellent
13. Use of Generic Skills <input type="checkbox"/>	Teacher does not make use of generic skills.	Teacher makes use of generic skills that are not related to pupils' learning activities and lesson objectives.	Teacher makes use of generic skills related to pupils' learning activities and lesson objectives.	Teacher put pupils' knowledge of generic skills into practice appropriately.	Teacher encourages learners to acquire generic skills and solve problems with such generic skills by themselves.
14. Use of Chalkboard <input type="checkbox"/>	Chalkboard is not used.	Writing on the chalkboard is in the appropriate size, colour strength and clear.	Writing on the chalkboard is well-planned with letters, figures and illustrations which are formed neatly and correctly	Writing on the chalkboard is systematically planned and logically organized. Besides, the date is also written for reference sake	Chalkboard is systematically used to summarize all important points or core points of the lesson for pupils to understand the lesson.
15. Questioning Skills (A) <input type="checkbox"/>	Teacher does not ask questions at all in the lesson.	Teacher asks only low-order (recall) and rhetorical questions such as yes-or-no questions.	Teacher asks well-balanced low/high order questions, pauses and calls on volunteers to respond.	Teacher asks low/high order questions which promotes higher-order responses and encourages even non-	Teacher asks low/high order questions, one at a time and sequence in order of difficulty which is suited to the level of

				volunteers to respond or ask questions.	pupils.
Questioning Skills (B)	Not clear to the learner's understanding	Clear but mentioned names before asking questions and/ it is directed to one place or specific learner	Clear questions are asked before mentioning names but not evenly distributed	questions are clear, but are asked before mention names and they are evenly distributed	Teacher asks questions before mention names, questions are evenly distributed and with good spacing
16. Feedback to Pupils	Teacher does not offer feedback on pupils' responses at all.	Teacher offers feedback on pupils' responses but simply tells pupils if their answers are right or wrong.	Teacher offers feedback on pupils' responses that promotes further or better understanding of the lesson.	Teacher gives supportive feedback to pupils who made a wrong response and uses the response to promote better understanding.	Teacher offers feedback on pupils' responses that promote active and mutual learning among pupils.
17. Use of TLMs	Teacher does not use any TLM in the lesson.	Teacher uses TLMs, but not relevant to lesson objectives.	Teacher uses TLMs which are relevant to lesson objectives at appropriate stages in the lesson.	Teacher uses TLMs which are stimulating and attractive for pupils and make pupils use them actively.	Teacher uses TLMs which are relevant to pupils' previous lesson/topic/daily life and readiness and make pupils understand new concepts and pose/solve problems through TLMs.
18. Pupils' Participation	Teacher keeps talking without involving the pupils.	Teacher introduces activities which arouse pupils' interests but demonstrate them by the teacher him/herself.	Teacher introduces activities, and pupils participate in them actively and with interest.	Teacher introduces activities that equip pupils with generic skills through problem-solving. (Teacher initiates Inquiry-based learning)	Teacher introduces activities that promote mutual learning among pupils (Pupils initiate collaborative inquiry-based learning).
SUB TOTAL:					

19. (TLAs) <input type="checkbox"/>	Appropriate for the level	Covers all the objectives	Each is linked with a particular objective	Each is linked with a particular objective and sustains learners' interest throughout the lesson	Each is linked with a particular objective, sustains the learner's interest throughout the lesson and prepares the learner for further learning
20. Learner Centeredness <input type="checkbox"/>	Teacher spends most of his/her time talking	Lesson encourages teachers and learners to share the talk time equally	Lesson reduces teacher talk time and increases the learner's talk time	Lesson increases learners' talk time and promotes hands-on activity but not minds on	Lesson increases learners' talk time and promote both mind and hand-on
21. Language and Vocabulary <input type="checkbox"/>	They are appropriate for the grade level	Contain no destructive words	Concepts and terms are always defined	Clear and appropriate for the subject	Use in context
22. Promot of Values <input type="checkbox"/>	Antagonistic to scientific and societal values	Antagonistic to either scientific or societal values	Scientific and societal values are wrongly Represented	Scientific and societal values are presented in a limited way	Positive presentation of societal and scientific values
23. Scientific Facts <input type="checkbox"/>	All facts are outdated and full of mistakes	Many outdated facts with mistakes	Some outdated facts but no mistakes	Facts are up-to-date without mistakes but not well-presented	Facts are up-to-date and well-presented
24. Misconceptions <input type="checkbox"/> SUB TOTAL:	Lesson full of misconceptions	Identified misconceptions were never addressed	Identified misconceptions were appropriately addressed in few instances	Identified misconceptions were mostly addressed in appropriate ways	All misconceptions identified were appropriately addressed
25. Evaluation	Teacher does not	Teacher assesses pupils'	Teacher assesses pupils'	Teacher assesses the pupils'	Teacher assesses pupils'

n of Lesson <input type="checkbox"/>	evaluate lesson.	knowledge/understanding during the lesson, but the assessment is not related to the objectives of the lesson.	knowledge/understanding during the lesson which is related to the objectives of the lesson	understanding during the lesson (formative assessment) and restructures the development of the lesson based on the results of the evaluation of the pupils' understanding.	readiness/understanding/achievement in the lesson using appropriate questions based on at least 2 profile dimensions in the syllabus (knowledge, understanding, application, process skills and attitudes).
26. Questions for Assessment of Learning <input type="checkbox"/>	Questions are linked with the objectives and are relevant to the topic	Promote low-order thinking, link with objectives and are relevant to the topic	Promote high-order thinking, link with objectives and is relevant to the topics	Promote both low and high order thinking, relevant to the topic and linked to objectives	Promote both low and high-order thinking and stimulate learners' interest in further learning
III. Classroom Organization and Management					
27. Classroom Arrangement <input type="checkbox"/>	Teacher does not arrange the classroom to provide lessons.	Teacher arranges the classroom for lessons/activities, but the pupils are not well organized.	Teacher arranges the classroom to suit activities at the beginning of the lesson and gets pupils well organized.	Teacher arranges the classroom as planned to suit the activities before starting the lesson in advance.	Teacher arranges the classroom to suit a variety of activities appropriately, timely and in the right place, and the classroom arrangement is well-organized.
28. Classroom Setting <input type="checkbox"/>	Setting does not conform to the class activity	Class setting conforms to activity but exposes learners to danger	Class settings conform to activity and protect learners from danger	The friendly setting conforms to activity and considers individual differences	Friendly setting which conforms to activity considers individual differences and engages all learners
29. Class Control <input type="checkbox"/>	Teacher allows pupils to do whatever they want.	Teacher constantly orders pupils what to do.	Teacher sometimes communicates to pupils what to do and ensure order in the classroom.	Teacher and pupils communicate with each other and ensure a good atmosphere for teaching and learning in the class together.	Pupils cooperate in putting the class in order and ensure a good atmosphere without teachers' control.
Iv. Improving Instructional Activities					

30. Reflective Practice by the Teacher	End of the lesson and marking of exercises ends the teachers role in teaching and learning	Teacher uses pupils' reactions to determine the success level of the lesson and ends there	Teacher uses pupils' reactions to conduct further investigations on why such behaviour was exhibited and ends there	Teacher use pupils' reactions towards teaching and learning to conduct further investigations and use the findings to motivate learners to learn	Results obtained from further investigations are used to modify teaching/learning activities to get everyone involved in the lesson to achieve desirable learning outcomes.
31. Portfolio Assessment	Teacher do not know about portfolio development	Teacher have little information so do not build a portfolio	Teacher build portfolio but is not supervised by the lead mentor	Teacher develops a portfolio under the supervision of the lead mentor but does not satisfy the portfolio rubrics developed by the NTC	Teacher develops a portfolio in line with the NTC portfolio rubrics and uses the portfolio content to improve subsequent lessons.
SUB TOTAL:					

TOTAL SCORE:

General impression of the Observer on the teacher's performance:

Overall Performance = total score* 0.7

=

.....

SIGNATURE OF LESSON'S OBSERVER

APPENDIX B**QUESTIONNAIRE ON PRE-TERTIARY IN-SERVICE TEACHERS'
PERCEPTION OF THE NTS (QPITPENTS)**

Thank you in advance for your answers to this ANONYMOUS survey. This research is being conducted to gather information on how science teachers are complying with the National Teachers' Standards, including things that may influence their practices

The reason why your participation in this survey is needed is to help understand how you are working within the standards and understand the challenges you are facing with the use of the National Teachers' Standards. This will help to provide useful suggestions to the National Teaching Council on the development and use of standards. Your honesty and openness are important. If you agree to participate, this survey will take about 15-20 minutes to complete. There are NO right or wrong answers. Please check the first box to confirm that you agree to participate and understand that this survey is completely anonymous.

1. ☐ Do you agree to participate in this survey?

I agree to participate and understand that this survey is completely

☐ anonymous.

I do not agree to participate in this survey

SECTION A: BIO DATA

This section solicits information on employment history. Kindly indicate your response with a tick in a box that correspond to an option which appears to describe your opinion to the statement.

2. Which Science Subject are you teaching currently?

☐ Chemistry

☐ Biology

☐ Physics

☐ Integrated Science

3. About how old are you currently? Select Range from option below.

☐ 20 -29years

☐ 30 – 39years

☐ 30- 49years

☐ 50years and above

4. What Qualification do you have?

☐ Cert A

☐ Diploma

☐ Bachelor degree

☐ Master degree

5. Are you a male or female?

☐ Male

☐ Female

6. How many years have you been teaching as a science teacher?

- ☐ Between 1 and 4years
- ☐ Between 5 and 8years
- ☐ Between 8 and 11years
- ☐ Above 11 years

SECTION B

TEACHERS' PERCEPTION OF NTS

For each of the statements in questions 7 to 15, respond by ticking one of the boxes that have an answer which corresponds to your perception of the NTS.

7. The National Teachers' Standards are designed solely for the National Teaching Council (NTC) to implement their mandate.

- ☐ I strongly agree
- ☐ I agree
- ☐ I am not sure
- ☐ I disagree
- ☐ I strongly disagree

8. The National Teachers' Standards can create unhealthy competition among teachers.

- ☐ I strongly agree
- ☐ I agree
- ☐ I am not sure

☐ I disagree

☐ I strongly disagree

9. The National Teachers' Standards must be used as a guide is for training of teachers at the pre-tertiary level only.

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

10. Science Teachers do not need the National Teachers' Standards to carry out their roles as teachers.

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

11. The National Teachers' Standards does not make any meaningful contribution to my work as a teacher.

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

12. The National Teachers' Standards when used by science teachers cannot enhance their competences.

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

13. If teachers comply with the National Teachers' Standards, their competences can be improved.

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

SECTION D

FACTORS THAT ENHANCE TEACHERS' CAPACITY BUILDING

For each of the statements in questions 18 to 20, respond by ticking one of the boxes that have an answer which corresponds to your perception of the NTS.

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

14. The National Teachers' standards can be used as a guide in my lesson planning, delivery and assessment.

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

15. I do not receive capacity building training from studying the NTS.

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

16. Teachers in my school cannot use regularly workshops organised by certified service providers to study the NTS.

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

17. Supply and demand-driven training programmes on NTS can improve my lesson delivery.

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

18. Science teachers do not have opportunities to use NTS to enhance their competences.

☐ I strongly agree

I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

19. Several policy statements in the NTS make provision for me to build my competences as a science teacher.

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

SECTION E

FACTORS THAT INFLUENCE TEACHERS' COMPLIANCE TO THE
NTS

For each of the statements in question 21 to 24, respond by ticking one of the boxes that have an answer which corresponds to your perception of the NTS.

20. Every teacher including yourself has been sensitized on the use of the
NTS

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

21. Teachers do not have access to the NTS.

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

21. When I read the NTS, I am not able to relate the content to science teaching,.

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

22. I receive capacity-building training from my employers through at least two of the following platforms: SBI, CBI, PLC, and sensitisation workshop.

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

23. Teachers in my school regularly attend INSET and workshops organised by certified service providers

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

24. I am familiar with where to access supply and demand-driven training programmes in case, I want to enhance my competences

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

25. Government has not made any capacity building provision for the of science teachers.

☐ I strongly agree

☐ I agree

☐ I am not sure

☐ I disagree

☐ I strongly disagree

APPENDIX C**INTERVIEW GUIDE ON PRE-TERTIARY IN-SERVICE SCIENCE****TEACHER PERCEPTION OF AND COMPLIANCE WITH NTS****(IGOTPACWINTS)****Preamble: Self Introduction**

Permission to record

Copyright waiver

Section 1: Introduction

- What do you do in this school?
- What are your main responsibilities?
- Since when have you be in this school?

Section 2: Teachers perception of the NTS

- What have you heard about the National Teachers' Standards?
- To what extent do respondents need information from the National Teachers' Standards to guide their work?
- What contribution does the National Teachers' Standards provide to science teachers?
- What is the significance of professional knowledge as a domain of the NTS to you as a science teacher?
- In what areas of teachers' practice can be influenced by the professional knowledge domain of the NTS?
- Is there a possibility that the NTS can enhance the competences of those who use them than those who do not use them?

Section 3: Compliance to NTS

- To what extent have you been adhering to the standards in the NTS?
- Why do teachers prepare or do not lesson plan?
- What influence teachers decision on the use of either leaner or teacher centred approaches?
- How often do teachers give activities to learners?
- How often do teachers control behavior in class?

Section 4: Approaches to enhance teachers compliance to NTS

- How familiar are respondents to PLCs, School Based INSET, Cluster-Based INSETS?
- Why INSETS organise for teachers?
- Which organizations organise INSETS for teachers?
- What are the content areas for INSET programmes?

Section 5 : Factors to inhibit compliance

- Have teachers been sensitized on the NTS?
- How often do teachers read the NTS?
- How often do teachers comprehend the content of the NTS?

APPENDIX D

INTERVIEW GUIDE ON TEACHERS' PERCEPTION OF NTS
(IGONTPOINTS)

Research Question i: What are pre-tertiary science teachers' perception of the NTS?	
	According to the NTS 1a, teachers are to critically and collectively reflect to improve teaching and learning. In your opinion, how will a teacher do this in the absence of colleagues?
	Though the NTS aims at empowering teachers to engender effective learning among their learners, some teachers are of the view that the introduction of the NTS rather creates unhealthy competition among teachers. What is your view about this?
	There is no doubt about the fact that the NTS set minimum benchmarks to measure the performance of teacher but beyond this, there is an assurance that the NTS can be used to train teachers at both Pre-Service and In-Service sectors. Share your views on why you agree or disagree that the NTS can be used to train teachers at both pre-Service and In-Service sectors.
	The NTS is required to guide teachers' practice in Ghana though there are lots of structures that provide internal and external supervisors for teachers. As a teacher, do you use the NTS as a reference document or you always rely on your supervisors and why do that?
	According to NTC, the NTS is for In-Service teachers to inform their career progression and promotion but some experience science teachers are of the view that science teachers can do their work without the NTS. How do you align yourself with any of these two schools of thought? Under what circumstance will you and other teachers choose some competency needs over Professional Knowledge? Do these responses reflect that of the teachers in this school?
	Under what circumstance will you and other teachers choose some competency needs over Professional Knowledge?
	Teachers who use the NTS in preparation, delivery and reflections of lessons are in the good position to enhance their competences better than their colleagues who do not use the NTs. How do you agree or disagree to this assertion?

APPENDIX E

PRE-TERTIARY IN-SERVICE SCIENCE TEACHER INTERVIEW

SCHEDULE

Teacher Demonstration of competences in the NTS, Teachers' compliance with the NTS and approaches to enhance teachers' perception of the NTS

<p>Research Question (ii)</p> <p>What teaching competences based on the National Teaching Standards are demonstrated by pre-tertiary in-service science teachers?</p> <p>2b. What teaching competences based on the National Teaching Standards are demonstrated by primary, JHS and SHS pre-tertiary in-service science teachers</p>	<p>How do you use the NTS in teaching and learning?</p> <p>In what ways are the standards used in your professional career?</p> <p>How often do you use the competences in the NTS to benchmark your practice as a teacher in a particular grade level?</p>
<p>Research Question (iii)</p> <p>How are pre-tertiary science teachers complying with the domains of the NTS?</p>	<p>When do you plan your lesson and what critical areas do you consider when planning your lessons or the learner plan?</p> <p>How do you leverage learners' experience to involve them in your lessons?</p> <p>What learner-centered approaches do you apply in preparing your lessons?</p>
<p>Research Question (iv)</p> <p>Identify approaches that can be used to positively enhance the perception of pre-tertiary science teachers to ensure compliance with the NTS</p>	<p>How do you update your competences to be abreast of new trends in education?</p> <p>What are the most affordable and accessible fora do you use to learn with your colleagues?</p> <p>How do the district and your school support you in your career growth?</p>

APPENDIX F**PRE-TERTIARY IN-SERVICE SCIENCE TEACHER INTERVIEW****SCHEDULE****Perception of and Compliance with the National Teachers' Standards**

Please, response to the following questions so that we can plan for effective interaction

Name:

School:

Phone Number:

e-mail:

The following interview times would suit me:

First preference	Day	Date	Time
Second preference	Day	Date	Time
Third preference	Day	Date	Time

I would prefer:

Face to face interview

Telephone interview

I have no preference

APPENDIX G

AN INTRODUCTORY LETTER FROM SUPERVISOR TO GRANT

UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION
DEPARTMENT OF SCIENCE EDUCATION

Tel: 03320 96801/96951
Email: dse@ucc.edu.gh
Website: www.ucc.edu.gh



University Post Office
Cape Coast
Ghana

Your Ref:
Our Ref: DSE/S.3/V.2/11

12th October, 2018

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

LETTER OF INTRODUCTION

We write on behalf of **Mr. Lawrence Sarpong**, a Ph.D. (Science Education) student with registration number **ED/SED/15/ 0005** who has been assigned to collect data at your District.

Mr. Lawrence Sarpong is conducting a research on the topic: **"DEVELOPING PROTO-TYPE SCIENCE TEACHING STANDARDS AND PERFORMANCE INDICATORS IN GREATER ACCRA REGION"**.

We therefore write to introduce and request that you grant him the needed assistance.

Counting on your usual cooperation.

Thank you.

Yours faithfully,

A handwritten signature in black ink, appearing to read 'Anthony'.

Prof. C. Anthony-Krueger
SUPERVISOR