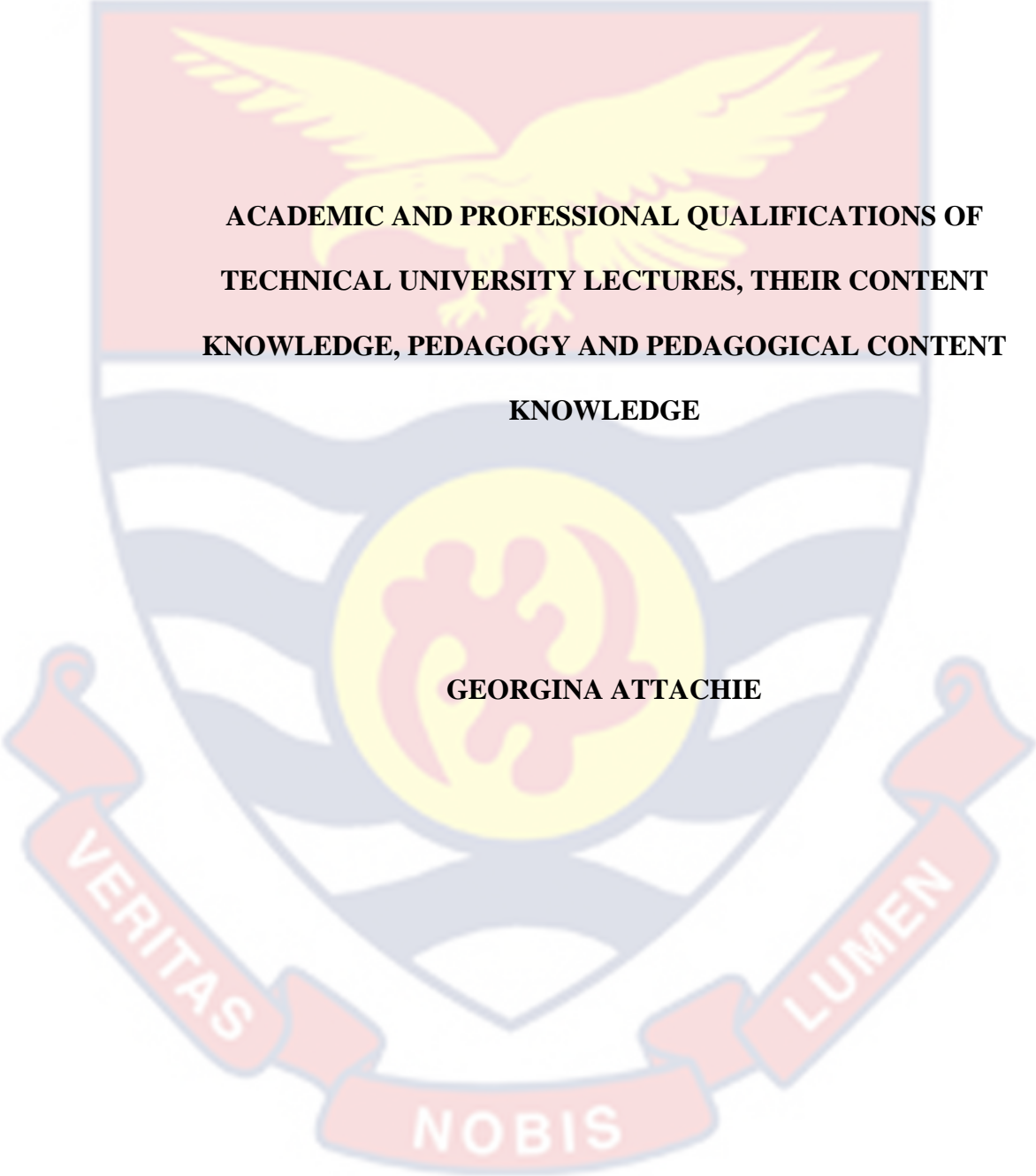UNIVERSITY OF CAPE COAST
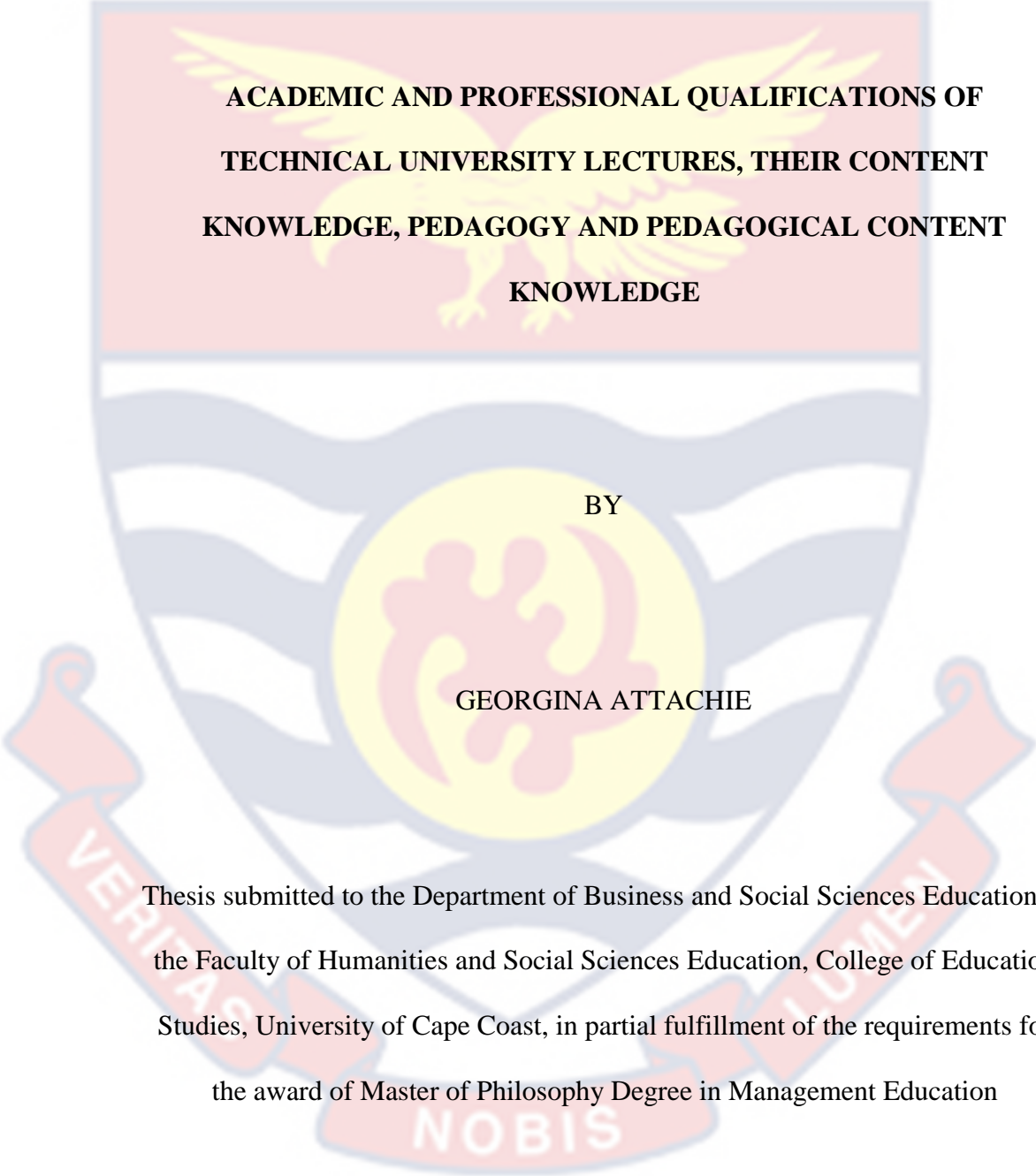
ACADEMIC AND PROFESSIONAL QUALIFICATIONS OF TECHNICAL UNIVERSITY LECTURES, THEIR CONTENT KNOWLEDGE, PEDAGOGY AND PEDAGOGICAL CONTENT KNOWLEDGE

GEORGINA ATTACHIE

2023

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University of Cape Coast

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ACADEMIC AND PROFESSIONAL QUALIFICATIONS OF

TECHNICAL UNIVERSITY LECTURES, THEIR CONTENT

KNOWLEDGE, PEDAGOGY AND PEDAGOGICAL CONTENT

KNOWLEDGE

BY

GEORGINA ATTACHIE

Thesis submitted to the Department of Business and Social Sciences Education of

the Faculty of Humanities and Social Sciences Education, College of Education

Studies, University of Cape Coast, in partial fulfillment of the requirements for

the award of Master of Philosophy Degree in Management Education

JULY 2023

DECLARATION

Candidate's Declaration

I hereby affirm that this thesis is the result of my own original study and that no part of it has ever been submitted for credit toward another degree in this university or anywhere else.

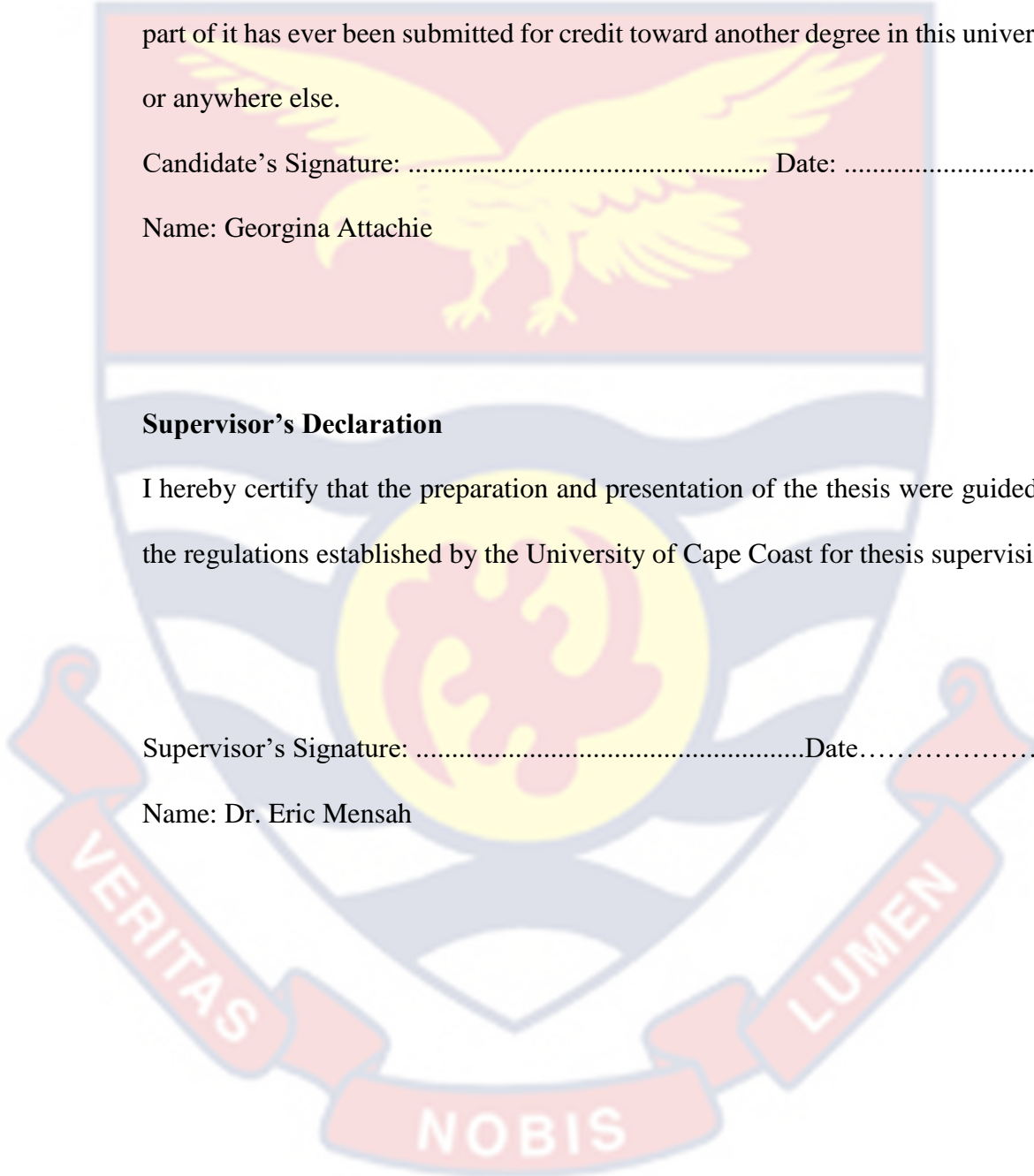Candidate's Signature: .... Date: ....

Name: Georgina Attachie

Supervisor's Declaration

I hereby certify that the preparation and presentation of the thesis were guided by the regulations established by the University of Cape Coast for thesis supervision.

Supervisor's Signature: ....Date…………………..

Name: Dr. Eric Mensah

ABSTRACT

This study seeks to assess the influence of academic and professional qualifications on lecturer's appreciation of content, teaching skills and the amalgamation of the two at Cape Coast Technical University. The descriptive cross-sectional survey was used to carry out the investigation. A proportionate random sampling procedure was used to select 119 lecturers who have taught for two semesters and more. Primary data was gathered through questionnaires. The data were analysed using factorial ANOVA, frequency counts, percentages, means, and standard deviation. The findings showed that the highest academic qualifications attained by most lecturers at CCTU were MPhil and PhD degrees, and most of the lecturers were professionally trained teachers. Also, the study revealed that the lecturers' expertise in content, general pedagogy and PCK were high. However, academic and professional qualifications did not significantly influence lecturers' content knowledge (CK), pedagogical knowledge (PK) and PCK. It is therefore recommended that GTEC, MoE and the Dean of Schools design tailor-made courses for the nonprofessional lecturers to be upgraded with the requisite teaching qualifications to enhance their teaching.

KEYWORDS

Academic qualification
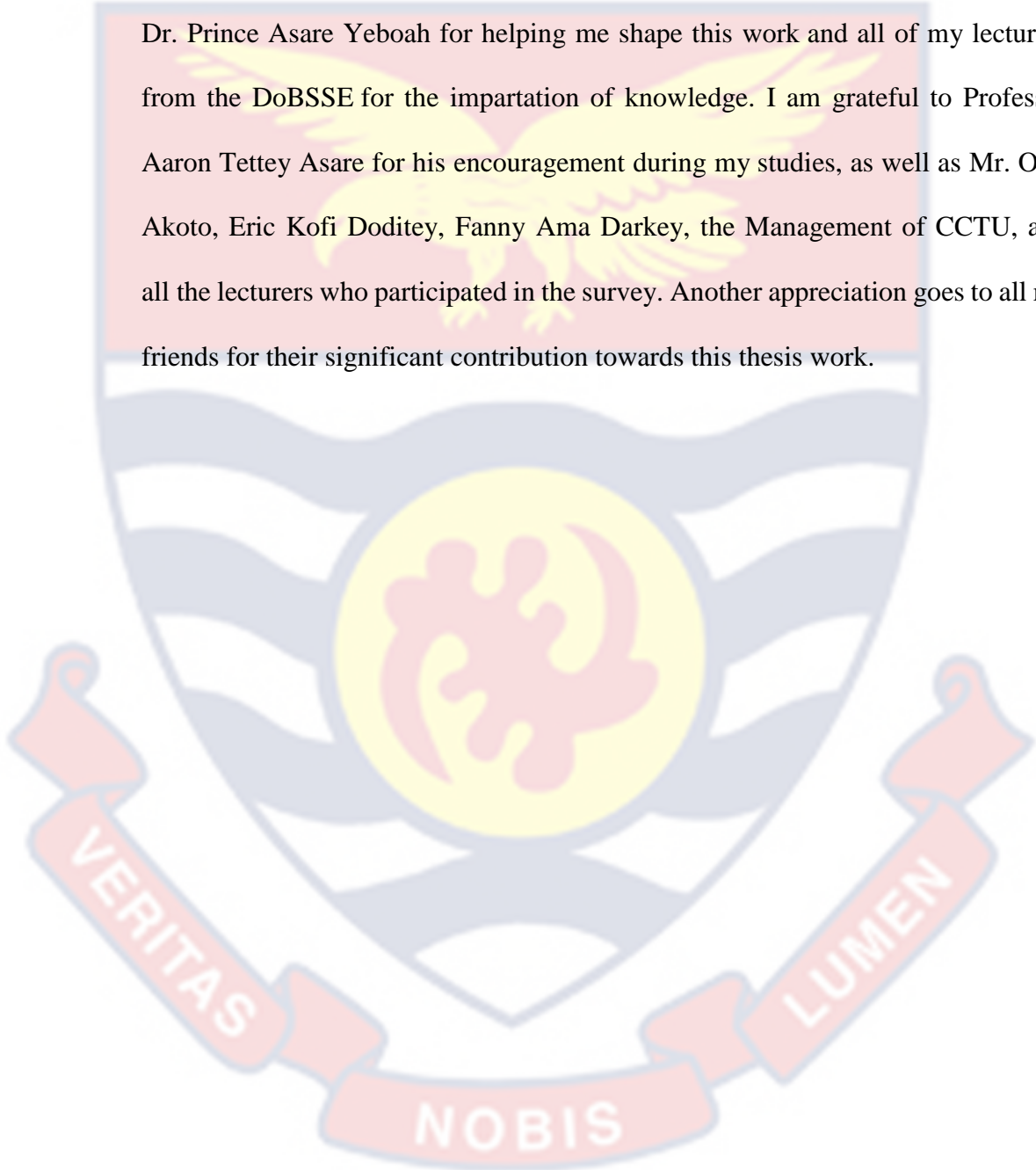
Professional qualification

Content

Knowledge

Pedagogy

ACKNOWLEDGMENTS

I would like to sincerely appreciate my supervisor, Dr. Eric Mensah, for his supportive advice and motivation in finishing this thesis work. I also want to thank Dr. Prince Asare Yeboah for helping me shape this work and all of my lecturers from the DoBSSE for the impartation of knowledge. I am grateful to Professor Aaron Tettey Asare for his encouragement during my studies, as well as Mr. Osei Akoto, Eric Kofi Doditey, Fanny Ama Darkey, the Management of CCTU, and all the lecturers who participated in the survey. Another appreciation goes to all my friends for their significant contribution towards this thesis work.

DEDICATION

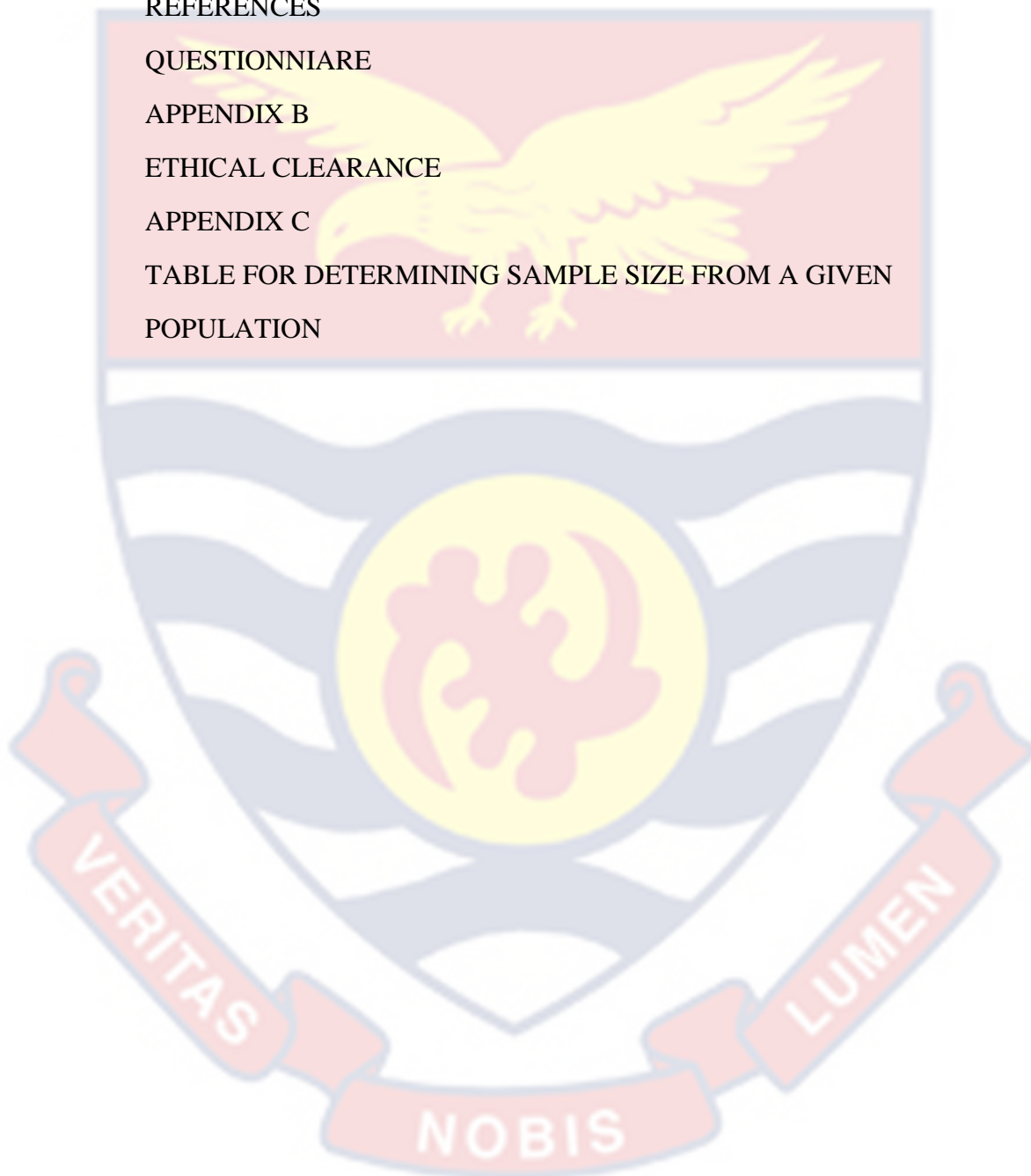To my Husband, Children and Siblings

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CHAPTER ONE

INTRODUCTION

The study primarily seeks to assess the Pedagogical Content Knowledge (PCK) of lecturers at Cape Coast Technical University vis-a-vis their academic and professional qualifications. Any educational system's standard is significantly influenced by the caliber of its tutors in relation to their academic and professional credentials, appreciation of pedagogy, content, and pedagogical content knowledge, as well as high level of commitment to core duties is very paramount (Oluremi, 2013).

Studies revealed that PCK is the expertise needed by tutors to ensure effective teaching (Shulman, 1986; Carlsen, 1999; & Morine-Dershimer and Kent, 1999). Effective teaching aids students in increasing their knowledge and comprehension, acquiring analytical and assessment abilities, and acquiring crucial classroom competencies (Kyriacou, 2009). Consequently, higher level education is important to a country's academic authority and this affects the economic, cultural, and political development of that country (Chen, Yang, & Yang 2020).

Having highly qualified employees, particularly teachers, is a crucial concern for teaching. Therefore, it become problematic for a country when educational institutions employ people who are unfamiliar with the content they teach.

Background to the Study

Teacher knowledge refers to the skills teachers must acquire for effective teaching. Effective teachers employ a range of teaching skills to ensure successful tutoring, significantly impacting pupils' academic success. Regardless of a teacher's talent, if they fail to interpret content to support student learning, their efforts are futile. Smith, Stanley, and Shores (as cited in Siaw-Marfo, 2011) asserted that having highly qualified teachers is crucial. They indicated that qualified teachers are essential for effective teaching, making it problematic for educational institutions to employ individuals unfamiliar with their subjects. Darling Hammond and Ball (as cited in Du Plessis Gillies, 2014) opined that assigning non-qualified teachers to teach is inappropriate, as these instructors lack necessary knowledge, contributing to the decline in instructional quality. Therefore, teachers must possess content knowledge (CK), pedagogical knowledge (PK), and pedagogical content knowledge (PCK).

Governments in highly developed countries recognise the value of higher academic qualifications and training. The Education Reform Act in the USA transformed Polytechnics into autonomous institutions to meet higher qualification needs (Chen, Yang, & Yang, 2020). The Higher Education Act of 1992 approved the conversion of many Polytechnics to universities (Gibbon, Muller, & Nel, 2012). Similarly, in Ghana, the Government upgraded and migrated Polytechnics into Technical Universities in 2016, prompting the Ghana Tertiary Education Commission (GTEC) to investigate the academic qualifications of lecturers in all 10 Technical Universities in Ghana.

Shulman (as cited in Leijen, Malva, Mikser, 2022) recommended knowledge categories for teachers, including knowledge of learners, general pedagogical knowledge, curriculum knowledge, and PCK. Leijen et al. (2022) called for a thorough and balanced organisation of teachers' knowledge bases. Ramdhany (2010) supported Shulman, highlighting the critical components of PCK: sound content and curricular knowledge, the capacity to use illustrations and analogies, understanding learners' thought processes and learning styles, recognising and correcting misconceptions, and imparting knowledge. Teachers integrating subject and teaching expertise are said to have PCK (Siaw-Marfo, 2011). Boskurt and Kaya (2008) described PCK as the amalgamation of content and pedagogical expertise, encompassing comprehension of learning challenges and student conceptions in addition to subject-matter knowledge. Simsek and Boz (2016) categorised PCK into information on teaching methods and visual aids and knowledge of learners' subject expertise at different levels.

Successful teaching requires understanding why and how particular activities lead to learning and the variables affecting these processes (Kyriacou, 2009). This study assessed the academic and professional qualifications of lecturers in general pedagogy, CK, and PCK. Content knowledge includes facts, theories, concepts, ideas, and language necessary for effective teaching (Rwanamiza, 2009). Studies on educational reforms emphasise that teachers need content knowledge (National Council for Accreditation of Teacher Education, 1997; Thomas, 1999; Davis & Falba, 2002; International Society for Technology in Education, 2002; Thompson, Schmidt & Davis, 2003; Dawson, Pringle & Adams, 2003). Teachers

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must possess a thorough understanding of their subjects and curricula (Rwanamiza, 2009). Mishra and Koehler (2006) stated that subject matter knowledge is essential for teaching. Kathirveloo, Puteh, and Matematik (2014) argued that teachers with inadequate content knowledge might have misconceptions, leading to incorrect teaching. Shulman (as cited in Bosu, 2010) defined pedagogy as classroom motivation, management, student involvement, and communication. Content and pedagogical knowledge are crucial for teaching difficult subjects (Shulman as cited in Lee & Luft, 2008). Effective teachers use powerful illustrations, analogies, explanations, examples, and demonstrations to make subject knowledge comprehensible (Lee & Luft, 2008). Kyriacou (2009) reported that effective teachers utilise specialized expertise. Brophy (as cited in Siaw-Marfo, 2011) emphasised the importance of teachers knowing how to impart information to students. Schneider and Plasma (2011) asserted that a teacher's effectiveness and efficiency are key to student success. Teachers significantly impact students' understanding of concepts, and anything less can negatively affect the educational system and national development.

Models and theories supporting teacher knowledge for effective teaching include the Danielson Framework for Teaching, Teaching Framework, and New South Wales Quality Teaching Models. Yeigh's definition of quality teaching (as stated in Acquah, 2014) has three main pillars: Significance (SIG), Quality Learning Environment (QLE), and Intellectual Quality (IQ). Yeigh (2008) found that IQ relates to instructional components supporting deep cognitive, challenging, and reflective student learning. The QLE emphasises well-organised classrooms

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and positive prospects, fostering positive dynamics and equitable student outcomes. The SIG dimension relates learning to ownership and students' sense of identity, focusing on pedagogy that gives learners a sense of purpose and importance.

In Ghana, teacher training and practice are governed by the National Teachers' Standard for pre-tertiary levels. These standards set expectations for professional competence, behavior, attitude, rights, and duties of pre-tertiary instructors (Ministry of Education Ghana, 2017). They outline the minimal standards required for obtaining a teaching license, ensuring that all qualified teachers practice at the expected level. These standards aim to improve the quality of educational experiences and outcomes for all students, elevate the status of teachers, and align with Goal 4 of the Sustainable Development Goals for 2030 (Ministry of Education, Ghana, 2017). Technical Universities in Ghana have standards for conduct, professional knowledge, practice, attitude, rights, and obligations of lecturers. However, the requirements for hiring lecturers, as outlined in Schedule 'E' of the Technical Universities Guiding Statute, are sometimes overlooked. For instance, a master's degree with research may qualify a candidate for Assistant Lecturer, while a doctorate degree or higher professional qualification is required for a Lecturer or Research Fellow.

The Ghana Tertiary Education Commission (GTEC) conducted a nationwide audit in 2018 on the qualifications of teaching staff in Technical Universities, revealing anomalies in the qualifications of some lecturers and the courses they teach (Doudu, 2019). The audit found that some lecturers taught courses they did not study at the Master's level, pursued online degrees in unrelated

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fields, or lacked research components in their master's certification, leading to recommendations for demotion.

The 'No Child Left Behind' (NCLB) Act in the USA, enacted over a century ago, addressed concerns about teachers' pedagogical content knowledge, emphasising the importance of expertise and knowledge in subjects taught and the quality of delivery (Harris & Bain, 2011). Ghana's education policy for hiring teachers is based on qualifications in teacher education and passing the teacher licensure certificate examinations. The National Teaching Council (NTC), established by the 2008 Education Act (Act 778), is responsible for creating frameworks for hiring teachers, continuous professional development, and routine reviews of professional practice and moral values. The NTC also issues teaching licenses as required by law. Siaw-Marfo (2011) found variations in teachers' perceptions of self-efficacy based on their professional training, expertise, and classroom experience. It was recommended that educational policymakers use efficacy belief instruments to gauge teachers' beliefs before assigning them to specific courses. Ingersoll (as cited in Aina & Olanipekun, 2015) explained that non-specialist educators lack adequate training and qualification, negatively impacting teaching preparation time, teacher commitment, and instructional time. This issue affects not only Nigeria but also affluent countries (Aina et al., 2015; Du Plessis & Gillies, 2014). Inadequately trained teachers can significantly impact the nation's educational standards, leading to undeserved marks for students and affecting both student and teacher development. The GTEC audit report suggests that the academic qualifications of lecturers may have been compromised, affecting

the quality of education (Duplessis Gillies, 2014). Lecturers lacking relevant backgrounds may struggle to implement curricula effectively. This study assessed the academic and professional qualifications of lecturers, focusing on their ability to integrate pedagogy and content for effective instruction.

The background emphasises the essential role of teacher qualifications in effective teaching. Employing non-specialist educators and inadequately trained teachers can severely impact education quality. This study aims to assess the academic and professional qualifications of lecturers at Cape Coast Technical University (CCTU) to validate their efficacy. Specifically, it evaluates lecturers' pedagogical knowledge (PK), content knowledge (CK), and pedagogical content knowledge (PCK). The study delves into various aspects of the lecturers' qualifications, beginning with an examination of their academic and professional backgrounds. It further investigates the level of pedagogical knowledge these lecturers possess, focusing on their understanding and application of teaching methodologies. The content knowledge of these lecturers is scrutinised to ensure they have a thorough grasp of the subjects they teach, which is essential for effective instruction. Additionally, the study explores how effectively the lecturers integrate their subject matter expertise with teaching strategies to enhance student learning, thereby assessing their level of pedagogical content knowledge. Finally, the study determines how academic and professional qualifications influence the lecturers' knowledge of content, pedagogy, and PCK. Through this comprehensive evaluation, the study aims to validate the efficacy of the lecturers at CCTU.

Statement of the Problem

The position of the lecturers at Technical Universities is in conflict with the Audit Report by GTEC and so resorted to court action. They were of the view that the audit team did not do a thorough investigation on their qualification and course content. Subsequently, there is the need to critically assess the lecturers' qualifications, competencies and background for teaching. The purpose of the GTEC staff audit was to make the transition of Technical University employees to the SSSS as smooth as possible. The majority of lecturers, particularly those in the business schools, have been teaching without having the required background in teaching, according to the GTEC Audit Report in general. Others earned Doctor of Philosophy (PhD) degrees online, which was prohibited by GTEC regulations. Others pursued Doctor of Business Administration without research, which was not acceptable for teaching in Technical Universities. Other lecturers with mismatched first, second and terminal degrees referred to as "skirt and blouse" are also teaching in the Technical University a practice GTEC indicates might have negative impact on the quality of students' knowledge. The report recommended that these lecturers go back to school to acquire the relevant degrees before they will be properly placed on the SSSS (Doudu, 2019). The call for lecturers to upgrade themselves may be in line with the assertion that the acquisition of professional education places a teacher at a better position to apply PCK. The review of the International Teaching Standards served as a foundation for teacher development because it highlighted how crucial it is for teachers to apply their subject-matter expertise in the

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classroom. This shows sound pedagogical content knowledge, secured curricula, and the ability to effectively engage students (Ministry of Education Ghana, 2017).

Cape Coast Technical University (CCTU) was captured in the audit report but not separately. The question then is, 'what is the state of affairs in CCTU in the light of the report?' There is therefore, the need to conduct a research to assess Lecturers' academic and professional qualifications, knowledge level of content, pedagogy and PCK to find out the caliber of lecturers at the university.

Studies on pedagogical content knowledge have been conducted in USA, Michigan (Harris & Bain, 2011; Chen et al. 2020), Malaysia (Ibrahim, Surif, Abdullah, and Sabtu, 2014), Nigeria, Kwara State, (Kola & Sunday, 2015) and in Ghana by Asare-Danso in Teacher Training Colleges and a few conventional Universities. However, the contexts under which these studies were conducted are no doubt quite different from Technical Universities in Ghana, even though they may appear similar. Again, it appears these studies did not look at the academic and professional qualifications on lecturers'. Hence, this study focuses on assessing the academic and professional qualification of lectures' PCK, at Cape Coast Technical University

Purpose of the Study

This study seeks to assess the academic and professional qualifications of the PK, CK and PCK of lecturers in view to validating their efficacy in CCTU.

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Objectives of the Study

The specific research objectives would be to:

1. assess the academic and professional qualifications of lecturers at Cape Coast Technical University

2. examine CCTU lecturer's level of pedagogical knowledge

3. assess the Content Knowledge of lecturers at CCTU

4. ascertain the lecturers' level of Pedagogical Content Knowledge at CCTU

5. assess the influence of Academic and Professional Qualifications on lecturers' knowledge of Content, Pedagogy and PCK

Research Questions

The following Research Questions served as a guide for the study:

1. what are the academic and professional qualifications of lecturers at CCTU?

2. what is the level of pedagogical knowledge of lecturers at CCTU?

3. what is the level of the content knowledge of lecturers at CCTU?

4. what is the level of PCK of lecturers at CCTU?

Research Hypotheses

1. H_0: There is no statistically significant influence of lecturers' academic and professional qualifications on their CK.

2. H_0: There is no statistically significant influence of lecturers' academic and professional qualifications on their PK.

3. H_0: There is no statistically significant influence of lecturers' academic and professional qualifications on their PCK.

Significance of the Study

The findings of the study would be useful to several stakeholders including lecturers, administrators, the Ghana Education Service (GES), the Ministry of Education (MoE), the Ghana Tertiary Education Council (GTEC), Academic Affairs Directorate, and management of Technical Universities as well as future researchers. The findings of the study will provide insight to the Human Resource Department, Dean and HOD on the level of content, pedagogy and pedagogical content knowledge of lecturers at CCTU for informed decision. The study draws the attention of GTEC that academic and professional qualifications are not relevant for the development of lecturers' PCK. The study shows that lecturers have high levels of knowledge in CK, PK, and PCK. Also, majority of the lecturers possess master's and PhD certificates, except for the few people who possessed first degrees and HNDs. It behoves the Quality Assurance Unit to streamline the teaching rank to ensure that the right caliber of teachers are teaching the students.

Furthermore, the quality of Technical University Education in Ghana can be improved if GTEC, MoE and the Management of TUs draw insights from the study's findings to design tailor-made courses for lecturers teaching at higher educational institutions. This would help the lecturers to get themselves upgraded with the requisite teaching qualifications since mismatched degree holders and non-professional teachers were found to be teaching at CCTU.

Lastly, the study would also provide grounds for further research and also contribute to the existing literature by extending knowledge on lecturers'

Pedagogical Contents Knowledge to the remaining nine (9) Technical Universities. The findings will also serve as a basis for future research.

Delimitation

The study was conducted at CCTU and was limited to the sample size (119) out of 170 lecturers. The PCK theory underpinned the study, where attention was placed on content knowledge, pedagogical knowledge and pedagogical content knowledge.

Limitations

A major limitation was that some lecturers were hesitant to answer all the questions because they felt that the questionnaire was education biased and feared they might score low marks on the tests relating to pedagogy since they did not read Education. The researcher removed the uncompleted responses of lecturers. Others also complained that listing the courses they teach might reveal their identity and so did not list the courses even though they were assured of anonymity and confidentiality. These feelings may affect the validity of the findings therefore the researcher removed all responses which courses were not listed. Again, the researcher was unable to control the relationship between lecturers' qualifications and PCK with their experience. Also, respondent's biases might have influenced the findings due to self-reportage.

Organisation of the Study

The study has five main chapters and Chapter One covered introduction, problem statement, purpose, research questions and hypotheses, significance of the study, delimitation, and limitation. Literature is reviewed in the Chapter

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Two which contains theoretical framework, models, empirical reviews, and conceptual framework. The Chapter Three includes the following: an introduction, a research paradigm, research approach, research design, a study area, population, sample and sampling procedure data collection instrument, validity and reliability of the instrument, an ethical consideration, data collection procedure and data processing and analysis. The findings are discussed and interpreted in chapter four. The Chapter Five which is the final chapter is made up of summary of the findings, conclusions, recommendations and areas for further research.

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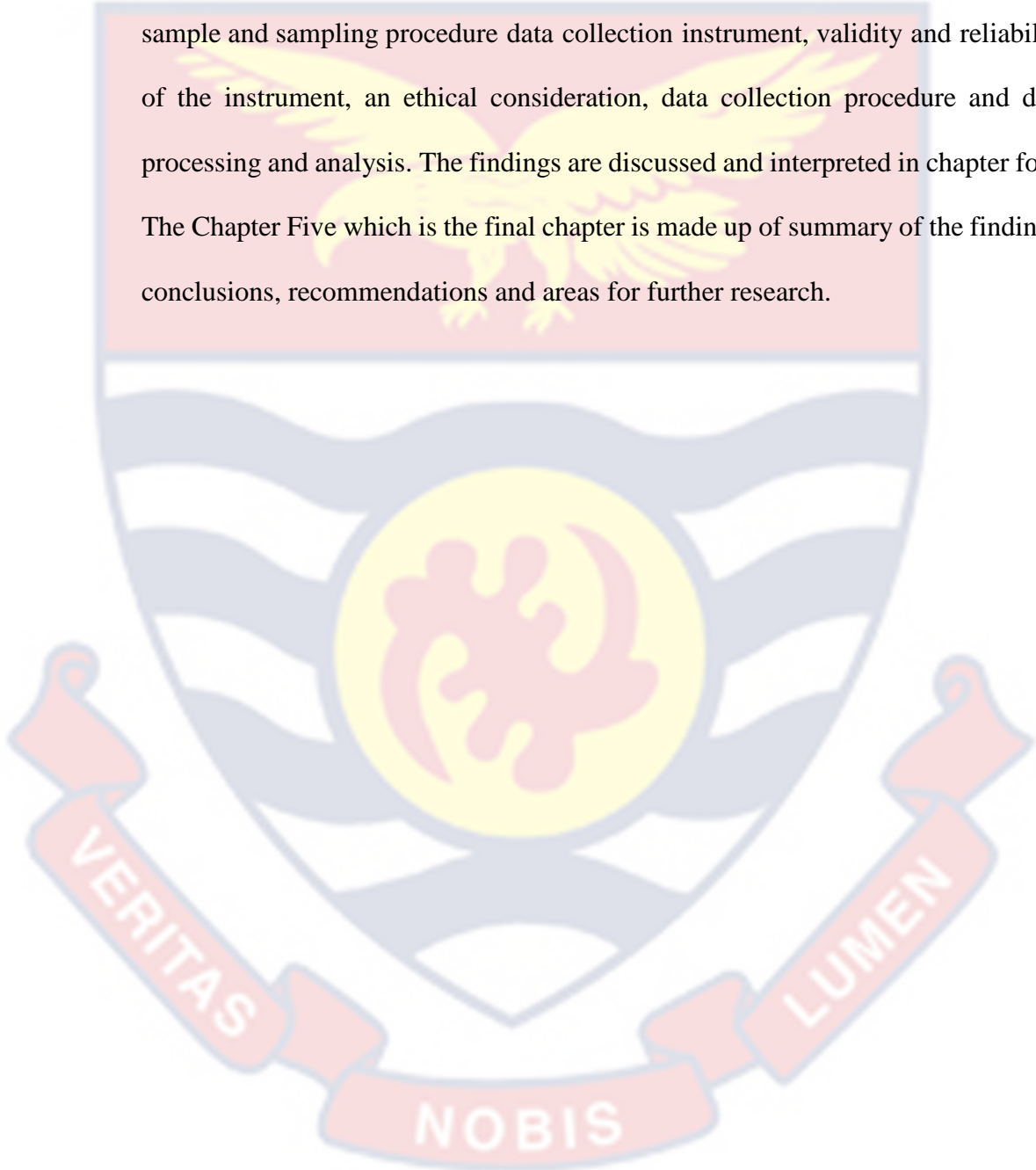
CHAPTER TWO

LITERATURE REVIEW

Overview

This chapter explores the literature on this study, assessing the influence of academic and professional qualification on pedagogy, content and pedagogical content knowledge level of lecturers at Cape Coast Technical University (CCTU). Each PCK item that is used in the study is thoroughly discussed. For the purpose of the review, Theoretical underpinnings of PCK from Shulman (1986) and Gess-Newsome, (1999) theoretical models of teacher knowledge base is explained. Additionally, models of teacher knowledge base by Grossman (1990), describing education for new and experienced teachers, effects on out-of-field teachers on education, academic and professional qualification of lecturers, measuring PCK, the concepts of PCK, the constituents of PCK, knowledge of the subject matter and instructional strategies for teaching are appropriately discussed in this chapter. Empirical studies on, lectures' comprehension of Content, Pedagogy, and the combination of the two are also discussed. The final section discusses the conceptual framework of the study followed by the summary of the literature review.

Theories of PCK and Models

Shulman's (1986) work on PCK describing the, knowledge, skills, and instructional techniques that instructors need to attain, has received significant attention. Following that, PCK became an essential necessity for subject-matter experts in pedagogy for efficient instruction. Shulman established and described

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the idea of PCK in his piece from 1986 and put forth a theoretical framework for its growth. According to Shulman, these included not only classroom management skills but also understanding of techniques and ideas from students. According to Shulman (1986), PCK is the best technique for presenting and articulating a topic that is comprehensible to students. He continued to indicate that PCK comprises knowledge about student challenges, preconceptions and the efficient ways to handle the students. He saw PCK as the nexus of subject-specific PK and CK. He argued that effective teaching is neither gained by having skills and understanding of pedagogical practice nor achieved by being an expert in a certain topic but rather, the amalgamation of both.

When Shulman started his research, he compared and contrasted the criteria and methods used to evaluate both present and previously certified teachers. Prior to the contemporary age, teachers were mostly judged on their content knowledge. It was considered that if teachers could demonstrate that they possess the necessary knowledge of a subject, then they would be able to transfer or impart that information to their students. The methods or processes of instruction received relatively little consideration, and historical study has shown that very little is known about effective teaching techniques. This implied that in order to become a successful teacher, a person ought to have specific subject matter, more than what their students are required to understand. This idea was juxtaposed by Shulman in the middle of the 1980s and he resolved that it was inadequate (Shulman, 2013). Using policy-based educational research, he found that the criterion for teacher preparedness had swung the other way, with content being subordinated to

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pedagogical practice (Shulman, 2013). These criteria were more heavily influenced by the practices that were believed to facilitate efficient instruction. Although basing teacher evaluations on content knowledge was a wise policy decision, Shulman contended that it had a cost. That is classroom management, student's ideas and other pedagogical techniques are relegated to the background. These policies although sometimes narrower, their interpretations have been predicated on teacher effectiveness referenced to particular research outcomes without an understanding of such research's limitations. This resulted in a system whereby instructors' readiness for the job was assessed only on the basis of their management and classroom practice knowledge, without reference to the subject matter they were actually instructing. The research that most of these rules and policies were based on was frequently abstracted from individual subject areas, resulting in a generalised version of instruction. This absence of the subject matter Shulman calls "the missing paradigm."

In contrast to how instructors set up their classrooms, split up their time, and arrange courses, Shulman (1986) examined the sources of teachers' expertise. How do educators decide how to present a subject? Shulman also looked at the transition of newly graduated teachers from successful college students to successful teachers. As a result, he taught teachers how to modify their subject-matter knowledge so that it is understandable by students, as well as how to explain an idea or clear up student misconceptions. In applying Shulman's theory to this study, the researcher observed that while topic knowledge is crucial, it does not guarantee a teacher will be successful in the classroom. Instead, educators should

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also have knowledge of methods for evaluating students' comprehension and identifying their misconceptions, as well as instructional strategies to dispel any misunderstandings students may have formed. Teachers should have a variety of teaching techniques at their disposal to help students connect what they are learning to prior knowledge (Carpenter, Fennema, Peterson & Carey, 1988).

Shulman proposed a theoretical framework on PCK to establish the relationship between subject-matter, pedagogical and curriculum knowledge as shown in Figure 1.
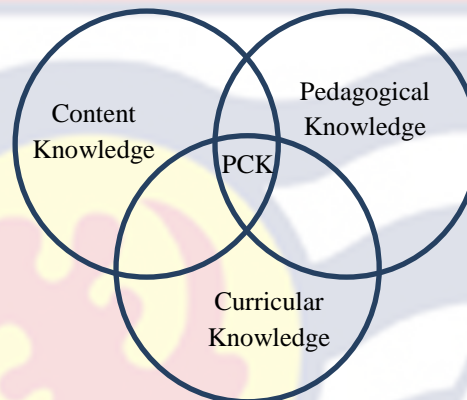
*Figur*e 1: Shulman's Theoretical Framework on PCK

*Sou*rce: Shulman (1986)

This approach was proposed by Shulman (1986) to clarify the connections between subject matter, skills for teaching, and curriculum expertise. These components, in Shulman's opinion, are connected. Using facts, concepts, grammar, set of standards and guidelines that underpin the content, he described content knowledge as the subject matter underlying structure. The skill for teaching is often known as PCK. According to Shulman, PCK contains all the representations and teaching techniques necessary for effective delivery. This includes a sizable

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collection of concrete illustrations, comparisons, and clarifications pertinent to the subject enable the student to acquire the content effectively. It is more than just a list of tactics; it is about understanding how and when to use them. PCK also comprises comprehension of student viewpoints and awareness of what makes a subject challenging or simple for learners. This covers ways to identify and correct widespread misconceptions.

According to Shulman, (1986) the teacher education initiatives would need to be modified to account for the link between content and process. The process toward incorporating PCK into the necessary knowledge base for teachers, as called for by Shulman (2012), involves both research and educational advancement.

Gess-Newsome (1999) Theoretical Models

Gess-Newsome (1999) offered the Integrative Model and Transformative Model as two theoretical frameworks to explain the emergence and growth of PCK. The integrative approach views PCK as the point where the academic fields and contextual knowledge converge. PCK is viewed in the transformational paradigm as the outcome of the transformation of pedagogical knowledge, subject matter knowledge, and contextual knowledge as shown in Figure 2.

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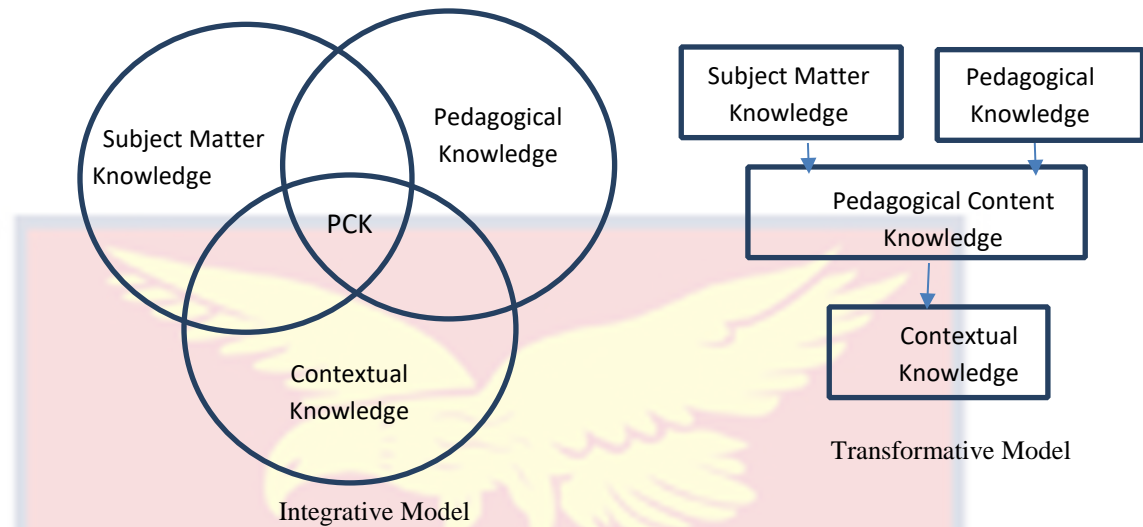
Figure 2: Theoretical Models of Teacher knowledge

Source: Adopted from Gess-Newsome (1999).

Integrative Model Theory

According to Gess-Newsome's (1999) integrative model theory, context, pedagogy and subject matter are the three constructs that make up teachers' knowledge, but PCK does not exist as a domain of knowledge. According to this perspective, teaching is the act of fusing information from these three disciplines. These approaches consequently have an effect on the course requirements for teacher education. The conventional teacher education programs, which are divided into several disciplines for instance, subject-matter, pedagogy, and practice, frequently use an integrative model of teachers' knowledge.

Kind (2009) explains that content knowledge is one of the fundamental skills instructors ought to possess but was not originally included in Shulman's (1987) PCK plan. The PCK models of Abell (2008), Magnusson, Kracjik and Borko (1999), Carlsen (1999), and Grossman (1990) followed this direction leaving the

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content information outside of PCK and as part of knowledge base. Other proposals differed from the original idea of Shulman, incorporating content knowledge to PCK (Banks, Leach, Moon, (2005); Koballa, Gräber, Coleman, Kemp, 1999; Veal & Makinster, 1999; Fernandez Balboa, Stiehl, 1995; Cochran, Deruiter, King, 1993; Marks, 1990) Therefore, Abell (2008) argued that additional empirical studies at various levels were required to comprehend PCK development and inform public policies regarding teacher education.

Transformative Model Theory

The transformative model was viewed as one of the most useful exercises included in the initial training. According to Gess-Newsome (1999), PCK in this instance would be the transformation of context, pedagogy and subject matter knowledge into a unique form.

Additionally, the New South Wales Quality Teaching Model and the Danielson Framework of Quality Teaching provide guidance for teachers' expertise for efficient instruction. Danielson framework classifies teaching as a complicated activity into 4 areas of responsibility. These are preparation and planning, the learning environment, instruction, and professional accountability. Alvarez and Anderson-Ketehmark (2011) indicated that the purpose of Danielson's framework was to support teachers' self-evaluation, planning, mentoring, peer coaching, supervision, and evaluation. There is no doubt that out of field teachers account for a country's poor education system (Saleem, Rani & Dogar, 2021).

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Models of Teacher Knowledge Base and PCK by Grossman (1990)

Grossman (1990) defines PCK in his model of teacher knowledge as the knowledge foundation for teaching which is made up of four interdependent parts which are, (i) knowledge of context, (ii) pedagogical content knowledge (iii) subject matter and knowledge (iv) general pedagogical knowledge. Grossman examined Shulman's idea of knowledge base for teachers. As a result, the three knowledge base that make up PCK were directed by an understanding of the motivations of teachers for instructing such content. Given that the model incorporates teachers' knowledge and beliefs, PCK's formal and practical nature is explained in Figure 3.
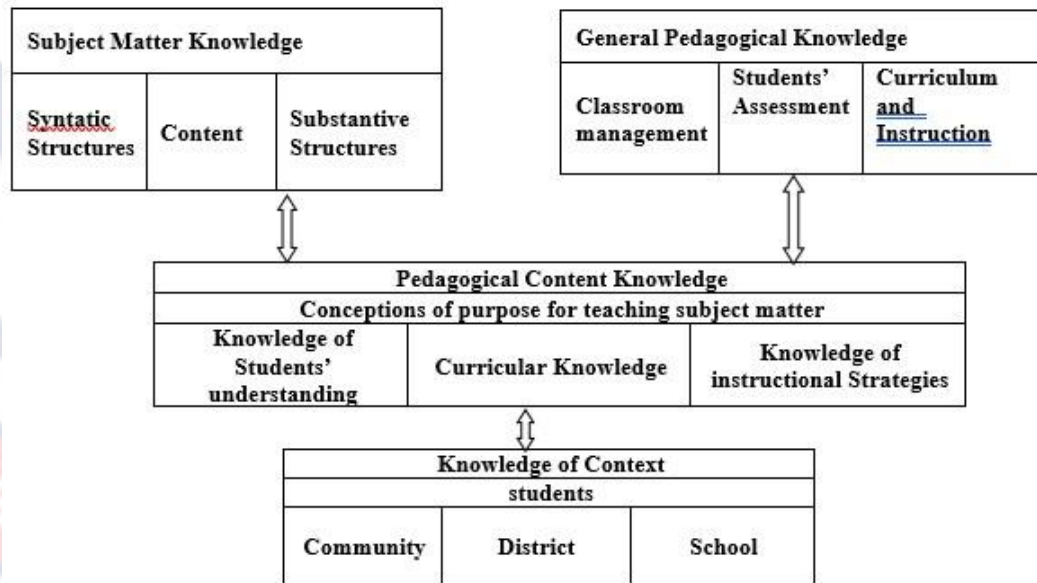
Figure 3: Model of Teacher Knowledge

Source: (Adopted from Grossman, 1990).

Carlsen (as referenced in Fernandez (2014) presented an idea for improvements to the knowledge base of teachers which differed slightly from Grossman's (1990) concept. Carlsen's idea was based on Knowledge of both

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general and specific educational contexts. Understanding the context in general often entails knowledge about the country, community, and school under question. On the other hand, understanding of the specific educational context, focuses on classroom and student-centered. As illustrated in Figure 4, Carlsen's model also took into account general PK, CK, substantive and syntactic structures, and other types of knowledge.
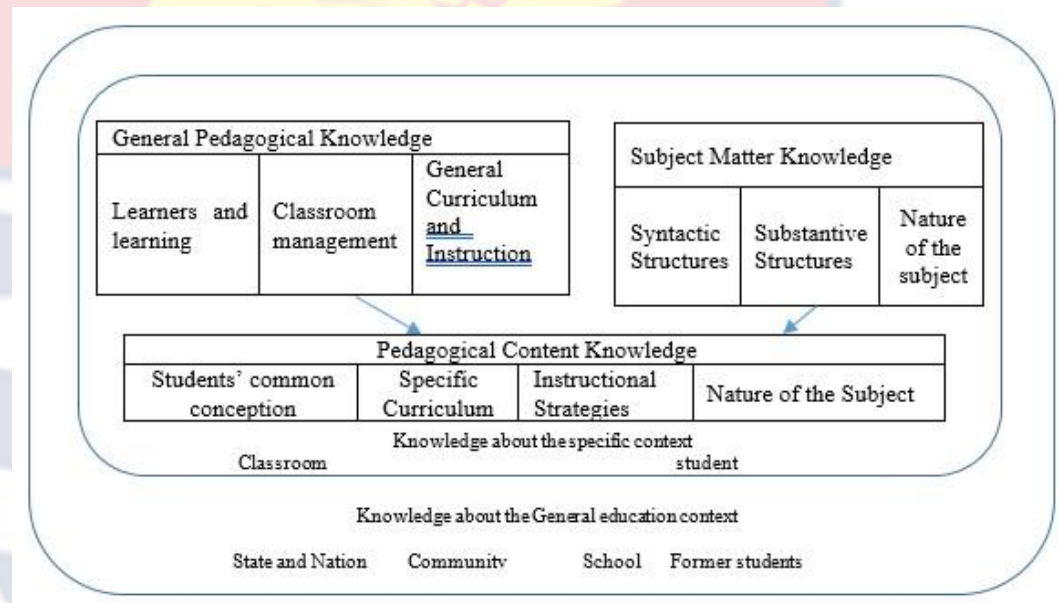
Figure 4: Domains of Teacher Knowledge

Source: (Adopted from Carlsen, 1999).

Shulman's model existed long before Grossman and Carlsen's knowledge base for teachers was propounded. One of the most important knowledge base that teachers must acquire to effectively teach is PCK, Shulman (1987).

Managing the classroom, assessment of students, curriculum and instruction are the three components that make up pedagogical expertise. Effective teachers optimise contact hours, promote active participation and involvement in learning activities during class. Additionally, they ensure that students grasp the

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topic, complete their level tasks and activities appropriately to ensure high success rate, establish a positive and encouraging classroom environment, demonstrate effective behaviour management, and finally, the ability to motivate students to learn. When teachers determine what students have learned, they draw on their assessment knowledge. For example, formative and summative assessments. Curriculum and instruction comprises the information a teacher needs to implement and designs as well as the information on the curriculum and associated curricular goals recommended by the appropriate educational authorities. (Shulman, 1987; Tamir, 1988; Magnusson, Krajcik, & Borko, 1999 and Grossman, 1990).

Behar (1994), explained three other characteristics of PCK which include (i) knowledge of instructional strategies, (ii) knowledge of students' comprehension, and (iii) curricular knowledge. Understanding instructional tactics involves having a solid understanding of the subject matter as well as how the teacher presents it through examples, explanations, and teaching techniques. The learning process and the students' issues with content knowledge are covered by knowledge of students' comprehension. The ability to apply theoretical concepts and behaviors related to curriculum planning, implementation, and evaluation falls under the category of curricular knowledge. Curriculum knowledge enhances one's capacity to react to the social context and dynamics of the classroom claim (Joyce, Weil, & Showers, 1993).

Effective teaching policy discussions are closely related to ideas of teacher accountability and responsibility (Berliner, 2014). According to the accountability reform paradigm, teachers' performance is assessed using value-added metrics that

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purport to compare the productivity of each teacher to each student performance (Berliner, 2014). It appeared that teachers' performance was being impacted by the market-driven performance agenda of neo-liberal education policy, which measured teachers' effectiveness against students' results on high stakes, standardized national tests. Consequently, a lecturer is said to have performed well when his students perform extremely well in his subject whereas, students who perform poorly are linked to the poor performance of the subject teacher which is not always the case (Berliner, 2014). Critical policy scholars reported the high levels of fear, anxiety, mourning and loss of hope experienced by lecturers as they navigate and negotiate the contradictory and conflicting discourses of this policy (Ball, 2016; Clarke, 2013; Singh, 2018). As a result, some teachers for fear of students' failure, allow students to cheat during examinations to pass well. This should not be the case; If teachers possess the subject matter knowledge, instructional strategies and curriculum and instruction, they exhibit intellectual quality (IQ), create Quality Learning Environment (QLE) and Significance (SIG) where students connect learning to ownership as identified by Yeigh (2008).

Teacher and Knowledge Base

Three other types of teacher knowledge bases were also put out by Shulman (1986). They are case knowledge, strategic knowledge and propositional knowledge. Firstly, according to Shulman (1986), case knowledge is the comprehension of potential events that fall in a predetermined range and can be compared. An incident can be recounted, but a case needs to be clarified, analyzed, defended, broken down, and put back together. These are methods of studying or

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explaining theoretical construction, not a generalisation of an event. Secondly, strategic knowledge goes beyond mere knowledge but the skill to judge professionally. This, Shulman called "the wisdom of practice". He indicated that it is a strategy used by teachers when they are faced with contradictions or issues for which there are no obvious solutions. Evidently, teachers use their strategic knowledge to reason and determine the truth when propositional and case knowledge collide. Thirdly, propositional knowledge refers to the lessons taught to teachers or the axioms based on experience.

Basically, teacher's readiness to explain content has a substantial impact on how learners acquire competencies (Awoniyi, 1982). Teachers may be conversant with new and developing trends in curricular modifications, however, Awoniyi (1982) maintained that if they are not well-grounded in the knowledge and abilities to teach it, they may not be able to effectively execute a curriculum innovation.

Additionally, Kafu (2010) noted the necessity for ongoing training to prepare instructors for the additional difficulties that come with implementing curriculum improvements. According to Kafu (2010), two types of teacher preparation which are pre-service and in-service education are necessary for successfully implementing a curriculum.

Pre-service Education of Teachers

Initial teacher training in the various educational institutions is very crucial for beginners who intend to teach. (Gess-Newson, 1999). Hugh (as stated in Mulenga, 2019) asserted that in addition to teacher training, the execution of curricular changes and the persistence of new approaches in schools also depended

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on teacher know how, skills and attitudes cultivated during initial teacher training. Therefore, it is crucial for teacher educators to master the methods for connecting with the fundamental attributes of an expert and how to encourage these potentials in student teachers. Hugh, (as referenced in Mulenga, 2019), made a further observation that novice teacher education, which is meant to make curriculum delivery easier, is generally plagued with issues. For this reason, before a new programme is mounted in any institution, the Department concerned should first ensure the availability of qualified teachers to handle the course. However, the aim of teacher education is to give people the professional and personal abilities required in classrooms and other learning environments. Pre-service and in-service teacher education can occur across a number of years, in a variety of contexts, and with a variety of goals. Together, they make up a continuum of professional development (Gess-newsome, 1999).

In-service Education of Teachers

In-service education refers to the initiatives designed to address alleged competency gaps. Teachers' professionalism and personal development are promoted through this ongoing process (Daresh & Playko, 1995). When individuals require specialized training to fill up skill gaps, in-service education is appropriate (Daresh et al., 1995). Namunga and Otunga, (2012) indicated that in-service training could be conducted anytime during a teacher's career, whether full- or part-time. The instructions provided by Daresh et al. (1995) for in-service education are helpful. They suggested that in-service education ought to ensure that programs are tailored to the participants' local needs and that participants should be

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actively involved and encouraged to identify their needs and potential retraining areas. They believed that beginning training in the areas of specialisation that lecturers sought upgrading in would make in-service education for teachers more effective. Jerotichl, Kurgat, and Kimutai (2017) emphasised the need for lecturers to regularly participate in in-service training opportunities within the educational system in order to improve their teaching methods. Jerotichl, et al. (2017) stated that teachers needed to arm themselves with new kinds of knowledge, fresh approaches to instruction, and an understanding of the goals and parameters of a new curriculum. Programs for teacher in-service education should be accessible to lecturers who implement curricula because they must reach their intended audience. One of the tenets of this study as previously mentioned, is assessing the backgrounds of lecturers at Cape Coast Technical University to verify if they have the required qualifications to teach.

Effects of Out-of-field Teachers on Education

Any educational system's success and a country's overall success depend heavily on its teachers (Kola & Sunday, 2015). Kola et al. (2015) lament on the frequency with which some Heads of Department assign faculty members to teach courses without taking their teaching ability into account. In their study, they used the common example that merely because a teacher has a strong PCK in mathematics, does not necessarily follow that they should be capable of teaching physics. They referred to this approach as assigning non-specialist faculty members to teach courses they did not have the expertise to teach. According to Kola et al. (2015), the outcome could lower the standard of education. Inadequate subject-

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matter knowledge has been seen by some to be a key element in reducing the standard of excellent teaching, and it has been stated that out-of-field teaching is a sign of a teacher's lack of it. According to Darling-Hammond and Ball (as referenced in Kola and Sunday, 2015), out-of-field teaching is a concern for educational systems, and the majority of the issues it creates are so significant that they may be impossible to measure. The most important effects of out-of-field teaching are likely those that are difficult to quantify. Ingersoll (1999) stated that there are numerous effects of off-field teaching. Some of these include a reduction in teaching time, a reduction in preparation time, and a reduction in teacher dedication and morale. The distribution of teachers' preparation time across all of their courses may shift if they are assigned to teach disciplines in which they lack the necessary training. In order to prepare for the course or courses for which they lack preparation, they may reduce the time they are expected to devote to other courses.

Less time is available for out-of-field teachers who focus on learning new content to understand the requirements and interests of their learners (Salleh & Darmawan, 2013). According to Pillay, Goddard, and Wills (as referenced in Hobbs, 2012), out-of-field teaching may damage "teaching competence" and interfere with a teacher's sense of identity, self-efficacy, and wellbeing. Out-of-field instruction was identified by McConney and Price (2009) as a contributing factor to stress among inexperienced teacher. In McConney et al. (2009), Webster and Mark concisely noted the issue of out-of-field teaching, which

prevented educators from seeing the true extent of the teacher shortage in the schools.

Academic and professional qualifications

According to Schulz (as stated in Cheng et al., 2020), human capital is essential for gaining a competitive edge and is critical in achieving high productivity. As stated by Cheng et al. (2020), academic and professional qualifications is found in human capital, which is developed by knowledge and abilities acquired through training. Sial, (2005) argued that while lecturers' credentials are important, professional education training is more crucial because trained teachers are generally considered to be more effective teachers than untrained teachers. Ruhela and Singh (as cited in Khurshid, 2008) posited that higher academic qualification and professional teachers are the success of every educational institution. Furthermore, because teachers play pivotal roles in student learning, their knowledge, their unique tasks and obligations are expected to be above those of the students.

The numerous academic degrees that a teacher can hold to qualify them to teach are referred to as academic and professional qualification (Hakielimu, 2011). These include diplomas in teacher certifications, Degrees such as Bachelor's, Master's, Mphil and Doctorate. According to some academics, CK, PK, and PCK are positively correlated with greater education levels (Goldhaber & Brewer, 2000). According to Aina and Olanipekun (2015), a person's qualification is their distinctive expertise that qualifies them for a given job or activity. As a result, teachers must possess set of abilities in order to be qualified to teach. The abilities

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a teacher needs to teach effectively could therefore be included in their certifications. These abilities consist of formal education, work experience, subject-matter expertise, pedagogy research, and teacher certification (Zuzovsky, 2009). Even with a certificate of instruction, a person cannot teach since they do not have the required subject-matter knowledge. In a similar vein, someone who just completed a short period of training without completing the required number of years lacks the qualifications to be a teacher. (Darling-Hammond as mentioned in Aina et al., 2015). Hakielimu, (2011) asserted that one of the key elements influencing a teacher's PCK is his level of qualification. According to Aliyu, Yashe, and Adeyeye (2013), one of the most important factors in the teaching process is a teacher's qualifications. Ibrahim (2000), opined that instructors' credentials can significantly improve their PCK. Therefore, contrary to what some people erroneously believe, a teacher's credentials may go beyond the degree they possess. A certificate from any university is not the only requirement for a teacher's qualification. In her study on "teachers qualifications and their impact on students' achievement findings," Zuzovsky (2009) established a connection between four indicators of a teacher's qualifications: (i) their formal education; (ii) their education in the subject they teach; (iii) their education in pedagogical studies; and (iv) their certification and licensing authority. However, Shulman (1987) asserted that PCK is dependent on a teacher's subject-matter expertise, pedagogical knowledge, and the manner in which the instructor distils this expertise into multiple forms so that students in diverse learning contexts can comprehend the

subject matter. However, Smith and Banilower (2015) indicated that measuring PCK is difficult to identify and measure owing to the lack of precise definition.

Measuring PCK

According to studies on PCK, any teacher professional development must first include an evaluation of the instructor's PCK (Henze, Van Driel, & Verlop, 2008; Park & Oliver, 2008; Nilsson, 2008). Loughran, Berry, and Mulhall (2006) stated that little study has been done to evaluate the measurement and quality of teacher PCK, despite the fact that significant research has been done to measure it. Smith *et. al* (2015) claim that this was brought on by a lack of a precise operational definition. The components of PCK have been identified by certain academics, including Tamir (1988), Magnusson, Krajcik, and Borko (1999), for the purpose of evaluating teachers' PCK. However, Magnusson, et al. (1999)'s PCK model was widely used in scientific education research. However, the goal of this study is not to assess lecturers' PCK, but rather to assess the knowledge level of lecturer's PCK. Keller, Neumann, & Fischer, (2017) believe that PCK is a crucial subject in education and that high levels of PCK would predict high levels of student accomplishment. A universal and consistent approach for calculating PCK has not yet been developed (Park & Oliver, 2008). As a result, instead of measuring lecturers' PCK, the study attempted to assess their knowledge level of PCK. To accomplish this, the researcher created a test for assessing CK, PK, and PCK of the lecturers at CCTU.

According to Gess-Newsome (1999), PCK was first described by Shulman in two distinct techniques to measuring PCK, that is i) integrative

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knowledge category and ii) transformative knowledge category. According to Shulman (1987), the integrative view of PCK involves a "amalgamation" of other knowledge categories, such as content knowledge and general pedagogical knowledge.

Baumert et al. (2010) demonstrated a strong association between PCK and content knowledge using this definition of a PCK model, despite the fact that PCK and content knowledge are still distinct concepts. According to a different perspective, PCK could be considered a distinct class of knowledge with its own distinctive identifiers (Magnusson, Krajcik, & Borko, 1999). Gess-Newsome (1999) referred to the second model as a transformative model of PCK because it could be viewed as a transformation of knowledge from other knowledge categories (such as knowledge of management curricula, understanding of management, instructional strategies, and assessment of management literacy). Both PCK model approaches acknowledged that understanding particular student conceptions and learning difficulties, as well as knowledge of instructional strategies that incorporate these understandings, are crucial components of measuring PCK (Park & Oliver, 2008).

Since Shulman first described teachers' pedagogical subject knowledge, numerous ways for assessing it have been created (Henze, Van Driel & Verlop, 2008; Park & Oliver, 2008; Nilsson, 2008). Interviews, paper-and-pencil tests for theoretical knowledge, video vignettes for reflective knowledge, teacher training as an intervention, video recording of actual instruction, and very frequently a combination of two of these methods were used to measure these. The research

projects that employed these techniques could be divided into two categories: small-scale assessments and large-scale evaluations. Paper and pencil assessments and a quantitative analysis of observations cannot be employed in small-scale investigations because psychometric standards are not achievable. On the other hand, because of the heavy workload, intervention and interviews cannot be employed in large-scale investigations. Small-scale studies were utilised to study PCK at the start of the PCK research intervention using an observation or intervention and interviews (Lee & Luft, 2008; Van Driel, Verloop, & De Vos, 1998). This investigation seeks to determine whether CCTU lecturers have the relevant knowledge to teach. According to (Park and Oliver, 2008), small-scale studies have served as the foundation for greater quantitative research. Large-scale research also revealed more general findings about PCK and the relationship to other knowledge categories, as well as the relationship to the students' outcomes (Baumert et al., 2010). Significant research, for instance, found that better lessons were developed by teachers with higher PCK scores, which had a favorable impact on the students' understanding of the subject test results. Baumert *et al*. (2010).

In assessing the knowledge level of lecturer's PCK at Cape Coast Technical University, the researcher adopted the paper-and-pencil test to assess the lecturers' knowledge on curriculum, assessments, instructional strategies, knowledge of the students' conceptions and misconceptions, classroom management their educational and professional qualifications.

PCK is frequently implicit, making its measurement challenging, time-consuming, and difficult (Rohaan, Taconis, & Jochems, 2009). Some researchers enable more effective investigation; for instance, Park, Jang, Chen, and Jung (2011) developed the PCK rubric instrument for measuring purposes. Most research on PCK assessed the perceptions of teachers using 5-point scale (Siaw Marfo, 2011; Owusu, 2011; Bosu, 2010). This study is a quantitative survey, therefore did not use interview and observation. It however, assessed teachers by using 2-point scale (True or False and Yes or No) tests with the view that knowledge is tacit and in order to assess the teachers' knowledge they need to be tested and rated. This was done in consonant with Baumert *et al.* (2010).

Concepts of PCK

Shulman (as cited in Kola et al (2015) explained PCK as the combination of content and pedagogy used in the domain of teachers to mean professional expertise. Chai, Koh and Tsai (2010) posited that in the parlance of teachers, PCK meant teacher expertise in teaching and efficiently managing the classroom. In a related term, Koehler (2011) posited that PCK is not developed in a day but over time and through experience to equip student learning. As a result, it was disturbing when Doudu (2019) published that some teachers of Technical Universities in Ghana were incompetent because they did not have relevant background to teach at the technical universities. According to Cheang, Yeo, Chan, and Lim-Tei (2007), PCK focuses on the delivery of content. Examples include their subject-matter expertise, their pedagogical knowledge (including

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their understanding of teaching, learner development, and learner conceptions), and how subject-matter expertise plays a role in pedagogical reasoning.

According to Darling-Hammond (2000), there is a growing understanding that instructors' familiarity with discipline-specific pedagogy is essential to their ability to effectively convey content across a variety of courses that students will understand. While arguing that "studies have shown that novice teachers often struggle to present concepts in a manner understandable to their students because they have little or no PCK at their knowledge of PCK" Kagan but Reynolds (1992) disagreed. It is clear from the aforementioned paragraph that PCK is a crucial knowledge foundation for instructors to possess to teach effectively.

Ball, Thames, Phelps (2008); Hill, Ball & Schilling, (2008); Park & Oliver (2008); Hill, Rowan, and Ball (2005); Gess-Newsome (1999); Van Driel, Verloop, & de Vos (1998); Cochran, DeRuiter, and King (1993) are just a few of the studies that were done after 1990 to conceptualize PCK in various subjects. Based on Shulman's definition, these researchers conceptualized PCK using a number of different elements and strategies. Cochran, DeRuiter, and King (1993), for example, asserted that the idea of knowledge lacked a dynamic framework and was incompatible with the structuralism school of thought. They also retitled pedagogical content knowledge as pedagogical content knowing and asserted that it is dynamic in nature and improves with each new teaching experience that teachers acquire. In contrast to the other researchers, Cochran et al. (1993) expanded the conceptual framework by defining PCK in their own terminology

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under four components. Knowledge of the learning environment, content knowledge, student characteristics, and pedagogical expertise.

Pedagogical Content Knowledge is the body of information that deals with how concepts are represented and put forth, pedagogical strategies, and the factors that influence how difficult or simple concepts are to acquire, as well as the prior knowledge of learners (Mishra and Koehler, 2006). Regarding pedagogical content knowledge, Shulman (1986) and De Jong (1999) both hold the same opinion.

Gess-Newsome (1999), in his pursuit to re-conceptualized PCK, revealed two basic structures: the integrative model and the transformational model to explain the structure of knowledge that teachers should possess. The integrated model includes the connection of pedagogical, contextual, and content information that the teacher combines during teaching. PCK is absent because each component retains its unique personality. A new knowledge category that incorporates the synthesis of these three knowledge categories is expressed by the transformative model.

Researchers disagree on a definition or conceptualization of PCK (Van Driel & Berry, 2010). It is still debatable in the literature whether PCK has a framework unique to each subject or a more general structure applicable to every course. It is challenging for academics to come to a consensus on PCK because of its dynamic, complex, and integral nature (Van Driel et al., 2010).

PCK continues to be the most frequently utilised framework in studies on teacher education, despite this widespread impression of PCK in the literature

(Segall, 2004). In several publications, dissertations, theses, and courses, PCK is a popular topic. As a result, Shulman has held a prominent position among authors who are cited. Segall (2004) argued that it is crucial to conduct a comprehensive review of studies on PCK because of a general overview of the existing situation and the thought to present a guide for future researchers in the field. Research in the fields of science, fractions, algebra, and functions employed Shulman's approach and were largely done in the US. Large-scale research had previously employed these tests as instruments for gathering data. In their 2019 paper, Delgado-Rebelledo and Zakaryan outlined six potential approaches to PCK. These included (i) the nature of teachers' PCK, (ii) the connection between PCK and subject matter expertise, (iii) the connection between PCK and instructional strategies, (iv) the connection between PCK and student learning, (v) the connection between PCK and personal characteristics, and (vi) the evolution of teachers' PCK. A key outcome of these perspectives is offered by Delgado-Rebelledo et al. (2019) based on their studies. For instance, PCK and content knowledge had a strong relationship, PCK was necessary for effective teaching, PCK and student learning had a positive relationship, gender had no bearing on PCK, providing native-language instruction to teacher candidates had a positive impact on PCK, teaching experience had a positive impact on PCK, and PCK varied among teachers from different counts. In view of the NCTE report, which indicated that technical university lecturers lack adequate backgrounds for teaching, the study seeks to evaluate the influence of academic and professional qualification on the pedagogical content knowledge of CCTU lecturers.

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Elements of pedagogical content knowledge

The elements of PCK are; i) mastering of content, ii) mastering of teaching strategies, iii) understanding learners' conception and iv) learners' challenges, v) instructors teaching experience Shulman (1986). Also, understanding how topics were organised over time as well as effectively using resources to design programmes for learners.

De Miranda (2008) defined PCK as the knowledge drawn from three different knowledge bases and synthesised to guide teachers in their instruction. These include instructional knowledge, context knowledge, and content.

Content knowledge is unique to subject teachers and this distinguishes managers from a management teacher. It is obvious that there are numerous components of PCK, for that reason, the study concentrated on the elements Shulman listed. The three PCK components that Shulman (1986) identified as the core of teachers' PCK are chosen because they enable instructors to convert the topic in a way that will help learners to easily grasp the content. In transforming the content, the instructor must first have a firm understanding of it, the instructor must acquire a method for making the subject understandable to the students, the instructor must be aware of any potential misconceptions that the students may have about the subject in order to design explanations that would either dispel the misconceptions as needed.

Content Knowledge for teaching

CK is one of the element of PCK identified by this study. Turnuklu and Yesildere (2007) explained that CK is related to knowledge of the subject matter

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and its representations. For any topic, the teaching process begins with the teacher's comprehension of what must be taught and how it must be taught to the students. Though learning ultimately remains the learner's responsibility, if teaching efforts are successful, the learner will acquire comprehension. Typically, a teaching method involves a number of exercises in which learners are provided a sequence of instructions and the opportunity to learn (Shulman, 1987). The study by Turnuklu et al. (2007) revealed that to teach mathematics effectively, teachers need to have a thorough understanding of the mathematical knowledge. Their findings suggested a connection between a teacher's subject-matter expertise and the success of their math lessons. They argued that a teacher's influence on the caliber of their instruction and the methods they employed and provided would be positive if they have a solid conceptual understanding of mathematics topics. Mishra et al. (2006) supported Turnuklu (2007) by indicating that instructors with solid subject-matter knowledge develop creative methods to clearly communicate the subject matter and make it understandable to students.

The NCTE Report published by Doudu (2019) revealed anomalies in the teaching and administrative procedures in the Technical Universities. The Staff Audit revealed that teachers taught without relevant background, had on-line PhD certificates and mismatched degrees. From the report, it appeared that teachers teaching at the technical universities lacked the expertise to teach hence, the need to assess the knowledge of the subject matter, knowledge of instructional tactics and the understanding of knowledge of learners' preconceived ideas and their

confusion. In this study, a questionnaire was designed to assess the respondent's general pedagogy knowledge, content and pedagogical content knowledge.

Knowledge of Instructional Strategies in Teaching

The teacher's decision regarding the instructional technique to use is crucial. Different lessons call for various teaching strategies. The selection of such an instructional technique, according to Shulman (1987), depends not only on the teacher's expertise in the subject area but also on that of the students' comprehension levels.

A teacher's successes in class depends on his/her expertise in PCK and experience in teaching. Lim (2007) proposed that prior to the start of a lesson, a teacher must (i) plan the lesson, (ii) choose a teaching strategy, and (iii) select a language that will suit the learners' level of understanding. According to Lim (2007) teachers who are skillful in PCK, always take their learners' developmental stage i nto account when deciding on the teaching strategies to apply. Although a teacher must have in-depth understanding of the subject in order to be effective, Cockburn (2008) argued that for learning to occur, the teaching approach must be effective. Tanners (2003) asserted that to achieve effective instructional tactics, teachers should encourage the students to participate in the lesson by actively engaging them, supporting them to apply their past knowledge and skills to solve issues, and establishing a suitable learning environment. According to Ingvarson, Beavis, Bishop, Peck, and Elsworth (2004), outstanding educators are knowledgeable about varieties of efficient teaching approaches and procedures that foster learners' enthusiasm of the subject. Furthermore, these educators frequently select

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instructional techniques that aim to give every student the best possible learning environment.

De Miranda (2008) opined that teacher's expertise requires understanding of using various strategies to create learning experiences that are best suitable for the students. This entails adapting training to accommodate for different learning styles, talents, interests and understanding the ideal way to teach a subject to give students the finest learning experience.

The various teaching strategies used may vary from one teacher to the other and in various circumstances, but they all navigate around the same basic ideas. In addition to the instructional tactics proposed by Tanner (2003), Westwood (2004) expanded these instructional strategies by adding that expert teachers manage student's behaviour and inspire them to learn. Westwood (2004) assessed how instructors applied their pedagogical techniques to the students' benefit. According to Eysink, de Jong, Berthold, Kolloffel, Opfermann, and Wouters (2009), an effective instructional technique encourages active learning on the part of the student. Eysink et al. (2009) defined active learning as the processes of the learner interpreting, exemplifying, categorizing, and arranging the knowledge. Baumert et al. (2010) also proposed three elements of instructional techniques in their study on teachers' knowledge, critical thinking in the classroom, and learners development. These elements are essential for starting and maintaining perceptive learning processes. These three elements are: (i) Opportunities for learning that are both cognitively demanding and well-structured. (ii) Monitoring the

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progression of knowledge, providing individualised response, and using adaptive instruction (iii) effective time and classroom management.

The outcome of the discussion thus far is that teachers should use instructional strategies that promote debate and justification of concepts in the topic in order to establish learning (Eysink et al., 2009). Educators should also address any confusion of students about a subject and provide guided practice until students are independent (Tanner, 2003; Lim, 2007). Westwood (2004) asserts that the selection of a technique to promote a structured enabling environment that enables students to hear what their counterparts have to say and to encourage debate among the students.

Knowledge of Learners' Conceptions and Misconceptions

According to Fennema and Franke (1992), understanding the "perception of students" is "knowing about the strengths and weaknesses (academic challenges) of a category of students and designing an enabling environment as well as preparing appropriate lessons to meet their needs. Smith, DiSessa, and Roschelle (1993) asserted that no students go into the classroom with no prior knowledge. The students bring certain topical preconceptions to the classroom. They may interpret these knowledge differently than their teachers do as they learn, and teachers might not be aware of the full range of knowledge these learners convey to the classroom. According to the constructivist perspective on learning, every type of learning entails the interpretation of phenomena, contexts, and experiences, perspectives of the student's existing knowledge. Although PCK is understood to be knowledge of pedagogy and how to teach a subject, it was insufficient to establish an expert tuition

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without understanding the students (Kulm and Wu, 2004). According to Tanner, Bottoms, Feagin, and Bearman (2003), the ideas students have varied. Their preconceived notions about the subject clashed with the new teachings. In their study, teachers were put to the test to determine whether it was their duty to identify the reasons for student learning gaps and successes, in addition to what a teacher should do when their pupils become confused during sessions. Critically, it is important teachers take into account students' conceptions of a subject when deciding on teaching methods to enhance learning. Documented misconceptions regarding the subject or content must be taken into account as teachers adapt the material to make it more accessible for students (Tanner, et al. 2003). Understanding typical mistakes and misunderstandings among students can give teachers insight into how they think, their focus on the topics for teaching (Ryan & McCrae, 2009).

To determine how much students already know about the subject, teachers must conduct a baseline assessment. Teachers can help correct the known and the unknown by becoming aware of what students already know. This will enable them to address misconceptions and help students understand new information (Ryan & McCrae, 2009). It is critical to understand misunderstandings in order to evaluate any potential errors that students may have made in understanding what they had previously been taught. According to Smith et al. (1993), students' confusion are bits of incorrect knowledge that might come from learners' prior knowledge from both inside and outside of the classroom. Poor subject matter expertise on the part of teachers could also help students adopt these misunderstandings because

misconceptions could arise from faulty prior studies (Smith et al. 1993). Misconception yields incorrect solutions to problems (Smith et al. 1993). Such misunderstandings typically develop when a new lesson is incompatible with the learner's existing conceptual understanding of the subject. Misconceptions also obstruct the understanding of new ideas because of their power and faulty content. According to Ingvarson (2004), effective teachers possess extensive knowledge of the learning process. They are aware of the most recent theories that are pertinent to the subject. These instructors are familiar with the proper language, models, and representations. Effective teachers design their lessons to address any misconceptions that students may have about a particular subject. They are aware of the common misunderstandings that students may have and plan their lectures accordingly. Such instructors promote debate and defense of whatever ideas students may present in class (Ingvarson, 2004). Smith et al. (1993) assert that for classroom education to be effective in eradicating misconceptions, teachers must clearly contrast the proper notions with the students' false beliefs. The chosen lesson should include activities and demonstrations that provide counter-evidence and tenable conceptual alternatives to target misconceptions (if the teacher is aware of the learners' misconception). Students then internalise the clash of views during classroom debates as a psychological process of competitiveness that ultimately leads to the removal of the misunderstanding.

The knowledge of subject matter representations and a comprehension of particular learning challenges and student conceptions are the two main components of Shulman's (1986) idea of PCK, as already mentioned. These

components should be used with flexibility as they are obviously connected. According to the study (Shulman, 1987), the greater the number of representations available to teachers, the better equipped they are to identify learning challenges and use their PCK. Teachers need to be well-versed in any potential challenges that students may encounter when a particular subject is covered. This will allow the teacher to plan out potential justifications and illustrations that will help the students understand the subject matter being taught. The teacher will also be able to prepare any necessary prior subject knowledge for a specific topic that would enable students to readily connect to the new knowledge if they are aware of such learning challenges.

Empirical Review

Lecturer's Knowledge of CK, PK and PCK at the university

Brijlall (2011) investigated the relationship between subject matter expertise and instructional practice in South Africa using the perspectives of two university lecturers. The study used a qualitative method. Two university lecturers who taught a second-year class of 78 undergraduate teacher candidates participated in the study. The scaffolding process and the educational theories of Vygotsky were used to conceptualize the research. These instructors were given questionnaires to fill out, in which they shared their opinions on content knowledge in general. In order to compare actual lesson instruction, students' perceptions of the subject matter, and classroom activity, video recorded lessons on rates of change in calculus were observed.

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Brijlall (2011) researched on the lecturers' conceptions of content knowledge, both lecturers defined CK as relevant to the comprehension of a certain mathematical concept or topic. This knowledge entails more than just understanding mathematics; it also entails understanding the connections between different subjects and how a single subject fits into the overall picture. The instructor observed a favorable relationship between subject-matter expertise and in-class performance. The classroom performance was increased by in-depth subject understanding. Instead of only giving students' answers, it offered them clues.

Ibrahim, Surif, Abdullah, and Sabtu (2014) stated that the instruction of experts and novice lecturers differed in terms of the practice of PCK based on five PCK components. The study used a qualitative technique. Eight lecturers from the Faculty of Science at University Technology Malaysia were selected for this study, four of whom were experts and the other four were novices. Instructional observation and interviews were used to get the data. Interviews, audio and video were recorded in addition to note-taking were used to conduct the lesson observations. A content analysis technique was used to review the data. The study discovered there were variations between experienced and inexperienced lecturers in their pedagogy, comprehension of student issues, and importance of the subject. Again, professional lecturers were found to be experts at comprehending pedagogy and student issues, but they lack comprehension of the importance of the subject. The results also showed that both experienced and inexperienced science professors were experts in their fields and evaluation techniques. Yilmaz and Tinmaz (2016)

studied student perceptions of faculty members' instructional skills in Turkey to see if these perceptions varied based on a few important characteristics. The study used a descriptive/exploratory design. Students in the faculty of engineering, economics, theology, and administrative sciences constitute the population. The sample of the study consists of 792 level 300 and 400 university students. Data were gathered using the Pedagogical Competences Scale. T-tests, means, standard deviations, variance analyses, and Mann-Whitney U tests were used to analyse the data. The findings showed that while most lecturers are seen sufficient by students for their democratic attitudes, only a small number of them were assessed to be so for the course's measurement, process, and evaluation. While there were disparities between male and female students in democratic attitude, measurement, assessment, and evaluation, there were no appreciable differences in other proficiencies between the sexes of the students. According to the findings, few lecturers generally possessed pedagogical competency in the eyes of the students. According to the subscales of pedagogical skills, lecturers were viewed as having a democratic attitude and competence regarding course introduction, however, some lecturers were proficient in skills related to course process, measurement, and assessment. Negassa and Engdasew (2017) evaluated the effects of pedagogical skill training for university lecturers in Ethiopia on methods for instruction as determined by teaching components. In the study, a mixed-methods technique was used. Descriptive survey design was used. 111 tutors participated in the study using 1 hour 46 minutes on seven modules from 2009 to 2013 participating in Pedagogical Skills Improvement. The participants were chosen using stratified sampling

methods. The six distinct schools' teachers were grouped into five categories based on their level of pedagogical preparation. The data was gathered using checklists and a questionnaire. Frequency counts and percentages were used to analyse the quantitative data. However, classification and categorisation were used to analyse the qualitative data. Negassa *et al*. (2017) discovered that receiving pedagogical skills training has an impact on their ability to manage the classroom, design lessons, and engage students in active learning. The teachers discussed constructive and destructive influence of pedagogical training on their instruction, some challenges they faced, redundant concepts, modules that were not up to par, as well as lengthy training period and enormous class size, inadequate facilities, low motivation, and inability to completely apply what they had learnt.

Asare-Danso (2017) evaluated the tutors of Religious and Moral Education (RME) for the mastery of technology pedagogical content at the Institute of Education, University of Cape Coast in Ghana. 50 tutors from all 38 Colleges of Education participated in the survey. 45 items in a five-point Likert-type questionnaire were administered to the teachers of the Colleges of Education teachers sampled at a workshop organised by the Institute of Education, University of Cape Coast for the purposive sampling. The gathered information was examined using descriptive statistics. According to the study's conclusions, RME tutors at Ghanaian institutions of education displayed strong TPACK. The study that the tutors had solid pedagogical knowledge with regard to pedagogical competence. The instructors were competent at outlining both the development of basic ideas and other course objectives. However, some of the

teachers appeared to lack knowledge of the many modern pedagogies. The tutors were also discovered to have solid knowledge of their subjects.

Syahrul (2019) evaluated how students perceived the instructional skills of English lecturers. The study was carried out using a mixed-method technique. 600 students comprised the study's population, while 240 students comprised the sample. Data were collected through questionnaire and observation. While employing means and standard deviations to analyse quantitative data, the qualitative data were descriptively analysed. The findings demonstrated that students' perceptions of the pedagogical competency of English lecturers received a mean score of 40.02 and a percentage of 75%, was viewed as high. In simple terms, the instructors in the English program demonstrated good teaching abilities.

Sojanah, Suwatno, Kodri, and Machmud (2021) evaluated how Indonesian teachers' TPACK was impacted by their teaching background, motivation, facilities and infrastructure, training, and, self-efficacy. Quantitative approaches used descriptive and explanatory techniques. 217 Economics teachers were chosen by proportional random sampling comprised the sample of responders. Questionnaires were employed to obtain the data, which was then analysed using Structural Equation Modeling (SEM) and descriptive analysis. The findings demonstrated that various TPACK dimensions, including the teachers' CK, PK, and PCK, were high. Among the seven TPACK aspects, the instructors' PCK score was the highest. The teachers' TPACK appears to be poor overall. Additionally, it has been discovered that instructors' TPACK positively impacted

by their self-efficacy, teaching experience, motivation, training, facilities, and infrastructure.

Kola and Azeez (2023) also looked into how lecturers perceived their knowledge of technological pedagogical content knowledge in the colleges of education, Nigeria. Teachers' responses to the questionnaire were employed in this research to gather data. Descriptive statistics were used to analyse data on 29 Five-point Likert scale questions. Investigations indicated that instructors used a variety of instructional pedagogies and had the technology expertise necessary for their work. The results also indicated that the tutors had extensive understanding of CK, PK, and PCK. This was consistent with the study done by Zhu and Wang's (2020). Their findings revealed that teachers had improved on their teaching skills, knowledge of students, and the mastering of subject-matter knowledge and environment.

Influence of Academic and Professional Qualifications on the Lecturers' CK, PK and PCK

Indonesian biology teachers' TPACK was examined by Antony, Subali, Pradana, Hapsari, and Astuti (2019) in relation to their teacher training and classroom experience. It was Survey research. All of Indonesia's public secondary schools took part in this study. 14 Biology instructors from high schools in Magelag City comprised the study's sample. A two-way ANOVA was used for the data analysis. The results shows that instructor's credentials and experiences in teaching pooled a significant score of p 0.05. Teacher's credentials and teaching experience had a sizable impact on Biology teachers' TPACK in the end. The TPACK

elements, which represented competency in the form of requisite knowledge about the science subjects, made this possible.

Fritsch, Berger, Seifried, Bouley, Wuttke, Schnick-Vollmer, & Schmitz, (2015) assessed how prospective teachers' CK and PCK were affected by their university teacher training. A paper-and-pencil test was used to evaluate potential teachers' accounting backgrounds on their CK and PCK in Germany and Austria. 1,401 novice instructors from German and Austrian universities constitute the entire sample. Variations in prospective teachers' CK and PCK were anticipated given the structural differences in their teacher education. The mean of both novice teachers' CK and PCK was compared using an independent two-sample t-test. Multiple regression models developed to determine how opportunity to learn (OTL) affected prospective teachers' CK and PCK. According to Fritsch et al. (2015), compared to potential teachers in Germany, prospective teachers in Austrian universities had much higher CK and PCK scores. Additionally, it was difficult to tell the difference between German master's level future instructors with a business specialization and those having an additional teaching specialty. The CK score for the German and Austrian groups was also significantly impacted by university-based OTL in accounting.

On the other hand, Kimani, Kara, and Njagi (2013) reported that higher-level professional credentials did not always translate into improved teaching abilities. Additionally, Haron, Zalli, Othman, and Awang (2021) examined connection amid teachers' PK, learning environments, and teaching effectiveness in Malaysia. The deductive descriptive method was employed in this survey

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investigation. The information was gathered through a series of questions that delved into the demographics of the respondents, their teaching expertise, environments, and teaching effectiveness. Three participating schools' total of 144 teachers contributed to the responses. Partial Least Squares Structural Equation Modeling (PLS-SEM) were employed to process and analyse the data that had been gathered. The results showed a strong relationship between instructors' PK, good instruction, and educational establishments. Mohammed (2015) evaluated the elements influencing physics instructors' PCK. A survey study design was used to address two research issues. Using stratified random sampling methods, 20 teachers were chosen from the population. A five-point Likert scale was used to collect the responses to the research questions, and the responses to the survey were analysed using the simple statistical techniques of the standard deviation and mean. The findings indicated that teacher attitudes, the substance of textbooks and curricula, and teacher motivation all had an impact on the PCK of physics teachers.

Sutrisno, Wijaya, Haupt, Recard, and Husna (2023) studied the TPACK of lecturers, gender, years of experience, training, and platform that was most frequently during the emergency online teaching in Indonesian. A mixed-method approach and a survey methodology were employed for the investigation. The sample size comprised 555 educators who participated in the web-based questionnaire. A semi-structured interview for10 of the participants was conducted. The research revealed that the lecturers' technological aptitude was less than their PCK components. Additional research revealed that while gender

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and the most often used platform affected CK and PK, teaching experience only affected PK. There was no impact of prior platform training on TPACK.

Motsoeneng (2023) examined PCK of technical practical training such as TVET, entrepreneurship education, student' content and knowledge training. Meetings, class observations, discussion were used as the operationalisation of participatory action research to gather data. According to the survey, TVET instructors had a hard time making entrepreneurship instruction more useful. Finding the right approach to address students' misunderstandings and errors presents a challenge for instructors. During class visits, it was found that lecturers' conceptual grasp of the entrepreneurial curriculum was lacking, making it difficult for them to identify students' mistakes. Given inadequate teaching techniques and student knowledge, the majority of lecturers lack the skills necessary to develop effective teaching tactics. Findings revealed lecturers were to blame for the students' difficulty, mistakes, and misunderstandings since they were unable to identify the root causes of these issues. By re-explaining the steps involved in answering questions, which the students could not comprehend, lecturers often remove students' confusion, errors, and misconceptions.

Vereijken and Van der Rijst (2020) investigated the quantum of knowledge for teaching in the Netherlands, based on theory, practice and subject matter. The research was conducted using a thorough methodology. The case study approach used for the investigation involved four lecturers specifically chosen to take part in the study. Data were gathered via semi-structured interviews and observations. The data was analysed based on topics in accordance with four of the lecturers'

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personal account. Results revealed that in-depth subject matter knowledge greatly influenced the teaching of theory and practice. In addition, teaching subject matter was relevant to approach towards teaching. The results implied that subject-specific content, not the discipline, informs education. Participants also made reference to their prior knowledge of the subject. These encounters also appeared to influence how theory and practice were taught. While two participants explained how their research expertise influenced their teaching style, the other participants showed how their real-world experience (such as working with cases and guest speakers) had an impact. This conclusion implied that lecturers' in-depth knowledge of a subject greatly influenced their ability in teaching that subject satisfactorily (Barendsen & Henze, 2019).

Hakim (2015) examined the impacts of teacher competencies such as pedagogical, professional and social competence on the performance of learning. This study's methodology and the proportionate sampling method were related. The outcomes of data analysis utilising multiple regression revealed that social, professional, personal, and pedagogical competence all had a substantial impact on improving learning outcomes. The simultaneous and combined declaration of all teaching competencies as key contributors improved the level of performance during the learning process. Pedagogical instruction has been a key contributor to the development of learners. The effectiveness of learning was discovered to be significantly impacted by pedagogical knowledge, and PK is primarily concerned with the mastery of instructional contents and the skill to achieve learning and the obligation to do a satisfactory job.

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Additionally, Castro, Glewwe, Heredia-Mayo, and Montero (2021) discovered that teacher instruction programs enhance student learning and that increase learning especially in the classrooms of teachers whose pedagogical expertise had significantly improved. The result suggests that one mechanism connecting teacher coaching to student learning is the development of teachers' pedagogical skills. Similarly, Yeboah-Appiagyei, Osei, and Fentim (2014) found that educators with strong professional backgrounds and certifications have the required skills to facilitate successful learning and instruction.

Conceptual Framework

Conceptual framework gives coherent concepts organised to communicate the ideas of the variables in a study (Schwartz, 2006). The framework in Figure 5 appears to link academic and professional qualification to CK, PK and PCK. Academic qualification is perceived as first, second and terminal degrees whereas professional qualification by way of Teacher certificate is seen as PGDE, bachelor of education master of education and philosophy. However, Zuzovsky (2009) posited that professional (teacher) qualification means formal training, work experience, subject-matter expertise, pedagogy research, and teacher certification.

Teachers' level of education is one of the crucial factors that affects their CK, PK, and PCK (Hakielimu, 2011).
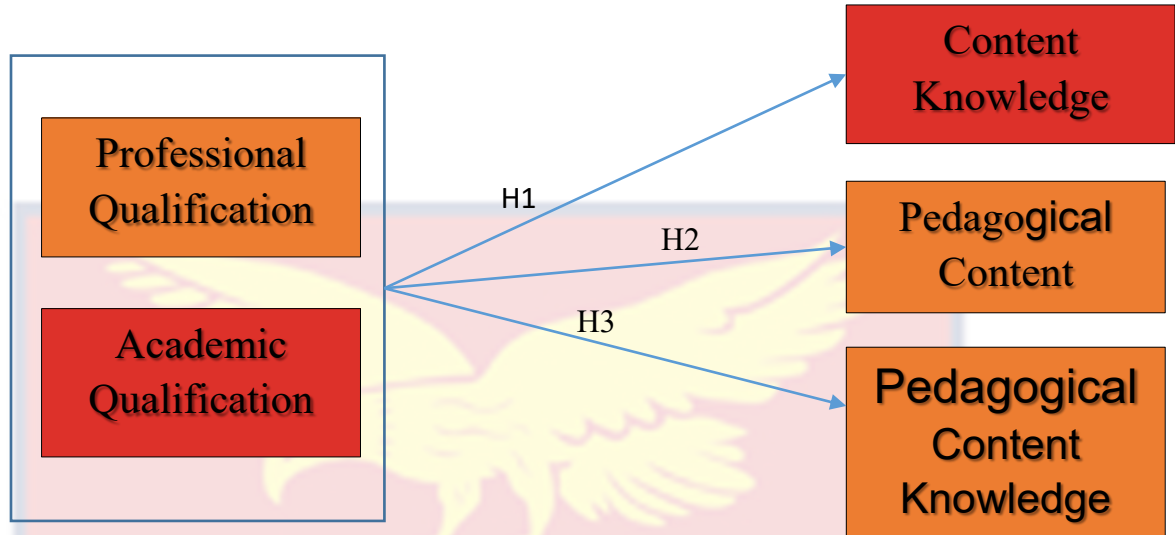
Figure 5: Influence of Academic and Professional Qualification on PCK

Source: (Author's Construct, 2022)

As depicted graphically in Figure 5, the question is does academic and professional qualification have an influence on PCK? Studies have indicated that teachers learn teaching skills through professional certification as well as subject-matter knowledge through academic training (Teacher Education). According to Goldhaber and Brewer (2000), higher degrees exhibit favorable connection with CK, PK, and PCK. Higher degrees mean, the academic credentials a teacher must have in order to practice as a teacher. These include a teacher certificate (certificate "A"), a postgraduate diploma in education, bachelor's degree, masters, or doctoral degree, and other credentials. A measure of a teacher's qualifications called certification takes into account both teaching and learning as well as subject-matter expertise. Master's, MPhil, or doctorate degree are required to be eligible to teach at a university because teaching requires expertise in managing students and classroom materials as well as in instructing others (Hamilton Ekeke, 2013).

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According to Pereira, (2022) most lecturers' inability to address issues outside of the traditional classroom setting can be attributed to the continued reliance on master's degrees for teaching in higher institutions. Even if someone possesses a master's degree certificate, they may not be qualified to teach because they may lack the necessary skills. Similarly, a teacher who spent a short time in training without finishing the required number of years does not have the qualifications to be a teacher (Darling-Hammond as referenced in Aina et al., 2015). Therefore, academic and professional qualifications significantly influence lecturers' CK, PK and PCK.

Summary of the Literature Review

The literature began with the theoretical framework of the study. Two theories underpin this study. Namely, Shulman's theory of Knowledge Growth and Gess-Newsome theoretical model of PCK which are essential to the study. Shulman (1986) filled the disparity between the knowledge that instructors ought to have and their abilities to make instruction accessible to learners. These according to Shulman these were not just excellent abilities to manage a classroom but also understanding teaching methods and ideas from students which are specifically related to the subject matter being presented.

According to Shulman (1987) PCK is "the most beneficial method for expressing and articulating what is being discussed and making it obvious to learners". The two theoretical models proposed by Gess-Newsome (1999) explained the source and growth of PCK; Namely, the Integrative and Transformative Model. The integrative model explained PCK as the link

between academic fields and knowledge of the context. In contrast, the transformative model described PCK as the outcome of a change of instructional expertise, CK, and understanding the context. These theories complement each other in terms of their orientation. They are carefully based on the goal of the study and undoubtedly, their relevance to the study cannot be underestimated.

Shulman (1986) asserted that propositional expertise, case expertise, and strategic understanding are the three types of knowledge that teachers must possess. It is believed that though much research has been carried out to measure teacher's PCK, Loughran (2006) opined that little has been done to assess its measurement and quality.

In order to support the study, other studies on PCK were reviewed. Also, a conceptual framework was designed based on the objectives of the study.
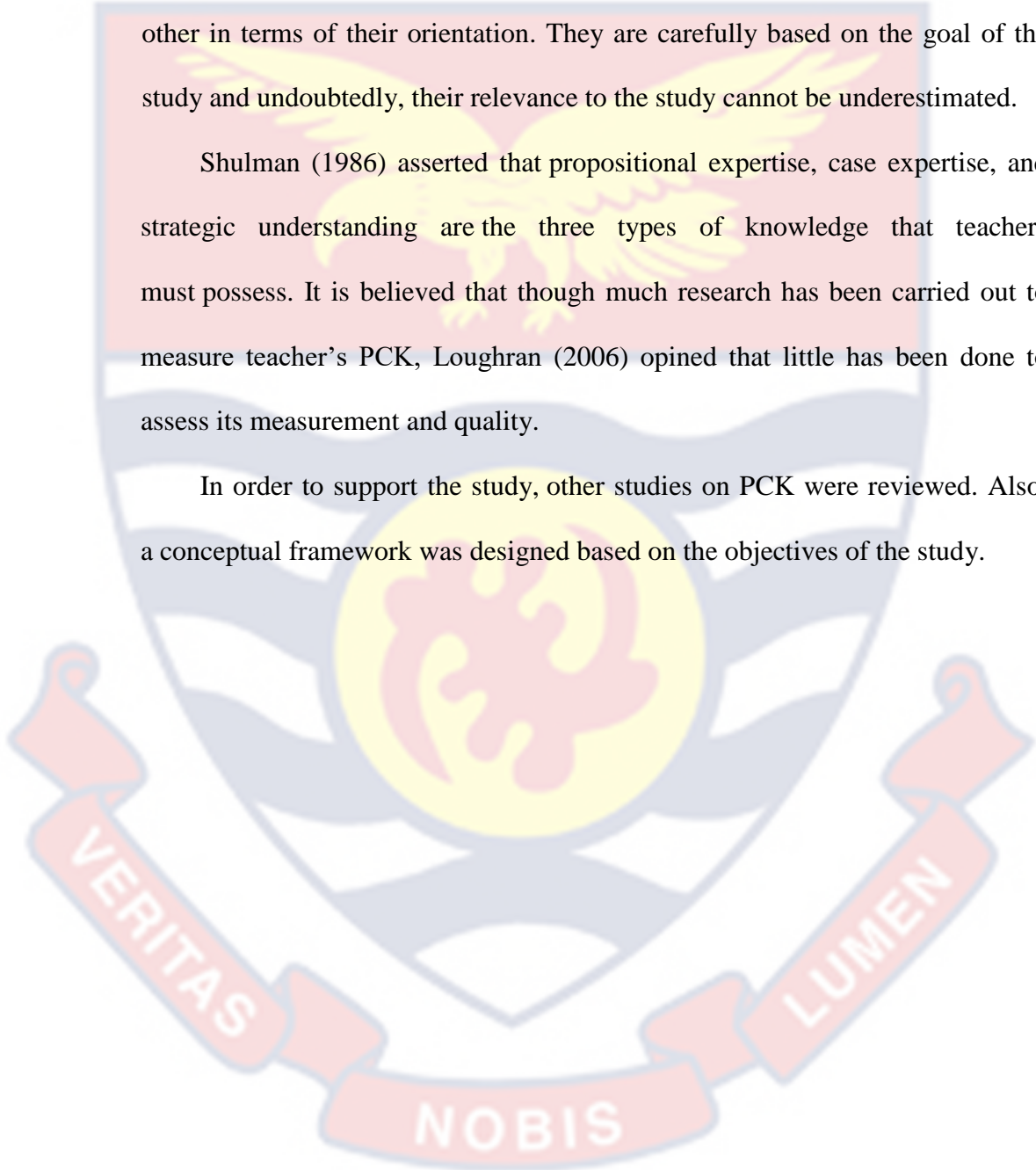
CHAPTER THREE

RESEARCH METHODS

Overview

The chapter describes the procedures by which data required for the study was collected and analysed. In addition, the following were discussed; research paradigm, research approach, research design, population, sample and sampling procedure, data collection instrument, validity and reliability of the instrument, ethical consideration, data collection procedure, data processing and analysis.

Research Paradigm

The focus of the study sought to assess the influence of academic and professional qualification on CK, PK and PCK of lecturers at CCTU. The suitable paradigm for the study is the positivist paradigm. According to the positivist paradigm, actual events may be examined theoretically and logically explained. French philosopher Auguste Comte (as cited in Omair, 2015) first proposed positive paradigm. The paradigm establishes a worldview based on scientific method of study. Tashakkori and Teddlie, (2009); Teddlie and Tashakkori, (2003) and Patton, (1990) are philosophers who believed that one requires a worldview that would offer research techniques that are deemed most appropriate for examining a certain phenomenon. Comte (as cited in Omair, 2015) advocated that understanding human behaviour should start with observation, experimentation, and reasons based on experience. It is therefore, an authentic method of enhancing the understanding of human. Positivist paradigm was chosen as the preferable worldview for this study because it defines observations in terms of facts and quantifiable entities (Fadhel,

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2002). This paradigm's research relies on deductive reasoning, hypothesis creation, testing, and providing operational definitions and expressions in order to draw conclusions. It sought to offer justifications and make projections based on quantifiable results. My approach involves, first seeing the phenomena through the analysis of quantitative data. Just as Helmes and Stokes (2013) indicated that knowledge can be gained through the interaction between individuals and their world. The researcher assumed that interacting with the lecturers is one way of unearthing the truth about some of the related-issues of PCK in the study.

Research Approach

A research approach is an action plan that gives bearing to carry out research resourcefully and systematically. The researcher used quantitative approach for the study so that the data can be quantified. Furthermore, the sample size of 118 is large and considered to be representative of the population of 170. The questionnaire would be useful to identify the academic and professional qualification of lecturers and their level of pedagogy, content and PCK as issues which may be associated with the conditions prevailing at Cape Coast Technical University.

Creswell (2009) outlined three types of research methods; qualitative, quantitative, and mixed. Pietersen and Maree (2007) described quantitative approach as a traditional, impartial, and organized method of gathering numerical data. This makes it possible for the researcher to explore for correlations between variables. Since the samples used in quantitative research are often large and regarded as representative of the community, the information can be quantified.

The findings are interpreted as representing a broad and adequately complete picture of the entire population (Martin & Bridgmon as cited in Queiros, Faria & Almeida, 2017). Queiros, *et al*. (2017) outlined how quantitative research strongly emphasis on impartiality and is especially suitable when it remains possible to draw conclusions about a population from samples of that group. It uses formal processes and standardised methods to acquire data.

The strength of quantitative research according Queiros, *et al.* are; i) easy to collect data and analysed, ii) can reach large audiences, iii) extremely representative without being influenced by the subjectivity of the researcher. Comparatively, the drawbacks of quantitative research are that i) it is difficult to construct, ii) very laborious, and expensive. iii) dependability of the data relies on the quality of the responses, iv) The structure is restrictive, and v) it fails to accurately reflect respondents' behaviours, and emotional changes.

Research Design

A cross-sectional survey was used as the research design for the study. Levin (2006) states that a cross-sectional survey is conducted at once or over a brief period of time. Usually, it is done to determine how common a result is for a given community. The goal of this study is to evaluate how professional and educational backgrounds influence the CK, PK, and PCK of lecturers at Cape Coast Technical University. The outcome under study is a 'state' for example, lecturers having relevant background or not having the requisite qualification). It is used to directly examine samples from a population to directly describe the features of that population. It also establishes the situation or problems as they stand (Kothari,

2004). Again, it helps in reporting issues as they prevail without necessarily explaining them. Cross-sectional surveys are frequently used to choose a sample, and the response rate determines how effectively results may be extrapolated to the entire population. It is common practice to use data from the entire population for a sizable cross-sectional study. It is likely that the sample would be quite representative if it is chosen at random. Nonresponse in large-scale surveys is one of the drawbacks of cross-sectional surveys. However, follow-ups, phone calls, and promptings are methods to reduce nonresponse. Prejudiced response is another disadvantage. An individual is more inclined to reply he/she possess a particular attribute. When a characteristic's is connected to the possibility of an outcome, bias will result and making causal inferences is challenging given additional restrictions. The perks of cross-sectional surveys are less expensive and require little time to execute, in addition they can estimate the prevalence of an outcome of interest because the sample is typically drawn from the entire population allowing for the assessment of a wide range of outcomes and risk variables (Levin, 2006).

Primarily, descriptive Surveys, questionnaires, and observation are used in cross-sectional research to gather data from one or more groups of people about their experiences, traits, attitudes and opinions (Cohen, Manion & Morrison, 2007; Leedy & Ormrod, 2005). The study endeavoured to assess the command of academic and professional qualification on pedagogical content knowledge of lecturers at CCTU. Also, the study endeavoured to ascertain peculiar characteristics of these lecturers.

Descriptive cross-sectional design is the most suited when researchers need to probe the variables that are influencing a phenomenon but do not have a firm grasp on them. The chosen design involves gathering data to address the issues about the lecturers' knowledge. Considering the research questions that are premised on the purpose of the study as well the type of the population being used, it was appropriate to utilise this design to assist the researcher in achieving the aim and to draw relevant conclusions from the study (Teddlie & Tashakkari, 2009; Alise & Teddlie, 2010). The researcher described the characteristics of the population by directly examining the samples of the population through the use of a questionnaire. Given that descriptive cross-sectional surveys are solely quantitative and cannot utilise interview and questionnaire schedules simultaneously, the researcher used a questionnaire exclusively for the study.

In assessing the PCK of lecturers, observation in addition to the questionnaire would have been appropriate nevertheless, owing to the sensitivity of the study coupled with the attitude of some lecturers, only questionnaire was used for the study. The reason was that reports from the Quality Assurance unit of the Cape Coast Technical University revealed that lecturers felt uncomfortable when observers from the quality section sat in their class to monitor their teaching. According to them, some lecturers drove them out of the lecture halls during such occasions.

Study Area

CCTU was founded in 1984 as a second cycle institution and was originally known as Cape Coast Polytechnic. It is situated in Cape Coast South. It was in

operation in 1986 under the intermediary program that resulted in the issuance of non-tertiary credentials. The Polytechnic was elevated to a tertiary level in 1992 following the passage of the Polytechnic Law (PNDCL 321) to run programs in various disciplines leading to the award of Higher National Diploma (HND) in Business, Engineering, Applied Sciences, and Arts by the National Council for Tertiary Education (NCTE), now known as the Ghana Tertiary Education Commission (GTEC). The Technical Universities ACT, 2016 (Act 922), was revised in 2018 ACT (ACT 974), mandates Technical Universities to provide higher education in Vocational Training, Applied Arts, Engineering, Applied Science, and Technology, and other related disciplines. (CCTU Congregation Brochure, 2021).

Population

All the academic staff at CCTU constituted the target for study (N=170). It comprises 135 males and 35 females from four Faculties. Specifically, Engineering, Applied Sciences and Technology, Business and Management Studies, Applied Arts. The rank of these lecturers ranges from assistant lecturer to professor. Table 1 presents the population distribution.

Table 1: Population Distribution of Schools in Cape Coast Technical University

Schools	Department	Male	%	Female	%	Total	%
Business & Management Studies	Accounting & Finance	9	5	1	1	10	6
	Marketing Studies	12	7	1	1	13	8
	Secretaryship & Management Studies	6	4	3	2	9	5
	Procurement & Supply Chain Management	5	3	1	1	6	4
Applied Sciences & Technology	Hotel, Catering & Hospitality Management	4	2	8	5	12	7
	Mathematics & Statistics	14	8	0	0	14	8
	Food Sciences & Postharvest Technology	3	2	2	1	5	3
Applied Arts	Tourism Management	7	4	1	1	8	5
	Fashion Design and Textile Studies	3	2	8	5	11	6
	Liberal Studies	7	4	3	2	0	6
	Electrical/Electronic Engineering	11	6	2	1	13	8
	Civil Engineering	15	9	1		16	9
	Building Technology Engineering	20	12	0	0	20	12
	Mechanical Engineering	15	9	3	2	18	11
	Renewable Energy Technology	4	2	1	1	5	3

Table 1 continued

	135	79	35	22	170	100
Total	135	79	35	22	170	100

Source: Directorate of Quality Assurance and Academic Planning, CCTU (2021).

Sample and Sampling Procedures

To increase external validity, guarantee accurate study representation, and minimize any other outcomes at the conclusion of data collection, a sample size of 140 was employed in the study. Rouder and Haaf (2018) suggests that to achieve 80% to 85% power of sample size, a 10% to 20% increase of respondents is advised to ensure generalisation of the study. Krejcie and Morgan's (1970) approach to determining the sample size indicates that, given a population size of 170, 118 samples size, representing 69% of the population, would be a suitable sample size for the study. However, 140 samples, representing 84% of the population, were employed.

Based on Krejcie and Morgan's table for calculating sample size for a given population, a proportionate random sampling was used to select the lecturers from each school (see Appendix C). The proportionality principle was applied to choose the sample from each of the schools after using Krejcie and Morgan's table to establish the sample size. Given a sample size of 140 lecturers, the School of Business, with a number of 38 lecturers, 31 lecturers would be proportionately selected; The School of Applied Sciences and Technology, with a population of 31 instructors, 25; would be selected; the school of applied arts, which has 29 lecturers, proportionately selected 24; and the school of engineering, which has 72 instructors, had 60 respondents. This is shown in Table 2.

Table 2: Distribution of Sample Size

Schools	Male (n)	Sample Size	Female (n)	Sample Size	Total Sample Size
School of Business and Management Studies	32	26	6	5	31
School of Applied Sciences and Technology	21	17	10	8	25
School of Applied Arts	17	14	12	10	24
School of Engineering	65	54	7	6	60
Total	135	111	35	29	140

Source: Field data, 2022

To identify each strata (Schools), the proportional stratified method was utilised. The Directorate of Academic Planning and Quality Assurance, CCTU, provided a list of all full-time and part-time lecturers. The researcher made sure the study's count of males and females was accurate after determining the number of lecturers that would be needed. The names of the instructors were written on manila card that had been sliced into thin strips. Following a thorough shaking, the manila cards were placed in a fishbowl and each card that was picked had its name recorded on paper. This was carried out for each faculty until the number for each faculty was reached.

Data Collection Instrument

The researcher used questionnaires as data collection tool. The questionnaire was an assessment test to ascertain the lecturers' knowledge level of PK, of CK and PCK. According Kerlinger (1973), questionnaire was frequently employed in

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the educational research to gather large quantities of data, elicit factual data regarding conditions, practices, opinions and attitudes. Therefore, questionnaire was utilised because of its suitability of the study.

Structured survey was simple to administer, disseminate, wider coverage at less cost, it ensured standardisation and relatively inexpensive to analyse (Gravetter & Forzano, 2006; Kothari, 2004). Undoubtedly, the structured questionnaire comes with its own limitations. For instance, the use of the structured questionnaire was likely to limit participants in their responses. However, in order not to limit knowledge and respondents to what literature only says, opportunity was also given to respondents to offer other suggestions as it may relate to the information required. It took me more than 5 weeks to collect the data. The researcher did several calls and follow-ups to get a sufficient response rate. The researcher was initially able to retrieve 109 data which was inadequate for the sample size of 118. Consequently, the researcher identified the lecturers whose data were not received and went back to the field to collect ten additional responses totaling 119. These delayed the computation of the data and increased the cost of the study.

Questionnaires enable the researcher to have uniformity in the manner in which questions are posed and how respondents also provided responses in a careful manner (Creswell & Creswell, 2018). Furthermore, it was crucial to secure respondents' privacy especially while collecting sensitive data such as respondents' knowledge level. Questionnaires are therefore deemed very helpful in protecting respondents' privacy because their responses could be confidential.

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Observation in addition to the questionnaire would have been very appropriate for this study but looking at the sensitivity of the study coupled with the attitudes of some lecturers, the researcher decided to use questionnaires only. The reason being that reports from the Quality Assurance unit of the CCTU revealed that lecturers felt uncomfortable when observers from the quality section sat in their class to monitor their teaching. According to them, some lecturers drove them out of the lecture halls during such occasions.

Open-ended and Close-ended items comprised the content of the questionnaire for respondents. The closed-ended questionnaire was informed by Kothari (2004). Kothari indicated that a highly structured questionnaire is one in which almost all answers are limited to alternatives whereas open-ended questions that require respondent's comments in their own words are held to the minimum. Despite the fact that some factors under investigation required respondents to provide statements of knowledge and viewpoints, Owusu (2011) indicated that respondents do not feel comfortable answering open-ended questions. The reasons may be related to having to write in their own words. As a result, 95% of respondents are likely to leave open ended questions unanswered. The researcher therefore, used Owusu's, idea to design very few open ended questions.

The survey was divided into five sections A to E, which reflected the areas covered by the research goals. The purpose of the study was stated in the questionnaire's introductory sentence, and respondents were promised that their answers would be kept anonymous. True/False and Yes/No scales were used in

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Sections A through C. Borg and Gall (as cited in Owusu, 2011) indicated that True/False and/or Yes/No, as a method of measuring level of knowledge is the most acceptable, straightforward, and accurate way to assess one's degree of knowledge. The assessments were marked, scored, and graded in percentages. In all, there were 37 questions under 5 sections, 'A' to 'E'. Section 'A' comprised14 items that required information about respondent's general pedagogical knowledge. The Section 'B' was made up of 5 items that intend to solicit information about respondent's content knowledge. The Section 'C' had seven items that sought information about respondent's pedagogical content knowledge. The Section 'D' was made up of six items that sought information about respondent's academic and professional qualification and the courses the respondents teach. Section E elicited responses about the background information of the respondents.

Instrument Validity and Reliability

The instrument used for the study was carefully reviewed by my supervisor and other professionals in the field of education to ensure that it met content validity before final approval was given. The researcher incorporated the necessary adjustments to the questionnaire based on expert advice. In order to guarantee the instrument's dependability, a pilot test was conducted at Takoradi Technical University. Takoradi Technical University was chosen because the lecturers share similar characteristics with lecturers at Cape Coast Technical University in terms of demographic information, professional qualifications, and areas of expertise. For the purpose of this study, forty lecturers

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were chosen at random. By measuring the questionnaire's internal consistency using Cronbach's alpha, reliability was established. De Vellis (as stated in Owusu, 2011) regarded the reliability coefficient of 0.8 that was attained as being extremely reliable for judging the suitability of the instrument. The confidentiality of the responses provided by respondents was guaranteed. Due to the importance of pilot testing to the outcome of the study, the goal of these measurements was to ensure an objective assessment of the responses. The minimal time frame given to the respondents for the completion and collection of the questionnaire was two to four weeks. The purpose for the pilot test was to revise the questionnaire to be precise and successful in eliciting the necessary responses. The pilot testing would enable the researcher identify potential issues that were expected to arise during the course of the study, and create an accurate pattern for coding the responses. A critical change that was made on the questionnaire (pilot test) was changing from assessing the perceptions of lecturer's knowledge of pedagogy, content and PCK to testing their PK, CK and PCK instead. The reason being that perceptions may be right or wrong. Also, few grammatical errors were noted and corrected.

Data Collection Procedures

The questionnaires were personally administered by the researcher to guarantee a high return rate of responses. Prior to the physical administration of the questionnaire, an application letter, a consent letter from the researcher's supervisor, and an introductory letter were obtained from the head of the Department of Business and Social Sciences Education (DoBSSE) University of

Cape Coast and submitted to the Institutional Review Board (IRB), UCC), to obtain approval for the administration of the questionnaire. When permission was granted by IRB, the researcher submitted the letter to the Deans of Schools and Heads of Department of the various schools at CCTU. The objectives of the letter was to get approval to solicit for the cooperation of the respondents. After that, the researcher moved from office to office to administer the questionnaire to the sampled lecturers.

The noted problems encountered during the administration of the questionnaires were issues with responding to the open-ended questions. Some respondents were reluctant to list their first and second semester courses because they felt it would give a clue to their identity. The researcher explained to them that because the study was not geared toward a specific department, the individual identity would not be revealed moreover, the completed questionnaire will not be given to any individual. Others complained that the questionnaire was education biased so they had difficulty in responding to especially the pedagogical questions. The administration of the questionnaire began from September 11, 2022 and ended on October 16, 2022. The collection of the questionnaire lasted for more than 5 weeks. At the end of the collection of the data, 109 questionnaires were retrieved, representing 77%. In order to achieve a good representation of the population in order to generalise the findings as suggested by Krejcie and Morgan (1970) and Rouder and Haaf (2018), the researcher called on lecturers who could not return their questionnaires and was able to retrieve 10 additional data totaling 119, returned rate representing 85%.

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Ethical Consideration

Ethical clearance was received from the Institutional Review Board (IRB) at the University of Cape Coast (UCC) before the questionnaires were administered. The permission letter received from the IRB was submitted to the Deans of School and Heads of Department of CCTU to solicit for responses from the lecturers. A research ought to be unbiased, backed by science, and to be honest, and accurately reported (Gray, 2013). The objectives and intended outcome were made clear to the respondents. They were urged to express their opinions freely and as honestly as possible. They also had the choice to revoke their consent at any time and without incurring any sort of penalty. The responders to the study were protected from harm and under strict assurances of secrecy and anonymity. All of these ethical guidelines were followed by this research's approach. Prior to the data collection, an organisational entry protocol was observed. The purpose of the entire study and the enormous advantages its successful completion would bring to the University and the nation as a whole were explained to the respondents. The lecturers received no monetary guarantee.

Data Processing and Analysis

The information was assembled and adjusted to ensure accuracy. SPSS was then used to analyse the responses. Computation was done using mean distributions, frequencies, percentages and standard deviations. Results were obtained by analysing the responses using descriptive and inferential statistics. Data collected on the background of the teachers were presented in the form of tabulation, that is, through frequency counts and then expressed as percentages to enable comparisons

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to be made. Frequency counts and percentages were used to analyse the information collected on Research Question One. However, the information acquired for research questions two, three and four were analysed using means and standard deviations. Finally, Factorial ANOVA was employed to analyse the data in respect of the research hypotheses. The hypothesis was tested at a 0.05 level of significance. Table 3 shows the summary of data analysis techniques:

Table 3: Summary of Data Analysis Techniques

Research Questions/Hypotheses	Data Analysis Techniques
What are the academic and professional qualifications of lecturers at Cape Coast Technical University?	Frequency counts and percentages
What is the level of pedagogical knowledge of lecturers at Cape Coast Technical Universities?	Means and standard deviations
What is the level of content knowledge of teachers at Cape Coast Technical University?	Means and standard deviations
What is the knowledge level of PCK of lecturers at Cape Coast Technical University?	Means and standard deviations
There is no statistically significant influence of academic and professional qualifications on lecturers' CK.	Factorial ANOVA
There is no statistically significant influence of academic and professional qualifications on lecturers' PK.	Factorial ANOVA
There is no statistically significant influence of academic and professional qualifications on lecturers' PCK.	Factorial ANOVA

Summary of Research Methods

Quantitative methods were used for collecting and analysis data. The study employed a cross-sectional survey. A structured questionnaire was used to collect data. Using a simple selection at random, 140 respondents were selected from the four Schools. Standard deviations, percentages, means, and frequency counts were employed on Research Questions One through Four.

Finally, the research hypotheses were processed with the help of factorial ANOVA. The researcher ensured that the respondents were morally and ethically protected by abiding by the principles of beneficence, human dignity, and fairness.
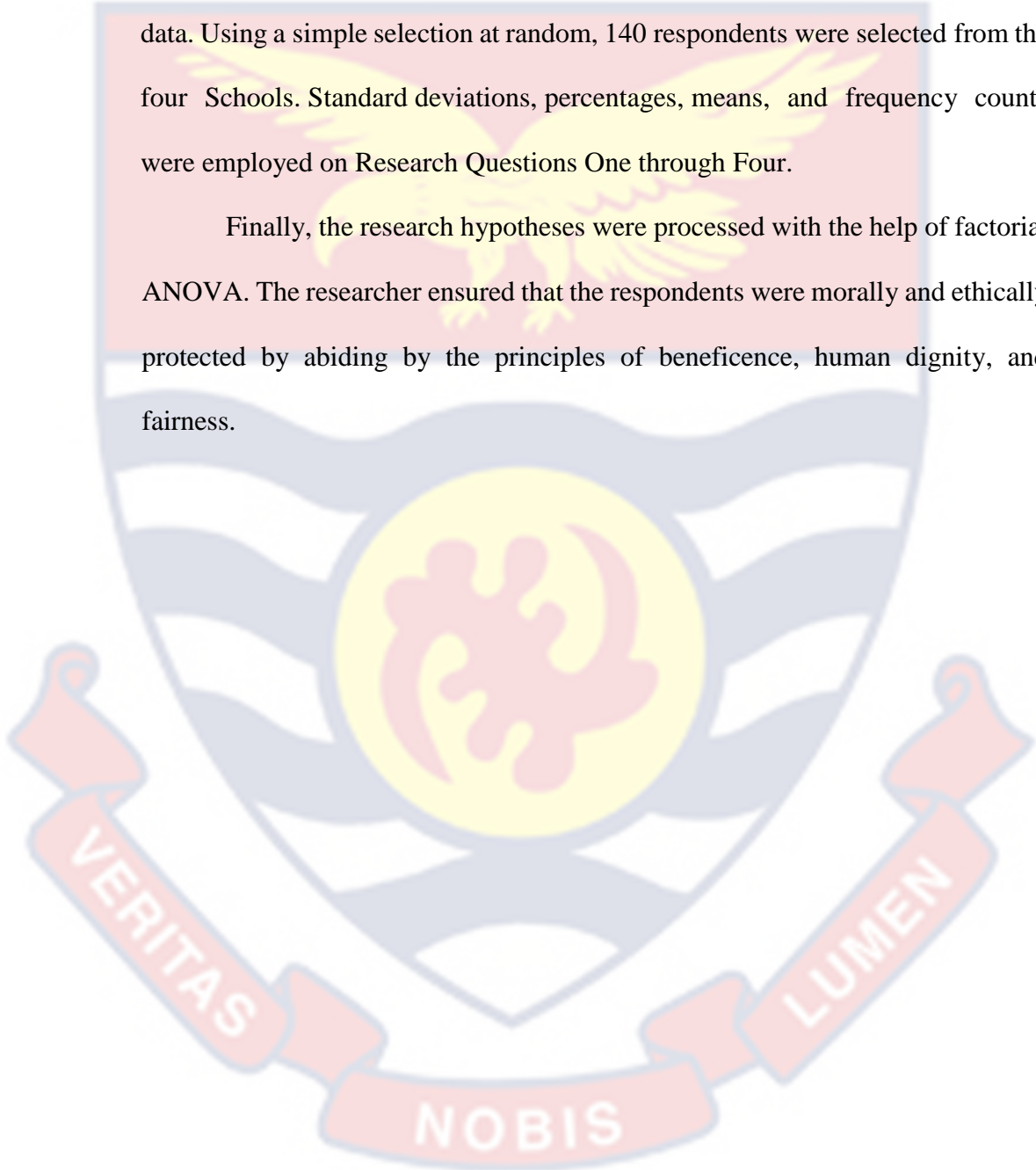
CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This chapter presents the results and discussions on the data gathered to assess the sway of professional and academic qualification on CK, PK and PCK of lecturers teaching at the Cape Coast Technical University (CCTU). Quantitative data were collected to address four research questions and two hypotheses. Valid data were gathered from 119 respondents from various schools at CCTU. There were no missing data, hence the presentation of the findings and their discussion were centered on the valid responses that were obtained. The respondents' demographic characteristics have been explained followed by the presentation and discussion of results to answer the research questions and hypotheses.

Demographic Characteristics of Respondents

The respondents' peculiarities were collected because they provided information on the calibre of lecturers who are teaching at CCTU. The peculiarities of the population that were gathered on the respondents were their gender, years of teaching experience and educational level. Frequency counts and percentages were employed to evaluate the raw information collected. The findings have been outlined in Table 4 as follows:

Table 4: Demographic Characteristics of Respondents

Variable	Sub-scale	Freq.	%
Lecturers' Gender	Males	91	76.5
	Females	28	23.5
Years of teaching experience	Less than a year	1	0.8
	1-5 years	38	31.9
	6-10 years	31	26.1
	11-15 years	17	14.3
	16 years and above	32	26.9
Level of Education	HND	2	1.7
	Bachelor's degree	3	2.5
	Master's degree	79	66.4
	Doctorate	35	29.4

Source: Field Data (2022)

The results in Table 4 indicate that the male respondents were more (n = 91, 76.5%). The female lecturers were 53% less than the male lecturers. The female respondents thus constituted a little below one-fourth of the total respondents. The data gathered from the field indicated that in all four schools at CCTU, males constituted the majority of the lecturers. The respondents were all homogenous, hence the study's sample size was proportionately distributed across the four schools at CCTU. Therefore, the male respondents dominating the study was not by coincidence or due to sampling errors.

The respondents' years of teaching experience were essential to this study because it informs the in-depth information that was gathered regarding the lecturers' pedagogical content knowledge. The findings in Table 4 indicate 31.9%

of respondents had been teaching between 1 to 5 years in the university (n = 38, 31.9%). Followed by 26.9% of the respondents had teaching experience of 6 to 10 years. Only one respondent was found to have had less than a year of teaching experience at CCTU.

Concerning respondents educational background, the findings indicate that majority of the lecturers had attained second degree (n = 79, 66.4%). This was followed by lecturers who had doctorate degrees (n = 35, 29.4%). The results further showed that three (3) respondents had attained a bachelor's degree whilst only one (1) respondent held a Higher National Diploma (HND) certificate.

It is evident that respondents who have bachelor's degrees and HND did not qualify to teach at a Technical University. As opined by Du Plessis Gillies (2014), it is out of place to hire nonqualified teachers to teach because nonqualified teachers have been found to have inadequate content and expertise to teach. This is a significant factor in the decline of high-quality instruction.

Results and Discussion

The findings of the data analysis conducted are presented to answer the research questions. The findings were further followed by using extant literature to support the discussions. Based on the study objectives and driving hypotheses, the key results were presented and discussed.

Research Question One

What are the academic and professional qualifications of lecturers at CCTU.

This research question seeks to authenticate academic and professional qualifications of lecturers at Cape Coast Technical University. The survey participants were asked to list their highest academic and professional teaching qualifications. The data that were gathered on the respondents' highest academic and professional teaching qualifications have been presented in Figures 6 and 7 respectively.

Lecturers' Highest Academic Qualifications
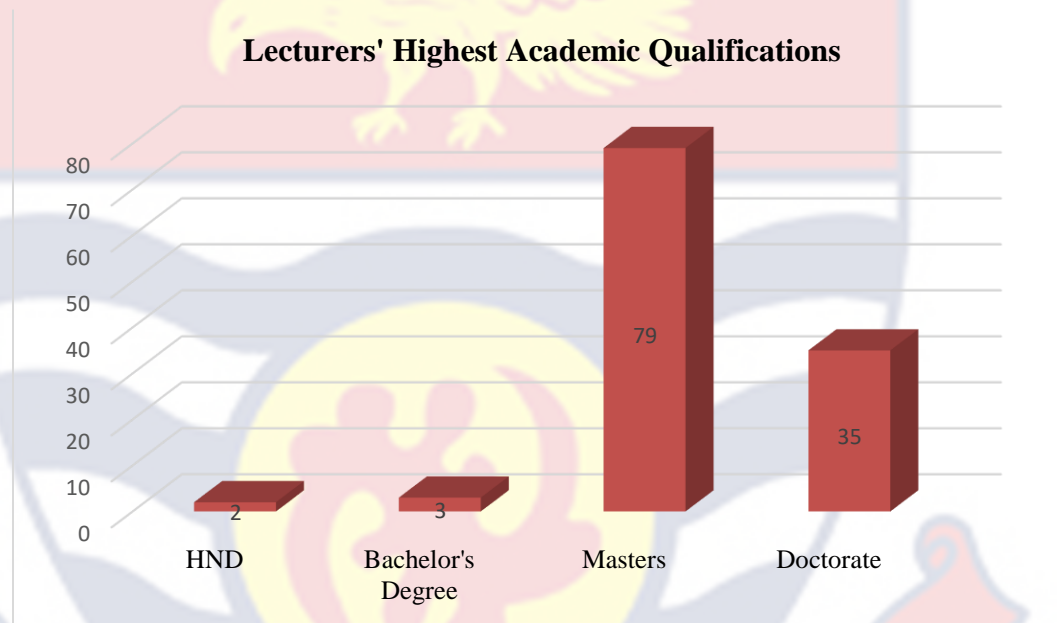
Figure 6: Lecturers' Highest Academic Qualifications

As shown in Figure 6, the highest academic qualification that has been obtained by 66.4% of the respondents was the second degree. Following, 29.4% of the respondents whose highest academic qualification was the Doctor of Philosophy degree. In all, 2.5%, 66.4% and 29.4% of the respondents possessed first, second and terminal degrees, respectively. Notwithstanding that, just two respondents representing 1.7% of the respondents held an HND certificate as the highest academic qualification. Even though the respondents had attained these

various types of academic qualifications, not all of them possessed the requisite teaching qualifications. Figure 7 indicates the categories of respondents who were professional and non-professional teachers at CCTU.

Professional and Non -Professional Teachers at CCTU

Non-professional teachers, 44, 37%

Professional teachers, 75 63%
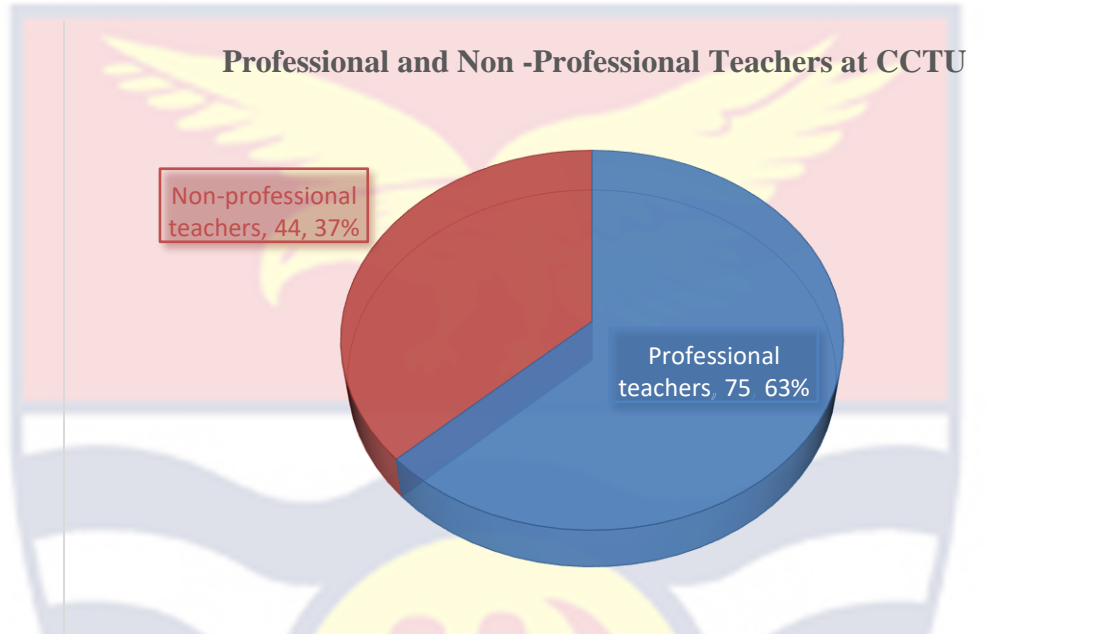
Figure 7: Professional and Non-Professional Teachers at CCTU

Figure 7 shows that the bulk of the survey participants were professionally trained teachers (n = 75, 63.0%). On the other hand, nonprofessional teachers comprised lecturers 44, representing 37.0% of the total respondents. Out of the 37% non-professional teachers, a few of the respondents indicated that they had not attained any professional teaching qualification(s) (n = 16, 13.5%). However, some respondents indicated that they possessed Master of Arts, Science, Business Administration, Master of Commerce, and Technology certificates as professional teaching qualifications (n = 28, 23.5%). The aforementioned qualifications are non-research disciplines, and the lecturers who held these qualifications obviously had

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not gone through any teacher training programmes that qualified them for professional teachers.

Obviously, the lecturers possess content knowledge from their various subject areas. However, there is the likelihood that instructional strategies and methods of delivering the content might be difficult for them. This is because such lecturers had not acquired any teacher training qualification which could have enhanced their pedagogical skills. This makes them non-professional teachers; however, they were still being assigned courses to teach at Cape Coast Technical University. It then raises concerns regarding the kind of graduates that are being churned out by the university. The non-professional teachers include those nine respondents who explicitly noted that they did not have any professional teaching qualifications but would like to obtain a professional teaching qualification in the future to enhance their teaching skills.

Discussions

The study has revealed that the highest academic qualifications attained by most lecturers at CCTU were master's and doctorate degrees. Also, the study revealed that most of the lecturers at CCTU were professional teachers since they possessed the requisite teaching qualifications. As teachers are exposed to the teacher training programmes, it opens them up to a variety of teaching methods, and they can state explicit lesson objectives that guide them in their teaching. These teachers become professionals who have built confidence in teaching and can capitalise on their teaching skills to address students' challenges in the classroom. The teacher preparatory programmes also introduce prospective teachers to best

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practices regarding the assessment of students in the schools. However, the same thing cannot be said about 37% of the non-professional teachers who were identified at CCTU, due to their non-teaching background. Teaching is a skill and not everybody possesses that special skill to deliver on the subject matter to students.

Similar findings were revealed in the staff audit reported which showed that some lecturers held Ph.D degrees obtained by online which is against GTEC requirements for teaching (Duodu, 2019). This study showed that majority of the lecturers had attained such terminal degrees; however, the current study could not verify the lecturers' certificates and the institutions that awarded the degrees.

The staff audit report exposed anomalies regarding the TU lecturers' qualifications (Duodu, 2019). Additionally, the report revealed that majority of lecturers were inexperienced teachers, and some even held doctoral degrees in philosophy that they obtained online, in violation of GTEC rules. Contrary to the above, the current study revealed that most lecturers at CCTU possessed the requisite teaching qualifications, and only 37% of the lecturers are non-professional teachers.

Moreover, the study found that approximately, 24% of the lecturers at CCTU had attained master' and doctorate degrees, some of which are non-research disciplines. Similar findings were revealed through the NCTE's staff audit report that some lecturers have either Doctor of Business Administration from the

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Universidad Empresarial de Costa Rica or doctorate in Finance from the Swiss Management Centre University and the University of Central Nicaragua. The report identified the above qualifications as non-research doctorates which are not acceptable for teaching (Duodu, 2019).

Teaching in a higher institution is quite challenging because the patrons (students) are trained in various professions. Education equips the lecturer to effectively help learners to acquire the desired knowledge and skills for the industry. Academic knowledge of specific disciplines alone without pedagogical knowledge may not yield the best results for achieving educational objectives. It is thus essential that educators at the various grades of education who appreciate philosophy, psychology and statistics of education, apply this in their teaching profession and easily relate well with different learners. The same was reiterated by Negassa and Engdasew (2017) in their study indicating that the use of lesson plan, active learning, continuous assessment, and classroom management were all influenced by pedagogical skills training. A sharp contrast by Kimani, Kara and Njagi (2013) indicated that additional professional qualifications outside the teacher training school did not always lead to increased teaching competencies.

Professional teaching certifications come in a variety of packages that instruct lecturers on how to perform in the classroom. This aids in providing instructors with all necessary resources to effectively communicate knowledge to learners. Again, teacher professional development programs equip lecturers with the knowledge and skills necessary to effectively apply teaching and learning approaches to students with diverse learning styles. The teachers' failure to use this

talent impedes effective learning. For instance, Motsoeneng (2023) discovered in his research that most lecturers lack the ability to construct efficient teaching techniques because they have insufficient knowledge of the subject matter, teaching methods and student backgrounds.

Additionally, the teaching and learning processes depend heavily on communication skills. Also, maintaining students' interest in the lessons is greatly aided by the teacher's ability to communicate with them effectively. As a result, if there are still lecturers at higher education institutions without the necessary teaching credentials, the caliber of graduates produced by Technical Universities cannot be upheld.

The discussions up to this point have been supported by Haron et al. (2021), whose study results demonstrate a significant relationship between teachers' pedagogical knowledge, educational facilities, and the quality of teaching. In addition, other authors (Castro et al., 2021; Hakim, 2015; Yeboah-Appiagyei et al., 2014) have revealed that instructors who possess sound professional training and qualification are well-equipped with the prerequisite competencies that enable them to promote effective teaching and learning.

Research Question Two

What is the level of Pedagogical Knowledge of lecturers at CCTU?

This question aimed to evaluate the level of instructional expertise among instructors at CCTU. Items on question two were given to the respondents to test their level of pedagogical knowledge. The pedagogy-related items were primarily concerned with a broad range of approaches and tactics that the teacher needed to

utilise to carry out the teaching activity. Most importantly, the lecturers' familiarity with the proper selection of teaching/learning tools, assessment, and classroom management techniques. A dichotomous scale was used to develop the items that is "Yes/No" and "True/False". Frequency counts and percentages were used to analyse the data. The results have been presented in Table 5 as follows:

Table 5: Responses to the Lecturers' General Pedagogical Knowledge

General Pedagogical Knowledge	True		False	
	n	%	n	%
Teachers are required to explain to pupils the standards that will be used for assessment (whether a class test, assignment, or class discussion) before conducting an examination.	115	96.6	4	3.4
During teaching, the responsibility is not on the teacher to ensure that students show interest in the subject.	9	7.6	110	92.4
In order to foster a healthy learning environment, teachers must provide clear peer support systems and encourage respect among their students.	117	98.3	2	1.7
The skills teachers need to teach are not a dimension of pedagogical knowledge.	19	16.0	100	84.0
A teacher should be able to facilitate the subject matter knowledge to promote learning.	119	100	0	0.0
A teacher who wants to develop the communication skills of students can use the discussion method.	115	96.6	4	3.4

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Table 5 Continued

The use of a variety of instructional materials for teaching improves a teacher's content knowledge.	113	95.0	6	5.0
A teacher must evaluate his or her students using a range of assessment techniques.	119	100	0	0.0
When students are confused, a teacher must provide further clarification.	117	98.3	2	1.7
Optimizing instructional time during teaching is a dimension of pedagogical content knowledge (PCK).	109	91.6	10	8.4
Identifying causes of success or gaps in student learning is not the responsibility of the teacher.	12	10.1	107	89.9
The general agreement of any sound scheme of assessment should satisfy the following criteria: validity, reliability, practicability and cost effectiveness, fairness and usefulness.	115	96.+6	4	3.4
In designing course outlines, objectives are to be written in terms of learning product rather than the learning process.	98	82.4	21	17.6
Objectives are listed to cover learning outcomes rather than subject matter when designing course outlines.	103	86.6	16	13.4

Source: Field Data (2022)

Table 5 indicates that all respondents (n = 119, 100%) accurately determined that a teacher ought to be competent to provide subject matter knowledge to foster learning. Despite this, some respondents (n = 2, 1.7%) were

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unaware that instructors were required to foster a positive learning atmosphere, communicate peer support systems, and encourage respect among students. Additionally, some respondents (n = 2, 1.7%) were unaware that a teacher is required to offer additional explanations when students are confused. How lesson objectives are stated is crucial as it guides the teacher to evaluate his/her lessons. It is noteworthy that 21 respondents answered incorrectly to the item "*In designing course outline, objectives are to be written in terms of learning product rather than learning process*", and this constitutes 17.6% of the total study's respondents. In the same vein, 16 (13.4%) respondents thought that objectives are listed to cover subject matter rather than learning outcomes when designing course outlines.

Moreover, all respondents knew that a teacher must use a variety of assessment strategies to assess his/her students (n = 119, 100%). However, out of the total respondents, 96.6% of them were aware that in conducting an examination, teachers must explain to students the criteria that would be used for assessment (whether a class test, assignment or class discussion). Also, a similar number of respondents correctly answered that the general agreement of any sound scheme of assessment should satisfy the following criteria: validity, reliability, practicability and cost-effectiveness, fairness and usefulness (n = 115, 96.6%).

Fourteen (14) test items were constructed to measure the lecturers' knowledge of PK. The lecturers' responses to these test items were marked and graded out of 100%. For purposes of analysis, the following grading guidelines were used to interpret the lecturers' pedagogical knowledge scores: 0-49 = low knowledge; 50-59 = average knowledge; 60-69 = above average knowledge; 70-79 = good

knowledge and 80-100 = very good knowledge. The results have been presented in Figure 8 and Table 6 as follows:
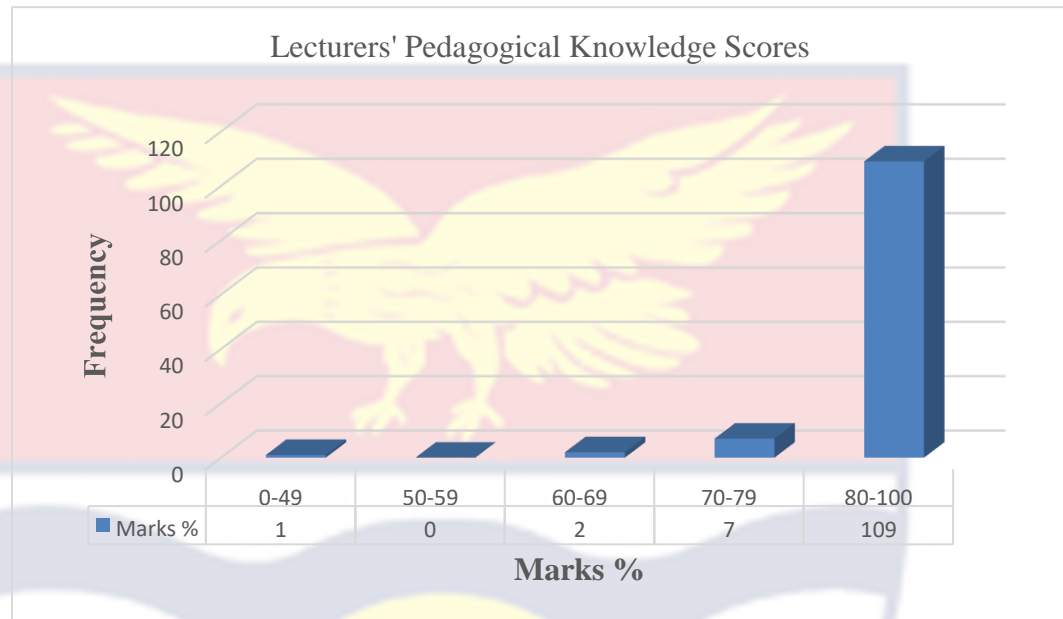
Figure 8: Lecturer's Pedagogical Knowledge Scores

As depicted in Figure 8 above, most of the obtained scores on pedagogical knowledge were from 80-100% (n = 119, 91.6%). In other words, 91.6% of the respondents had a very good knowledge of pedagogy. This was followed by respondents whose obtained scores were from 70-79% (n = 7, 5.9%). This indicates that 5.9% of the total respondents had good pedagogical knowledge. Moreover, the respondents whose scores fell within the range of 60-69% were just two, representing 1.7% of the total number of scores. This means only two of the lectures had an above average knowledge of pedagogy. Notwithstanding, only one of the obtained scores was within the range of 0-49%. This implies that out of a total of 119 respondents, only one of them had low knowledge of pedagogy. To examine further the lecturers' overall pedagogical knowledge level at Cape Coast Technical

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University, an average score was computed. The results have been displayed in Table 6.

Table 6: Lecturers' Knowledge Level of Pedagogy at CCTU

	N	Minimum	Maximum	Mean	SD
Pedagogical Knowledge Scores	119	43.00	100.00	93.29	8.87

Source: Field data (2022)

Mean interpretation: below 50%=Low knowledge level; 50%=Average knowledge level; and above 50% = High knowledge level

As shown in Table 6, the highest obtained score on pedagogical knowledge was 100% and the findings showed that 55 of all responders obtained such a maximum score. Conversely, the least score was 43% and analysis of the results showed that just one respondent obtained this lowest mark. As mentioned earlier, it was such a respondent who got a low knowledge level of pedagogy at CCTU. Table 6 indicate that generally the survey participants scored a high knowledge level of PK at Cape Coast Technical University. This is shown in the mean and standard deviation scores (M = 93.29, SD = 8.87). The size of the standard deviation implies that most of the lecturers' scores on pedagogy were clustered around the average score. That is, the lectures were highly homogenous, hence, they possessed similar characteristics/traits. It is evident in Figure 8, where 109 of the total respondents' observed scores were from 80-100%.

The lecturers' high knowledge of PK means that almost all of them were aware that in conducting examinations, teachers must explain to students the criteria

that would be used for assessment (whether a class test, assignment or class discussion). Similarly, the lecturers knew very well that a teacher must use a variety of assessment strategies to assess his/her students. Also, the lecturers' high knowledge level of pedagogy is an indication they knew about the fact that the general agreement of any sound scheme of assessment should satisfy the following criteria: validity, reliability, practicability and cost-effectiveness, fairness and usefulness.

Discussions

The study revealed that the lecturers' knowledge level of PK was high. It means that the CCTU lecturers have the skills needed to teach at the university to promote learning. During teaching, it is the teacher's obligation to ensure that the students have an interest in the subject. This is possible to accomplish, if the teacher provides alternative explanations when students are confused. Also, students would be interested in the lessons if teachers could make the classroom a positive place to learn, define peer support systems, and encourage respect among students. The lecturers at the CCTU had adequate knowledge about the assertions concerning teaching since their pedagogical knowledge level, as reflected in the observed scores, was found to be high. In that regard, the lecturers were again aware that it is the teachers' responsibility to identify causes of success or gaps in students' learning.

The findings are well-grounded in literature as some authors (Asare-Danso, 2017; Kola & Azeez, 2023; Sojanah *et al*., 2021) have reported that concerning pedagogical knowledge, the teachers had good pedagogical knowledge. The

teachers knew how to state lesson objectives as well as the development of core points, among others. In addition to that, Asare-Danso (2017) further disclosed that a few of the college tutors did not seem to know the various contemporary pedagogies. This contradicts the findings which indicate that the lecturers at CCTU possessed high knowledge of all the issues concerning PK.

Additionally, teachers need to prove that they could select, use, and change educational resources to meet the requirements of learners. The instructional resources enable the teacher to deliver lessons that facilitate students' understanding of key concepts. The lecturers who took part in the study had very good knowledge in that regard, most of them knew also that the utilisation of different instructional materials for teaching not only promotes learning but improves teachers' content knowledge as well. The study reveals that most of the lecturers at CCTU were aware of the appropriate means of stating achievable lesson objectives. That is, they knew that in designing course outlines, objectives are to be written in terms of the learning product rather than the learning process and objectives should be listed to cover learning outcomes rather than subject matter when designing a course outline. Thus, it appears the lecturers' sufficient knowledge of these pedagogical issues contributed to their high performance in the pedagogy scores.

The NCTE's staff audit report showed that lecturers were teaching with mismatched degrees, and some had no relevant teaching background. This would mean that such lecturers would possess little or no knowledge about teaching pedagogies. Conversely, it appears this was not the case with the CCTU lecturers

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who were involved in the study. Except for one respondent who scored below 50% on the pedagogical knowledge test, the findings showed that generally, the lecturers possessed very good knowledge of PK. Thus, even though the same anomalies were also identified in the NCTE's report regarding non-professional teachers teaching at the TUs in Ghana, the CCTU lecturers' knowledge of PK was high and should be allowed to teach. This high knowledge of PK might be accounted for by their accumulated experience in teaching and through other in-service trainings organised by CCTU's Academic Affairs Directorate. Instead of demoting them, the NCTE should have provided an opportunity for such few lecturers to upgrade themselves with the required teaching qualifications. Consistent with existing research, Zhu and Wang (2020) established that teachers have improved in their understanding of subject matter, pedagogy, students, and environmental context.

In contrast, Yilmaz and Tinmaz (2016) discovered that students thought few of the instructors in general possessed pedagogical abilities. According to the studies of pedagogical skills, lecturers were considered as having open-minded attitude and competence regarding course introduction, but only few of the lecturers were perceived to be skilled in proficiencies connected to course procedures and assessment.

The inconsistencies between the findings and that of existing studies could be because the earlier authors (Yilmaz & Tinmaz, 2016) conducted students' assessment of their lecturers' pedagogical competencies; however, the current study used a self-rated assessment (i.e., pen and paper tests) to examine the lecturers' knowledge level of general PK.

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Research Question Three

What is the knowledge level of Content Knowledge of lecturers at CCTU?

This research question sought to assess lecturers' knowledge level of content knowledge at Cape Coast Technical University. The respondents were presented with items to test their understanding of content knowledge. The "True" or "False" test items focused on issues involving content. Percentages and frequency counts were used to analyse the responses gathered on the lecturers' content knowledge, and the results have been outlined in Table 7 as follows:

Table 7: Responses on the Lecturers' Knowledge of Content Knowledge

Content Knowledge	True		False	
	n	%	n	%
A teacher can teach without the knowledge of the logic in the subject area.	12	10.1	107	89.9
The teachers' knowledge of core concepts of subjects reflects their deep understanding.	109	91.6	10	8.4
The teacher's content knowledge does not include the mastery of particular content to meet students' learning needs.	14	11.8	105	88.2
The content problem teachers must contend with does not include assisting students to do tasks.	28	23.5	91	76.5

Source: Field Data (2022)

Table 7 depict that 89 percent of the respondents knew about the fact that a teacher cannot teach without the knowledge of the logic in the subject area (n = 107, 89.9%). However, only 10.1% of the respondents did not know about it. Similarly, the 91 percent of the survey participants were aware that the teachers'

knowledge of core concepts of subjects reflects their deep understanding (n = 109, 91.6%). Most of the lecturers further revealed that the teacher's CK does include mastery of particular content to meet students' learning needs (n = 105, 88.2%). Lastly, 28 respondents answered "True" to the statement "The content problem teachers must contend with does not include assisting students to do tasks", although the majority of the respondents answered correctly to the same test item (n = 91, 76.5%).

Five (5) test items were constructed to measure the lecturers' knowledge of CK. The lecturers' responses to these test items were marked and graded out of 100%. For purposes of analysis, the following grading guidelines were used to interpret the lecturers' content knowledge scores: 0-49 = low knowledge; 50-59 = average knowledge; 60-69 = above average knowledge; 70-79 = good knowledge and 80-100 = very good knowledge. The results have been presented in Figure 9 and Table 8 as follows:

Lecturers' Content Knowledge Scores

	0-49	50-59	60-69	70-79	80-100
Marks %	2	7	0	28	82
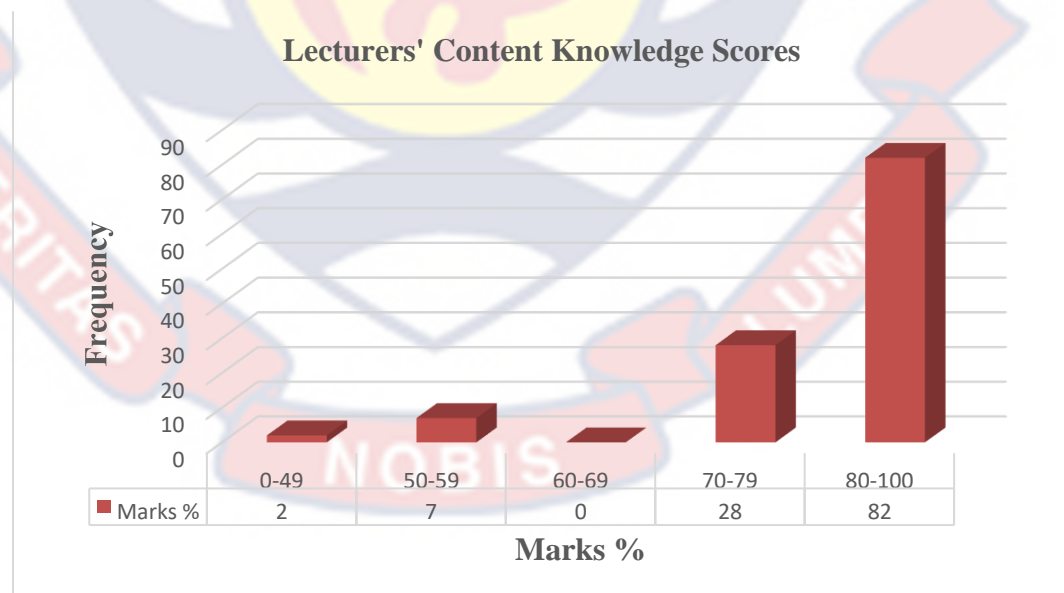
Figure 9: Lecturers' Content Knowledge Scores

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It is shown in Figure 9 that 68.9% of the observed content knowledge scores fell in the range of 80-100%. That is, most of the survey participants had marks which were 80% and above (n = 82, 68.9%). This means that most of the lecturers at Cape Coast Technical University had very good content knowledge. This was followed by 23.5% of the respondents who possessed good content knowledge. This group of respondents' observed scores ranged from 70-79%. On the other hand, a few of the respondents (n = 7, 5.8%) had scores ranging from 50 to 59%, and this represents average CK. Finally, the findings indicate that two content knowledge scores fell in the range of 0-49%. In other words, two of the total study's respondents possessed content knowledge which was below average. Generally, a mean score was computed to assess the lecturers' overall content knowledge level at CCTU. The findings are outlined in Table 8.

Table 8: Lecturers' Knowledge of Content Knowledge at CCTU

	N	Minimum	Maximum	Mean	SD
Content Knowledge Scores	119	0.0	100.0	89.71	17.95

Source: Field Data (2022)

Mean interpretation: below 50%=Low knowledge level; 50%=Average knowledge level; and above 50% = High knowledge level

As depicted in Table 8, the highest score obtained on content knowledge was 100% and the outcomes showed that 82 of the overall responses obtained maximum score. On the other hand, the least score was 0% and analysis of the results showed that just one respondent obtained this zero score. This same respondent was among one other respondent who got low content knowledge at

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CCTU (*See Figure 9).* Thus, these two extreme scores might have reduced the overall mean score for the lecturers who took part in the study. Despite the outliers in the scores, table 8 depict that participants scored high in knowledge of content at Cape Coast Technical University. This is shown in the mean and standard deviation scores (M = 89.71, SD = 17.95).

Research Question Four

What is the knowledge level of PCK of lecturers at CCTU University?

This research question sought to examine lecturers' knowledge level of pedagogical content knowledge at Cape Coast Technical University. The participants were given test items to assess their PCK. "True" or "False" test items focused on the current understanding of the major issues involving understanding of the subject matter, an understanding of students' abilities and interests, an application of different teaching strategies as well as the lecturers' understanding of how various types of classroom activity might be managed. Percentages and frequency counts were employed to scrutinise the responses gathered on the lecturers' PCK, and the results have been presented in Table 9 as follows:

Table 9: Responses on the Lecturers' Knowledge of PCK

Pedagogical Content Knowledge	True		False	
	n	%	n	%
PCK requires that the best method should be used to teach a particular content or topic.	108	90.8	11	9.2
Adapting teaching to students' conceptions and misconceptions is a dimension of PCK.	102	85.7	17	14.3
Teachers use their understanding of various cultures to help dispel students' misconceptions about other cultures while they are teaching..	101	84.9	18	15.1

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PCK requires that a teacher should use multiple forms of representation.	114	95.8	5	4.2
In order to help students understand new concepts during instruction, teachers assist them in integrating fundamental principles from many academic areas.	119	100	0	0.0
A teacher challenges students to provide their own definitions and justifications for concepts.	117	98.3	2	1.7
Evaluating students' ideas evident in assignments and discussion is a teaching task that describes the work of making sense of things that students do, say, and produce.	115	96.6	4	3.4

Source: Field Data (2022)

Table 9 revealed that the 119 respondents knew that instructors assist students in connecting key concepts from numerous subject areas to comprehend new ideas during teaching (n = 119, 100%). Similarly, almost all the respondents were aware that during the teaching and learning process, the teacher encourages learners to develop their own explanations and definitions of ideas (n = 117, 98.3%). However, only two respondents indicated false to the above assertion. A greater portion of the respondents was knowledgeable about the fact that PCK requires that the best method should be used to teach a particular content or topic (n = 108, 90.8%), and PCK requires that a teacher should use multiple forms of representation (n = 114, 95.8%).

Moreover, 18 respondents did not know that during teaching, teachers use understanding of different cultures to help students dispel the misconceptions they may have about those cultures. Notwithstanding that, most of the respondents knew about this fact (n = 101, 84.9%). Regarding the assessment of students' learning,

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most of the respondents knew that evaluating students' ideas evident in assignments and discussion is a teaching task that explains the process of interpreting what pupils say, do, and achieve. (n = 115, 96.6%). The rest of the four respondents did not know of this fact.

Seven (7) test items were constructed to measure the lecturers' knowledge of PCK. The lecturers' responses to these test items were marked and graded out of 100%. For purposes of analysis, the following grading guidelines were used to interpret the lecturers' knowledge of PCK scores: 0-49 = low knowledge; 50-59 = average knowledge; 60-69 = above average knowledge; 70-79 = good knowledge and 80-100 = very good knowledge. The results have been presented in Figure 10 and Table 10 as follows:
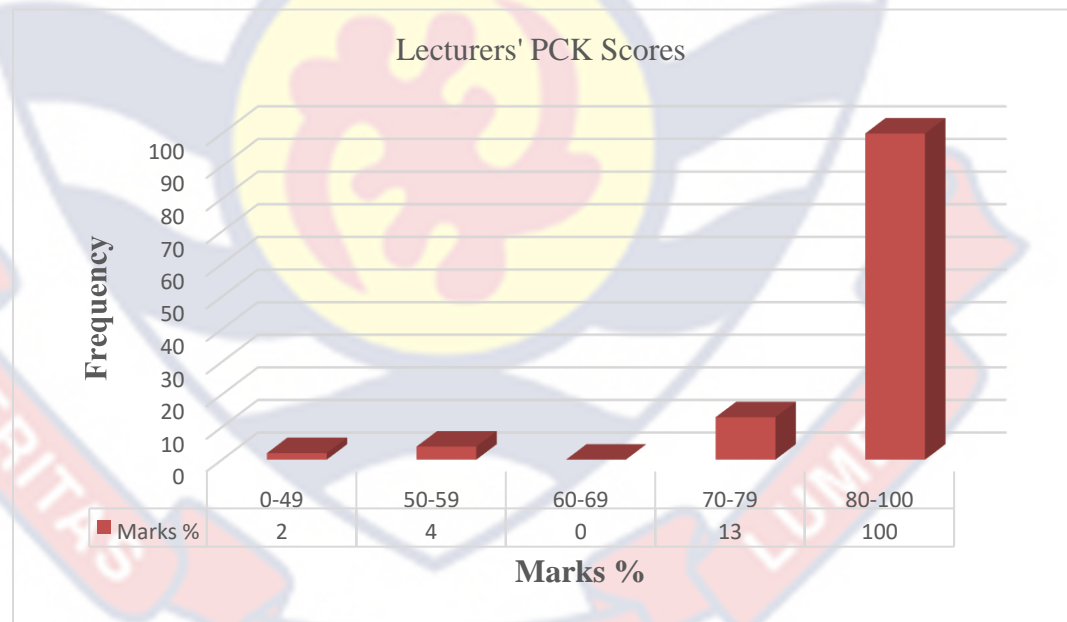
Figure 10: Lecturers' PCK Scores

It is shown in Figure 10 that 84.0% of the observed PCK scores fell in the range of 80-100%. That is, most of the participants pooled 80% and above (n = 100,

84.0%). This means that most of the lecturers at CCTU had very good pedagogical content knowledge. This was followed by 10.9% of the respondents who possessed good PCK. This group of respondents' observed scores ranged from 70-79%. On the other hand, a few of the respondents (n = 4, 3.4%) had scores ranging from 50-59%, and this represents average PCK. Finally, the results indicate that two of the PCK scores fell in the range of 0-49%. In other words, two of the total study's respondents possessed pedagogical content knowledge which was below average. Generally, a mean score was computed to assess the lecturers' overall PCK level at Cape Coast Technical University. Table 10 describes the findings.

Table 10: Lecturers' Knowledge of Pedagogical Content Knowledge at CCTU

	N	Minimum	Maximum	Mean	SD
PCK Scores	119	0.0	100.0	92.41	15.12

Source: Field data (2022)

Mean interpretation: below 50%=Low knowledge level; 50%=Average knowledge level; and above 50% = High knowledge level

As depicted in Table 10, the highest obtained score on pedagogical content knowledge was 100% and the findings discovered that 85 of the participants obtained a maximum score. On the other hand, the least score was 0% and analysis of the results showed that just one respondent obtained this zero score.

This same respondent was among one other respondent who got low knowledge of PCK at CCTU (*See Figure 10).* Thus, these two extreme scores might have reduced the overall mean score for the lecturers who took part in the study.

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Despite the outliers in the scores, Table 10 depict that participants possessed high Knowledge level of PCK at Cape Coast Technical University. This is shown in the mean and standard deviation scores (M = 92.41, SD = 15.12). Meaning, lecturers knew the connections between content, pedagogy and students. In other words, the lecturers were aware that a key component of PCK combines content and pedagogy to enhance the understanding of how specific topics, problems, situations are arranged, conveyed, and tailored to the wide range of interests and skills of learners. Similarly, their high knowledge of PCK indicates that they understood the fact that adapting teaching to student's conceptions and misconceptions is a dimension of PCK.

Discussions

The study found that the lecturers at Cape Coast Technical University possessed a high knowledge level of CK. This is because most of the lecturers knew that a teacher cannot teach without the knowledge of the logic in the subject area, and most of them were aware also that the teachers' knowledge of core concepts of subjects reflects their deep understanding. Content knowledge referred to the amount stuff the teacher possess. Thus, the instructor might have gained mastery over the relevant subject matter before he/she would teach the contents to learners. The lecturers who were sampled for this study had adequate knowledge of content which include the mastery of particular content to meet students' learning needs. The lecturers' high content knowledge level also indicates that most of them knew very well that the content problem teachers must contend with does include assisting students to do tasks.

The findings of this study are consistent with Fritsch *et al*., (2015); Asare-Danso, (2017); Zhu and Wang (2020) and Sojanah *et al*., (2021) who asserted that teachers possessed good content knowledge. This study agrees with Ibrahim *et al*. (2014) that both expert and novice instructors are knowledgeable in content and pedagogy.

Discussions

The study found that the lectures at the CCTU possessed a high knowledge level of PCK. The lecturers' high PCK level means that they knew that teachers are to assist students in integrating basic concepts from a variety of disciplines to aid in their understanding of new ideas throughout instruction. By so doing, the students are encouraged to develop their own definitions and explanations of topics during teaching and learning interactions. In assessing learning outcomes, the lecturers were aware that evaluating students' ideas evident in assignments and discussion is a teaching task that explains the process of interpreting what learners do, say, and accomplish. The current study's findings are grounded in literature as Syahrul (2019) found that students' perception towards lecturers' pedagogical competence was regarded as high. That is, the lecturers have good pedagogical competence. The results of this study is in agreement with the findings of Sojanah et al., (2021); Sutrisno et al., (2023); and Zhu & Wang, (2020), who asserted that teachers have developed knowledge of students, pedagogy, content and the environment.

The GTEC 2018 staff audit report indicated that some lecturers were without relevant teaching background (Duodu, 2019). This clearly makes the

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supposed lecturers non-professional teachers. However, it appears lecturers at CCTU could effectively teach since their knowledge of PCK was found to be high. That is, the lecturers possessed understanding of major issues involving subject matter, an understanding of students' abilities and interests, and teaching strategies, among others. Hence, the lecturers' PCK competencies could enable them to teach at CCTU, even though the qualifications of some lecturers do not permit them to be teaching.

Research Hypotheses Testing

The hypotheses testing results were presented in this section. Three hypotheses were proposed and tested at the 0.05 alpha level. The dependent variables are CK, PK and PCK. The independent variables are academic qualification and professional qualification. Before the hypotheses were tested, the dependent variables were subjected to normality assumptions and employing Levene's test for variance equality to determine the homogeneity of variances. Table 11 and Figure 10 contain summaries of the findings.

Table 11: Tests of Normality

Variable	Mean	5% TM	Median	Skewness	Kurtosis
Content knowledge	89.71	92.04	100.00	.222	.440
Pedagogical knowledge	93.29	94.33	93.00	.222	.440
Pedagogical content knowledge	92.41	94.62	100.00	.222	.440

Source: Field data (2022)   TM = Trimmed Mean

One key assumption that must be established in all parametric tests, is the normality assumption. This assumption was checked using central tendency (mean,

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5% trimmed mean and median), skewness and kurtosis. Aside from the descriptive statistics, the graphical approach using Histogram, and the dataset's normality were further verified using a normal Q-Q plot.

In Table 11, it was obvious that the value of the median, mean, and 5% trimmed mean are similar. For example, concerning the data on pedagogical knowledge, the mean value (M = 93.29), 5% TM (TM = 94.33) and median (Mdn = 93.00) are approximately equal. This can also be seen in the data on CK and PCK. These findings indicate that the data are approximately normal.

Also, based on the coefficient of the skewness and kurtosis, it was concluded that the data on the three dependent variables followed a normal distribution. This is because the values of skewness and kurtosis fell within the range of the normal distribution permitted limits of -2 and + 2 (George & Mallery, 2019). Also, the findings indicated that there was not a significant departure from normalcy in the data because the values of skewness and kurtosis were below 3 and 7, respectively (Byrne, 2010; Hair, Black, Babin & Anderson, 2010). The outcomes of normalcy using a Histogram and Normal Q-Q plot are presented in Figure 11.
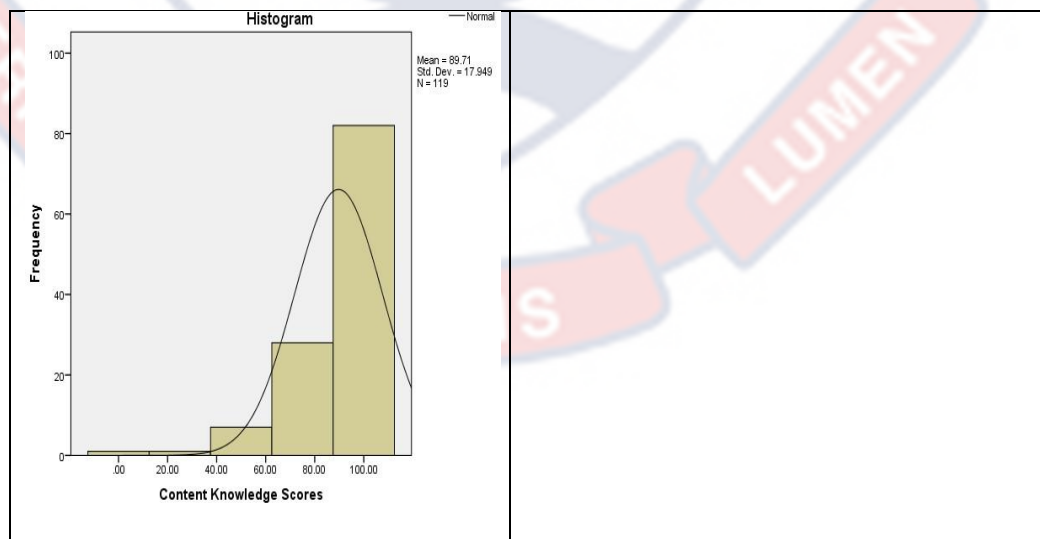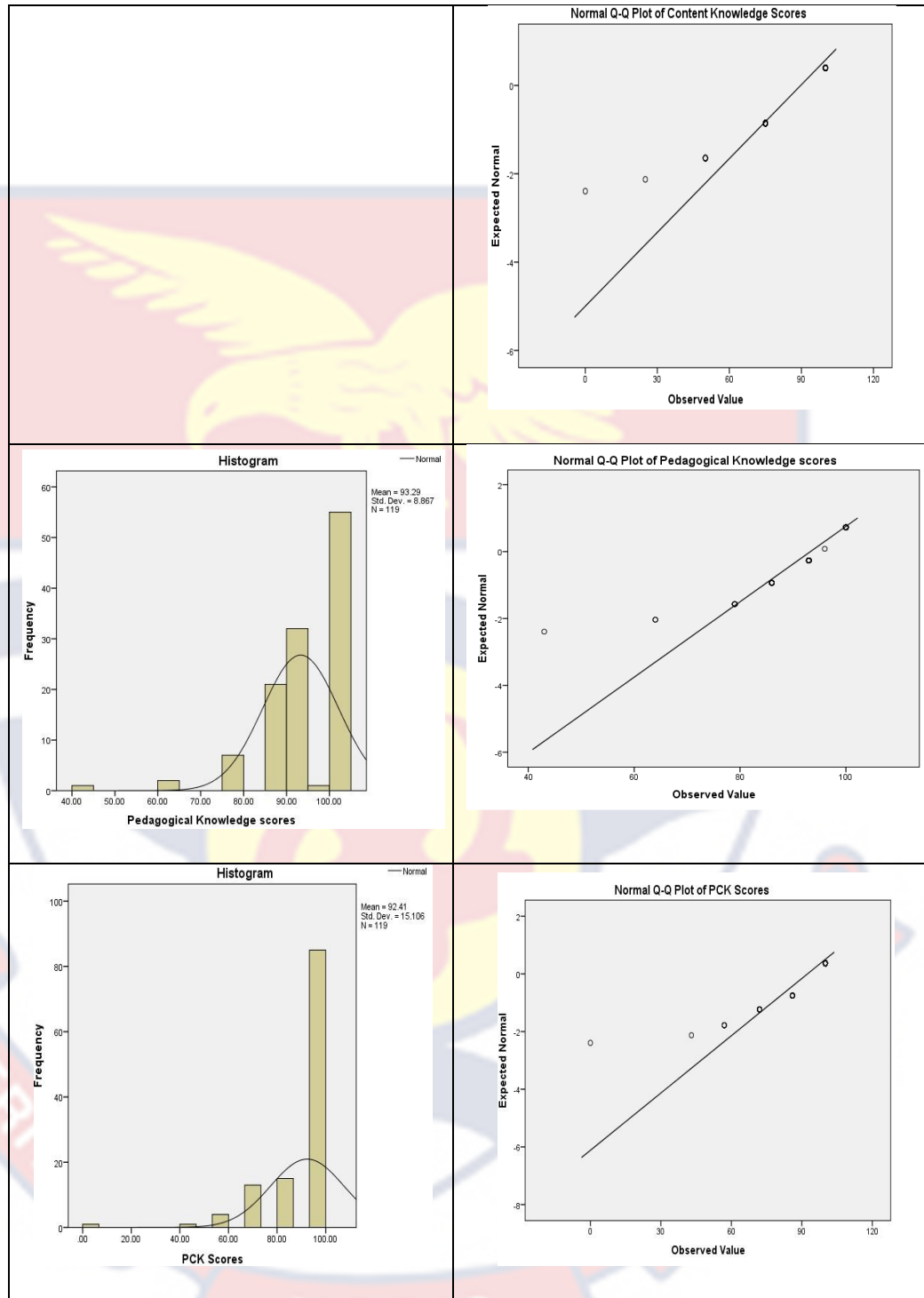
Figure 11: Normality test using histogram and normal Q-Q plot

In Figure 11, it was evident that the data points of each variable: CK, PK and PCK appeared normally distributed as they are approximately close to the diagonal

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line, and there seems not to be any kind of non-linear pattern to it. Overall, from both the normality tests and the graphical approach, it was concluded that the data points are normally distributed.

Research Hypothesis One

H₀: There is no statistically significant influence of academic and professional qualifications on lecturers' CK.

This research hypothesis sought to assess the impact of professional and academic qualifications on the lecturers' CK. A factorial ANOVA was performed to find out the influence of the factors (professional and academic qualifications) on the dependent variable (Content knowledge). The homoscedasticity test failed for content knowledge, $F(6, 112) = 2.555$, $p = .023$. The homogeneity of variances tests was essential in indicating the appropriate test statistic to use for post-hoc comparisons. The details of the outcomes of the factorial ANOVA have been presented in Table 12.

Table 12: Test of Between-Subjects Effects on Content Knowledge

Source	Type III Sum of Squares	df	Mean Square	F	p	η_p^2
Corrected Model	1441.252	6	240.209	.736	.622	.038
Intercept	178316.195	1	178316.195	546.063	.000	.830
Academic Qual.	1139.307	3	379.769	1.163	.327	.030
Professional Qual.	38.348	1	38.348	.117	.732	.001
Academic Qual.* Professional Qual.	196.715	2	98.357	.301	.741	.005
Error	36573.454	112	326.549			
Total	995625.000	119				
Corrected Total	38014.706	118				

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Source: Field data (2022)

Based on the test of between-subjects effects, the corrected model for content knowledge was not statistically significant $F(6, 112) = .736$, $p = .622$, $\eta p2 = .038$. Consequently, neither the main effects (academic and professional qualifications) nor the interaction effects showed any apparent changes (academic qualification professional qualification). No interaction effects between the factors mean that the influence of academic qualification on lecturers' knowledge of CK is not dependent on whether they are professional teachers or non-professional teachers. The outcomes offer sufficient proof for the null hypothesis. Therefore, there was no statistically significant correlation between academic and professional credentials and lecturers' understanding of CK. Accordingly, the null hypothesis was retained.

Discussions

The study revealed no statistically significant influence of academic qualification on lecturers' content knowledge. Similarly, professional qualification did not significantly influence the lecturers' CK. Based on that, no significant differences were found among the categories of academic and professional qualifications. To put it differently, the lecturers' CK was not significantly different from one another based on academic and professional qualifications. For professional qualifications, for instance, the lecturers' knowledge of CK was not significantly different among the professional and non-professional teachers at CCTU. Similarly, the CK scores did not differ significantly among the lecturers who have attained HND, bachelor's, masters and terminal degrees. That is, the lecturers in each category of academic qualifications did not perform better than the

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others in terms of their familiarity with CK. The findings of this study are inconsistent with that of the extant literature. For instance, Sojanah *et al*. (2021) discovered that instructors' training, teaching experience, self-efficacy and motivation positively impact their attitude and CK as a dimension of TPACK. Also, Fritsch *et al*. (2015) discovered that university-based opportunity to learn (OTL) had a significant influence on the CK score, and this is contrary to the current study's findings.

Moreover, the findings from this current study do not agree with that of Sutrisno *et al*.'s (2023) who found that teaching experience influenced content knowledge. Also, Barendsen and Henze (2019) revealed that experience has an impact on lecturers' expertise in teaching a specific topic. Contrary to this study, the experience of the teacher was not factored into the variables of this study. (academic and professional qualifications) which were found not to have had any significant influence on the lecturers' CK.

Research Hypothesis Two

H0: There is no statistically significant influence of academic and professional qualifications on lecturers' PK.

This research hypothesis sought to assess the effect of academic and professional qualifications on lecturers' understanding of PK. To assess the effects of the variables, a factorial ANOVA was employed (professional and academic qualifications) on the dependent variable (pedagogical knowledge). The homoscedasticity test on pedagogical knowledge revealed that equality of variances was presumed, $F(6, 112) = 1.197$, $p = .313$. The homogeneity of variances tests was

essential in indicating the kind of statistical test to use for post hoc comparisons.

The results of the analysis have been shown in Table 13 below:

Table 13: Test of Between-Subjects Effects on Pedagogical Knowledge

Source	Type III Sum of Squares	df	Mean Square	F	p	η_p2
Corrected Model	447.591	6	74.598	.946	.465	.048
Intercept	180787.880	1	180787.880	2293.349	.000	.953
Academic Qual.	141.775	3	47.258	.599	.617	.016
Professional Qual.	.798	1	.798	.010	.920	.000
Academic Qual.* Professional Qual.	198.156	2	99.078	1.257	.289	.022
Error	8829.115	112	78.831			
Total	1045028.000	119				
Corrected Total	9276.706	118				

Source: Field data (2022)

The General Linear Model (GLM) adjusted model findings revealed no statistically significant relationship between academic and professional credentials and lecturers' pedagogical knowledge, $F(6, 112) = .946$, $p = .465$, partial $\eta^2 = .048$. There were no statistically significant interactions between academic and professional qualifications, $F(2, 116) = 1.257$, $p = .289$, partial $\eta^2 = .022$. That is, the results showed that the influence of professional qualification on lecturers' knowledge of pedagogy is not dependent on the lecturers' level of academic qualifications.

The findings show that there was no statistically significant influence on academic qualification, $F(3, 115) = .599$, $p = .617$, partial $\eta^2 = .016$, and professional qualifications, $F(1, 117) = .010$, $p = .920$, partial $\eta^2 = .000$ on lecturers'

knowledge of pedagogy. Consequently, there are no notable variations among the categories of the independent variables. The findings indicated sufficient evidence to support the null hypothesis. In a nutshell, there was no statistically significant correlation between the lecturers' pedagogical knowledge and their academic and professional backgrounds. It turns out that the null hypothesis is not refuted.

Discussions

The study revealed no statistically significant influence of academic and professional qualifications on lecturers' PK. Based on that, no significant differences were found among the categories of academic and professional qualifications. In other words, there were no significant differences in the lecturers' PK based on academic and professional qualifications. For professional qualifications, for instance, the lecturers' knowledge of PK was not significantly different among the professional and non-professional teachers at CCTU. Similarly, pedagogical knowledge scores did not differ significantly among the lecturers who have attained HND, bachelor's, master's and terminal degrees. That is, the lecturers in each category of academic qualifications did not perform better than the others, as far as their knowledge of PK was concerned. This finding has been reported by earlier authors (Kimani, Kara & Njagi, 2013) who established that obtaining professional certifications beyond the initial level did not necessarily result in enhanced teaching abilities. However, the current study's findings are inconsistent with that of Sojanah *et al*.'s (2021) who discovered that motivation, training and resources, self-efficacy, and teaching experience together had a favourable impact on pedagogical knowledge, as a TPACK dimension. Similarly, there is

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inconsistency between the findings of the study and that of Sutrisno *et al*.'s (2023) who indicated that teaching experience affected pedagogical knowledge.

Research Hypothesis Three

H0: There is no statistically significant influence of academic and professional qualifications on lecturers' PCK.

Additionally, Table 14 compares the influence of the independent variables (academic and professional qualifications) on the dependent variable (pedagogical content knowledge).The test of homoscedasticity on pedagogical content knowledge indicated that equality of variances was not assumed, $F(6, 112) = 2.568$, $p = .023$. The kind of test statistic to use to conduct post-hoc comparisons was established by the homogeneity of variances testing.

Table 14: Test of Between-Subjects Effects on Pedagogical Content Knowledge

Source	Type III Sum of Squares	df	Mean Square	F	*p*	η_p2
Corrected Model	2344.257	6	390.709	1.780	.109	.087
Intercept	195328.155	1	195328.155	890.002	.000	.888
Academic Qual.	1687.131	3	562.377	2.562	.058	.064
Professional Qual.	75.905	1	75.905	.346	.558	.003
Academic Qual.* Professional Qual.	1099.862	2	549.931	2.506	.086	.043
Error	24580.567	112	219.469			
Total	1043177.000	119				
Corrected Total	26924.824	118				

Source: Field data (2022)

Table 14 reveal that the corrected model did not indicate a statistically significant effect of academic and professional qualifications on lecturers' knowledge of PCK, $F(6, 112) = 1.780$, $p = .109$, partial $\eta^2 = .087$. Again, there were no statistically significant interactions between academic and professional qualifications, $F(2, 116) = 2.506$, $p = .086$, partial $\eta^2 = .043$. This shows that the influence of academic qualification on lecturers' knowledge of PCK is not dependent on whether they are professional or non-professional teachers.

The findings show that there was no obvious influence of academic credentials that was statistically significant, $F(3, 115) = 2.562$, $p = .058$, partial $\eta^2 = .064$, and professional qualifications, $F(1, 117) = .346$, $p = .558$, partial $\eta^2 = .003$ on lecturers' knowledge of PCK. Accordingly, the null hypothesis was retained.

Discussions

The study revealed no statistically significant influence of academic and professional qualifications on lecturers' pedagogical content knowledge. Based on that, no significant differences were found among the categories of academic and professional qualifications. In a nutshell, based on academic and professional credentials, there were no appreciable disparities in the lecturers' PCK. For professional qualifications, for instance, the lecturers' knowledge of PCK was not significantly different among the professional and non-professional teachers at CCTU. Similarly, the pedagogical content knowledge scores did not differ significantly among the lecturers who have attained HND, bachelor's, master's and

terminal degrees. That is, the lecturers in each category of academic qualifications do not perform better than the others, with regard to their familiarity with PCK.

The findings corroborate with that of Kimani, Kara and Njagi's (2013) indicated that obtaining professional credentials beyond the initial level did not always result in improved teaching abilities. Similarly, Fritsch *et al*. (2015) found that the PCK of Austrian teachers was not affected by any of the university-based opportunities to study. On the contrary, Sojanah *et al*. (2021) identified factors that have a favorable impact on the PCK dimension of teachers' TPACK which include teaching experience, training, facilities and resources, self-efficacy, and motivation. In the same vein, Barendsen and Henze (2019) revealed that lecturers' experiences influence their competence of teaching particular subject matter. In relation to this current study, teaching experience was not considered as part of the independent factors that influence the lecturers' PCK.

The staff audit report conducted by GTEC showed that some lecturers do not have relevant background to teach at the Technical University (Duodu, 2019). The findings from the audit report appeared that the lecturers at CCTU who possessed the required teaching qualifications would perform better than their counterparts, with respect to their understanding of PCK. This assertion presupposes that the lecturers do not have CK, PK and PCK for teaching at the TUs. However, the findings at CCTU campus have revealed that the lecturers have CK, PK and PCK and there is no significant influence on their professional and non-professional knowledge of CK, PK, and PCK. It is interesting to note that CCTU lecturers with or without relevant teaching qualifications perform at the

same level on their knowledge of PCK. This suggests that GTEC could have considered the lecturers' knowledge of PCK in addition to their qualifications which were used as the yardstick to demote the lecturers who fell victim.

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CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter provides a summary of the study. It addresses the procedures used in data collection and analysis, it discussed the research questions created to assess lecturer's CK, PK, and PCK at CCTU. Conclusions are drawn based on the findings and recommendations and suggestions for further studies were made.

Summary of the Study

This was a survey undertaken at the Cape Coast Technical University to assess the Pedagogical Content Knowledge of the lecturers teaching at the university. The following research objectives guided the study:

1. assess the academic and professional qualifications of lecturers at CCTU.

2. examine CCTU lecturers' level of pedagogical knowledge.

3. assess the Content Knowledge of lecturers at CCTU.

4. ascertain the lecturers' level Pedagogical Content Knowledge at CCTU.

5. assess the influence of Academic and Professional Qualifications on the lecturers' knowledge of Content, Pedagogy and Pedagogical Content Knowledge.

The study adopted a positivist paradigm to this study. The CK, PK, and PCK of lecturers at CCTU were evaluated using a descriptive cross-sectional survey design within the positivist paradigm. The population for the study was all lecturers (n=170) at Cape Coast Technical University. 140 participants were chosen by simple random sampling techniques among four schools. The researcher used

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questionnaires in the form of tests to obtain responses from the academic staff. A return rate of 85% resulted in the collection of valid data from 119 participants. Ethical procedures were duly observed during the data collection. The findings were illustrated in graphs, charts, and tables Descriptive (percentages, mean, frequency counts, and standard deviations) and inferential statistical tools (Factorial ANOVA) were used to analyse the data collected.

Main Findings

Following a discussion of the findings, the following significant deductions were established:

1. The study established that the highest academic qualifications attained by most lecturers at CCTU are the Master of Philosophy and Doctor of Philosophy degrees. Also, the study showed that most of the lecturers at CCTU are professional teachers since they possess the requisite teaching qualifications.

2. The study indicated that the lecturers' knowledge level of general pedagogy is high. They are aware that in conducting examinations, teachers must explain to students the criteria that would be used for assessment. The lecturers at the CCTU had adequate knowledge about the fact that it is the teachers' responsibility to identify causes of success or gaps in students' learning.

3. The study found that lecturers at Cape Coast Technical University possess a high knowledge level of CK. The lecturers know that a teacher cannot teach without the knowledge of logic in the subject area, and they are aware

also that the teachers' knowledge of core concepts of subjects reflects their deep understanding.

4. The lecturers' knowledge of PCK is found to be high. The lecturers know the connections between content, pedagogy and students. They are aware that PCK involves a combination of pedagogy and content that results in a knowledge of how specific topics, problems, or situations are arranged, and presented for education while taking into account the interests and skills of different learners.

5. Again, the study showed that two (2) of the participants possessed HND and three possessed Bachelor's Degree and only one respondent obtained a score within the range of 0-47%.

6. There is no significant difference found in the factorial ANOVA results between the effects of professional and academic qualifications on CK, PK and PCK. Hence, no obvious differences are found in the main effects and the interaction effects.

Conclusions

From the findings, the lecturers are pedagogically disposed to teach in Technical Universities because the highest academic qualification attained by most lecturers were MPhil and PhD. Besides that, only few lecturers did not possess professional teaching qualifications. Thus, it can be deduced that not all lecturers teaching at Cape Coast Technical University are professionally trained teachers because some do not have relevant teaching background. This is a cause for concern as it cannot be established how such nonprofessional teachers can carry out the

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lessons and exercises conducted in the classroom. This is because it is one thing having content and another delivering the content skillfully.

Cape Coast Technical University lecturers possess a good level of pedagogical knowledge. This suggests that they can employ pedagogical approaches to techniques and strategies in teaching. The study deduced that the lecturers possess the requisite teaching skills needed to deliver content to the students at the university. The instructors have what it takes to ensure successful instruction and learning in the classroom.

From the findings the lecturers' knowledge level of CK is high. By implication the lecturers understand the syntactic and substantive structures and the nature of their discipline. Therefore, the lecturers possess a perfect blend of content and pedagogical skills and can effectively teach to enhance students' understanding of the lessons. In addition to having a thorough understanding of the subject matter, the lecturers also have a thorough understanding of the students' interests and talents and diverse teaching strategies and thus can manage various types of classroom activities.

The lecturers possess a high level of PCK. This implies that they can adapt pedagogies that fit the characteristics of their students to improve their (students) understanding. It can also be said that the lecturers have a strong awareness of the connections between the course material, pedagogy, and student knowledge. This is likely to ensure effective teaching and learning at the university.

Lastly, the results revealed that academic and professional qualifications does not significantly influence the lecturers' CK, PK and PCK. Also, no

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significant differences were found among the lecturers' CK, PK and PCK on the basis of their professional and academic qualifications. Thus, the study concludes that no matter the educational level, the lecturers at CCTU possess the same knowledge of CK, PK and PCK. Finally, the conclusion drawn is that both professional and nonprofessional teachers at CCTU have equal teaching competencies since the two groups' performance on CK, PK and PCK did not differ significantly.

Recommendations

The following recommendations are proposed based on the findings and conclusions of the study. Non-professional lecturers are encouraged to develop themselves to the level of teacher professionalism. Also, Heads of Department should organise regular workshops and seminars to sustain the pedagogical knowledge of lecturers. Furthermore, professional cooperative engagement is recommended among the lecturers to develop the few weaker ones since majority of the lecturers have high content knowledge. In addition, CCTU management must pay attention to lecturers' academic and professional qualification when developing their PCK because the lecturers score very high. Finally, the lecturers should sustain their PCK by keeping themselves abreast of 21st century teaching practices.

The Ministry of Education and GTEC should clearly spell out the criteria for recruitment and selection and the promotion of lecturers in TUs and the CCTU Management should strictly adhere to the directives spelt out for hiring the right calibre of lecturers to teach. Results prove that two (2) participant who are HND and first degrees holders, held themselves as lecturers which is not possible. The

Academic Planning and Quality Assurance Unit based on their oversight responsibilities should ensure that HND and Bachelor's Degree holders assist the lecturers or help students at the Laboratories rather than holding themselves out as lecturers. The Heads of Department and Dean of Schools of TUs should encourage them to upgrade themselves at higher educational institutions.

Suggestions for Further Studies

This study focused on only the academic staff of CCTU, so there is a need for future studies to consider other technical universities in Ghana. This will help unearth the PCK of lecturers in the remaining nine TUs. All the Technical Universities in Ghana are regulated by the Ghana Tertiary Education Commission (GTEC).

The study assessed the influence professional and academic qualification on the PK, CK and PCK of lecturers teaching at CCTU. This was observed after analysis of data from 119 respondents in just one out of ten technical universities in Ghana. Since this research was delimited to only 119 lecturers from CCTU, there is a need for further research that considers a larger sample in a different TU to obtain findings of the situations common to these universities. This will help provide broader insight into the subject matter.

Future studies can also explore the views of students, the Human Resources Section, and the Academic Planning and Quality Assurance Unit at CCTU regarding quality teaching among lecturers in the university and the hiring processes. Finally, there is a need for future studies to employ statistical tools which

will estimate the extent to which the lecturers' high knowledge of PCK influences

the quality of teaching at CCTU.

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APPENDIX A

QUESTIONNIARE

UNIVERSITY OF CAPE COAST

DEPARTMENT OF BUSINESS AND SOCIAL SCIENCES EDUCATION

This survey is only for academic use. Therefore, I kindly request your full cooperation and promise you that the information you supply here will be handled with the highest discretion. Mark the appropriate box for each of the following responses.

SN.	**Section A. General Pedagogical Knowledge**	**True**	**False**
	Please tick the appropriate box to indicate your knowledge on these statements by responding True or False		
1	In conducting examination, teachers must explain to students the criteria that would be used for assessment (whether class test, assignment or class discussion)		
2	During teaching, the responsibility is not on the teacher to ensure that students show interest in the subject.		
3	Teachers have to create a positive learning environment, clarify peer support structures and promote mutual respect within the classroom.		
4	The skills teachers need to teach is not a dimension of pedagogical knowledge.		
5	A teacher should be able to facilitate the subject matter knowledge to promote learning		
6	A teacher who wants to develop the communication skills of students can use discussion method.		
7	The use of variety of instructional materials for teaching improves teacher's content knowledge.		

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Please tick the appropriate box to indicate your knowledge on these statements by responding Yes or No		Yes	No
8	A teacher must use a variety of assessment strategies to assess his/her students.		
9	A teacher must provide alternative explanations when students are confused.		
10	Optimizing instructional time during teaching is a dimension of pedagogical content knowledge (PCK).		
11	Identifying causes of success or gaps in student learning is not the responsibility of the teacher.		
12	The general agreement of any sound scheme of assessment should satisfy the following criteria: validity, reliability, practicability and cost-effectiveness, fairness and usefulness		
13	In designing course outline, objectives are to be written in terms of learning product rather than learning process		
14	Objectives are listed to cover learning outcomes rather than subject matter when designing course outline.		
Section B: Content Knowledge (CK)		**True**	**False**
15	A teacher can teach without the knowledge of the logic in the subject area.		
16	The teachers' knowledge of core concepts of subjects reflects their deep understanding.		
17	Teacher content knowledge does not include the mastery of a particular content to meet student's learning needs.		
18	The content problem teachers must contend with does not include assisting students to do tasks.		
C: Pedagogical Content Knowledge (PCK)			

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Please tick the appropriate box to indicate your knowledge on these statements by responding Yes or No			
19	PCK requires that the best method should be used to teach a particular content or topic.		
20	Adapting teaching to student's conception and misconception is a dimension of PCK		
21	In order to help students understand new concepts during instruction, teachers assist them in integrating fundamental principles from many academic areas.		
22	PCK requires that a teacher should use multiple forms of representation		
23	Teachers help students to integrate core concepts from various subject areas in order to help them understand new concepts during teaching.		
24	A teacher encourages students to come out with their own explanation and definition of concepts.		
25	Evaluating student's ideas evident in assignments and discussion is a teaching task that describes the work of making sense of things that students do, say, and produce.		

Section D. Academic and Professional Qualification and Courses they teach

26. What is your highest academic qualification? ……………………………..

27. What is your highest professional teaching qualification?

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a)   Teachers' Cert 'A'   ☐

b)   Diploma in Education   ☐

c)   Postgraduate Diploma in Education   ☐

d)   Bachelor of Education   ☐

e)   Master of Education   ☐

f)   Master of Philosophy   ☐

g)   Master of Science   ☐

h)   Other, please specify …………………………………………………….

28. What programme did you pursue at First Degree? …………………………

29. What programme did you pursue at the Second Degree? ……………………

30. List the courses you teach in Semester One.

Course (Semester One)		Category of students		
		Degree	HND	Diploma
	a.			
	b.			
	c.			
	d.			
	e			
	f.			
	g			
	h			

31. List the courses you teach in Semester Two

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Course (Semester Two)		Category of students		
		Degree	HND	Diploma
a.				
b.				
c.				
d.				
e				
f.				
g				
h				

Section E. Lecturers Gender and years of experiences

32.   Gender

a)   Male   ☐

b)   Female   ☐

33.   How long have you been teaching at Cape Coast Technical University?

a) Less than a year   ☐

b) 1 – 5 years   ☐

c)   6 – 10 years   ☐

d)   11 – 15 years   ☐

e)   16 year and above   ☐

34. Are there any additional information you would like to give regarding   your

profession as a teacher at Cape Coast Technical University?

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…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

35. Will you recommend that lecturers who do not have professional teaching qualification should be given training in Postgraduate Diploma in Education?

    Yes ☐ No ☐

36.   If question 35 is yes. Please state your reason …………………………

    …………………………………………………………………………

    …………………………………………………………………………

    …………………………………………………………………………

37.   What is your opinion about the Staff Audit Report presented by NCTE in 2018 on qualification of Technical University lecturers?

    …………………………………………………………………………

    …………………………………………………………………………

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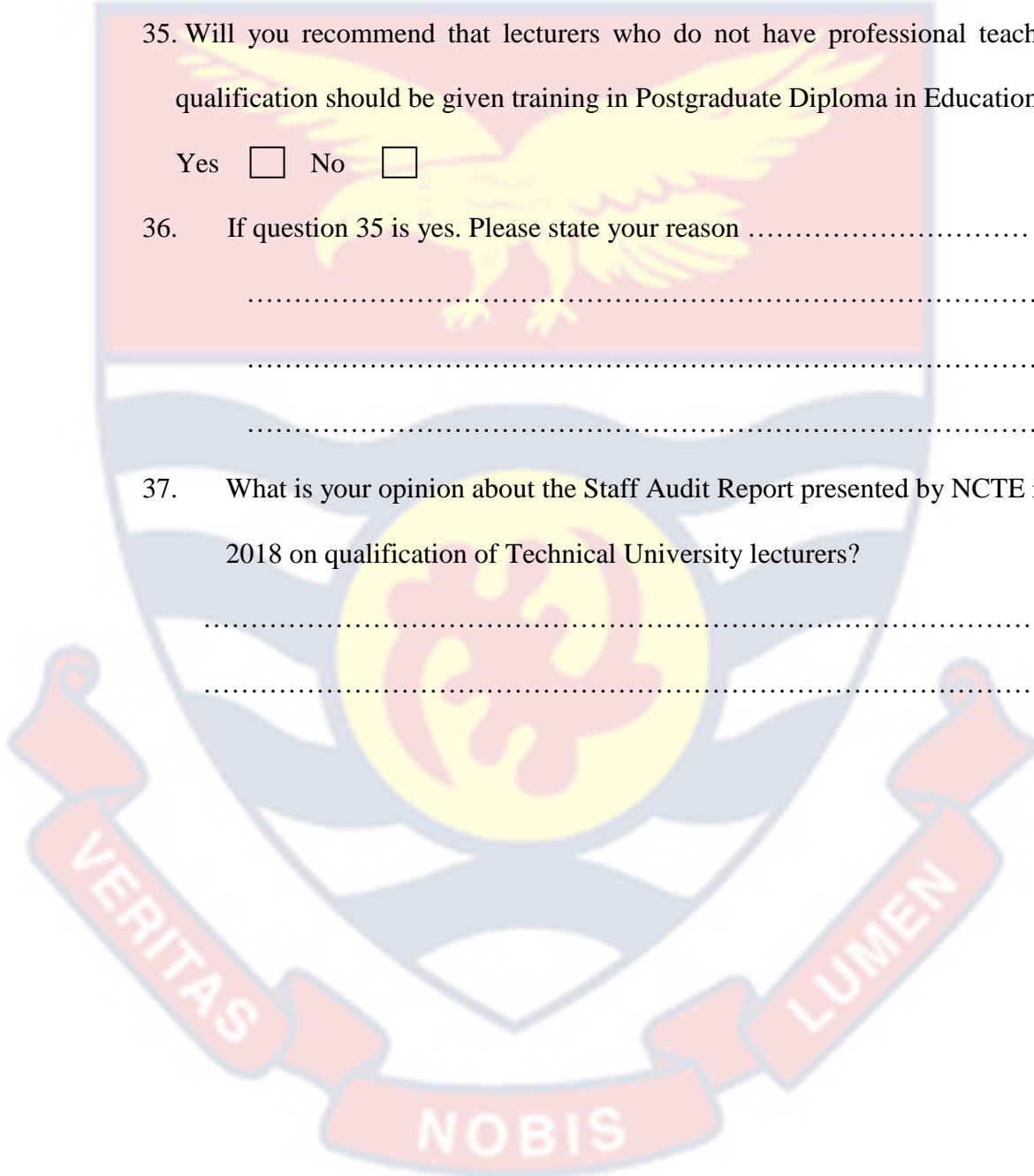
APPENDIX B

ETHICAL CLEARANCE

UNIVERSITY OF CAPE COAST

INSTITUTIONAL REVIEW BOARD SECRETARIAT

TEL: 0558093143 / 0508878309
E-MAIL: irb@ucc.edu.gh
OUR REF: UCC/IRB/A/2016/1537
YOUR REF:
OMB NO: 0990-0279
IORG #: IORG0009096

7TH SEPTEMBER, 2022

Mrs. Georgina Attachie
Department of Business and Social Sciences Education
University of Cape Coast

Dear Mrs. Attachie,

ETHICAL CLEARANCE – ID (UCCIRB/CES/2022/43)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted Provisional Approval for the implementation of your research **Assessing the Pedagogical Content Knowledge of Lecturers at Cape Coast Technical University and its Influence on Quality Teaching.** This approval is valid from 7th September, 2022 to 6th September, 2023. You may apply for a renewal subject to submission of all the required documents that will be prescribed by the UCCIRB.

Please note that any modification to the project must be submitted to the UCCIRB for review and approval before its implementation. You are required to submit periodic review of the protocol to the Board and a final full review to the UCCIRB on completion of the research. The UCCIRB may observe or cause to be observed procedures and records of the research during and after implementation.

You are also required to report all serious adverse events related to this study to the UCCIRB within seven days verbally and fourteen days in writing.

Always quote the protocol identification number in all future correspondence with us in relation to this protocol.

Yours faithfully,

Samuel Asiedu Owusu, PhD

UCCIRB Administrator

ADMINISTRATOR
INSTITUTIONAL REVIEW BOARD
UNIVERSITY OF CAPE COAST

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APPENDIX C

TABLE FOR DETERMINING SAMPLE SIZE FROM A GIVEN

POPULATION

BY KREJCIE AND MORGAN (1970).

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354

95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note:

N – Population size

S – Sample size

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