AKENTEN APPIAH-MENKA UNIVERSITY OF SKILLS TRAINING AND ENTREPRENEURAL DEVELOPMENT

DEPARTMENT OF MATHEMATICS EDUCATION

ENHANCING THE PRACTICAL SKILLS OF TVET STUDENTS USING MATHEMATICS AS A TOOL: A CASE STUDY IN SOME SELECTED TVET SCHOOLS IN KWAHU TRADITIONAL AREA

TENKORANG SEBEDEO ADU

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A thesis submitted to the Department of Mathematics, Faculty of Applied Science and Mathematics Education, Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development in partial fulfilment of the requirements for the award of Master of philosophy in mathematics education.

SEPTEMBER, 2023

DECLARATION

CANDIDATES DECLARATION

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

SIGNATURE: …… DATE: ……/……/…….

TENKORANG SEBEDEO ADU

SUPERVISORS DECLARATION

I hereby declare that the preparation and presentation of the thesis work were supervised in accordance with the guidelines on supervision of projects laid down by Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (AAMUSTED)

SIGNATURE: …… DATE: ……/……/……

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PROF. YARHANDS DISSOU ARTHUR (CO-SUPERVISOR)

DEDICATION

I dedicate this project to my lovely family and my beloved wife, Mrs. Sandra Adu-Tenkorang for the immense support.

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ABSTRACT

The study was undertaken to found out on how the practical skills of TVET students can be enhanced using mathematics as a tool. The instrument used for the study was a questionnaire. Three hundred and sixteen (316) respondents were used in the study consisting of two hundred and thirty-four (234) males and eighty-two (82) females. Simple Random Sampling procedure was used in to select the students while Purposive Sampling technique was used in the selection of form two students in the three TVET schools at Kwahu. The data-collection tools utilized in this study, which focused on variables such TVET students' attitudes toward mathematics (ATTI), interest in mathematics (SMN), and practical skills (PRASK), were modified from earlier studies carried out by other researchers. Structural Equation Model (SEM) software from Amos version 23 was used to analyze the gathered data. The findings of this study demonstrated that TVET students' attitudes toward mathematics had a substantial impact on their interest in mathematics. In addition, the results showed that TVET students' attitudes toward mathematics had a favorable impact and were statistically significant on their practical skills. Moreover, to enhance the practical skills of TVET students, it is recommended that stakeholders in TVET institutions gear the teaching and learning of Mathematics towards students' practical lessons. Also, emphasis on practice should take precedence over theory in the mathematics curriculum.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter presents an outline of the research strategy and gives a general summary of the studies covered in this thesis. An overview of the research's historical background opens the chapter. The chapter then moves on to talk about the goals and importance of the research. The objectives of this study and the research questions that follow come next. The study's delimitations and limitations are emphasized. The preliminary research model is introduced in this chapter. Each of the five chapters in this thesis is briefly described in the thesis outline.

1.1 Background of the Study

Numerous circumstances as well as issues in everyday life can be solved practically and with high relevance using mathematics. Therefore, it is a crucial and required subject in many school systems (Mundia, 2010). Mathematics is a foundational subject at all educational levels in Ghana, and the Ministry of Education lists it as one of the essential abilities for the twenty-first century as well as an indicator of achievement. However, Technical and Vocational Education and Training (TVET) schools only pay a minimal amount of attention to mathematics. Mathematics is a key component in enhancing practical abilities, even though it is not listed as a prerequisite for any courses offered in TVET universities. In Technical and Vocational Education and Training (TVET), mathematics is crucial for enhancing students' practical skills. However, the majority of TVET students have noticed that accepting mathematical knowledge might be challenging. This argument is supported by a fact that TVET primarily deals with

acquiring skills and expertise for the workplace, making it possible for students to create more prospects for effective tasks, financially viable careers, independence, and socioeconomic headway, according to Maclean and Wilson (2009), cited by Kongombe (2012).

In countries like Ghana, the foremost objective is to improve the standard of instruction and students' achievements, particularly since learning outcomes are closely linked to the quality of education provided. Consequently, this directly affects how things evolve in expansion of the economy, as higher quality education fosters it. According to Dike (2006), Technical and Vocational Education Training (TVET) is a well-planned program that commences with career exploration, supports standard academic and life abilities, and facilitates achieving high academic excellence, leadership, preparedness for industrial labour, advanced and ongoing education. Claudia (2019) believes that the best way to acquire usable skills to compete in the African economy is through TVET.

In Africa, technical institutions, vocational centres, polytechnics, universities, businesses, and apprenticeship training facilities provide technical and vocational education and training that differs from one nation to another. Ghana introduced TVET education in the year 2000 with the goal of contributing to the growth of a productive pool of workers that is matched to the needs of the economy with the educational system. The purpose of TVET in Ghana, as per UNESCO's 2016 mission statement, is to instil in young people the practical abilities needed to improve their livelihoods, as well as to provide fair accessibility to proficiency-based instruction. In 2006, the Ghanaian government founded the Council for Technical and Vocational Education and Training (COTVET) as a legal framework to oversee as well as coordinate every facet of TVET within the nation. COTVET's key goal is to equip the unemployed, especially young

people, with globally competitive capabilities that can be used in both the formal and informal sectors. The TVET system is regulated by the COTVET Legislative Instrument (2012), which also ensures its alignment with the National Qualification Framework (NQF).

Is TVET intended to train young people for a range of jobs or more widely for citizenship and employability? Educationalists claim that TVET credentials "are overly limited, task-focused, and bound to certain vocations, and have had their educational integrity stolen" (Wheelahan, 2015), while business diplomats, as mentioned by Rageth and Renold (2020), assert that occupational credentials must convene employers' requirement and serve as the foundation for a trained workforce and professional advancement. As a result, there is a natural conflict between the logic of business and that of education in TVET curricula. The relationship (or lack thereof) between theory (represented by academic topics) and practice (represented by learning through practice and work-based) is a clear indication of this tension.

Ryle (2009) advocated a segregation of theoretical knowledge and practical knowledge in order to develop a knowledge basis for TVET education. By emphasizing the correlation between "knowing how and knowing that" (p. 281) in TVET courses as well as highlighting the negative effects of ignoring this relationship, Winch (2013) elaborated on Ryle's difference. The continuous discussions concerning whether or not the educational program ought to be organized according to norms for the profession or expertise of discipline show that the connection among theoretical and practical knowledge has not received enough attention. Should the TVET curriculum emphasize the " minimum curriculum expansion and enrichment and details of the occupational field" (Fuller, 2015) or should it also cover a greater selection of scholarly courses and

civic education? According to Wheelahan (2015), theoretical courses provide the justifications behind the guiding philosophy that serve as the foundation for practice, while practical courses and classroom instruction offers opportunity and context for bridging knowledge to practice. The question of the link among the two categories, however, has not received enough attention (Winch, 2013).

Mathematical thinking and communication are crucial tools in producing goods and services, and technology in the workplace often exceeds human capabilities (FitzSimons, 2002). When it comes to workplace technologies, mathematical tools and equipment, ranging from basic to highly advanced, often surpass human capabilities. The aim of teaching and developing mathematical skills in both educational and professional settings is to reach a desired outcome, such as solving real-world problems. It is crucial to prioritize practical training in mathematics for self-sufficiency, as it provides a strong foundation for mental skills and professional discipline. According to Algani (2022), mathematics is the key subject in reaching this goal. The primary mission of teaching mathematics in technical and vocational education and training (TVET) is to impart knowledge that fosters mental skills and professional discipline (Maron, 2016).

As stated in SDG goal 8, which asks for all people to have decent jobs that are both full-time and productive, TVET aims to encourage inclusive, long-term, and sustainable economic growth. In order to accomplish this long-term objective, it is crucial to structure the mathematics content learned. In his book "The Global Achievement Gap," Wagner (2008) outlined seven key competencies, including critical analysis and problem-solving, teamwork and leadership, flexibility and adaptation, initiative and entrepreneurship, effective communication, information accessibility and analysis, as well as curiosity and

imagination. It is debatably true that mathematics has an essential role in the growth of these skills.

However, the degree of students' mathematical proficiency and the qualifications they pursued have come under fire within TVET institutions (Wolf, 2011). The goal of studying mathematics in TVET institutions is to meet context and practical needs, but this goal is at odds with the academic pathways' extensive understanding of mathematics and value placed on general understanding (Ernest, 2004).

Although TVET has a great deal of promise to advance Ghana's economy, there is still much that needs to be done to make TVET and skill development the engine of Ghana's economic growth and development. It is crucial to consider how to apply mathematics so as to enhance the practical abilities of TVET students in Ghana.

1.2 Statement of the Problem

In Ghana's 1992 Constitution, Article 25 Clause 1 states that all individuals will have access to technical and vocational education by all reasonable methods in recognition of the significant part that education plays in the life of a nation (Dzeto, 2014). Despite the search for educational opportunities, third-world growth is slow, therefore it begs the question of why a country like Ghana can't make the necessary strides.

All developing nations, including Ghana, place a high emphasis on developing citizens' practical abilities to yield productivity. According to Barffour-Awuah and Thompsom (2011), social and economic factors account for a majority of the government's desire to see technical and vocational skills increase. Ghana is presently working to reform its national TVET system in order to create locally-based, very competent workforces capable of supporting the growth of local industries and add to the development of the

nation. Similar to most underdeveloped nations, Ghana is at the intersection as it develops a fresh strategy for its TVET system. This system's goal is to create a workforce that is equipped and knowledgeable by tying the educational system to the demands of the industry (UNEVOC, 2016). Over the years, Ghana's TVET system has undergone a lot of adjustments but the sector's performance is far below expectations.

The disdain for technical and vocational education and training is often cited by experts as the missing connection in Ghana's industrial development (Nsiah-Gyabaah, 2007). The training content is out-of-date at certain point, and the hallmark of instruction and enlightenment has undyingly deteriorated, despite TVET being acknowledged as a crucial subsector for Ghana's industrial development. It is believed that if Ghana is to accomplish the commercial development objectives outlined in the Vision 2020 strategy, it must pay special fixation throughout all stages of education, focused on technical and vocational education in order to see any significant results.

This critical study focuses on how much practical content aids in competence transitions. Winch (2013), emphasized the significance of framing " the principal types of expertise that must be considered " in the context of practical training while preparing students for practice. Even though there has been " a sharp rise in articles focusing on TVET" (Gessler and Siemer, 2020), only a small percentage of these studies have a focus on actual TVET topics. In order to fulfill the requirement for review studies for the methodical collection, elucidation, and interpretation of knowledge, it is appropriate to conduct a critique of the literature on practical topics under rigorous scrutiny.

The demands of the curriculum, the kinds of exams, and the difficulties the institutions still experience in fulfilling their mission are the root causes of the issues facing TVET institutions in Ghana. While Ninnette (2014) touched on Ghana's socioeconomic

development and TVET's impact, Ansah and Kissi (2013) examined TVET in Ghana as an instrument for skill acquisition and economic development. Research on the difficulties TVET graduates encounter when transitioning from school to the workforce was also carried out by Bashiru (2020) in a few Technical Universities in Ghana.

Despite the significance of the earlier studies, TVET education in Ghana continues to face numerous obstacles. Many TVET learning institutions, particularly Polytechnics, struggle to produce graduates who are prepared adequately with practical skills by fusing academic instruction with hands-on experience. The idea of making TVET more useful and practical oriented for work in Ghana has, however, only been briefly discussed. Ghana's TVET schools fall short in terms of giving their graduates the necessary practical skills.

For the purpose of enhancing TVET students' practical abilities, this research aims to provide greater understanding in addressing the fragmented natures of the mathematics content, pedagogy, and quality of examinations.

1.3 Purpose of the Study

The development of TVET sector in Ghana has been challenging throughout the recent years. However, if policymakers, the government, and different TVET stakeholders retrace steps and reflect on how much the sector has deviated from its goals, assess the drift's sources, and put long-term fixes into action, the future bears promise. The greatest research is always done by recognizing the challenges and issues that will arise early on and addressing or removing them. This research attempts to comprehend the value of practical skills among students of TVET, as well as to promote the development of a

curriculum based on the incorporation of real-world mathematical concepts to ensure relevant practical skills.

The study's primary goal is to employ mathematics as a means to enhance the practical skills of TVET students in Ghana. The goal of the research is to examine whether the restructuring of the mathematics curriculum and content in Technical and Vocational Institutions in Ghana has been successful. The study's conclusions will be useful to people across a wide spectrum. The Ministry of Education in charge of TVET (for any plans to implement new curriculum), Ghana TVET Services (for the running of schools affected by such a plan to implement the new curriculum), and teachers in the various TVET schools (who provide implementation) will be the study's main audiences. By integrating the study provided here into the curriculum and teaching students mathematical concepts that are successful at increasing the practical skills of students, each of these groups of people would stand to gain.

1.4 Objective of the study

This study's primary goals are to:

1. assess the attitude of TVET students in Mathematics on their practical skills.
2. analyze the attitude of TVET students on their Mathematics interest.
3. determine how students Mathematical interest affect their practical skills.
4. assess how TVET students' mathematics interest serve as a mediating effect on their attitude towards mathematics and their practical skills.

1.5 Research Questions

To help with gathering information for the study, the following research questions have been developed:

1. What is the attitude of TVET students in Mathematics on their practical skills?
2. How does the attitude of TVET students affect their interest in Mathematics?
3. To what extent does students Mathematics interest affect their practical skills?
4. What is the mediating effect of students Mathematics interest on the relationship between their attitude towards mathematics and their practical skills?

1.6 Significance of the Study

The fourth goal of the SDGs reflects a worldwide commitment to ensuring equitable access to high-quality education (UN, 2019). In addition to being a fundamental right, attaining this objective, which entails " encouraging lifelong learning and making sure that all students have access to a high-quality education " is also essential for a sustainable future. Although there have been many setbacks on the path to achieving the 2030 goal, some success is bagged in closing the education disparity around the world. The significance of Technical Vocational Education and Training (TVET) globally is among the many landmarks.

This research will shed light on how practical Ghanaian TVET institutions are. Using mathematics as an instrument, it aims to enhance the practical skills of TVET students. The impact of TVET institutions in Ghana will be accurately conveyed by this research. The study will support the contributions mentioned in SDG goals 4 (Quality Education) and 9 (Innovation and Entrepreneurship, Building Industrialization, Innovations and Infrastructure).

The study's goal is to draw attention to the numerous issues Ghana's TVET system is currently experiencing. Atayo (2000), makes the following statement in support of the

significance of TVET: "The foundation for the survival of any future society is the learning of practical and applied skills as well as fundamental scientific knowledge." A nation can survive with TVET even if all other forms of education are eliminated. The paper also examines the causes of their emergence and offers pertinent solutions to alter the current situation and guarantee substantial advancement.

1.7 Delimitation of the Study

Empirical data from TVET institutions in Kwahu, in the eastern part of Ghana, were used in this research. The stakeholders of TVET institutions in Kwahu were the subject of much of the study. This is due to the fact that they have been a part of the TVET system for a while and can therefore attest with more information regarding questions pertaining to the school. To further the study's knowledge, data were gathered from three TVET institutions in Kwahu.

1.8 Limitation of the Study

The direct effects of mathematics on improving TVET students' practical skills was the main aim examined under this study. The elements that affect mathematics instruction and comprehension in TVET schools should be the subject of future research. Descriptive survey data, which may not be appropriate for causal analysis, was also a part of the study. On the other hand, the study was grounded in theories, research, and methodologies, therefore it is safe to believe the findings but longitudinal data ought to be considered in future studies. Students from three TVET institutions in Kwahu provided the data. The study used a variety of methodological tests to show that its findings were valid and trustworthy. However, while analyzing and applying the findings, it is important to take the data source into account.

1.9 Organization of the Study

This study is split into five chapters. The research background, issue description, aim, objectives, and research questions are all emphasized in the first chapter. A review of related material is the main subject of Chapter 2. The material on the research methods is contained in Chapter 3. In Chapter 4, the study's findings and a commentary are given. The summary, significant research findings, conclusions, recommendations, and suggestions for further study are all covered in Chapter 5 as a conclusion.

1.10 Conclusion

This chapter introduces the subsequent chapters and acts as the study's foundation. The background idea that underlies this investigation is described in this chapter. After reviewing the relevant background material, the study's research goals are stated.

After that, a breakdown of the research procedure is given, and then the contributions of the study are duly made. Finally, this chapter gives a summary of the arguments made in each of the chapters that make up the study's division.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Overview

This phase primarily discussed the write-up of the study's associated literature. It includes theories and concepts as well as empirical data supporting what other researchers have already learned or published about the subject.

2.1 The History of Technical and Vocational Education and Training (TVET).

Owing to the development of the steam engine and the first spinning machines in Great Britain, which led to the industrial revolution, TVET had become very popular in Europe and other developed countries by the end of the 18th century (European journal on vocational training, 2004). As a consequence, a great number of persons moved from the rural to the metropolis to work in the expanding factories. Considering that powerful countries increased their colonial activities in an effort to supply their domestic industries with the raw resources and manpower they needed, the industrial revolution in this era spread quickly throughout the developing world as well as Europe and the United States. Additionally, because of the factories' high demand for technical and vocational skills, the school curricula in these nations underwent extensive changes, some of which were closely interconnected to the practical skills needed by these factories (European journal on vocational training, 2004).

TVET in Africa has its roots in the continent's traditional schooling system, which aimed to equip students for societal roles for adulthood (Nsamenang & Tchombe, 2011). However, the introduction of western missionaries alongside European businessmen to Africa disrupted traditional educational practices as early as the 16th and 17th centuries.

The colonial race finished the job in the 18th and 19th centuries by establishing the formal education systems that are now found in the majority of African nations.

The Ghanaian educational system has long included technical and vocational education. In consonance of Atchoarena, Andre and Delluc (2001), TVET is a method of education that primarily assists students in gaining the technical expertise, practical proficiency and comprehension required for employment. TVET is used as a comprehensive word to refer to education and training components that includes technological and associated scientific research with the attainment of empirical skills and mindset for general and productive life. Wahba (2013) asserts that, TVET is a component of the educational system that offers training programs pertaining to work and the supply of skilled apprentices to the labor market. In this respect, TVET should be focused on preparing students for employment now and the foreseeable future.

In Ghana, technical and vocational education as well as apprenticeship were concerted by the National Vocational Training Institute (NVTI) prior to year 2000. The President gave his approval to NVTI's founding Act of Parliament, which was passed in 1970, on January 12, 1971. Its purpose is to synchronize every aspect of national traineeship as well as vocational and technical education (Ghana TVET Report, 2021).

The Institute's primary responsibilities were to:

i. plan training initiatives, including internships and in-plant education for office as well as industrial employees.
ii. educate the training administrators and teachers needed for those programs.
iii. support industry job development and vocational counseling.
iv. create training guidelines and test for trades.
v. start a long-term investigation into the nation's labor needs for qualified workers.

vi. provide and uphold culture and technology ties with institutions that span the world and other global entities engaged in vocational training pursuit; and

vii. pursuant to the standards set forth in this Act, to carry out all actions that are helpful in achieving the Institute's goals.

NACVET, the National Coordinating Committee for Technical and Vocational Education and Training, was established in 1990 to design policies and manage all aspects of TVET, but because NVTI in no way placed emphasis on its role of coordination, its goal was to satisfy Ghana's economic needs and prepare young people for both formal and informal sectors of the economy (Ghana TVET Report, 2021).

2.2 From 1990 to 2012, the TVET Sector's Evolution

The table below shows significant turning points in TVET development in Ghana.

Year	**Landmark/ Process**
1990	The launch of National Coordinating Committee for Technical and Vocational Education and Training
1993	The formation of the National Accreditation Board
1994	The introduction of National Board for Professional and Technician Examinations (NABPTEX)
1997	Promotion of the need for TVET change
2000	MOE and JICA development research on educational advancement "A Master plan to enhance Technical Education in Ghana" was developed.
2001	Technical and Vocational Policy Document (The initial strategy)
2002	NCTVET was suggested to be established in the Report on Education Reform.
2004	The National Consultative Forum for TVET Policy
2004	Finalization of Technical and Vocational Policy Document
2004	TVET Policy Submission by Cabinet

2005	Roundtable Conference Planning for the Technical Committee on Education
2005	Displaying of the Technical and Vocational Policy Document by Cabinet
2006	Directors of MOESS & MMYE established the CPTC (COTVET Preparatory Technical Committee)
2006	NERIC's formulation (National Education Reform)
2006	Workshop to raise awareness of COTVET Bill
2006	Parliamentary review of the COTVET Bill
2006	Adoption of the COTVET Act
2007	Release of the final NERIC report
2007	Inauguration of the board of COTVET (appointment of the COTVET's Ag. Exe. Director)
2008	The appointment of COTVET's executive director
2008	Beginning of the duty of executive director
2010	Beginning of the technical personnel's duties (Specialist in CBT and in policies)
2010	Coordinator for the Informal Sector commenced work with limited activities in momentary office.
2012	Adoption of L. I. 2195

Source: "Technical and Vocational Skills Development (TVSD) Policy Reform and Governance: The Case of Ghana"

2.3 The value of TVET

Technical and Vocational Education and Training (TVET) includes instruction, training, as well as the acquisition of skills related to a range of occupational fields, as well as to production, services, and means of sustenance (UNESCO, 2015). There are three stages of TVET; secondary, post-secondary, and tertiary, therefore, TVET is seen as a form of lifelong learning. According to Wahba (2013), TVET is a component of the educational system that offers training programs pertaining to work and the supply of skilled

apprentices to the labor market. TVET is a broad term that refers to the part of education that includes learning attitudes, skills, and information related to employment.

Technical and Vocational education is regarded as the driving force of both economic and social advancement in any developing nation, and Ghana is no exception. According to (Nsiah-Gyabaah, 2007), TVET is a key component in the growth concept that equips humankind to realize their full potential by broadening their horizons and becoming globally adaptive. Ghana's socio-economic development is pivoted on education with TVET as its central point to this realization. During the year 2000, the Ministry of Education created TVET as a distinct educational discipline. According to Bortei-Doku Aryeetey, Doh and Andoh (2011), the Council for Technical and Vocational Education and Training (COTVET) was created by the Ghana government in 2006 as a legal framework for TVET to coordinate, create national policies as well as monitor every facet of TVET in the nation. The TVET support project, which was launched by the Japan International Cooperation Agency (JICA) in 2004, has been testing CBT in technical and vocational training facilities and helped pass the COTVET law.

The three tenets of equitable growth; the economy, the domain as well as societal stability are all improved by technical and vocational education and training, both directly and indirectly (UNESCO, 2005). TVET provides a career focused knowledge and the kind of training based on skills required to govern the country's productive sector of the economy (Government White Paper on Education, 2004). The goal is to impart young people with the education and tools they need to successfully enter the job and pursue self-employment.

It is widely acknowledged that TVET institutions give people the practical skills they need for work or self-employment. By empowering both men and women to be

independent, this helps to end the nation's economic crisis. According to Johnson and Adams (2004), TVET programs offer the practical skills and learning opportunities that best satisfy the demands of the production as well as service belts of a given nation. Therefore, technical and vocational education is understood to be a way to support the development of human resources and could be stressed as a remedy to lower Ghana's rate of poverty.

2.4 TVET Curriculum Development for the Labor Market

In the twenty-first century, the labor market has become so fiercely competitive that finding gainful work now requires practical skills. To reduce the threat of unemployment in the nation, it makes a lot of sense for the educational system to redesign the curriculum, strategies, and methods to reflect the changing labor market. At all levels, the delivery of the curriculum needs to be evaluated in order for graduates from TVET institutions to be productive and able to fulfill the criteria of business and production. The wish to impart important fundamental skills should be considered when creating the curriculum for TVET programs.

The curriculum is typically viewed as being outdated and not meeting the standards of industry and the workforce, as well as the requirements of trainees. The mismatch between institutional training and industry requirements has a significant negative influence on the employability of graduates from TVET institutions, notably Polytechnic and Technical Institutes. In the end, this situation has effects on the economy of the country (Afeti, Baffour-Awuah, & Badu-Smith, 2003).

(ILO, 2017) argued for the relevance of training in technical and vocational fields in addressing graduate employability issues and young unemployment in general. Training

the brain, the heart, and the hand to instill in trainees the innovative and entrepreneurial skills necessary for the development of the economy is one of the fundamental focuses of TVET.

The government of Ghana is dedicated to fostering the development of an educated, skilled, and self-assured society that is prepared for the demands of the modern workplace through the One District, One Factory program. In this respect, it is important to support JICA's plan to implement Competence-Based Training (CBT) as a teaching methodology in TVET institutions. To ensure that programs' practical content is guaranteed, quality assurance methods must be implemented; and to motivate TVET graduates to enter the private industry and engage in independent work in order to generate their personal and national prosperity, entrepreneurship training must be incorporated into the curriculum.

The reason for this shift in training emphasis is that the skilled technical labor in developed nations has acted as an impetus for the growth and modification of sectors within their providence. Compared to traditional methods of education, CBT is more focused on careers and places more of an emphasis on training that is useful. The terms competency-based education (CBE) and competency-based learning (CBL) are used to describe courses that place a strong emphasis on developing the competencies needed to carry out professional responsibilities.

Do-it-yourself (DIY) learning is how (Agodzo, 2005) described competency-based learning. He claims that someone who has completed CBT must demonstrate how well-prepared he is for practical employment that necessitates on-the-job training. Knowledge, skills, values as well as personality all work together to make up competence.

The combination of these qualities produces the desired professional mindset and behavior, which establishes an individual's competency. It shifts the focus of education away from academic expectations for graduates in terms of what they should understand and be able to do in a variety of challenging circumstances.

CBT has the advantage of allowing students to learn what their potential employers are searching for in applicants when coupled and integrated with traditional or old learning methods. Several countries, including Canada, the United States, New Zealand, Australia, South Africa, and the United Kingdom have embraced and utilized CBT as a successful education and training method that can foster successfully the demands of people who are just entering the workforce, are reentering the economy, or are updating their abilities for a job they already have (JICA, 2001).

2.5 The Relevance of Mathematics as a Development Aid

Numerous circumstances and issues in everyday life can be solved practically and with high relevance through mathematics. It is therefore a key and compulsory topic in many school systems (Shahrill, Sultan, & Brunei, 2013). The Ministry of Education's Strategic Plan 2007-2011 lists mathematics as an indicator of achievement and one of the key skills for the 21st century. It is a fundamental subject at all levels of education.

Although there is no mention of mathematics as a prerequisite topic for enrollment in any courses provided by Vocational and Technical Institutions, it has been established that TVET students require a strong foundation in mathematics in order to succeed. According to Khiat (2010), many engineering concepts cannot be realized without mathematics, so mastering mathematics is essential to engineering. Students' academic success also heavily rests on their mathematical proficiency. As they see mathematics as

a crucial language in all engineering classes and research where mathematical modelling, manipulation, and simulation are heavily used, Bognár and Illés (2012) also supported this relationship.

For the benefit of students' development as contributing members of society in the twenty-first century, educators must provide them with both cognitive and practical experiences in mathematics. In order to produce essential occupational knowledge, it is advisable, according to Billet (2009), to completely integrate practice-based experiences with all aspects of education. It is thought that using applications rather than traditional lectures is the best method to teach mathematics at all levels.

According to the NTCM council (2000), all students, regardless of educational level, should be given actual mathematics lessons in order to see mathematics as a potent model for forecasting real-world phenomena. Knowing mathematics can offer someone a feeling of power and accomplishment. The most important subject for attaining self-sufficiency is mathematics (Algani, 2022). It aids students in preparing effectively for occupations that heavily rely on mathematics, such as engineering, sewing, woodworking, construction, and even agriculture. Adewumi and Adu (2012) observed that mathematics has the following two dimensions:

i. Mathematical understanding of how and why objects operate.
ii. Mathematics techniques/skills.

These are the ways in which the knowledge of mathematics is applied to tools and processes used in everyday life. Mathematics is important in every part of life, including the workplace and personal growth (Ball, Hill, & Bass, 2005). It enhances our capacity for critical and logical thought, promotes pragmatism, and sharpens our minds. Shopkeepers, conductors, bank tellers, and songwriters are just a few of the professions

that use basic mathematical concepts (D'Ambrosio and Ubiratan, 2007). According to Jurdark and Shahin (2001), while mathematics is a conceptual tool used in schools, it is a practical tool used to solve issues in the workplace. It affirms the crucial part that mathematics plays in our everyday lives as a tool for both individual growth and the expansion of the economy as a whole (Algani, 2022).

Nnenna (2015) noted that one way mathematics can help realize the overarching educational goals is by:

i. Fostering the development of strong computational and critical thinking practices.
ii. Increasing one's capacity for problem-solving using relevant mathematical information.
iii. Promoting and fostering originality, accuracy, logical, and abstract thought.
iv. Making it a practice to think systematically, reason logically, draw conclusions, make generalizations, and draw inferences.

Lay (2009) further argued that by including more information about the mathematics students have learned and how to use it in specific programs and requiring instructors to apply it to real-world issues, the image and application of mathematics in TVET programs could be better. Khiat (2010) made a similar proposal, arguing that engineering problems should serve as the foundation for the curriculum's teaching of concepts and formulas. This study suggests that doing so will help these aspiring engineers to engage in practical engineering tasks as part of their education and to develop an associational understanding of engineering mathematics.

2.6 Challenges and Remedies of TVET in Ghana

It cannot be overemphasized how important TVET is to Ghana's growth agenda. Despite this, Ghana's TVET landscape continues to encounter systemic obstacles that limit its chances of success in the future. The issues brought on by the current TVET goal drift are highlighted in the following:

2.6.1 Misalignment of Needs and Skills in the Market:

The TVET sector in Ghana seems to be catching up somewhat slowly, in contrast to academically focused education, which tries to keep up with market demands but has difficulties doing so. This has happened historically. While millions of occupations are changing and being reinvented, the future of employment continues to be significantly influenced by digitization, according to the International Centre for Technical and Vocational Education and Training (UNEVOC).

IFC (2019) lists the talents of the future comprising email communication, data analytics, web research, government online services access, basic software use (like Google Suites), generating and sharing content (on social media), online transactions, and digital marketing (World Bank, 2019). Similar to the boom in green industries, governments are fostering connections between technical and vocational education, and there is an increase in research in this field worldwide, however, research in this area is still scarce in Ghana.

The systems and infrastructure supporting TVET schools can never stay static. Only 29.4% of TVET programs in Ghana's 85 TVET institutions responded to a survey about how responsive TVET programs are to industry requirements, and 9.8% of respondents said there were no obvious connections between TVET programs and industry (Ghana

TVET Report, 2021). This demonstrates how quickly market demands are changing, necessitating a constant reorientation of the TVET program.

2.6.2 Low Preference for TVET Graduates in Industry:

Compared to university graduates, there is still a low preference for TVET graduates in the workforce. Similar to other places, TVET in Ghana already deals with a lot of unfavorable perceptions, which play a role in hiring decisions. The majority of parents and other stakeholders generally place a lesser value on vocational education than they do on academic education. Consequently, it is customary for employers to use the caliber of training offered, as well as subtly take into account the credibility of the institution of study attended, and the professional experience of graduates, among other variables, as standards for choices in order not to take a dangerous wager as to if employees fit into their career portfolio. Therefore, the root of this issue is creating professionally successful TVET graduates.

Although progress has been made toward involving industries, their involvement is still pitifully little despite having significant participants in the value chain of the TVET system. An up-to-date survey backs this up by revealing that approximately 26% of participants rated industry interest in TVET as exceptionally high, 22.4% as moderate, 12.9% as inadequate, and 11.8% as extremely minimal (Ghana TVET Report, 2021). However, 27.1% claimed they were unaware of businesses' interest in TVET. Currently, there is little interaction and cooperation between TVET institutions and business.

Considering it from a different perspective, some employers prefer TVET graduates to university graduates because they make up a more affordable labor population than their university-educated counterparts. Even when TVET graduates have developed the skill

set necessary for their progression up the institutional ladder, there are numerous TVET career paths that include heavy manual labor and usually involve low levels of engagement.

2.6.3 Lower than Average Enrollment Rate in TVET Institutions:

Recent years have seen advancements in the TVET sector, but a problem that prevents the sector's rapid expansion is the comparatively low enrollment in TVET institutions. Once more, this is partially attributable to how the public views and recognizes TVET. The majority of young people desire to work in academic disciplines like medical, law, accounting, economics, etc. Carpentry, hairdressing, and other low-paying occupations like auto repair are seen as inferior alternatives (Caggiano, 2017), thus, people are discouraged from considering jobs in TVET. The government's attitude toward TVET education, which downplays its enormous worth, also gives this more confidence. The value of TVET schooling is not as widely publicized as it is with schooling in SHS. People who may have been denied entry to academic universities are those who are most likely to enroll in TVET institutions. The ability of TVET graduates to subsequently explore higher education in the academic field after demonstrating their abilities in the workplace is not given enough attention.

To guarantee the best results, interventions to redirect Ghana's TVET program must work towards achieving its primary goal. It is crucial to remember that even though TVET system in Ghana encounters many difficulties, it is still possible to revolutionize the industry and put it on par with systems in developed nations. The list of remedies for this growing issue is provided below:

2.6.4 Regular TVET Curriculum and Institutional Audit and Monitoring:

The requirement of TVET institutions to routinely streamline or reorganize their curricula to meet market-relevant requirements is one method to address the problems with TVET in Ghana. The various stakeholders of Ghana TVET Service must take the necessary steps to develop an adequate curriculum for the social and economic requirements of the economy as well as a curriculum that offers opportunities to boost access as well as equity.

In light of this, the state should encourage participation in the TVET curriculum from all industrial schools and offer training while in the field and on the job (Kirior, 2017). There shouldn't be any void in the application of competency-based instruction in TVET curricula, as this will prevent students from acquiring skills that meet business requirements. The ability to solve problems should be taught in the classroom to promote business. To guarantee improved student training and development, greater oversight is necessary as well as evaluation of technical and vocational schools. Pre-primary and elementary schools should make a concerted effort to inform students about the equally important part of TVET-routed careers from an early age.

2.6.5 Enhanced Political Commitment and Investment:

Governments will inevitably push good interventions to the margins if they lack the political will or commitment to do so. The government should offer the TVET sector and institutions of higher learning equal amounts of attention. Increased political will might manifest itself as more financing for the TVET industry. Governments can improve labor market results by fostering stronger ties between educators and employers (Kafle & Pfeiffer, 2021). A shift in the situation must be spearheaded by the administration.

The government needs to take steps to better TVET institutions and, as a result, slow Ghana's critical decline in this area. Recently, Ghana rebranded polytechnics as technical universities, which attracted many students to enroll in TVET institutions all over the nation. In reality, research reveals that, in addition to the HND-related courses, which are somewhat practical oriented, the degree programs offer graduating students with more theoretical knowledge than what one would anticipate from a facility of this kind. The most serious issue is the proliferation of trade programs that TVET schools are enticed to implement, undermining their actual purpose. Stakeholders must be committed to stopping TVET schools and newly founded TVET universities from departing from their mandate, such as the Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (AAMUSTED).

2.6.6 Establishing ties between potential TVET entrepreneurs and the government's YouStart program:

The government of Ghana unveiled the GHS 1 billion YouStart program in 2022. The initiative's goals are to foster entrepreneurship across the country and generate at least 1 million employments for young people in the next three years. (2022 – 2025). Making clear connections by contrasting this initiative with the entrepreneurial potential of TVET is one of the most effective methods to accomplish this. It's possible that the YouStart program was created particularly to support the creation of creative start-up businesses as well as cultivate an entrepreneurial graduate student behavior considering the TVET sector's emphasis on innovation and its capacity to boost the nation's workforce's productivity. So doing would alter public perception and boost enrollment in TVET schools.

2. 7 Theoretical Framework

The study's theoretical foundation and review of the literature are summarized in this section; they are covered in greater depth. This part introduces McClelland's Need Based Theory, which served as the study's direction and helped define its goals. The Componential Theory, which was used to back McClelland's theory, is then briefly introduced. Studies on radical constructivism is done with a discussion on how mathematical concepts can be both "processes" and "objects". The Dubinsky's APOS Theory is further discussed.

2.7.1 The Need-based theory of McClelland

David McClelland, a psychologist from the United States, claims that, motivational needs are acquired over the course of a long-term involvement with the natural world, and different people prioritize divergent needs over others (Acquah, Nsiah, Antie & Otoo, 2021). McClelland concentrated on the three internal requirements namely; need for Achievement (nAch), need for Power (nPow) and need for Affiliation (nAff). The desire for excellence, achievement in connection to goals, and success is referred to as the nAch (Arnolds & Boshoff, 2003). According to Vrba Erasmus (2018), the need to influence others' behavior is what is meant by the nPow. The nAff is when a person chooses to interact with other people and seeks out their approval or acceptance (Acquah, Nsiah, Antie & Otoo, 2021). There is a challenge in identifying students primary needs and providing alternatives where these requirements may be fulfilled; this endeavor served as the study's focal point of investigation.

The theory of McClelland was chosen for this research because its core concepts is feasible to be operationalized in view of the fact that these concepts are universal (Bataeva, 2018). The three needs identified by McClelland were used in this research to

operationalize motivation. Additionally, his study findings are recognized as a content-oriented paradigm, which focuses on human needs and explains the various variables that either encourage or restrain an individual's behavior (Erasmus, 2018).

According to David McClelland, people learn their motivational needs through lifelong interactions with their environment, and they rank various needs in order of importance (Acquah, Nsiah, Antie, & Otoo, 2021). Employers face a challenge in identifying the key needs of their workforce and presenting chances where these needs can be satisfied, according to Erasmus (2018). Humans can develop their own skills because they are not fixed. (Vrba, 2014). According to Bataeva (2018:136), human behavior's major motivations begin to form when children are in primary school.

This research centered primarily on the need-based theory of McClelland (Erasmus, 2018), regardless of the fact that Herzberg, McClelland, and Maslow's ideas are classified as content-driven theories in research that focuses on requirements for humanity by explaining the various elements that can encourage or impede the behavior of a person. This is due to McClelland's theory's ability to operationalize its major categories and the fact that these categories are universal (Bataeva, 2018:140). Interpersonal performance as well as intrapersonal performance are a pair of notable operationalization of achievement used by Nijs, Gallardo-Gallardo, Dries and Sels (2014) as the primary criterion for talent.

2.7.1.1 The Need for Achievement (nAch)

The achievement need (nAch), according to Arnolds and Boshoff (2003), is a person's desire to attain success and to outperform expectations. A person with a nAch has the motivation to achieve objectives and get past challenges (Ncube & Zondo, 2018).

Achievers favor jobs that give them specific responsibility, feedback, and moderate risks, according to Vrba (2014). This is evident in the following manner in Bataeva's (2018:142) list of nAch category of empirical indicators: A person's commitment to a mission till completion, their thirst to continuously enhance their methods as well as outcomes the actions, their goal to outperform current norms when it comes to their chosen pursuits, and their readiness to accept culpability for every consequence of those actions.

According to Bataeva (2018), the final indicator also shows that people who accept personal accountability for their performance and have a high nAch tend to seek feedback on their performance, change the way they do things, and strive to perform preferably on fairly challenging endeavors.

An individual having a low nAch, on the other hand, is more concerned with how others view them than with how efficiently they perform their jobs, which is more indicative of a representative worker (Dobre, 2013). Arguments abound on the best motive profile that suits management style and which motivates business success, particularly among the nAch and the nPow. Noteworthy is the fact that study demonstrates that people having nAch prefer to concentrate on their personal accomplishment and perhaps not those of others, conversely, people with a desire for institutional authority concentrate on the success of the craft (McClelland & Burnham, 2003).

The nPow, as stated by McClelland and Burnham (2003), is the ideal stimulant for managerial approaches when considering McClelland's motivators. Their conclusion is further supported by Erasmus (2018), who claims that people with significant nPow but little nAff make effective managers and people with substantial nAch frequently produce excellent businesspeople.

2.7.1.2 The Need for Power (nPow)

The need to influence someone else's behavior in a manner that they otherwise would not have been referred to as the nPow (Vrba, 2014; Erasmus, 2018). Simply said, those who have a significant nPow hunt for places of authority in order to exert control over others (Royle, 2012). The two types of nPow are individual nPow, which is perceived unfavorably, and institutional nPow, also known as social authority, which is viewed favorably (Bhattacharya & Mittal, 2020).

In order for the need for institutional power to be used for the institution's benefit rather than the individual's nPow, McClelland and Burnham (2003) clarify that it must be disciplined and controlled. A person's desire to control others for their own gratification by disregarding their coworkers' best delight and purposefully causing harm to others is known as personal nPow (Bataeva, 2018:143).

In comparison, nPow is positively demonstrated by the subsequent three scientific signals: a person's desire for power, their concern for the welfare of their colleagues, and their efforts to create the ideal environment for resolving effective issues (Bataeva, 2018:143). When seeking institutional authority within a company, one should be mindful of the second power indicator, which speaks to concern for the welfare of coworkers and is located close to the affiliation need. Pursuant to the findings of McClelland and Burnham's (2003) study, a leader with a nAff, also known as an "affiliative manager," is a worker who desires to be appreciated by their staff as opposed to a leader with a nPow, who focuses exclusively on productivity.

Dobre (2013) uses the Sociological Theory to support his claim that a high nAff employee would not make an effective manager when compared to a power manager. Noteworthy is the claim made by McClelland and Burnham (2003) that a strong

employee also has other qualities, not just staunch prospective managers but those who are interested in authority and are unconcerned with the requirements of those in close proximity. In light of their findings, McClelland and Burnham (2003) further concluded that stronger workers are those who exhibit high levels of power motivation, low levels of affinity motivation, and high levels of inhibition.

2.7.1.3 The Need for Affiliation (nAff)

An individual experiencing nAff chooses to interact with other people and seeks out their approval or acceptance (Bhattacharya & Mittal, 2020). Affiliative workers want to have warm, close connections with other people (Erasmus, 2018). Additionally, if given the opportunity to work in groups, such workers are driven because they find fulfillment in the individuals they cooperate with as opposed to the task alone (Vrba, 2014). As a result, it has been demonstrated that group involvement significantly affects motivation (Steers & Shapiro, 2004).

The nAff is classified by Bataeva (2018:143) as having the subsequent trilogy of appearances: The effort a person makes to create and maintain good interpersonal relationships; an individual offering assistance to others; somebody who fears disapproval from people and needs to be accepted by them. As a result, workers in affiliations are sometimes viewed as compassionate as well as helpful. These people have a tendency to render erroneous and prejudicial choices, which prevents them from adhering to methodological approaches and demotivates those around them, in line with the 2003 study of McClelland and Burnham. In contrast to those who have a need for institutional authority, as was already stated, affiliative people aren't considered the most outstanding managers in business.

However, Royle (2012) indicates that the need to establish solid relationships with others also functions as a tool for organizations to use while navigating risky or uncertain environments, proving that the nAff ought to be taken into account. In order to balance the nPow (competition) and the nAff (cooperation), it is best to offer incentives that promote individual as well as collective achievement (Erasmus, 2018).

2.7.2 The Componential Theory

Considering Kessler (2013), it is indicated that certain within-individual components would ultimately unite to generate ingenuity, hence, the components were judged crucial for this investigation. Additionally, when an individual is intrinsically motivated, has extensive subject-matter knowledge, and has strong creative thinking abilities, their creativity is at its highest. Domain-relevant skills, according to Kessler (2013), are knowledge, experience, aptitude, talent, and technical expertise in the field in which the convergent thinker works. Cognitive styles and psychological traits that go along with autonomy, taking risks, fresh viewpoints on issues, regulated working practices as well as aptitude for idea generation are among the creativity-relevant skills (Kessler, 2013). It demonstrates that it is a skill that can be developed and learned through practice of methods to improve mental elasticity and independence, which is again backed by the instruction and advancement programs offered by the chosen business.

The Componential Theory states that originality is most likely to happen when a person's abilities intersect with their most compelling inherent desires and most ardent pride. The social environment is important to this research because it influences internal and external motivation as well as the connection between invention and creativity. Along with these, task enthusiasm, inventiveness, and domain-relevant abilities are other important elements. This procedure demonstrates that extrinsic motivation that is

constructive does indeed increase intrinsic drive. But whether this process will work well together depends on three key factors: the person's starting level of motivation, the kind of external motivator applied as well as the frequency of the extrinsic motivation.

Amabile's study developed significantly, leading to the creation of a concept known as motivational synergy (Kessler, 2013). This procedure demonstrates that external motivation that is constructive increase internal drive. This meant that the process now included both the individual creative process and the innovation process, demonstrating that the latter actually enhances the former when the aforementioned determinants allow extrinsic motivation to effectively complement intrinsic motivation (Amabile & Pratt, 2016).

The desire to express oneself has become especially relevant in relation to the modernization of ideals in today's culture (Bataeva, 2018:145). This drive prevails in creative endeavors because it is important and makes living enjoyable. The distinction between creativity and invention is though, subtle. Innovation is the execution of fresh, successful ideas that have never been introduced, whereas the process of coming up with fresh concepts, fantasies, and prospects before making them into reality is known as creativity (Surbhi, 2018). As a result, it is obvious that creativity is a prerequisite for innovation; but for this study, comprehension is more important on how creativity issues present in the development practical skills relate to innovation.

2.7.3 Theory of APOS by Dubinsky

APOS (Action-Process-Object-Schema) offers a structure for study and developing courses that promotes the creation of strategies for learning and assimilation of abstract mathematics (Brijlall & Ndlovu, 2013). The theoretical cornerstone of the framework is

the constructivism model, which focuses on the idea that individuals typically view mathematical challenges through the building of conceptual behaviors, procedures and components and organize them into concepts to make meaning from scenarios and overcome difficulties (Dubinsky & McDonald, 2008). Based on a study by Dubinsky and McDonald (2001), learning activities should be created to help students build these mental structures in their minds after identifying the likely mental structures for a specific idea.

Further supporting, the cognitive development model proposed by Piaget in 1967 used the APOS framework. The reflective conceptualization, as defined by Piaget, is crucial to Dubinsky's theory (Bowie, 1998). Bowie asserts that reflecting abstraction is comprised of two parts: the projection of reorganizing existing knowledge systems and elevating existing knowledge to a higher plane of cognition (Dubinsky, 1991). Reflective abstraction is thus a process of knowledge production, according to Dubinsky (1991), who described five types of construction:

a. Interiorization:

This is similar to the ideas put forth by Sfard and Piaget (Bowie, 1998). Bowie (1998) asserts that actions taken on things are internalized into a system of operations.

b. The coordination

In order to create a new process, several procedures must be coordinated. For example, Organization of the formation of derivative functions is required by the chain rule for differentiation (Bowie, 1998).

c. Capsulization

Sfard asserts that capsulation is analogous to reification. The shift from seeing something as a process to seeing it as an object is a big one (Bowie, 1998).

d. Generalizing

When pupils are able to see functions as a map to both numbers and vectors, for example, when the current schema is used in a variety of scenarios (Bowie, 1998).

e. Reversing

When an interiorized procedure can be turned around, example, pupils' capacity to recognize the reversing process of derivatives (Bowie, 1998).

An action is regarded as a transition, according to Weller, Arnon, and Dubinsky (2009) when it is a response to inputs that a person perceives as external. It requires specialized instruction as well as the deliberate execution of each transformational phase. Thus, a student is said to grasp how a function limit works in action if they can consider a function's limit, without needing an explicit expression and can only manipulate the variable in the expression by substituting values that are close to the limit.

According to Aydin and Mutlu (2013), process is a stage in which a person repeats and considers an action. The behavior may be interiorized into an internal process of thought, which means that a process takes place when an internal framework replicates the action only inside the subject's head. Individuals can envision performing the transition, rather of having to carry out each step explicitly. For instance, a student who understands how to design a values-driven thought process, thinks in terms of inputs, which may or may not be specified as well as actions made to the inputs to create outputs.

Using data from Weller, Arnon, and Dubinsky, (Aydin and Mutlu, 2013) asserts that, a person has internalized a process if they become conscious of it as a whole, understand that modifications can affect it as a whole, and are able to create these modifications (explicitly or in their imagination). For instance, when a person reaches the limit of a function notion, he or she may encounter situations that call for the use of various

activities and/or processes. These might involve the idea of an operation, $\lim_{x\to 2} \frac{|x-2|}{x-2}$, that takes two functions and creates a third function. To operate on this new function's one-sided limit, the procedure must be contained and converted into a component.

According to Weller, Arnon, and Dubinsky (quoted in Aydin and Mutlu, 2013), a schema can be thought of as a logical framework that organizes and links various acts, processes, and objects in a particular mathematical field. It is coherent in that it gives someone a way to decide whether the schema applies when confronted with a specific mathematical issue. For instance, the coherence could be found in the knowledge that in order to ascertain whether a function has a limit, $\lim_{x\to a} f(x)$, both the left and right input values of a, the associated result values as well as the method of converting components of the inputs into components of the outputs must all be taken into account.

2.8 Conceptual Framework

Any attempt to establish practical lessons in a sustainable way must acknowledge and take into account the integration of mathematics in the TVET classroom. The structure of a conventional TVET education system would need to be significantly changed in order to move away from classes that are specialized in one area. Additionally, it is advised that Mathematics teachers' pay close attention to the learning objectives and progressions that are particular to the subject in order to avoid undermining students' progress in these disciplines (Tytler, Williams, Hobbs, & Anderson, 2019). Similar consideration must be given to the cognitive demands placed on students when integrating mathematics, as doing so could overwhelm students and affects how well they can learn and remain motivated (Honey, Pearson, & Schweingruber, 2014). As a result, lessons that integrate mathematics must be used in addition to sessions that focus on a

single subject to guarantee that students have a firm knowledge base and understanding in each discipline before attempting to combine content from the two.

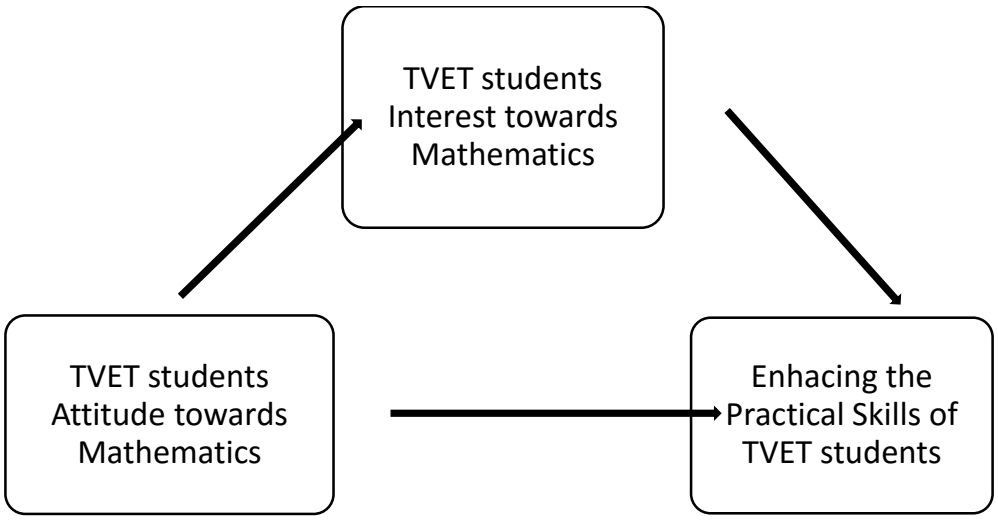
Integrating knowledge and abilities from the two areas is a crucial component that necessitates careful planning. Early on in learning, knowledge is frequently rigid. In the early phases of learning, "far transfer," or applying knowledge to situations that are significantly different, almost always fails (Willingham, 2009). In areas like mathematics, where students confront problems with comparable underlying structures and anticipated solution techniques, or "near transfer," teachers tend to focus more on offering obstacles (Renkl, 2017).

When this happens, the features of the numerical values or objects (if the task being changed is a word problem) are usually varied. Similar to the previous example, Minervino, Olguín and Trench (2017) found that exploring and comparing the underlying deep structure of problems often results in improved transfer. In order to challenge students to apply their information in cross-curricular contexts, it is vital to first create basic learning in a topic via successful single-subject teaching methodologies. The transfer process should be aided by using a context that is already familiar, such as a mathematical subject that was previously studied. This minimizes cognitive burden because of the context's familiarity. The greatest way to facilitate learners' "far transfer" of mathematical information into many contexts, especially transdisciplinary contexts, is to establish such an approach.

It has been recognized that the teaching and learning process benefits from placing a strong emphasis on discourse, as in a social constructivist perspective related to Vygotskian ideas. Chang (2011) put out a paradigm for the pedagogy in mathematics

education in the classroom that encourages teachers to incite discussion by posing challenging questions.

The main features of the study's framework are the attitudes of TVET students coupled with the interest of TVET students towards the learning of Mathematics in enhancing learners' knowledge to related practical skills.



2.8.1 TVET Students Attitude towards Mathematics

The concept of "attitude" refers to a person's conditioned tendency to respond favorably or adversely to a thing, incident, idea, or other person. According to Joseph (2013), it is seen as a belief that people have which conveys their thoughts and feelings and at times manifests in their conduct. People's conduct toward objects, circumstances, and other people is influenced by their attitudes since attitudes, action, and feelings are all interconnected.

Syyeda (2016) asserts that attitude is multimodal. It considers affection, cognition, and behavior as three factors. Emotions, worldview, and beliefs all contribute to affection. Cognition is a representation of how students view the value of the subject. Contrarily,

conduct is related to students' motivation for acquiring knowledge, which is seen in their manner, commitment, and in-class behavior.

These elements are used to gauge the following characteristics of the student's attitude toward mathematics:

i. Self-confidence, anxiety, enjoyment (Affection)

ii. Perceived usefulness (Cognition)

iii. Intrinsic motivation (Behavior)

2.8.1.1 Self-confidence

According to Adelson and McCoach (2011), self-confidence is defined as students' assessments of their numerical abilities including the attitudes of their own ability to study and perform well in mathematics. According to Hannula, Maijala, and Pehkonen's (2004) findings, students' self-confidence has a significant impact on their learning, which in turn affects how well they perform in mathematics. Students who are confident in their abilities, according to Van der Bergh (2013), have a lower anxiety of failing simply because they believe they are capable of succeeding at learning mathematics. These students are prepared to take on mathematical problems, which in turn increases their academic accomplishment. When compared, students lacking in confidence don't believe in themselves, hence, prefer not to take up mathematics task (Adelson & McCoach, 2011). Therefore, it is crucial to research how students feel about their own confidence and how it affects their performance.

2.8.1.2 Mathematics Anxiety

According to Chaman and Callingham (2013), an emotional reaction to a topic of mathematics is known as mathematics anxiety in which students have negative emotions

to mathematical ideas and assessments. In accordance with this definition, a feeling of stress, helplessness, and apprehension known as mathematics anxiety, hinders the studying of mathematics by preventing attention (Zakaria & Nordin, 2008).

According to Getahun, Adamu, Andargie and Mebrat (2016), mathematics anxiety is thought to affect students' achievement through affecting their attitude toward motivation for learning the subject. The capacity to think about, comprehend as well as manage an individual's learning (metacognitive knowledge) was found to be adversely connected with mathematics anxiety (Hoofar & Taleb, 2015). The less metacognitive information pupils have, which ultimately hurts their performance, the more nervous they are, according to this. Mohamed and Tarmizi (2010), conducted a comparative study at higher education institutions and discovered that anxiety has a significant detrimental impact on achievement in mathematics. Since anxiety is associated with students' attitudes and mathematical achievement, it is crucial to measure the extent of anxiety at all levels of education.

2.8.1.3 Enjoyment of mathematics.

The extent to which students love performing and understanding mathematics will determine how much they enjoy it (Kupari & Nissinen, 2013). Syyeda (2016) asserts that a student's pleasure with their education may have an impact on their behavior or way of thinking. PISA 2012 findings published by the OECD (2013) indicate that students may decide to pursue mathematics due to the fact they find it interesting and engaging. They also assert that enjoyment and interest affect understanding as well as the degree and regularity of learning engagement. In other words, students are more likely to engage in challenging tasks if they enjoy mathematics, which will enhance their educational experience and academic achievement. Since enjoyment, students' learning, and

performance are connected, it is important to assess students' level of enjoyment with mathematics in order to monitor students' learning and performance.

2.8.1.4 Perceived usefulness (Cognition)

Perceived usefulness, according to Adelson and McCoach (2011), relates to students' opinions about the importance of mathematics in the present and the future. It is believed that students' opinions on mathematics' usefulness have an impact on their attitudes toward it. If students are aware of how crucial mathematics is to their daily lives, they will be more driven to study, practice, and learn the subject (Syyeda, 2016). Although most students have unfavorable feelings towards mathematics, they show positive cognitive attitudes toward it. This demonstrates that students understand the value of mathematics in their daily lives and potential careers. According to Guy, Cornick and Beckford (2015) study, success is positively correlated with how beneficial mathematics is. Therefore, it is important to investigate the connection between mathematics value, attitudes, and performance.

2.8.1.5 Internal drive (Action)

According to Guy, Cornick and Beckford (2015), intrinsic motivation is linked to both interest and a desire to learn mathematics. Students have an inherent drive to pursue mathematics if they have a keen interest in undertaking the subject (OECD, 2013). Motivation, in accordance with Yunus and Ali (2009), is what drives learning. Intrinsic motivation has an influence on learning outcomes like involvement, achievement, and choice of career. Studying motivating factors in relation to attitude and achievement is therefore essential.

2.8.2 Relationship Between TVET Students Attitudes and Students' Interest in Mathematics

The relationship between attitudes toward mathematics and academic achievement has been a major subject of mathematics education research in the past (Ma & Kishor, 1997). Having a positive attitude toward mathematics is one essential component for students to succeed in the subject. The attitudes of students and their academic performance are related (Mohd, Mahmood, & Mohd, 2011).

Professionals have focused a lot of attention on how pupils feel about mathematics (Goldin, et al., 2016). According to Mullis, Martin, Foy, Kelly, and Fishbein (2020), students who have a good attitude about mathematics tend to like it, which may result in great performance. However, students who have a negative attitude toward mathematics are more likely to despise the subject, think it is pointless, and avoid it (Chouinard, Karsenti, & Roy, 2007). As a result, we can assume that there is a connection between a student's attitude and interest in mathematics.

According to Knight (2005), attitude is one of the key determinants of success. He classified attitude into three distinct groups: emotional reaction, behavior, and ideology. Zan and Martino (2007) differentiated among positive and negative attitudes by describing a positive attitude as a favorable mental view toward the subject and a negative attitude as an unfavorable mental orientation toward the subject. After examining a variety of definitions for attitudes, Mata, Monteiro and Peixoto (2012) described attitude towards mathematics as " an inclination toward a particular facet of mathematics that a person has developed by means of their ideas and experiences but that is malleable."

As a result, a student's attitude toward mathematics can be a reliable indicator of their interest in the subject. More recently, it was discovered in the Thai province of Songkhla that students' attitudes about learning mathematics and their interest as well as achievement were positively correlated (Khun-Inkeeree, Omar-Frauzee, & Othman, 2016). As a result, a key factor that may affect students' success is their attitude toward mathematics.

2.8.3 Synthesis of Mathematics Knowledge and Practical Skills

For students to acquire new concepts and connect them to their prior knowledge, relevant prior information is essential (Renkl 2017). It is crucial to offer opportunities for making connections between concepts once a foundation of knowledge and understanding in a particular topic or concept has been created in order to increase understanding and recall. This quality must be attained by sufficiently examining material from Mathematics and Practical Skills. Mathematics shouldn't only be utilized in practical courses as a means of facilitating the completion of tasks, and practical lessons shouldn't be seen as a way of giving mathematical concepts a helpful context.

Opportunities to blend prior knowledge from mathematics and practical classes also enables a student's learning route to continue logically, as advised by the updated Bloom's Taxonomy (Anderson, et al., 2001). Students may advance from difficulties with recall, comprehension, and application in a particular area of information to difficulties with analysis, assessment, and creation across areas of knowledge. The framework for such experiences is established by integrating transdisciplinary lessons into single topic training, which establishes foundational learning. The combination and application of previously acquired knowledge and abilities in situations other than those in which they were learned, however, frequently necessitate careful planning and support (Honey et al.

2014). In order to complete a complex assignment successfully, students must rotate between mathematical knowledge and skills and practical training. This approach should result in improved learning retention. Interleaving was shown to have a significant impact on student retention in mathematics by (Rohrer, Dedrick, Hartwig, & Cheung, 2020). Similar to how students are returning to content they have previously interacted with, the engagement with previously learned material after a period of time (distributed practice) is an intrinsic part. Additionally, distributed practice has been shown to significantly improve student learning retention (Rohrer D. , 2015).

2.8.4 Application of Mathematics to Related Practical Skills

Mathematical concepts are frequently abstract in nature, making it challenging for students to fully comprehend them. Tasks that allow students to apply these ideas to realistic practical lessons might increase representations of these ideas and promote better understanding. In general, learning is more successful when students can relate a new concept to the one, they are already familiar with (Richland, Zur, & Holyoak, 2007). When it comes to mathematics, this is especially accurate. Realistic Mathematics Education (RME), a theory of mathematics instruction, is based on this idea. Since the 1970s, RME has supported mathematics instruction in the Netherlands, and it has also been successfully used in the US and UK (Van den Heuvel-Panhuizen & Drijvers, 2020). To enable students to comprehend the importance and purpose of the mathematics they are learning; it is crucial in RME to pose issues to which they can relate (van den Heuvel-Panhuizen et al., 2020). This trait will promote learning during these cross-disciplinary lessons and may increase student interest in what they are learning.

2.9 Summary of Literature Review

The review of the related literature to the study was the main topic of discussion in this chapter. It incorporates theories, thoughts, and factual information that backs up what other scholars have discovered or written about the topic previously. Some of the subheadings covered in this chapter are the history of TVET, TVET curriculum development for the labor market, Students attitude towards Mathematics, the Relevance of Mathematics as a Development Aid, Challenges and Remedies of TVET in Ghana, and others.

The primary theoretical models used were the Needs-based theory by McClelland and Dubinsky's APOS Theory. The theory of McClelland was presented in this chapter in order to better comprehend students' objectives and motivators. The nAch, nPow, and nAff requirements were first identified by McClelland. According to the literature review, a student who aspires for success and outstanding leadership should have a high need for power, a low need for affiliation, and a high need for achievement (McClelland & Burnham, 2003). Dubinsky's APOS Theory was presented to support the theory of cognitive development as postulated by Piaget in 1967. The theory is predicated on the notion that individuals frequently invent mental activities, procedures and concepts in order to make meaning to and solve challenges involving mathematics-related problems. The conceptual framework linked TVET students' attitude and their interest mathematics towards the enhancement of their practical skills. The model was chosen because of its adaptability for supporting the challenging intellectual tasks that frequently call for knowledge and expertise from TVET institutions, and also, due to its shown value when applied to the study.

CHAPTER THREE

METHODOLOGY

3.0 Overview

The methodology of the research and the rationale behind it are covered in this chapter. The research design, which discusses how the data of the study is gathered and which research approach is best appropriate for this study, is discussed at the beginning of this chapter. The sampling design is next examined, focusing on the intended population and selection strategy for this research. The best method for gathering data for the present inquiry is then determined after a discussion of the statistical collecting tool. The process utilized to gather data used in this research is further described in the data gathering. The statistical analyses used for this investigation is then discussed.

3.1 Study Area

Kwahu in Ghana's Eastern Region is the study location with regard to this investigation. The term "Kwahu" alludes to a region and a population of Twi-speaking Akan's who reside in Ghana. Due to its highest habitable elevation in the nation, the name given to the area is "Asaase Aban" or the Natural Fortress. The Kwahu's are well known for their commercial endeavours and reside in the east edge of Ashanti in Ghana. The most distinguished Kwahu activity is trading, where people use any available means to save money for the opening of stores (Garlick, 1967).

In the manufacturing and hotel businesses, as well as in the industries of pharmaceuticals and building materials, Kwahu's have expanded strong resumés and taken on the gathering of larger assertions. Together with their Ashanti cousins, Kwahu's most likely

own the majority of residential and business properties in Accra alongside other significant towns in the nation's southern region.

Kwahu is famous for the Paragliding festivity at Atibie, where experienced pilots are eligible to take part. As part of their yearly celebrations, the community also holds the final Akwasidae of the year, which gives them a chance to reconnect with their forefathers, reflect on their collective accomplishments, make plans for the future, and thank God for safeguarding and providing for them throughout the years.

All towns and villages in Kwahu are home to a number of educational establishments. In the town of Abetifi, the Presbyterian Church operates the Presbyterian University of Ghana (PUG) and a College of Education. A government nursing school is located in Atibie and at Nkawkaw, the Catholic Church oversees and manages two nursing education centres. There are over 200 basic schools and about twenty-two (22) second-cycle institutions. In Kwahu, there are currently eight TVET schools.

3.2 Research Paradigm

The term "paradigm" describes a worldview, which is a basic philosophical perspective on the universe as well as methods of inquiry that a scholar can apply to a project (Creswell & Creswell, 2018). Humans construct their ideologies in light of their prior academic perspectives, role models, experts, scientific networks, and educational outcomes. Three paradigms; post-positivism, positivism and constructivism are further discussed.

According to Creswell (2013), post-positivism is a paradigm that can be seen in scientific investigations. For instance, post-positivists recognize the necessity to access and identify the factors that shape the consequences when a problem emerges. Post-

positivists therefore come to the conclusion that even if reality is unbiased, it can only be imperfectly grasped when it is described as a simple statistical probability (Brodsky et al., 2016).

In contrast, positivists believe that there is just one actual reality that can be properly understood, according to Brodsky et al. (2016). Positive and postpositivist research frequently uses quantitative techniques (Mackenzie & Knipe, 2006). The idea that biases or values ought to be taken into account when doing research is rejected by both post positivists and positivists (Brodsky et al., 2016). As a result, this paradigm is deemed suitable for the study.

According to the positivist paradigm, actual events may be experimentally observed and rationally interpreted. When assessing a scientific theory's validity, one should consider if our knowledge claims—that is, theory-based predictions—are in line with the data that our senses allow us to gather. Micro-level experimentation in a lab-like setting is emphasized in positivist research technique (methodological individualism), which removes the complexity of the outside world (e.g., social, psychological, and economic linkages between unemployment, and crime or suicide).

The conclusions reached through the "scientific method" are then used to recommend policies (such as job training for the unemployed). Psychologists are aware that this produces findings with internal validity, meaning that the relationships found in the experiment are legitimate in that particular setting. Although the outcomes of experiments offer insightful information about the nature of reality, they might not be externally valid. In other words, relationships observed in a controlled laboratory setting could not hold true in the complex exterior world where a larger number of factors interact.

3.3 Research Design

An operational or logistical strategy for the procedures and tasks necessary to accomplish a study might be imagined by a researcher using a research design (Kumar, 2011). Additionally, these processes must be accepted in order to present true, factual, and precise answers to the study questions. The research design's key purposes are; the researcher's questions, the sort of data needed for analysis, and the researcher's ontological and epistemological viewpoints which serve as the study's paradigm and axiology were all taken into consideration while choosing the design for this study (Brodsky et al., 2016). According to Kumar (2011), the focus, approach, and mode of inquiry are established by the differences in philosophical perspectives within each paradigm in connection to the study's aim, which in turn establishes the structural elements of the research design.

A research design is a strategy that outlines how information about a specific issue should be gathered and analyzed. A research design is the specification of techniques and procedures for gathering the necessary material, according to Green and Tull (2012). What information is to be gathered from which sources by what means is specified by the project's overall operational structure or pattern.

An exploratory survey approach was used for the investigation. In order to document a sample of people's attitudes, beliefs, actions, perceptions, or attributes for descriptive study, questionnaires are typically given to them at a certain time. According to Creswell (2013), questionnaires are a common tool used by researchers to collect statistically evaluated measurable numerical data that may be used to evaluate research questions or hypotheses. It was judged that, given the objective of this study, the survey's design effectively permitted data collection from a significant number of participants under a

reasonably brief duration. Additionally, because the study aimed to improve TVET students' practical skills through the use of mathematics, using survey methodology allowed for generalization of findings to include TVET students' attitudes and interest in mathematics in relation to their practical skills. A descriptive research approach is a study that collects data and incorporates accurate and appropriate data interpretation. In the field of educational inquiry, this approach is extensively utilized.

3.4 Population

The study design used for this study was a survey since it was possible to collect and analyze quantitative data quantitatively using both descriptive and inferential statistics (Saunders, Lewis, & Thornhill, 2012). A total of 1,500 second-year TVET students from three TVET schools in Kwahu, in Ghana's Eastern region, made up the study's population. All of the chosen TVET schools provided courses with a mix of students' learning abilities. The social, economic, and academic backgrounds of Mathematics students were also examined and taken into account.

3.5 Sample and Sampling Procedure

Purposive and simple random sample procedures were the two sampling methods used in the investigation. Despite the study's emphasis on TVET institutions in Kwahu, a purposive sampling technique was utilized to focus on second-year students. Students who studied Mechanical Engineering Technology, Electrical Engineering Technology, Building and Construction Technology as well as Fashion and Design Technology were chosen using a purposeful sampling technique. These were second-year students whose separate academic programs included mathematics.

After purposefully focusing on these student groups, a simple random sampling procedure was employed to select students from these groups who were present in the classroom throughout the data collection period. The simplest and most popular way of selecting a sample is simple random sampling, in which the sample is chosen unit by unit with an equal chance of being chosen for each unit at each draw. Every member of a population has an equal chance of being chosen as a responder when using simple random sampling (Thomas, 2020). Any research conducted on this sample should have high internal and external validity because randomization was used, and there should be less chance of biases like sampling bias and selection bias.

The data was gathered during class hours, after permission was sought from the teachers handling the class at the time of data collection. A systematic questionnaire was used in the study, and information was obtained over the course of four weeks.

The goal of the study was to determine whether using mathematics as a learning tool directly improves students' practicality. To meet the predetermined condition of having all TVET students eager to respond to the survey questions, a straightforward random selection is chosen for this study.

3.6 Sample Size

The number of components that is incorporated into a study is known as the sample size (Malhotra & Dash, 2016). The sample size is the portion of a population that is required to guarantee that there is sufficient information for valid conclusions (Sekaran & Bougie, 2010). The total number of people included in the sample, as defined by Kumar, Talib and Ramayah (2013), is the sample size (p. 122). It just alludes to the total number of participants in the study.

The methodology used by Miller and Brewer (2003) to determine the sample size used for this investigation. The equation reads as follows:

$$n = \frac{N}{1 + N(\alpha^2)}$$

where *N* is the population size (1,500), *n* is the sample size, and α is the significance level (0.05). The sample size calculation was based on a 95% confidence interval with a 5% margin of error because the study's focus was on human respondents, whose responses could be biased.

Pursuant to the formula, a total sample size of 316 students were chosen from the three TVET schools in Kwahu.

$$n = \frac{1500}{1 + 1500(0.05^2)} = 316$$

The total sample size for the study were from students who studied Mechanical Engineering Technology, Electrical Engineering Technology, Building and Construction Technology, and Fashion and Design Technology. Students who participated in the study were informed that the Principal and Head of the Mathematics Department of the schools had given their approval prior to the major data collection exercise.

3.7 Data Collection

The Faculty Ethics Committee and the Mathematics Department of AAMUSTED both gave their approval to the research concept and the tool used to gather information for this inquiry. The use of structured questionnaires for data collection was authorized.

Following the collection of all the data, descriptive analysis as well as confirmatory factor analysis was done. It is significant to note that, prior to the start of the actual research, an experimental study was conducted to be certain that the study questions were effective and that the appropriate and essential data was acquired to fill the knowledge

gap in the field chosen for this study. The discussion of the pilot study, topics related to the questionnaires, the validity of the research tools, and other instruments of measurement are covered.

3.8 Pilot Study

Before beginning the data gathering process, the questionnaire preparation procedure is seen as being essential. According to Turner (2010), this approach can alter or derail the process of gathering data and can either lessen or make troublesome situations which may arise after the research is conducted. In order to ensure that the study outcomes are met and the appropriate research questions are addressed, pilot testing is required (Roller & Lavrakas, 2015). With people who are comparable to and share the same interests as the target participants, a pilot study should be conducted (Turner, 2010; Mertens, 2014). During the data gathering phase, a small-scale pilot research was carried out to guarantee quality assurance. The pilot study eliminated superfluous phrasing and made obvious distinctions between questions that were comparable. Students from TVET institutions with the exception of the three chosen TVET schools made up the sample. Thirty-two students who were not included in the initial sample base but who had similar interests made up this small sample.

3.9 Data Collection Instruments

Every method of gathering data has benefits and drawbacks, but a researcher must choose the one that is most appropriate for their study's goals. In this study, a questionnaire was used to gather data since it was important to understand the respondent's responses to the research questions by examining the results (Mertens, 2014).

The accuracy and dependability of a structured questionnaire with closed-end items are often considered to be indicators of an instrument's validity. This survey was created to gather information on variables important to the study and was modified from an existing instrument. The use of questionnaires by the researcher allowed the quickly collection of information from a large number of respondents while still preserving anonymity and confidentiality.

There are two sections to the questionnaire. The study's participants' demographic data are gathered in the first section. The second section consists of a variety of inquiries meant to address the pertinent research questions. The technique uses five-point Likert scales to precisely measure views and opinions. These scales run from "SA" (strongly agree) at a value of 5 down to "SD" (strongly disagree), at a value of 1. Respondents can assess the extent of acceptance or disapproval with statements about their opinions on various issues by using these Likert scales.

There were 30 items on the survey, with five possible response alternatives: strongly agree (SA), agree (A), neutral (N), disagree (D), and strongly disagree (SD). The questionnaire method is most effective in situations where the entire, thorough tale is not necessary to obtain results that can be easily compared (Mertens, 2014).

This specific scale has a track record of gauging thoughts and opinions with accuracy. It enables respondents to express how much they agree or disagree with a set of statements about their opinions on a certain topic. The subsequent portion included a number of different elements, including TVET students' attitudes toward mathematics, their interests in mathematics, and how their interests in mathematics relate to their practical skills. These questions were designed to shed light on TVET students' attitudes and interests toward mathematics in relation to the improvement of their practical skills.

3.10 Validity and Reliability of the Research Instrument

Examining the instrument's validity and reliability can help to guarantee the reliability of the measurement tool. According to Kumar (2011), standardizing data gathering techniques is a laborious procedure, which is why validity and reliability are applied. A study process's appropriateness and correctness are two concepts that are collectively referred to as validity (Kumar, 2011). Validity of the research was further bolstered by looking at the following criteria: credibility, reliability and transferability. Demonstrating engagements, observational techniques, and audit trails supports credibility (Cope, 2014). In order to establish credibility for this study, each participant was actively involved throughout the data collection procedure. Close attention was paid to each participant's responses which were to ensure that all relevant information was recorded. The reliability of a study is determined by the researcher's methodology and methods, and is determined by whether the results were replicated with similar subjects under comparable circumstances (Kosh, 2006). Amabile's research, which was covered in Chapter 2, provided the dependability needed for this study.

The transferability condition is met when the findings are relevant to those who weren't involved in the study and when readers can connect the findings to their own experiences (Cope, 2014). Understanding the questions demonstrated the authenticity of the research tool used in the study. After the pilot testing, the research tool was deemed reliable. When there was ambiguity regarding the meaning of the questions, explicit explanations and clarification were provided along with the supplied responses in the pilot study.

The term "reliability coefficient" describes how consistent and transparent a set of instruments is in acquiring data from numerous respondents while removing any doubt or ambiguity. Cronbach's Alpha Reliability Test was used in this instance, and its

reliability coefficient of 0.05 was found satisfactory to support utilizing these instruments for the investigation.

3.11 Data Collection Procedure

The researcher distributed surveys to students in three TVET schools in Kwahu, giving out 316 questionnaires in all, with the aim to produce an entirely novel piece of content. Authorities at the legitimate schools gave their approval. After receiving authorization, the survey was carried out with each student. All participants who could comprehend the survey items completed the questionnaires individually. The surveys consisted of questions that demanded accurate responses.

3.12 Data Analysis

Data analysis serves to create information that will aid in addressing the research topic, not as an end in itself (Malhotra & Dash, 2016). Organizing, interpreting, and presenting acquired statistic to provide clarity on the study and ambiance of interest as well as maintain context-based analysis is a goal shared by a variety of data analysis techniques (Brodsky et al., 2016). The data analysis for this study considers the quantitative data analysis. To examine the survey's measurable data, a quantitative approach was applied. Structural Equation Modeling (SEM) was carried out using Amos (v.23). The SPSS computer application was used to code and enter the data collected from closed-ended items. This study makes it possible to generalize from the data that was collected and make predictions about the outcomes.

3.13 Ethical Consideration

The data gathering instrument and research proposal were submitted to and acknowledged by the AAMUSTED Faculty Ethics Committee as well as Rev. Dr. Benjamin Obeng Adu and Prof. Yarhands Dissou Arthur as main and co-supervisors respectively in order to make sure that all parties' interests were taken into consideration and were not at odds with one another. The Faculty of Applied Sciences and Mathematics team and the director from the chosen department approved the data collection.

A careful consideration to the likelihood of bias was taken. The participant's anonymity and confidentiality were also taken into consideration. The research questions served as the foundation for the data analysis. Subject to defined data that addressed the study questions, the respondents' answers were formulated.

Finally, by carrying out the pilot study mentioned earlier, the likelihood of posing difficult questions to participants was reduced. Additionally, participants were permitted to exit during any phase of the data collection process. All participants were made aware of this before the data collection.

3.14 Conclusion

The employment market of the twenty-first century has grown to be extremely competitive and demanding, requiring quality and relevant expertise as the primary requirement for students to get lucrative employment. In order to effectively meet the demanding demands imposed by this constantly changing labor market, institutions that provide formal education and training must reconsider and restructure their plans, methods, and activities for skill development. The purpose of this study is to strengthen the practicality of TVET students in Ghana with Mathematics as a tool.

This chapter covered the theoretical underpinnings of the study and provided a framework on which to explain the statistical analysis of the obtained information. The study was conducted out from a pragmatic paradigm employing a quantitative research method. The data collecting instrument is a structured questionnaire that utilized a sample size of 316 students from three selected TVET schools in Kwahu. The data collection method was recognized as trustworthy, legitimate, and ethical. There was a thorough justification provided for the sample size and target population. Additionally, this chapter offered an overview of data analysis techniques and discussed the rationale behind the choice of descriptive and confirmatory factor analysis. The ethical measures put in place to secure the safety of all participants and to reduce bias and partiality from the perspective of the researcher were also highlighted in this chapter.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.0 Overview

The purpose of the study was to determine how to enhance the practical skills of TVET students using Mathematics as a tool. According to the purpose outlined in this study's objectives, this chapter analyses the data that was gathered and discusses the findings.

4.1 Background Information of Students

The study presents information about the student's background in this section. Including gender, age, level, form, program of study, and religion. Table 1 summarizes the findings based on the respondents' background information

Table 1: Demographics

Demographics	Frequency (N)	Percentages (%)
Gender	**316**	**100.0**
Male	234	74.1
Female	82	25.9
Age	**316**	**100.0**
13-16 years	31	9.8
17-20 years	244	77.2
21-24 years	32	10.1
Above 24 years	9	2.8
Level	**316**	**100.0**
Form 1	0	0
Form 2	316	100
Form 3	0	0
Program	**316**	**100.0**
Electrical Engineering Technology	79	25.0
Fashion Design and Technology	79	25.0
Building and Construction Technology	79	25.0
Mechanical Engineering Technology	79	25.0
Religion	**316**	**100.0**
Christianity	266	84.2
Muslim	43	13.6
Traditional	4	1.3
Others	3	0.9

4.1.1 Gender of the Students'

From Table 1, out of three hundred and sixteen respondents, two hundred and thirty-four (234) representing 74.1% were males and eighty-two (82) representing 25.9% were females.

4.1.2 Age of the Students'

From Table 1, out of three hundred and sixteen respondents, thirty-one (31) representing 9.8% were from the ages of thirteen (13) to sixteen (16) years. Two hundred and forty-four (244) representing 77.2% were from the ages of seventeen (17) years to twenty (20) years. Thirty-two (32) representing 10.1% were from the ages of twenty-one (21) years to twenty-four (24) years and nine (9) representing 2.8% were the ages above twenty-four (24) years.

4.1.3 Level of the Students'

From Table 1, out of three hundred and sixteen respondents, all were form two (2) students representing 100%.

4.1.4 Program of the Students'

From Table 1, out of three hundred and sixteen respondents, seventy-nine (79) representing 25.0% studied electrical engineering technology. Seventy-nine (79) representing 25.0% studied fashion and design technology. Seventy-nine (79) representing 25.0% studied building and construction technology, and seventy-nine (79) representing 25.0% studied mechanical engineering technology.

4.1.5 Religious Affiliation of the Students'

From Table 1, out of three hundred and sixteen respondents, two hundred and sixty-six (266) representing 84.2% were Christians, forty-three (43) representing 13.6% were Muslims, four (4) representing 1.3% were traditional believers, and three (3) representing 0.9% were other believers.

4.2 Exploratory Factor Analysis (EFA)

The study used SPSS (ver. 23) to perform the Exploratory Factor Analysis (EFA). This analysis is an approach to statistics that seeks to pinpoint fundamental causes or dimensions that may be hidden within a large set of observed variables. This was the approach used to reduce or delete the number of indicators whose loadings were not in their right construct or whose loading values were below 0.5. The findings of the EFA are shown in Table 2 below.

Table 2: Exploratory Factor Analysis (EFA)

Rotated Component Matrix			
Measurement Items	**Component**		
	1	**2**	**3**
ATT1		.904	
ATT2		.922	
ATT8		.905	
SMN7			.797
SMN8			.751
SMN9			.873
SMN10			.835
PRASK4	.757		
PRASK6	.843		
PRASK7	.887		
PRASK9	.873		
KMO and Bartlett's Test			
Total Variance Explained			78.752%
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.			.858
Bartlett's Test of Sphericity	Approx. Chi-Square		2528.492
	Df		55
	Sig.		0.000
Determinant			0.567

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

The number of indicators loaded at their correct construct was further used for further analysis for the study. From Table 2, it was identified that the number of indicators for the Attitude of TVET students in Mathematics (ATTI) in their right construct was three (3), the number of indicators for TVET Students Interest in Mathematics (SMN) in their correct construct was four (4), and the number of indicators for Practical Skill of TVET Students (PRASK) in their correct construct was four (4). The coefficient of the determinant was calculated as 0.567 with a KMO of .858. The KMO provided an explanation for the 85.8% premise of adequate fit among the observable variables in their accurate construct on the latent variables. With a Chi-square of 2528.492 and a degree of freedom of 55, the Bartlett's Test of Sphericity revealed a significant level of 0.000. A Cumulative Variance of 78.752% was also indicated by the three latent variables in addition to the EFA result. Additionally, on the rotated component matrix, the indicator(s) that were not in the proper construct were eliminated.

4.3 Descriptive Analysis

The study adopted a descriptive analysis. Utilizing the mean and standard deviation, the descriptive analysis was utilized to examine the indicators' normality test. Each component from the exploratory factor analysis (EFA) constituted the basis for the outcome.

Table 3: Descriptive Analysis.

Variables	Mean	Std. Dev
Attitude of TVET Students in Mathematics (ATTI)	**3.1448**	**1.25305**
ATTI1: Mathematics has no usefulness in TVET courses.	3.0735	1.29510
ATTI2: I can't study mathematics no matter how I try.	3.1502	1.30819
ATTI8: I am always lost in thought during mathematics lessons.	3.2109	1.31325
TVET Students Interest in Mathematics (SMN)	**3.6789**	**0.97461**
SMN7: The way mathematics is taught makes me love the subject.	3.4441	1.21854
SMN8: I hate to miss mathematics lessons.	3.5719	1.16662
SMN9: Mathematics is useful in many aspects of life.	3.8754	1.15212
SMN10: I believe I can do mathematics.	3.8243	1.20007
Practical Skill of TVET Students (PRASK)	**3.2572**	**1.27670**
PRASK4: Mathematics does not promote real-world practical skills	3.2971	1.41576
PRASK6: Knowledge of mathematics does not guarantee success in practical skills.	3.2907	1.43953
PRASK7: Mathematics has no usefulness in my practical skills.	3.2173	1.50131
PRASK9: Using practical skills in coursework does not need mathematics.	3.2236	1.41460

Table 3 provides an examination of the descriptive statistics for each of the observed variables which are the Attitude of TVET Students in Mathematics (ATTI), TVET Students Interest in Mathematics (SMN), and Practical Skill of TVET Students (PRASK) using their mean scores and corresponding standard deviation. From Table 3, the total mean score and the standard deviation were reported as 3.6782 and 0.97461. Among each of the observed variable loaded under TVET Students Interest in Mathematics (SMN), the lowest mean was obtained from item 7 "The way mathematics is taught make me

love the subject." (Mean = 3.4441; Standard Deviation = 1.21854) while the highest mean score was identified for item 9 "Mathematics is useful in many aspects of life" (Mean = 3.8754; Standard Deviation = 1.3325). It was identified that item 10 "I believe I can do mathematics" showed a mean of 3.8243 and a standard deviation of 1.20007. "I hate to miss mathematics lessons" another item that was analysed by the respondents confirmed with Mean = 3.5719 and Standard Deviation = 1.16662.

The descriptive analysis of Practical Skill of TVET Students (PRASK) had a total mean score of 3.2572 and a standard deviation of 1.27670. The mean score of "Mathematics has no usefulness in my practical skills" had a means score of 3.2173 and a standard deviation of 1.50131. This is seen to be the lowest mean score while "Mathematics do not promote real-world practical skills" (mean = 3.2971 and standard deviation = 1.41576) showed the highest mean score among all the indicator under Practical Skill of TVET Students (PRASK). The indicator "Knowledge in mathematics do not guarantee success in practical skills" with a mean = 3.2907 and a standard deviation = 1.43953 which was reported to be the second highest among the indicators. These mean score lies between 3.2 to 3.3.

The highest mean score for indicators under the attitude of TVET students in mathematics (ATTI) was seen by item 8 "I am always lost in thought during mathematics lessons" (mean = 3.2109 and standard deviation = 1.31325). This explained that TVET students' practical skills improve when they develop a positive attitude towards mathematics. The lowest mean was identified on item 1 "Mathematics has no usefulness in TVET courses" (mean = 3.0735 and standard deviation = 1.29510). This indicator has a total mean of 3.1448 and a standard deviation of 1.25305.

4.4 Reliability Analysis

In order to evaluate the internal consistency of the observed variables, Cronbach's Alpha (CA) was also used. Utilizing the retained variable items from the Exploratory Factor Analysis (EFA) results, the CA was calculated using SPSS (ver. 23) software. When the CA score is at least 0.7, it is said that the reliability of the observed variables has been attained.

Table 4: Reliability Analysis

Variables	Number of Items	Cronbach's Alpha
Attitude of TVET Students in Mathematics (ATTI)	3	.957
TVET Students Interest in Mathematics (SMN)	4	.841
Practical Skill of TVET Students (PRASK)	4	.907

From Table 4, it was determined that the CA for every latent variable was more than 0.7, indicating that a level of internal consistency had been attained. TVET Students' Attitude toward Mathematics had a CA score of .957, TVET Students' Interest in Mathematics had a CA score of .841, and Practical Skills of TVET Students had a CA score of .907.

4.5 Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) was analyzed with the use of Amos (ver. 23) statistical package. The retained measurement items from the exploratory factor analysis were utilized to assess the model fitness of the study data. The main intent of the CFA was to determine whether the study data fit for further data analysis. According to Bamfo et al. (2018), the CFA model fit based on the following conditions: CMIN/DF should be

less than 3, TLI and CFI must be at least 0.9, RMEAS and RME should be less than 0.08, and PClose must be statistically insignificant (p-value > 0.05). From Table 5, since the model fit criterial does not goes beyond the recommendations of the model fitness as recommended by Bamfo et al. (2018), then the study data fit the model.

Table 5: Confirmatory Factor Analysis (CFA)

Model Fitness: *CMIN = 79.718; DF = 40; CMIN/DF = 1.993; TLI = .978; CFI = .984; RMSEA = .056; RMR = .0495; PClose = .263*	***Std. Factor Loadings***
Attitude of TVET Students in Mathematics (ATTI): CA = .957; CR = .957; AVE = .882	
ATTI1: Mathematics has no usefulness in TVET courses.	.931
ATTI2: I can't study mathematics no matter how I try	.942
ATTI8: I am always lost in thought during mathematics lessons	.94
TVET Students Interest in Mathematics (SMN): CA = .841; CR = .843; AVE = .575	
SMN7: The way mathematics is taught make me love the subject.	.735
SMN8: I hate to miss mathematics lessons	.687
SMN9: Mathematics is useful in many aspects of life.	.835
SMN10: I believe I can do mathematics.	.769
Practical Skill of TVET Students (PRASK): CA = .907; CR = .900; AVE = .691	
PRASK4: Mathematics do not promote real-world practical skills	.809
PRASK6: Knowledge in mathematics do not guarantee success in practical skills	.877
PRASK7: Mathematics has no usefulness in my practical skills.	.824
PRASK9: Using practical skills in a course work do not need mathematics.	.814

From Table 5, attitude of TVET students in mathematics (ATTI) had three (3) indicators with Cronbach's alpha (CA) value of 0.957, composite reliability (CR) of 0.957, and

average variance extracted (AVE) of 0.882. Moreover, TVET students' interest in mathematics (SMN) had four (4) indicators with Cronbach's alpha (CA) value of 0.841, composite reliability (CR) of 0.843, and average variance extracted (AVE) of 0.575. In addition, Practical Skill of TVET Students (PRASK) had four (4) indicators with Cronbach's alpha (CA) value of 0.907, composite reliability (CR) of 0.900, and average variance extracted (AVE) of 0.691.

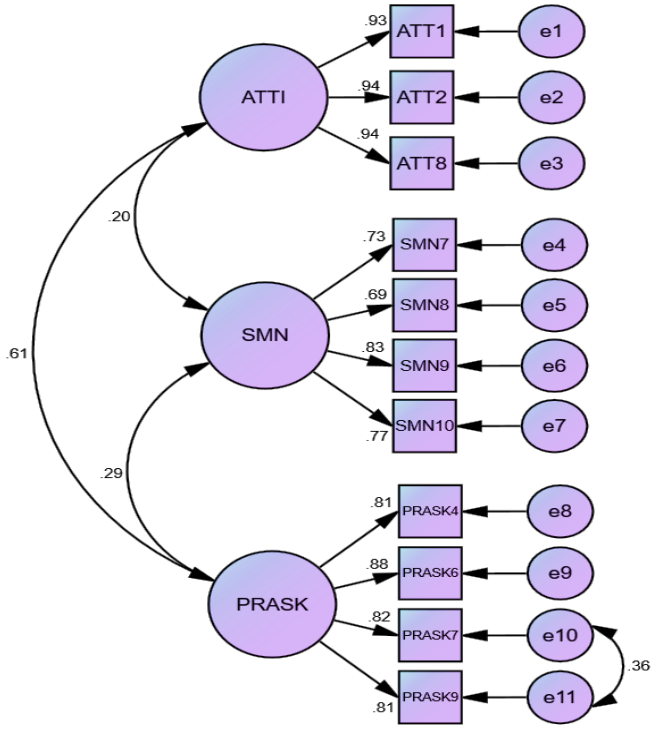


Figure 1: Confirmatory Factor Analysis (CFA)

4.6 Discriminant Validity

Discriminant validity was performed with the use of Amos (ver. 23) statistical package. The discriminant validity is calculated by taken the square root of Average Variance Extracted ($\sqrt{(AVEs)}$). According Fornell and Larcker (2014), discriminant validity is achieved when the least value of the square root of the AVEs is greater than the highest value of the intercorrelated variable.

Table 6: Discriminant Validity

Variables	ATTI	SMN	PRACSK
ATTI	***.939***		
SMN	.198***	***.758***	
PRACSK	.611***	.289**	***.831***

From Table 6, the least value for the square root of the AVEs was .758 (TVET students' mathematics interest) and the highest intercorrelated value was .611 (TVET students' attitude towards mathematics and their practical skills in mathematics). Since the least value for the square root of the AVEs was greater than the highest value for the intercorrelated value, the discriminant validity has been achieved as recommended by Fornell and Larcker (2014).

4.7 Results of the Path Analysis

The hypothesis of the study was tested with the used of Amos (ver. 23) statistical package. The current study make use of one (1) dependent variable, one mediator, and one independent variable. The control variables used for the study were gender, age, level of education, programme of study, and the level of the students. Table 7 presents the analysis results to answer the research questions.

Table 7: Path Analysis Summary

Direct Effect	*Std. estimate*	*S. E*	*C. R*	*P-Value*
Gender → PRASK	-.198	.119	-.1665	.096
Age → PRASK	-.120	.094	-1.273	.203
Level → PRASK	2.453	.919	2.670	.008
Program → PRASK	-.343	.048	-7.115	.000
ATTI→ SMN	.147	.047	3.154	.002
ATTI → PRAKS	.405	.049	8.350	.000
SMN →PRASK	.286	.067	4.284	.000
Indirect Effect	***Std. Estimate***	***Lower Bound***	***Upper Bound***	***P-Value***
ATTI → SMN → PRASK	.114	.048	.185	.004

From Table 7, gender and age of the respondents had a negative and insignificant impact on practical skills of TVET students with (β = -.198; C.R = -.1665) and (β = -.120; C.R = -1.273) respectively. In addition, level of the students had a positive and significant impact on practical skills of TVET students (β = 2.453; C.R = 2.670). Moreover, program of study had a negative impact but significant on practical skills of TVET students (β = -.343; C.R = -7.115).

4.7.1 Research Question 1: What is the Attitude of TVET Students in Mathematics on their practical skills?

The effect of attitude of TVET students in mathematics on their practical skill in was analysed by (ATTI→PRACSK). From the analysis results in Table 7, TVET students' attitude in mathematics had a positive impact and statistically significant on their practical skills with a p-value less than 1% (β = .405; C.R = 8.350). According to the

findings, the practical skills of TVET students were positively impacted by their attitude toward mathematics by 40.5%.

4.7.2 Research Question 2: What is the Attitude of TVET Students in Mathematics on their mathematics interest?

The effect of attitude of TVET students in mathematics on students' mathematics interest was analysed by (ATTI→ SMN). From analysis in Table 7, TVET students' attitude on mathematics has a positive and significant impact on their mathematics interest with a p-value less than 1% (β = .147, C.R = 3.154). The result further explains that, there was 14.7% positive impact of TVET students' attitude towards mathematics on their mathematics interest.

4.7.3 Research Question 3: Does Students Mathematics Interest affect their Practical Skills?

The research question three (3) seek to determine whether students' mathematics interest has effect on their practical skills. The direct effect of TVET students' mathematics interest on their practical skills was analysed by (SMN→ PRACSK. The analysis result in Table 7 shows that, TVET students' mathematics interest had a direct positive effect and statistically significant on their practical skills with a p-value less than 1% (β = .286; C.R = 4.284). The analysis result shows that, TVET students' mathematics interest has 28.8% significant impact on their practical skills.

4.7.4 Research Question 4: What is the Mediating effect of Students' Mathematics Interest on the Relationship between Attitude of TVET Students in Mathematics and Their Practical skills?

Research question four (4) sought to determine the mediating outcome of TVET students' mathematics interest on the relationship between TVET students' attitude towards mathematics and their practical skills. To determine the mediating outcome of TVET student's mathematics interest, the research first determine the direct effect of TVET students' attitude towards mathematics on their practical skills and it was positive and statistically significant (β = .045***). Moreover, the effect of TVET students' attitude towards mathematics on their interest in mathematics was found to be positive and statistically significant (β = .147***) as presented in Table 7. In addition, the effect of TVET students' mathematics interest on their practical skills was positive and statistically significant (β = .286***). Again, the coefficient for the indirect effect on TVET students' practical skills (ATTI→ SMN → PRACSK) was .114, and statistically significant (since both the lower and upper BCs were positive). This however represents a partial mediating effect since TVET student' attitude towards mathematics also had a direct positive effect and statistically significant on TVET students' practical skills.

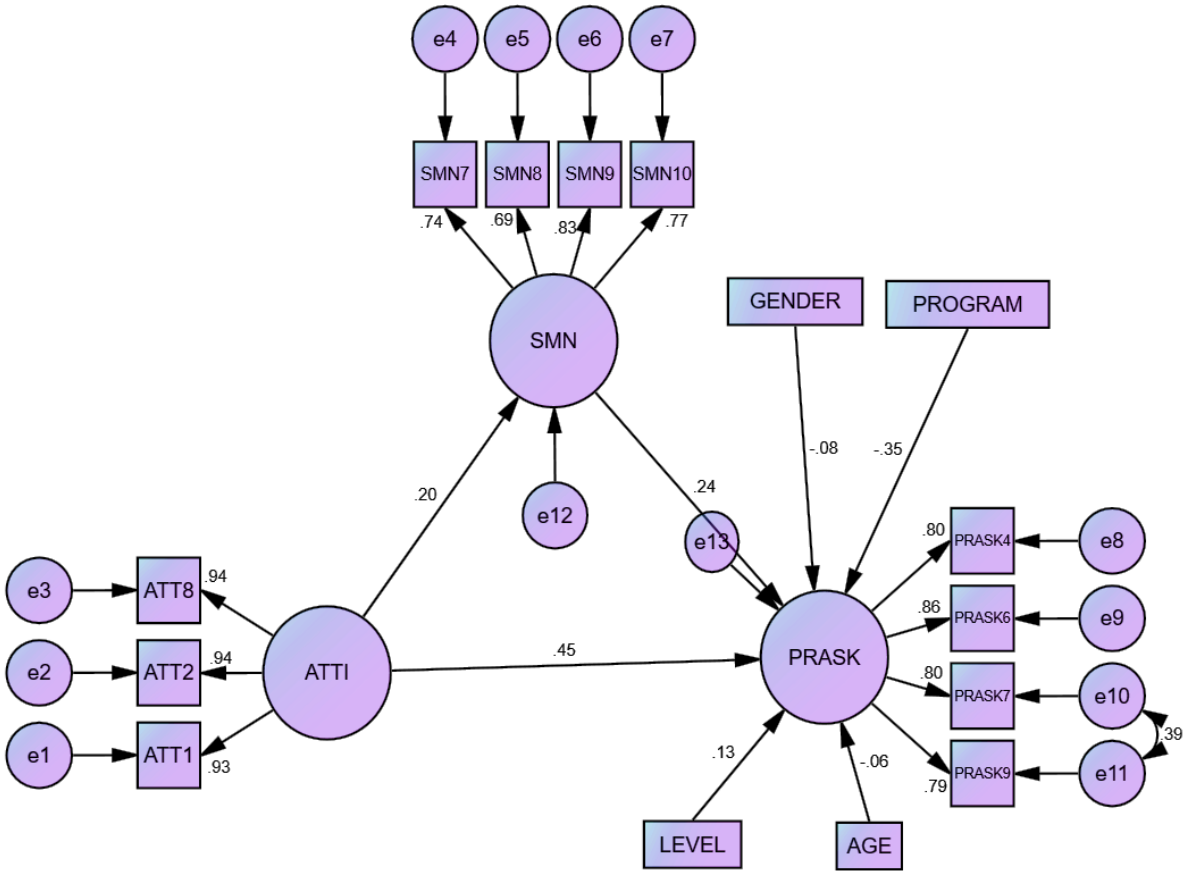


Figure 2: Path Analysis Diagram

4.8 Discussion of Results

It was determined that learning mathematics had a substantial impact on the practical skills of second-year students in three chosen TVET schools in Kwahu among the TVET students sampled for the study. The majority of previous research on mathematics education has concentrated on grammar schools, with relatively little focus on TVET institutions. As a result, this study adds to the body of knowledge on mathematics instruction in TVET institutions. For instance, Akinoso (2011), claimed that students learn mathematics more actively and effectively when they show a significant interest in the subject.

The results showed that TVET students' attitudes toward mathematics had a favorable impact and were statistically significant on their practical skills. This accounted for a 40.5% positive effect on TVET students in relation to their practical skills. A great deal of the students in this study believed that their TVET courses and the study of mathematics were two different things. However, mathematics generally became more pertinent, significant, and rational when it was linked to students' acquisition of practical skills. The emergence of operational mathematics as an applicable topic in TVET portrayed an alteration in viewpoint that positively impacted the way pupils connected with mathematics, even though students continued to place limited emphasis on the practical aspects of their courses (Hodgson and Spours, 2008) and only identified a small number of utilitarian purposes for mathematics (Ernest, 2004).

According to the analysis, connected mathematics classroom methods in TVET can help students cross some of these gaps by presenting mathematics as a subject that can include both academic knowledge and practical skills. In addition to highlighting the significance of common goals in mathematics classrooms for TVET students, this study's connected instructional methodology mirrors several embedding ideas from earlier research (Eldred, 2005).

The findings of this study demonstrated that TVET students' attitudes toward mathematics had a substantial impact on their interest in mathematics. A study by Mullis, Martin, Foy, Kelly, and Fishbein from 2020 supported the idea that students who have a good attitude toward mathematics likely to be interested in the subject, which could result in great performance. However, students who have a bad attitude about mathematics often despise and think little of the subject. As a result, it is established that there is a link between a student's attitude and their interest in mathematics.

The results of this study also showed that the impact of mathematics on TVET students' practical skills was not only direct but also indirectly mediated by their interest in mathematics. Lazarides and Buchholz (2019) discovered that certain students' performance was influenced by the quality in mathematics education. In a similar vein, Fauth et al. (2019) discovered that student interest was significantly influenced by the quality of the teacher's instruction in science education. These links allowed for a type of "boundary crossover" that helped students resolve some tensions between their practical skills and their mathematics study. These approaches offer ways in which more integration and more involvement can be introduced into the student perspective while studying mathematics in TVET institutions, notwithstanding the basic gaps that still exist between the methods of instruction for mathematics and practical skills.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.0 Overview

The main findings from the research are outlined in this section utilizing statistical analysis. On the backbone of the results obtained, suggestions are offered for dealing with specific issues found in the study, and a general conclusion is also deduced from the results of the study.

5.1 Summary

The main goal of this study was to look into how mathematics may be used to help TVET students enhance their practical skills. In Ghana's Eastern region, in Kwahu, a study was carried out. Students from three TVET schools in the district made up the participants in this study.

A quantitative design approach using descriptive survey methodologies was used to collect the data for this study. The target audience was made up of 1,500 students from three TVET schools in Kwahu that offered programs in mechanical engineering technology, electrical engineering technology, building and construction technology, as well as fashion and design technology. Three hundred and sixteen (316) respondents were chosen at random using a Yes/No strategy to conduct data analysis.

The data-collection tools utilized in this study, which focused on variables such TVET students' attitudes toward mathematics (ATTI), interest in mathematics (SMN), and practical skills (PRASK), were modified from earlier studies carried out by other researchers. Structural Equation Model (SEM) software from Amos version 23 was used to analyze the gathered data.

A detailed understanding can be attained by carefully examining how the dataset's variables are related to one another. This study provides insightful information about how mathematics can be used to improve TVET students' practical skills. Stakeholders in Ghana's TVET sector may improve the practical skills of TVET students by better understanding these dynamics, with a focus on the efficient teaching and learning of mathematics. For the goals of data analysis, the study used a number of analytical techniques, including exploratory factor analysis, confirmatory factor analysis, direct path effect discriminant validity, and indirect effect analysis. The investigation discovered the following results:

1. The gender of the respondents from the demographics had a negative and insignificant impact on practical skills of TVET students having a p-value less than 5%.
2. The level of students had a positive and significant impact on the practical skills of TVET students.
3. Program of study had a negative impact but significant on the practical skills of TVET students.

5.2 Conclusion

The results of the study indicates that TVET students' attitude in mathematics have a positive impact and statistically significant on their practical skills with a p-value less than 1% (β = .405; C.R = 8.350). The results indicate that, there was 40.5% positive effect of TVET students' attitude in mathematics on their practical skills. This finding buttresses the fact that when the attitudes of TVET students are geared towards a positive direction, it will greatly enhance their practical skills which will adversely affect the economy of Ghana.

Additionally, TVET students' attitude on mathematics has a positive and significant impact on their mathematics interest with a p-value less than 1% (β = .147, C.R = 3.154). The result further explains that, there was 14.7% positive impact of TVET students' attitude towards mathematics on their mathematics interest. This emphasizes the significance of building and upholding favorable attitudes toward mathematics among TVET students. The attitude of TVET students toward mathematics and their interest in mathematics are significantly correlated. In light of this, it is proposed that in order to change students' attitudes about learning mathematics, it may be necessary to pique their interest in the teaching and learning process.

Also, in determining whether students' mathematics interest has effect on their practical skills, the results of the study indicated a direct effect of TVET students' mathematics interest on their practical skills. The analysis of the study showed that, TVET students' mathematics interest had a direct positive effect and statistically significant on their practical skills with a p-value less than 1% (β = .286; C.R = 4.284). The analysis result shows that, TVET students' mathematics interest has 28.8% significant impact on their practical skills. In this regard, the practical skills of students can be enhanced when students have interest in Mathematics and can as well link to their practical lessons. Teachers in the various TVET schools in Ghana teaching Mathematics, therefore, needs to endeavor in linking mathematical concepts to students' practical lessons so as to uplift students' interest towards the learning of Mathematics.

Furthermore, in assessing TVET students' mathematics interest as a mediating effect on the relationship between TVET students' attitude towards mathematics and their practical skills, the effect of TVET students' attitude towards mathematics on their interest in mathematics was found to be positive and statistically significant ($\beta = .147^{***}$). Also, the

effect of TVET students' attitude towards mathematics on their practical skills was positive and statistically significant (β = .045***). In addition, the effect of TVET students' mathematics interest on their practical skills was positive and statistically significant (β = .286***). However, the study indicated TVET students' mathematics interest as a partial mediating effect since TVET student' attitude towards mathematics also had a direct positive effect and statistically significant on TVET students' practical skills.

In conclusion, it can be confidently emphasized that when the teaching and learning of Mathematics is efficiently and effectively done in TVET schools, the practical skills of the students in said schools will be greatly enhanced. This will help prepare students effectively for occupations that heavily rely on mathematics, such as engineering, sewing, woodworking, construction, and even agriculture. It is agreed that TVET can offer both men and women practical skills, boosting their independence and self-assurance. As a result, it is viewed as a way to support skill development, human resource growth, and industrial development. As a result, TVET should be seen as a solution to the nation's ever-growing poverty problem. Therefore, it is crucial to guarantee that all Ghanaians have equal access to TVET programs, which must be excellent and pertinent to the needs and aspirations of our society.

5.3 Recommendations

The research's conclusions point to the following recommendation:

1. To enhance the practical skills of TVET students, it is recommended that stakeholders in TVET institutions to gear the teaching and learning of Mathematics towards students' practical lessons.

2. There must be recurring, cooperative policy evaluations between universities, polytechnics, and the government to improve the substance of the mathematics curriculum.
3. The emphasis on practice should take precedence over theory in the mathematics curriculum.
4. Some topics like Matrices and Linear Transformation, Trigonometry, Calculus and its Application, Mechanics as well as Correlation and Regression need to be inculcated in TVET courses since they are engineering oriented program.
5. To ensure that the results are representative of Ghana, a significantly larger sample size is advised from the demarcated 16 regions.

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APPENDIX A

AKENTEN APPIAH-MENKA UNIVERSITY OF SKILLS TRAINING AND ENTREPRENEURAL DEVELOPMENT

SCHOOL OF GRADUATE STUDIES

DEPARTMENT OF MATHEMATICS EDUCATION

QUESTONNAIRE

Dear Respondents,

Please spend some few minutes in responding to this questionnaire. The study sought to assess " **The use of Mathematics in enhancing the Practical Skills of TVET students".** This is purely an academic exercise, and as such, your confidentiality is highly guaranteed. There are no right or wrong answers, so just provide answers which are applicable to your circumstance. You will need about 10 minutes to complete this questionnaire.

Section A: Demographics

Please indicate your response by ticking [√] the right alternative as applicable in your case

1. What is your gender?

   Male [ ] Female [ ]

2. What is your program of specialty? ……

3. What is your class level?

   Form 1 [ ] Form 2 [ ] Form 3 [ ]

4. What is your age?

   13-16 [ ] 17-20 [ ] 21-24 [ ] above 24 [ ]

5. What is your religious affiliation?

   Christian [ ] Muslim [ ] Traditional [ ] Others [ ]

Section B: Attitude of TVET students towards the learning of mathematics

Please indicate the extent to which you agree with the following statements regarding to your attitude towards mathematics. Respond using a Likert scale of ***1=Strongly Disagree, 2= Disagree, 3= Indifferent. 4= Agree, 5= Strongly Agree***

S/N	STATEMENT	1	2	3	4	5
1	Mathematics has no usefulness in TVET courses.					
2	I can't study mathematics no matter how I try.					
3	Mathematics is meant for the intelligent few.					
4	I believe I can get better with mathematics.					
5	Mathematics is too difficult and should not the studied.					
6	Understanding mathematics do not enhance my practical skills					
7	Mathematics is a boring subject.					
8	I am always lost in thought during mathematics lessons.					
9	Mathematics should be an optional subject of study.					
10	I have confidence in solving mathematics related questions.					

Section C: TVET Students Interest in Mathematics

Please indicate the extent to which you agree with the following statements regarding to your interest in mathematics. Respond using a Likert scale of ***1=Strongly Disagree, 2= Disagree, 3= Indifferent. 4= Agree, 5= Strongly Agree***

S/N	STATEMENT	1	2	3	4	5
11	I like doing mathematics on my own.					
12	I get bored when I can't solve a particular Mathematics problem					
13	Organizing my thoughts in Mathematics is often difficult.					
14	Even if the concept of Mathematics is difficult, I can learn.					
15	I avoid solving Mathematics questions when possible.					
16	Learning of Mathematics is a waste of time.					
17	The way mathematics is taught make me love the subject.					
18	I hate to miss mathematics lessons.					
19	Mathematics is useful in many aspects of life.					
20	I believe I can do mathematics.					

Section C: TVET Students Interest in Mathematics towards their Practical skills

Please indicate the extent to which you agree with the following statements regarding to your attitude towards mathematics. Respond using a Likert scale of ***1=Strongly Disagree, 2= Disagree, 3= Indifferent. 4= Agree, 5= Strongly Agree***

S/N	STATEMENT	1	2	3	4	5
21	I love using mathematics to explore my practical skills					
22	Adapting practical skills with mathematics get me bored					
23	I can approach practical lessons with knowledge in mathematics					
24	Mathematics do not promote real-world practical skills					
25	I reason mathematically during practical lessons					
26	Knowledge in mathematics do not guarantee success in practical skills					
27	Mathematics has no usefulness in my practical skills					
28	The link of mathematics to my practical skills makes me love the subject.					
29	Using practical skills in a course work do not need mathematics					
30	I am open to experimentation of mathematics concepts in my practical skills					