

CHAPTER I

INTRODUCTION

1.0 BACKGROUND OF THE STUDY

“Education is the process of facilitating learning or the acquisition of knowledge, skills, values, beliefs and habits” (UNESCO, 2015). Education provides the knowledge needed to integrate well into today’s complicated society and serves as a lifelong companion for every person to achieve success. Education cannot be mentioned without Teacher Education (TE). Teacher Education is the backbone that produces the right professionals to implement educational policies. There is a need for quality TE to produce quality teachers who can deliver quality education.

A country cannot develop beyond the quality of its education system, and the quality of education depends on the quality of teachers (Adu-Pimpim et al., 2011). The actual implementer of the educational policies of any nation is the teacher. The teacher has the responsibility of training the workforce of any country. That makes TE significant, empowering teachers with the knowledge to work effectively. According to Kapur (2018), the primary importance of TE is training quality teachers to achieve the desired academic outcomes of a nation. The Sustainable Development Goals (SDG-4) aim to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all (United Nations, 2021).

Quality education is only made a reality with quality teachers, and quality teachers will not be available without quality teacher education. Pathak (2019) states that three (3) processes govern quality educational input: curriculum, teaching-learning, and evaluation. The quality of education depends mainly on the above three indicators and applies to TE. There is a need to investigate how Teacher Education Institutions (TEIs) undertake the processes governing quality inputs to realise quality TE. The present study will attempt to study the Mathematics Education Programmes (MEPs) in Ghana’s Teacher Education Universities (TEUs).

1.1 Democratic Republic of Ghana: A country in West Africa

Ghana is a West African country located on the Gulf of Guinea coast. However, a small country by size and population, Ghana is one of Africa’s leading countries partly due to its significant natural wealth and status as the first black

African country south of the Sahara to achieve independence from colonial rule (Ministry of Foreign Affairs and Regional Integration, 2024).

Ghana is well-known for its green forests, a wide variety of wildlife, and extensive sandy beaches along a lovely coastline with resources including gold, bauxite, manganese, diamond, crude oil, and timber. The establishment of direct sea trade with Europe in the 15th century significantly impacted the local population, many of whom actively traded with the Portuguese, Dutch, British, and other Europeans. The Gold Coast, a future British colony, got its name from readily available gold, the original trading emphasis.

On May 6, 1957, the present-day Ghana gained independence from a British colony. Nationalist and Pan-African leader Dr Kwame Nkrumah, who became Ghana's first president, spearheaded the drive for independence. Ghana is a unitary multiparty republic with one legislative house (Parliament); the affairs of Ghana are controlled by the political party that wins power through democratically organized elections on a four-year term basis. The capital of Ghana is Accra, the official language is English, and the currency for monetary transactions is the Ghana Cedis (GH¢).

Ghana is divided into 16 regions of 145 districts, 109 municipalities and six (6) metropolitan assemblies. As of 2021, Ghana had a population of 30,832,019, and the national literacy rate among the population six years and older was 69.8%. Eleven million five hundred forty-one thousand three hundred fifty-five (11,541,355) people are in the working population; of these, 9,990,237 have employment, and 1,551,118 are unemployed, representing 58.1% of people aged 15 and over (Ghana Statistical Service, 2021). In Ghana, formal education is free up to the SHS level. According to Sasu (2020), the free SHS policy had 404,856 pupils enrolled as of March 2020, contributing to 3.99% of the Gross Domestic Product (GDP) spent on education. The government introduced the free SHS in September 2017, effective from the academic year 2017–2018. Table 1.0 shows the school education gross ratio enrolment and the number of teachers at the school level as of 2020.

Table 1.0: Gross ratio enrolment and number of teachers at the school level as of 2020

Gross primary school enrolment ratio since 2008-2020	103.44
Number of teachers in primary Education in Ghana 2010-2020	265 000
Gross secondary school enrolment ratio 2008-2020	77.7
Number of teachers in secondary Education in Ghana 2010-2020	208 000

Source: Unesco Institute of Statistics (2022)

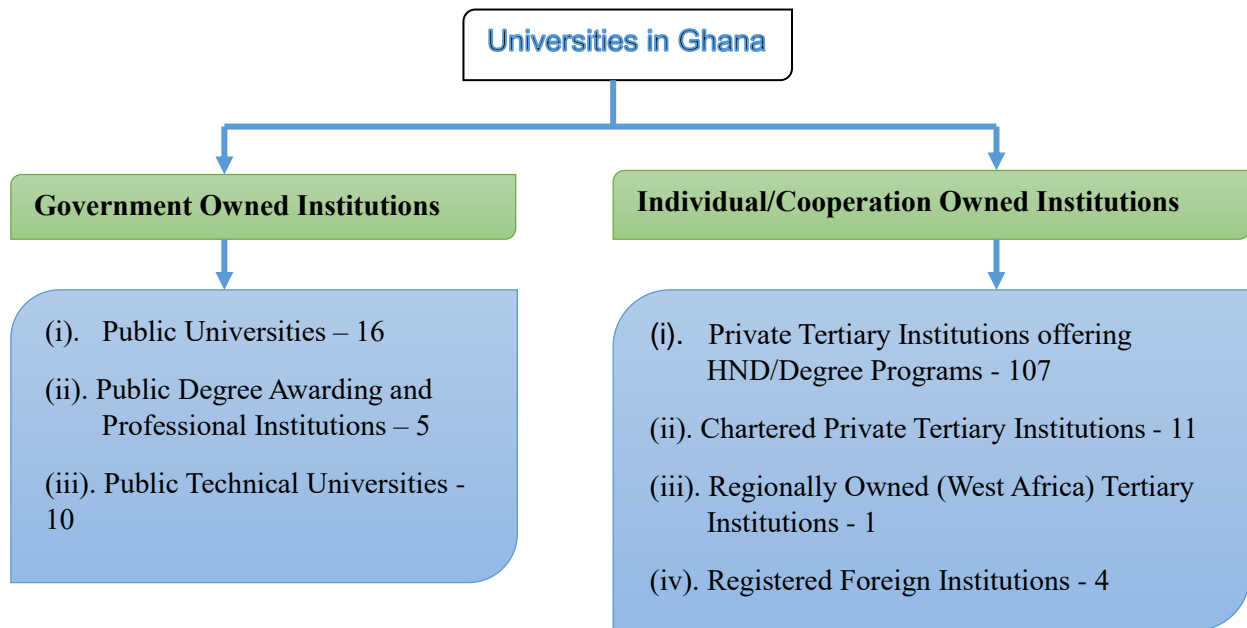
1.2 Education in Ghana

Pre-tertiary Education in Ghana begins with early childhood, that is, pre-school (Crèche and Nursery, age 3-5), followed by basic education, six (6) years of primary Education (Class 1-6, age 6-12) and three (3) years of Junior High School education (JHS 1-3, age 13-15). Then, it continues with three (3) years of Senior High School education (SHS 1-3, age 16-18). Tertiary Education follows a university degree (4 years), Teaching/Nursing/Agriculture College (4 or 3 years, depending on the study area). Education in Ghana is free and compulsory from Preschool to Senior High School in all public institutions.

The Ministry of Education (MoE) formulates educational policies and ensures that all levels of education are functioning as expected (Ministry of Education, 2021). The MoE tasks the Ghana Education Service (GES) to oversee the day-to-day running of schools at the pre-tertiary level, from preschool to Senior High School (SHS).

In Ghana, the education system consists of public and private institutions at the pre-tertiary and tertiary levels. Private universities in Ghana are owned by individuals or corporate institutions rather than the government of Ghana. According to the GTEC (2022), there are 31 public and 123 private registered institutions/universities in Ghana. The Ghana Tertiary Education Commission (GTEC) has categorised Universities in Ghana into various groups, as shown in Figure 1.0 below.

Figure 1.0: Universities in Ghana

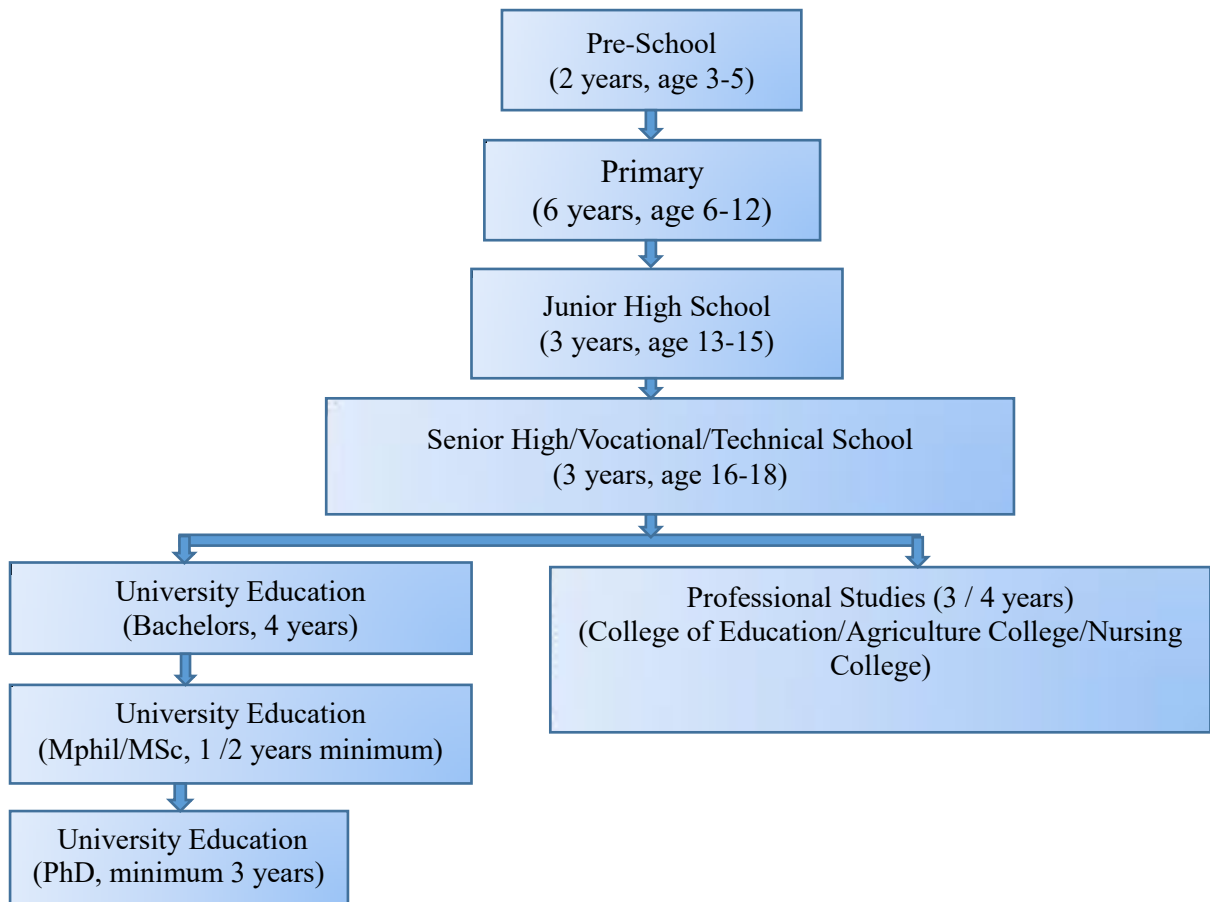


Source: Ghana Tertiary Education Commission (2022)

The Ghana Tertiary Education Commission (GTEC), formed out of the merger of the National Council for Tertiary Education (NCTE) and the National Accreditation Board (NAB) under the new Education Regulatory Bodies Act 2020 (Act-1023), is mandated to see to the smooth running of tertiary institutions in Ghana (Ministry of Education, 2021). The objects of the Commission are to regulate tertiary education in all its forms to promote;

- (i) Efficient and effective administration and accreditation of tertiary education institutions;
- (ii) Principles of the provision of the consistent quality of service by tertiary education institutions;
- (iii) Advancement and application of knowledge through teaching, scholarly research and collaboration with industry and the public sector; and
- (iv) The development of appropriate human capital for the sustainable advancement of the national economy (Republic of Ghana, 2020). The structure of the current education system in Ghana can be seen in Figure 1.1.

Figure 1.1: Structure of the Education System in Ghana



Source: Kamran et al., 2019 (<https://wenr.wes.org/2019/04/education-in-ghana>)

1.3 Teacher Education in Ghana

The Institute of Statistics defines teacher education as “formal teacher training (Pre-service or In-service) designed to equip teachers with the knowledge, attitude, behaviour, and skills required for teaching at the relevant level” (UNESCO, 2021). Teacher education is putting in place the necessary measures to holistically equip pre-service teachers with the required skills to dispatch their duties effectively and efficiently.

Teaching the teacher how to teach is an essential job with a look at how relevant the teacher’s work is. Teacher training in the advanced education division is immensely significant in advancing teachers’ teaching abilities and acclimatising them to acquire new teaching procedures (Rauteda, 2023). According to the Incheon Declaration, member states must ensure that educators and instructors are empowered,

sufficiently hired, well-trained, professionally qualified, driven, and supported within systems that are well-resourced, effective, and efficiently governed [As cited in UNESCO, 2016].

Teacher training in Ghana dates back to pre-independence (Antwi, 1992). Teacher education in Ghana has undergone numerous changes from pre-colonial to post-colonial. Sir Hugh Clifford, in 1918, Governor of the then Gold Coast, currently Ghana, initiated the training of teachers in every province. According to Graham (1971), by 1933, the Gold Coast's colonial government had significantly emphasised teachers' training.

The fundamental standard of teacher education in Ghana is “ To provide teachers with better knowledge and skills, together with better incentives to use their knowledge and skills for the benefit of children, through the creation of an accessible, integrated teacher education and training system which provides a structure for continuous professional development throughout their teaching careers” (MoE, 1993). According to the Report of the President's Committee on Review of Education Reform, teacher education aims to train and develop the correct type of teacher, one who is competent, committed and dedicated. Further, a good teacher ought to be:

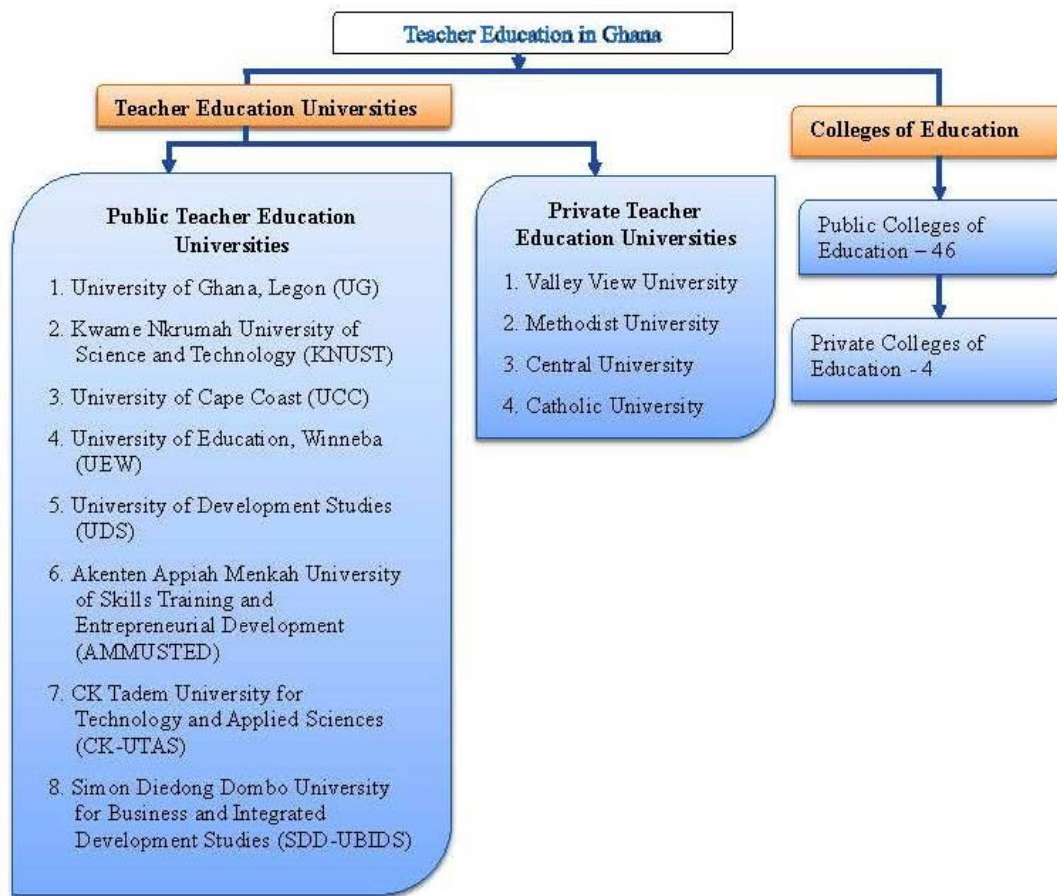
- (i). “Applying, extending and synthesising various forms of knowledge;
- (ii). Developing attitudes, values and dispositions that create a conducive environment for quality teaching and learning in schools;
- (iii). Facilitating learning and motivating individual learners to realise their potential fully;
- (iv). Adequately preparing the learner to participate fully in the national development effort” (Republic of Ghana, 2002).

Teacher education in Ghana has two faces. Teacher Education Universities (TEUs) predominantly offer subject-specific area-based undergraduate (e.g. Bachelor of Education (B.Ed) in Mathematics, Bachelor of Education (B.Ed) in Science, Bachelor of Science (B.Sc) in Mathematics education, etc.) and post-graduate programmes. Colleges of Education (CoEs) offer programmes under B.Ed in Basic Education. The courses offered at the CoE level are B. Ed Early Childhood Education, B.Ed Primary Education, and B.Ed J.H.S. Education. According to Communications

Bereau (2018), the President of the Republic of Ghana, Nana Addo Dankwa Akufo Addo, stated that all CoEs, beginning from the 2018-19 academic year, would be upgraded to University Colleges to offer 4-year Bachelor of Education (B.Ed) degree programmes.

Some Teacher Education Institutions (TEIs) at the TEUs and CoEs level offer training programmes for specialised areas like Technical and Vocational Training Education (TVET). Special Education (SPED) is inclusive at the CoEs level, whilst TEUs have a specialised programme, B.Ed Special Education, to train pre-service teachers for the Special Schools (e.g. Akropong-Akuapem School for the Blind) in Ghana. A complete list of Ghanaian CoEs offering Technical and Vocational Education And Training (TVET) programmes has been made public by the GTEC (Ansah and Ernest Kissi, 2013). Akenten Appiah Menkah University of Skills Training and Entrepreneurial Development (AMMUSTED) offers technical, technology and vocational programs at the TEU level. Examples of such programmes on offer at AMMUSTED are B.Sc. Information Technology Education, B.Sc. Mechanical Engineering Technology Education, and BSc Wood Technology Education. The number of TEUs/CoEs in Ghana can be seen in Figure 1.3.

Figure 1.2: Teacher Education Universities/Colleges of Education in Ghana



Source: Ghana Tertiary Education Commission (2022)

1.3.1 Teacher Education Universities

In Ghana, Teacher Education Universities (TEUs) are essential in the education sector. Whilst the Colleges of Education (CoEs) have the responsibility of preparing pre-service teachers for the basic level (Preschool, Class 1-6, JHS 1-3) of school education, the TEUs train pre-service teachers predominantly for second circle institutions (Senior High, Vocational, and Technical Schools, i.e., SHS 1-3). Second circle education is the transition between pre-tertiary and tertiary Education in Ghana. The quality of education at this level is essential. Pre-service teachers trained by TEUs prepare students for tertiary education, which makes TEU training crucial.

Out of 32 public universities, eight (8) TEUs exist. TEUs are universities with education schools and/or faculties and/or departments tasked with preparing pre-service teachers for the Ghana pre-tertiary school system. The eight (8) public TEUs

are the UG, the KNUST, the UEW, the UCC, the AMMUSTED, the UDS, the SDD-UBIDS, and the CKT-UTAS.

Curriculums concerning TEUs differ slightly from university to university. Although this is the situation, the curriculum must meet the quality requirements of GTEC for the programme to be given accreditation to run in the TEU. Every programme at the tertiary level has to be scrutinised by the GTEC to ensure it meets the minimum requirements to be given accreditation before tertiary institutions can run it. GTEC (2019) states that after submitting the necessary documents for a programme's accreditation, the documents submitted are assessed by experts. Additionally, a visit to the institution is planned to determine whether the programme will receive accreditation.

The learning cultures of the TEUs, although not entirely the same, are similar. All universities in Ghana operate the lecture system of interaction. Students attend lectures depending on their lecture schedule for the day. The number of students for a course depends on the school. Students engage in group discussions and individual studies at the end of the day to clear their doubts later. Evaluation is generally in the form of tests and individual and group assignments.

In Ghana, the vice-chancellor is the highest authority in university leadership (Mu-azu & Nabila, 2016). The Dean of Faculty is the faculty leader, and the department has the Head of Department (HOD) as the highest authority. The HOD ensures the day-to-day running of the various departments. There are other leadership positions at the department level, such as the Examination Officer. The various leaders of the department work with the HOD to ensure that all academic activities are flowing as expected. The HOD also liaises with higher authorities of the university to ensure that the department's needs are supplied for all department activities.

1.3.2 Eligibility and Intake Capacity of TEUs

There is a general eligibility criterion for entry into tertiary education in Ghana. For entry into tertiary education, WASSCE (a required external examination) candidates must have passes (minimum C6) in English, Mathematics (general), and Integrated Science (three core subjects) and three subjects from their field of study. Regardless of this, every institution has its eligibility criterion. According to the (ITA, 2022), while university admissions criteria differ by institution in Ghana, the National Accreditation Board (NAB) sets the minimum admissions requirements for

all providers. That is, candidates must receive a grade of C6 in at least three WASSCE core subjects and three WASSCE elective subjects. Kokutse (2011) stated that the NAB assessed private university admissions methods and mandated that students admitted to private colleges but did not receive the required admission grades must retake those exams before graduating.

Intake capacity at the university level in Ghana differs from university to university. Public universities in Ghana cannot absorb all eligible students, making private tertiary institutions relevant to tertiary education in Ghana. It also makes admission into public tertiary institutions very competitive. According to GhanaWeb (2021), the University of Ghana, Legon, the oldest University in Ghana, enrolled 15 020 fresh undergraduate students in the 2020/2021 academic year. Meanwhile, the UCC enrolled 7,164 new students in undergraduate and post-graduate programs for the 2020/2021 academic year (University of Cape Coast, 2022).

As of 2019, the population of students in the various tertiary institutions of Ghana were as follows: Public Universities; 264994 Technical Universities and Polytechnics; 50386 Private Universities and Colleges, 64870 (Sasu, 2020). The NAB tertiary education statistics also reported a population of 264,994 for public universities, 9825 for specialised tertiary education institutions (e.g. Institute of Professional Studies), and 50386 for technical universities and polytechnics (NAB, 2019). The profile of the TEUs is shown in Table 1.1 below:

Table 1.1: Profile of the Teacher Education Universities of Ghana

Ser. No.	Public Teacher Education University	Date of Establishment	Date of Introduction of Education Programs	Teacher Education in Mathematics Program	Estimated Enrolment	CoEs Affiliated
1.	The University of Ghana, Legon (UG.)	August 1948	2019	B.Sc in Education (Mathematics)	61,000	6
2.	Kwame Nkrumah University of Science and Technology (KNUST)	January 1952	2019	BEd. Junior High School Education (Mathematics)	74,441	5
3.	University of Cape Coast (UCC.)	October 1962	Established as a teacher education Institution	BSc Mathematics Education	75,000	14
4.	The University of Education, Winneba (UEW.)	September 1992	Established as a teacher education Institution	BSc Mathematics Education	69,000	15
5.	The University of Development Studies, UDS	May 1992	2007	BEd. Mathematics	20,039	6
6.	The Akenten Appiah Menkah University of Skills Training and Entrepreneurial Development (AMMUSTED)	August 2020	Established as a teacher education Institution	BSc. Mathematics Education	27,804	
7.	The CK Tadem University for Technology and Applied Sciences (CK-UTAS)	May 2020	Established with a teacher education department	BEd. Mathematics	3500	
8.	The Simon Diedong Dombo University for Business and Integrated Development Studies (SDD-UBIDS),	May 2020	Established with a teacher education department	B.Ed Accounting and Mathematics	2368	

1.3.3 Teacher Education Reforms in Ghana

Two traditional TEUs, UEW and UCC, have been the only universities that have trained teachers. Recently, other major public universities introduced teacher education programmes. AMMUSTED was carved out of UEW in 2019 by an Act of

parliament. SDD-UBIDS and CK CKT-UTAS were established out of UDS by Acts of parliament in 2019. The president of Ghana signed the University Bill 2020 into law on August 27 2020, which divided the UEW into two (Public University Bill, 2020). The Winneba and Ajumako campuses formed the UEW to train Humanities and Sciences teachers. The Kumasi and Akuapim-Mampong Campuses have been made autonomous as AAM-USTED. AAM-USTED is mandated to train teachers in the Technical, Technology, and Vocational fields at the Kumasi Campus and Agricultural Sciences at the Akwapim-Mampong Campus.

Teacher training at the CoE level has seen many reforms since 1937 to improve the quality of its products. In 2004, reformers went for the rebuilding of Teacher Education. Pre-service teachers' time on CoE campuses was shortened to two (2) from three (3) years, and the third year was committed to OCTP - practising how to teach in real classroom situations in schools. It was an upgrade on the four-week practice on campus directed by teacher educators with minimal contribution from field teachers. The new (in-in-out) model was to build up pre-service teachers' ability to convert their theoretical knowledge into teaching skills and produce teachers who can create practical, interactive classroom situations (Institute of Education, 2005). This model also presented "On-Campus Teaching Practice" for student teachers to work on their teaching skills before OCTP. Regardless of the changes, the Institute of Education (2014) stated that there was room for improvement with the model since reformers felt that to intensify pre-service teachers' expertise, they required experience in real classrooms with school teachers as their guides. In 2014, the in-in-out teacher education system was adjusted to involve practising teachers as guides to pre-service teachers, with teacher educators providing support for field training. These progressions have moulded teacher education in Ghana into its present structure.

In 2015, a reform, the Transforming Teacher Education and Learning (T-TEL), financed by the UK's Department for International Development (DFID), was initiated. It emphasised further development of the college classroom practice of teacher educators through activity-based learning, teaching-learning materials (TLMs), and group work (T-TEL, 2016). Supporting the T-TEL reform was the view that participatory and active learning involving TLMs as instruments to cultivate student-focused instructional methods can affect the quality of practicum (T-TEL, 2016).

The most recent reform is the transformation of CoEs into degree-awarding institutions. The Ministry of Education has, as of 2018, given CoEs the mandate to train and award four-year Bachelor of Education degrees to prospective teachers. Under this reform, the public CoEs have been affiliated with public TEUs for support and development. Before this, there were three significant reforms, these are:

- (i) The Education Act of 2008 (Act-778) created the National Teaching Council to professionalize the teacher through licensing.
- (ii) The Colleges of Education Act of 2012 (Act-847) upgraded Colleges of Education into tertiary institutions.
- (iii) Pre-Tertiary Teacher Professional Development and Management (PTPDM) Policy in 2012 to design a career progression path for teachers in Ghana (National Teaching Council, 2020).

1.3.4 Quality Teacher Education

Today's teachers need to be thorough professionals with strong academic credentials, pedagogical skills, moral convictions, and ethical standards. According to Clement and Rencewigg P (2020), subject content knowledge, adequate communication abilities, and the ability to create an engaging classroom environment through humour are the most desirable characteristics of a quality teacher from students' points of view. Ensuring quality in education should not be just an issue of relevance but a necessity. The ability of the teacher to effectively deliver as his profession demands is essential. Quality education is an enzyme for national development. The teacher may be the main element in providing quality education, making their training vital.

Quality education is satisfying fulfilment, and meeting stakeholders' assumptions is the predominant definition given by most stakeholders (Saini et al., 2022). With the more prominent stakeholder being a nation, quality must be assured in the training of teachers to equip them to discharge their duties as expected. Teacher quality and training will be more essential than ever in a period of advancing educational standards and accountability (Sharma, 2019).

The National Teaching Council (NTC) has set standards for teachers in Ghana. The NTC expects TEIs to base their training on these standards to ensure teachers are given the best training in Ghana. The standards are categorised as follows:

- (i). **“Professional Values and Attitudes:** These include Professional Development and Community of Practice;
- (ii). **Professional Knowledge:** It includes Knowledge of Educational Frameworks and Curriculum and Knowledge of Learners;
- (iii). **Professional Practice:** It includes Managing the Learning Environment, Teaching and Learning, and Assessment” (NTC, 2018).

From the NTC point of view, these standards ensure the quality of teachers and teacher education. According to NTC (2018), “these three domains and aspects encompass what teachers should value, know and do, and intersect with one another to develop a teacher competent enough to teach at the end of their four-year initial teacher training.” The quality of teacher education goes a long way to influencing the quality of universal education that most countries crave. TEIs in Ghana must ensure these standards are met to provide quality teacher education.

According to Lakshmi and Chaudhari (2019), researchers have identified the critical quality indicators in teacher education, including curriculum design, curriculum transaction, evaluation system, research and development, infrastructure and learning resources, student support and progression, organisation and management, etc. A particular focus is also placed on the internship/OCTP programme, although it falls under the broad curriculum umbrella.

1.3.6 Mathematics Education Programmes (MEPs) in Ghana

Mathematics is essential for every Ghanaian child to progress from pre-tertiary to tertiary education. MEPs in Ghana are meant to train mathematics teachers at the pre-tertiary level of the Ghana education system. Mathematics teachers’ training for the pre-tertiary education level in Ghana happens at the CoEs and TEUs levels.

The CoEs run the B.Ed. Junior High Education (Mathematics and ICT) programme to train pre-service Mathematics teachers for the basic level (Primary and Junior High School (JHS)) of school education. The TEUs run degree-in-education programmes to train teachers (pre-service mathematics teachers), mainly to teach mathematics at the SHS level of school education. Three of the TEUs (UCC, UDS, CKT-UTAS) run the Bachelor of Education (B.Ed) in Mathematics, two (UEW, AMMUSTED) run the Bachelor of Science (B.Sc) in Mathematics Education, SSD-

UBIDS run the Bachelor of Education (B.Ed) in Accounting and Mathematics, UG runs the Bachelor of Science (B.Sc) in Education (Mathematics), and KNUST runs the BEd. Junior High School Education (Mathematics). These programmes prepare pre-service teachers mainly for Mathematics but also have minor areas that offer the pre-service teachers expertise in teaching two subject areas. For example, the B.Sc Mathematics Education programme run by the UEW has Mathematics as its major area and ICT as its minor. This means the programme's graduates can teach Mathematics and ICT at the school level.

After satisfying the general eligibility criteria, candidates must have had Elective Mathematics as one of their electives at the SHS level for admission into the MEPs. Although the qualification criteria differ for each institution, candidates must have minimum requirements per the NAB regulations to gain admission. According to the University of Cape Coast (2022), “applicants must pass Elective Mathematics plus any two (2) of the following elective subjects: Economics, Geography, Business Management, Accounting, Physics and Chemistry” to gain admission to the B.Ed Mathematics programme. The various universities also have admission criteria for O’Level and A’Level holders as well as a matured entrance in some cases for the opportunity for candidates above a specified age (e.g. candidates above 25 years) to gain admission into these programmes.

The admission requirement for non-WASSCE holders (GCE “A” Level holders) for UG is any three (3) “A” Level subjects, including Mathematics (University of Ghana, 2022).

That of UEW is as follows;

School Certificate/GCE Entry Requirements

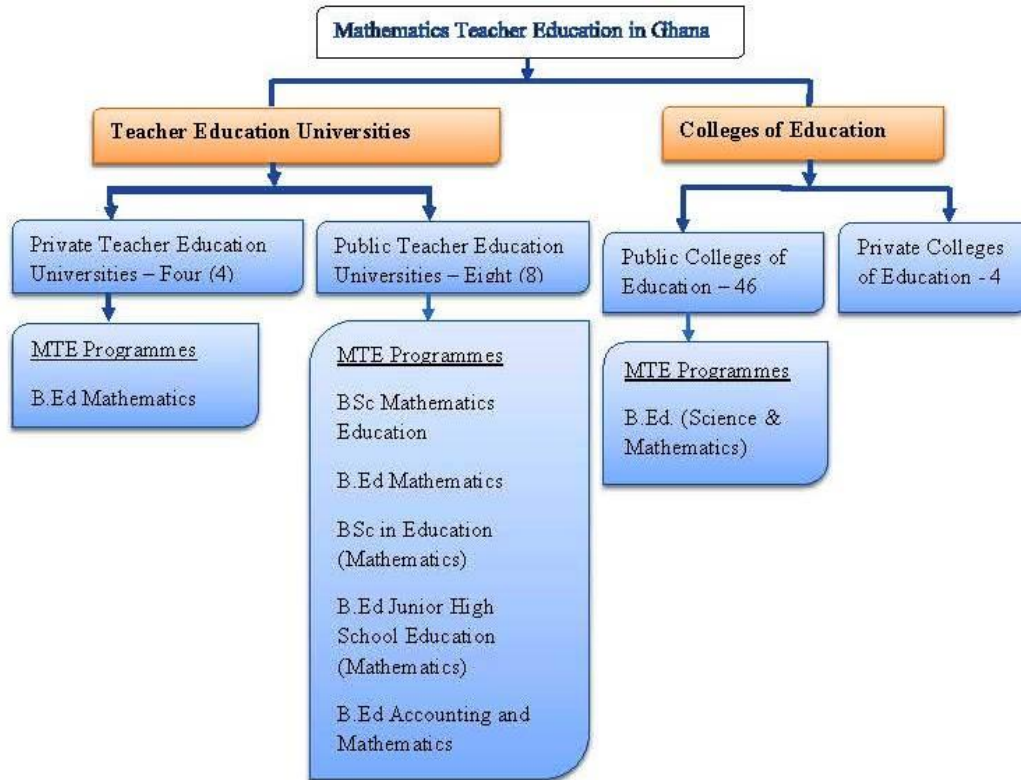
- (i). “Five (5) credits at GCE “O” Level, including English Language and Mathematics, as well as Two (2) “A” Level passes other than General Paper in relevant subjects (Mathematics).

Diploma Holders

- (i). Must possess a Higher National Diploma or equivalent from a previous field or area of study (Mathematics).
- (ii). Full-time applicants may pass an interview” (University of Education, Winneba, 2022).

Figure 1.3 below is the structure of Ghana's mathematics teacher education programmes.

Figure 1.3: Mathematics Teacher Education Programmes in Ghana



CK-UTAS describes the B.Ed in Mathematics programme as a four-year integrated academic programme that blends theory (in the form of lectures and seminars) with practical training in methodology and fieldwork and exposes students to current topical issues of Mathematics teaching and environmental relevance (CK-UTAS, 2022).

For candidates to graduate with a bachelor's degree from any of these TEUs, candidates must meet the minimum requirement for graduation per the quality requirements in Ghana. In Ghana, candidates must obtain at least 120 credits to graduate with a bachelor's degree. Undergraduate courses are assigned 0,1,2, or 3 credits, which depict the course's contact hours weekly. Candidates must pass all core and elective courses, accumulating a minimum of 120 credits to be eligible to graduate with a bachelor's degree.

At UCC, undergraduate courses are assigned 0, 1, 2 or 3 credit(s). To qualify for the award of a degree, candidates must satisfy the following requirements:

- (i). “ Pass all courses taken - general, faculty, or departmental;
- (ii). Meet Inter-Faculty course requirements;
- (iii). Accumulate a minimum of 120 credits (including Advance Credits);
- (iv). Attain a minimum Cumulative Grade Point Average (CGPA) of 1.0;
- (v). Settle all financial and other obligations to the university;
- (vi). Be in good standing - not barred for disciplinary reasons” (University of Cape Coast, 2022).

MEPs aim to prepare mathematics teachers for the Ghanaian school system. Since the quality of Mathematics education and students’ performance in Mathematics is highly dependent on the quality of teachers’ training, the investigator has been inspired to study the MEPs in the TEUs of Ghana.

1.3.7 Employability Opportunities for TEUs MEPs Graduates

To achieve universal primary and secondary education by 2030, according to the UNESCO Institute for Statistics (UIS), which is the global repository for SDG4 statistics that are comparable internationally, the globe will need to hire and train around 69 million teachers (Unesco, 2016). Employment opportunities for MEP products in Ghana are not an issue. There is demand for teachers, and demand for mathematics teachers takes centre stage in the public and private sectors. According to GhanaWeb (2020), the deputy spokesperson of the Ministry of Education (MoE) disclosed that since 2017, the government of Ghana has employed 93,724 teachers. It was also mentioned that, in 2020, the government would employ 6,000 graduate teachers to augment the education sector of Ghana. Although there is a high demand for mathematics teachers, many graduates are still unemployed due to the government’s inability to meet the financial requirements of employing these graduates.

In Ghana, to be eligible for employment as a mathematics teacher at the school level, one must have at least a diploma from a CoE. Preferably, a Mathematics education degree is needed to teach at the school level (Both J.H.S. and SHS levels). With a diploma in Basic education, one is eligible to teach at the JHS level only. A degree in Mathematics education is required to teach at the SHS level. After the required certification, all prospective professional teachers must obtain a licence by writing a licensure examination. Kwofie (2017) stipulated that teachers’ knowledge

and abilities, knowledge of the subject content to be taught, and knowledge of how to teach it to a wide range of students are significant variables in teacher licensing.

Teachers' licensing is the National Teaching Council (NTC) mandate. The Education Regulatory Bodies Act, 2020, Act (1023) mandates the NTC to promote teacher professionalism in Ghana. Among the key mandates of the NTC are the following;

1. "Licensing and Registering teachers
2. Keeping an up-to-date database of teachers
3. Developing and periodically reviewing professional standards and code of ethics.
4. Conducting teacher licensure examination
5. Providing teachers with a framework for Continuous Professional Development (CPD)"

(National Teaching Council (NTC), 2021).

1.4 Challenges of Teaching Mathematics at the School Education Level

Teaching and learning mathematics comes with challenges for teachers and learners. The quality of delivery in the Mathematics classroom is dependent on certain factors. Thirteen factors that affect the way mathematics is taught have been divided into five categories: pedagogical, conceptual, technology, modelling, and individual factors (Mohammed, 2021). One such factor is the quality of the teacher in terms of content and pedagogical knowledge. Learners' interest in the subject also affects the teaching and learning process as it determines their active participation in the classroom.

One challenge that affects the teaching of Mathematics is the teachers' Content Knowledge (CK). Without maximum control over the content delivered, teachers struggle to make learners understand what they are trying to impact. The teacher needs to understand what he wants to teach to help his students understand the concept he is trying to explain. Appiahene et al. (2014) cited the lack of competent teachers as one of the problems in mathematics teaching in the Kumasi Metropolis of Ghana.

The status of mathematics teachers is also a concern in Ghana. In Ghana, teachers at the basic level are generally not valued in their communities. Though arguably, high school teachers are somewhat valued in their communities, salaries

concerning teachers are low. Due to people's knowledge of the earnings of the teaching profession compared to other professions in Ghana, teachers are undervalued. According to Osei (2006), although they are grossly underpaid in Ghana, secondary school teachers are not always undervalued in their communities. The author further stated that teachers are under financial pressure to find alternative means of income, which hinders their ability to be change agents in the increasingly modernising Ghanaian communities.

Another challenge to teaching mathematics is the lack of teaching-learning materials (TLMs). Mathematics is seen by many as an abstract concept, which makes it difficult for learners to comprehend. Teachers must involve TLMs during lessons to ease the subject's abstract nature and make mathematics feel tangible and practical. Most of the time, this is not the classroom situation due to the absence of TLMs or teachers' unwillingness to involve them in the teaching process. As such, learners see Mathematics as an abstract concept, decreasing their interest. Ameyaw (2019) concluded that teachers should employ teaching and learning resources in the classroom during and before the delivery of the lesson to aid students in comprehending the concept that teachers want them to grasp.

Limited time for mathematics lessons in the school's timetable is also challenging for teaching and learning mathematics. In Ghana, the GES stipulates a specific time for teaching subjects at the school level. With such restrictions, teachers find it challenging to involve the necessary tools and procedures at the right pace to enable learners to comprehend concepts gradually with less difficulty. Also, teachers teach Mathematical concepts hurriedly to prepare their students for their final exams due to limited time. The lack of enough time also deprives teachers of the ability to involve TLMs in the teaching process since using these materials demands much time. The involvement of ICT tools is also affected by the limited time available for teaching Mathematics, although it can improve understanding of concepts. Appiahene et al. (2014) stated that the lack of time also challenges Mathematics teaching.

Students' interest and motivation to learn Mathematics is another challenge facing teaching Mathematics. The teacher is responsible for teaching, and the learner is responsible for learning. When learners are less interested or motivated to learn a subject, it is challenging for the teacher to impact them. When students are not interested in what the teacher teaches, they are not motivated to learn, making it difficult for teachers to make them active participants in the classroom. According to

Reys (2010), President of the Association of Mathematics Teacher Educators (AMTE.), one of the challenges to Mathematics education is students' interest in and motivation to learn the subject.

Another challenge that sums up all the challenges is the poor mathematics learning outcomes at the school level. Mathematics teaching aims to make students understand concepts to pass internal and external examinations and progress in their education. In Ghana, students must pass Mathematics to move from one stage of the education ladder to another. This has not been the case, as many students tend to fail their final Mathematics exams. According to Fokuo et al. (2022), the poor performance of students in Mathematics in Ghana can be attributed to factors such as lack of coverage of mathematics curriculum content, lack of interest in mathematics, and students' belief that they cannot understand mathematics.

The following are some of the challenges facing mathematics teaching in Ghana. Identifying these challenges and suggesting solutions will improve the quality of mathematics teaching and school education.

1.5 Mathematics Teacher Education from an International Perspective

Teacher education in different countries may be of various forms and diverse perspectives. Although countries have different approaches to teacher education, there is always a common goal: to produce quality teachers to give the citizenry of a nation the best education. According to Nilsen and Gustafsson (2016), the operationalization of teacher quality includes criteria such as teacher education level, employment experience, participation in professional development activities, and teacher traits such as self-efficacy. For the teacher to exhibit all these characteristics, it is evident that the teacher will have to undergo some training. The quality of the Mathematics teacher cannot be compromised, looking at how vital Mathematics is to the academic development of learners. According to Wu (2022), the quality of a nation's mathematics education depends on the quality of its mathematics teachers; consequently, the professional development of teachers is a critical matter. Nilsen and Gustafsson (2016) again outlined that significant relationships exist between teacher quality, instructional quality, and student achievement.

Baumert et al. (2010) stipulated that in several within-country studies, it has been demonstrated that the quality of Mathematics teachers influences student

achievement. Among the factors that determine students' performance, a mathematics teacher's effectiveness in teaching mathematics plays an essential role (Ertem et al., 2019). Different countries have different approaches to Mathematics Teacher Education (MTE). Among the various pathways other countries use to train their mathematics teachers, the researcher will examine the mathematics teacher education pathways in Singapore, China, Korea, Japan, and Hong Kong. The selection of these countries is based on their performance in TIMMS 2019 since Ghana has also participated in it in previous years.

Since 1995, the International Association for the Evaluation of Educational Achievement (IEA) has conducted the Trends in International Mathematics and Science Study (TIMMS), an international evaluation that compares and tracks students' progress in grades 4 and 8 in mathematics and science every four years. “Since 1995, TIMSS has monitored mathematics and science achievement trends every four years, at the fourth and eighth grades” (IEA, 2023). Table 2.0 shows the average scale score in Mathematics of the best-performing countries in the 2019 TIMMS evaluation.

Table 1.2: 2019 TIMMS Average Mathematics Achievement and Scale Score Distributions

Serial No.	Country	Average Scale Score	
		Grade 4	Grade 8
1	Singapore	625(3.9)	616(4.0)
2	Chinese Taipei	599(1.9)	612(2.7)
3	Korea Rep. of	600(2.2)	607(2.8)
4	Japan	593(1.8)	594(2.7)
5	Hong Kong SAR	602(3.3)	578(4.1)

Source : (IEA, 2019)

Effective teachers and school administrators are the foundation of the Education system. A high-quality teacher population is not the outcome of random chance but the result of purposeful policy decisions. A quality teacher workforce results from a thorough selection, training, compensation, and development system for teachers and principals.

1.5.1 Singapore

Singapore might not be a big nation with plenty of resources, but its ability to create an education system that outshines comparatively bigger and economically more stable countries is fascinating. Over the years, Singapore has outperformed its competitors in globally recognised evaluation systems such as TIMMS and the Program for International Student Assessment (PISA). The release of the 2019 TIMMS report showed that Singapore had the highest average score obtained by candidates in Mathematics at grade 4 and grade 8 levels (IEA, 2019). Teachers' quality plays an essential role in the achievement of learners. If learners from Singapore perform at such high standards in Mathematics, there must be quality Mathematics teachers, which also depends on quality Mathematics teacher education.

Singapore's Teacher Education system is built on solid policies that promote the recruitment, training, compensation, and professional development of teachers. Recruitment of preservice teachers is the sole responsibility of the Ministry of Education in Singapore. The ministry makes sure that the top one-third of the secondary school graduating class is recruited as preservice teachers, which indicates how highly they rate the teaching profession in Singapore. The working conditions of teachers in Singapore are good, which motivates high-performing candidates to opt for the teaching profession. Additionally to the profession's appeal are the excellent working conditions of Singaporean teachers (Darling-Hammond et al., 2017). The National Institute of Education (NIE) (Nanyang Technological University) provide training for recruits. The training of teachers is closely linked with schools to enable practising teachers to serve as mentors to preservice teachers.

A bachelor's degree in mathematics or statistics is the initial prerequisite for selecting mathematics preservice teachers for Singapore's secondary school or junior college training. Regardless, mathematics teachers at the primary level can be picked from candidates with bachelor's degrees from any field. The Ministry of Education is particular about language proficiency and considers the performance of candidates in English during the selection process. Candidates who make it to the next stage undergo a rigorous selection process. Applicants for the next selection process must attend an interview with a short presentation, a written assignment, and a panel

discussion (NCEE, 2016). Additionally, the ministry may require applicants to take specific Entrance Proficiency Tests (EPTs) to validate their expertise.

Successful candidates are then given a contract teaching stint offer for a compulsory teaching stint at a school. During the teaching stint, candidates are evaluated for interest and suitability for the teaching profession. After a successful teaching stint, candidates can enrol in the National Institution of Education (NIE) for their Post Graduate Diploma in Education (PGDE) programme, which lasts between 16 months and two years, and candidates can specialise in Mathematics. During the training, preservice teachers can decide the level of Education they want to teach. The candidates can specialise in educational levels such as primary, secondary, and junior college while completing this course of study; also, the MoE fully finances the PDGE programmes, although prospective MoE math teachers are required to fulfil a teaching bond (Asia Society, 2023). Preservice teachers, after their training, have to pass a teaching practicum exam.

Singaporean teachers are expected to undergo 100 hours of professional development every year. This can be in the form of in-service training organised by the NIE or school-based training on areas that need significant improvement, as well as introducing new teaching methods. Schools mostly fund teachers' growth and development through special funds set aside.

The MoE ensures that teachers are well-paid and motivated to execute their duties. Each year, the Ministry of Education evaluates various starting salaries for different occupations and may change the salaries of beginning teachers to ensure that teaching is viewed as appealing to new graduates as other professions (Asia Society, 2023). The competitive remuneration attached to the teaching profession makes it attractive for people from all professions to want to be teachers.

1.5.2 Republic of China

China is known worldwide for its enormous population growth over the years. A country with one of the largest populations in the world also has the most significant human resource, and the ability to develop such a resource makes it the most profitable asset of the country. Investment in human capital through knowledge expansion promotes labour productivity, social welfare and stability (Norton and

Zhang, 2018). A quality education system is needed to train human resources, and there can be no quality Education without quality teachers. Based on the performance of China in TIMMS evaluation, there is no doubt that China has a quality teacher education system. China was among the best five, based on the mathematics average scale grade score of grades 4 and 8. The performance is no doubt based on a strong MTE.

Teachers' Education in China has evolved in terms of the policy as its population grew. Over the years, China has transformed from a planned economy to an affluent one. The dramatic change in the people from people who accepted the initial form of Education to those who wanted a more sophisticated form of Education meant teachers, and as such, teacher education needed to change to meet the people's expectations.

Teacher education in China has mirrored its increasing societal evolution dating back to the middle of the 1990s. The team for the teacher education system in China has always been based on quality improvement since this period, and it can be subdivided into three phases. The three subdivisions are restructuring (from the mid-1990s to 2005), capacity building (from 2005 to 2016), and revitalisation (since 2017) (Rao, 2020). According to Wu and Huang (2018), China, to prepare quality teachers for the new education curriculum reform at the beginning of the 21st century, issued these official documents: Curriculum Standard for Teacher Education Programme (Experimental) (Ministry of Education of China, 2011a), Professional Standards for Teachers at different levels (Ministry of Education of China, 2012), and Interim Rules for Teacher Qualification Examination (Ministry of Education of China, 2013). These documents highlight the significance of teacher education and present methods and approaches for enhancing its quality.

MTE places more emphasis on content knowledge than pedagogical knowledge on the premise that without solid content knowledge, it is practically impossible to build strong Pedagogical Content Knowledge (PCK). Shulman (1986) outlined that the preservice preparation of Mathematics teachers in China strongly emphasises acquiring CK but less on acquiring student-teaching experience or PCK. Some of the most common courses taken by preservice elementary Mathematics teachers, according to Wu (2022), include Mathematical Analysis, Spatial Analytic

Geometry, Projective Geometry, Non-Euclidean Geometry, Theory of Probability, The Structure of Algebra, a Brief History of Mathematics, Mathematical Modeling, Advanced Algebra, and Elementary Number Theory including modified versions of Calculus and Linear Algebra.

Preservice secondary Mathematics teachers take their programme at the Normal University with credit points three times that of the teacher education curriculum. Some content courses the preservice secondary Mathematics teachers take include Ordinary Abstract Algebra I and II, Differential Equations, Probability and Statistics, Classical Geometry, Complex Analysis, Number Theory, Real Analysis, Differential Geometry, and Combinatorics and Graph Theory. To make up for PCK, schools prioritise teacher development and lifelong learning. Hence, lifelong learning is a vital aspect of the teaching culture of the Chinese, allowing all teachers to feel a sense of belonging and be surrounded by a robust backing system. They mostly obtain their teaching knowledge through school-based programs for continued professional development. According to Wu and Huang (2018), mathematics teacher preparation in China has shifted significantly from relying exclusively on topic knowledge to including content and practice-based knowledge.

1.5.3 Republic of Korea

The Act on Elementary and Secondary School Education of Korea's Article 21, Segment 2 specifies the classification and credentials of teachers. Teachers in elementary or secondary schools in Korea are divided into Grade I and Grade II teachers. According to a presidential decree, teachers must achieve specified qualification requirements for each category and hold a licence from the Minister of Education.

The teaching profession in Korea has various routes. Preservice teachers get teacher education from CoEs, Universities of Education, General Colleges, Departments of Education, and universities offering teacher education programmes. Although some complete their training in elementary education departments at higher education institutions, most elementary school teachers finish their education at four-year national universities. Departments of Education in General Colleges affiliated with universities or CoEs typically provide four years of training for secondary school

teachers. Also, after completing a non-education programme at a university or college, prospective teachers can be trained as teachers in graduate schools.

In Korea, preservice secondary school mathematics teachers are trained in the Departments of Education of General Colleges, graduate schools of education, and universities' CoEs. These universities' CoEs are purposefully established to train mathematics teachers. Secondary school Mathematics teachers are trained in universities' colleges of Education, which exist solely for this reason, in general, college education departments, education courses, and graduate schools of Education (Kwon, 2004).

Secondary school teachers often receive four years of preparation at CoE or departments of Education within general colleges affiliated with universities. Graduate schools offer teacher education to students who have completed Non-education College or university programmes and wish to become teachers (Sang et al., 2015). This also applies to the prospective Mathematics teachers. Due to the delicate nature of the teaching profession and mathematics teaching, prospective mathematics teachers are expected to have higher marks in their previous qualifications to be considered for admission to the CoEs. Applicants to CoE are expected to receive high marks on an aptitude exam and a "humaneness test" (interview), as well as the scholastics accomplishment test and the high school achievement score, due to the uniqueness and professionalism of the teaching profession (Kwon, 2004).

The curriculum of Mathematics teacher education in Korea focuses more on CK. Some CK courses include Linear Algebra, Abstract Algebra, Geometry, Topology, Complex Analyses, Discrete Mathematics, Differential Equations, etc. The pedagogical knowledge courses are Theory of Mathematics Education, Teaching Secondary School Mathematics (3), Mathematics and Education and Computer and Mathematics Education, and

As is practised in Korea, prospective teachers write the Teacher Employment Test (TET) before formally being given the licence to practice. The Teacher Employment Test for potential secondary school teachers is conducted in two stages: the first involves a written examination of pedagogical, curriculum, and subject area knowledge. The second phase involves an in-depth interview, a candidate's

programme for the teaching and learning process, and a teaching evaluation (Sang et al., 2015).

The MoE of Korea is particularly serious about teacher professional development. Teachers, by mandate, are required to complete some levels of professional development programmes for promotion. The MoE of Korea or TEIs organise these programmes. Sang et al. (2015) stipulated that the Korean educational authority offers several training programmes to enhance the teaching profession through education offices and institutions. For a School Teacher Grade I certificate, teachers with at least three years of employment experience must complete a 180-hour professional career development programme during break-in to improve their teaching skills.

1.5.4 Japan

Teacher education in Japan requires prospective teachers to attain training from an accredited institution and the licence to practice for the necessary level and subject. Future teachers must also attain specific credits during their training to qualify for employment. To become a public school teacher in Japan, one must graduate from a Ministry-approved university teacher education programme and earn a teaching certificate for a specific school level (primary, lower secondary, or upper secondary) and subject (Ginshima and Matsubara, 2015). Hedrick (2015) stipulated that completing a certification programme alone is insufficient to teach; prefectures determine which examinations an applicant must pass to be issued a licence. In Japan, the teaching profession is attractive and attracts many applicants due to its recognition. According to the Japanese Ministry of Education, 166,729 applicants for all teaching vacancies in 2009, and 26,910 were hired (Hedrick, 2015). Sabrin (2018) stipulated that similar to Korea, teacher education in Japan is very competitive because it is a highly rewarding (financially and socially) and coveted profession in the country. In 1999, only one in twelve graduates obtained employment.

As pertaining to all teachers in Japan, prospective Mathematics teachers have to obtain the required training and certification from an accredited institution and be certified accordingly to practice. According to Shimizu (1999), in line with the provisions of the Educational Personnel Certification Law, a student must earn a

teacher's certificate by finishing the subjects in a university course to qualify as a teacher in the Japanese educational system. Prospective mathematics teachers apply and take a competitive national exam to be selected to pursue an educational degree at an accredited institution. After attaining a bachelor's degree, preservice teachers can either practice with the right level licence or further their Education to the master's level.

Teacher professional development is an integral aspect of the teacher education system in Japan. After appointment as a teacher, the Japanese Education system mandates all newly recruited teachers to undergo a one-year training programme to get used to the teaching system. In addition, a group of experienced staff is designated to mentor new teachers by offering and receiving observations, lectures, feedback on teaching materials and lesson plans, and collaborative planning and feedback among colleagues. This is the same for newly recruited Mathematics teachers. New teachers must partake in a one-year induction programme consisting of 30 days of out-of-school training and 60 days of in-school mentor-based training (Schumann, 2006; Watson, 2016).

Teachers are also allowed to further their development through further studies with permission from the Board of Education. They can either go for two-year full-time graduate studies with a salary or opt for a full-year programme and the remaining part-time without financial support. Teachers can also have a maximum of three years of study leave without financial backing for further studies.

1.5.5 Hong Kong SAR

The pathway to becoming a teacher in Hong Kong has two alternatives: a five-year Bachelor of Education programme or a postgraduate diploma in Education for university graduates who want to join the Education fraternity. Teacher Education institutions are of three categories in Hong Kong: those funded by government (government-aided) schools and schools under the Direct Subsidy Scheme (DSS) (Bautista et al., 2022). Aided schools are run and operated by sponsoring entities such as nonprofit and religious organisations, whilst Government schools are managed directly by the Education Bureau (EDB). Local schools, which comprise three basic types: Government schools, Aided schools, and schools under the Direct Subsidy Scheme (DSS), provide teacher training to preservice teachers (Bautista et al., 2022).

There are two primary forms of teacher education programmes: five-year undergraduate Bachelor of Education (BEd) programmes and one-year full-time (or two-year part-time) Postgraduate Diploma in Education (PGDE) programmes with university graduate admissions (Education Bureau, 2022). Since these programmes focus more on teaching theories and classroom pedagogies, students (BEd and PGDE) are expected to complete a teaching block practice session.

By the Education Ordinance, prospective teachers must be registered as registered or permitted teachers. Registered teachers hold the accepted teacher qualifications outlined in the Education Ordinance, whereas permitted teachers possess only academic qualifications without teacher training qualifications. Permitted teachers are issued a permit to teach specific subjects in schools (Education Bureau, 2022).

As previously mentioned, a minimum of a bachelor's degree is required to teach in Hong Kong. This degree can be either a five-year bachelor's degree in education from an accredited university or a bachelor's degree in a content area with a postgraduate diploma in education. This applies to mathematics teachers in Korea as well. A degree in Mathematics Education or a degree in Mathematics together with a postgraduate diploma in Education is needed to qualify to teach Mathematics in Hong Kong. The government's long-term objective is to require all new teachers to have professional training and a degree (Education Bureau, 2022).

There are degree programmes (Bachelor of Education [BEd]) and postgraduate programmes (Postgraduate Diploma in Education [PGDE]) for becoming a primary or secondary school teacher. The following five Universities offer these Education programmes in Hong Kong: the University of Hong Kong, The Education University of Hong Kong, The Chinese University of Hong Kong, Hong Kong Baptist University, and Hong Kong Metropolitan University (formerly The Open University of Hong Kong). The Universities run government-funded and self-funded programmes. After completing the education programmes, candidates are certified as qualified teachers recognised by the EDB (Lai and Tang, 2019).

Teachers' Professional Development (TPD) is integral to teacher training in Hong Kong. The Hong Kong government is particular about professional teacher development as it improves students' development. "To further enhance the

professionalism and professional status of teachers, the Government has commissioned a study on the development of teacher competencies and a professional development framework that would provide the empirical basis and enrich a common continuing professional development framework for teachers” (Education Bureau, 2022). In 2013, the Committee on Professional Development of Teachers and Principals (COTAP) was formed from the Advisory Committee on Teacher Education and Qualifications. COTAP is a governmental advisory body that provides expert advice on policies, measures, and strategies to foster teaching professionals' Professional Development (PD) at all career stages. The COTAP is also responsible for commissioning educational research, assessing studies and PD programmes for teachers and principals, and providing a forum for many stakeholders (e.g., school leaders, educational bodies, and organisations) to share their expertise (Bautista et al., 2022). Professional development of Hong Kong teachers is provided by the following entities: the EDB, the local universities, primary and secondary schools, teacher unions, and private organisations. There are Core and Elective PD training schemes. Core training consists of a series of planned (required) modules and courses the EDB offers, whereas several other providers deliver elective training (e.g., EDB, universities, and teacher unions). Mathematics teachers in Hong Kong have to abide by all the regulations for teachers' PD.

From the assessment of the teachers' education, particularly the mathematics teacher education programmes of these nations, certain aspects are common among the five countries. These attributes common with the mathematics teacher education of these five (5) best-performing countries regarding mathematics at the TIMSS assessment include:

1. The emphasis on recruiting top-performing candidates as pre-service teachers for training. This has been made possible due to the importance attached to the teaching profession and the good in-service benefits available to teachers in these countries.
2. The training systems' prioritisation is placed on the subject's content base. The training processes place vital relevance on the subject content knowledge of the subject mathematics. It is laudable to say, without the content, what does the

teacher have to teach? It is, therefore, essential that mathematics teachers are equipped with enough content knowledge ahead of pedagogy.

3. The training systems ensure that teacher PD is integral to the training process. It is also guaranteed that, in all cases, pre-service teachers gain enough experience regarding pedagogical knowledge through learning from the experience of field mathematics teachers.
4. It can also be noticed that teachers are given the necessary recognition in these nations by providing good in-service benefits. This helps attract the best graduates into the teaching profession and also helps keep trained teaching professionals in the system.

1.6 Mathematics Teacher Education from Indian Perspective:

Recommendations from NEP, 2020

Every serious nation's educational system must prioritize mathematics education. Mathematics is known to be the mother of all subjects and, therefore, must be given some priority for better educational outcomes. The structure of our brains and how most societies construct their school curriculum demonstrate that mathematics is the mother or foundation of science (Chiu, 2007). Mathematics enhances critical thinking, which is needed in all other subjects for concept understanding. Students' success in overcoming challenges can be enhanced by critical thinking (Yumiati, 2013). Therefore, for India's current educational policy, NEP 2020, to lay out its recommendations for enhancing mathematics education and mathematics teacher education is not surprising. The National Education Policy (NEP) 2020 envisions a transformative approach to teacher education in India, emphasising the need to prepare mathematics teachers to be highly skilled. The policy recognises that well-trained quality mathematics teachers are crucial to achieving educational equity and excellence and improving mathematics instruction.

The NEP 2020 has outlined features that should be enshrined in India's MTE system. The policy has outlined how mathematics education programmes should be structured and implemented, together with the structure and features of mathematics education at the various levels of India's education ladder.

A significant recommendation of the NEP 2020 is the introduction of the Integrated Teacher Education Programs (ITEP). This means simultaneously merging subject specialisation with pedagogical skills. In this regard, mathematics teacher education will simultaneously equip prospective mathematics teachers with CK, PCK and PK. The programme will integrate foundational courses in mathematics, advanced studies and hands-on teaching experience.

The NEP 2020 recommends that;

- i. Teacher education should be multidisciplinary
- ii. By 2030, all teacher education programmes should be multidisciplinary and integrated
- iii. Since they will be offering 4-year ITEPs, all standalone TEIs must become multidisciplinary institutions by 2030.
- iv. By 2030, the four-year integrated B.Ed. programme offered by these multidisciplinary HEIs will represent the bare minimum of education required of school teachers.
- v. The 4-year ITEP will combine Education with specialised subjects (mathematics, history, etc.) (Ministry of Human Resource Development, 2020).

The policy focuses on conceptual literacy and numeracy (Bashir and Jan, 2023). The NEP 2020 wants mathematics teachers to have problem-solving skills and conceptual clarity. Teacher education programmes are recommended to involve innovative teaching strategies using activity-based learning, collaborative problem-solving, and digital tools. The policy further promotes preparing mathematics teachers to help kids develop a growth attitude and deal with mathematics anxiety.

Teacher education is also meant to adopt a competency-based framework, focusing on measurable outcomes such as effective classroom management, formative assessments, and the ability to link mathematical concepts to real-world applications; according to NEP 2020, it is also supposed to teach prospective mathematics teachers to design and implement inclusive and differentiated instructional strategies.

Technology has come to stay and will continue to expand (Holtgrewe, 2014). NEP 2020 encourages the use of technology, including simulation of software, e-resources, and AI-driven learning tools. The National Education Policy (NEP) 2020 advocates for the "extensive use of technology in teaching and learning and education planning and management," which is in line with the increasing demands of the times (Ministry of Human Resource Development, 2020). Therefore, mathematics teacher training is expected to build the competence of prospective mathematics teachers to integrate ICT tools in their classrooms.

Continues Professional Development (CPD) is important for keeping up to date with the latest developments in Education for teachers (Maciejowska, Čtrnáctová and Bernard, 2015). NEP 2020 mandates 50 hours of annual CPD for teachers. Mathematics teachers will get access to webinars, workshops, and modular courses that highlight the most recent advancements in the discipline. Driven by their interests and an awareness of learning as a lifelong process, teachers, head teachers, and teacher educators are expected by NEP 2020 to engage in at least 50 hours of continuing professional development (CPD) annually (National Council of Educational Research and Training, 2022).

The NEP 2020 also encourages flexibility in courses offered to enable mathematics teachers to pursue additional qualifications or specialisations in areas like data science and applied mathematics. A credit-based system has also been introduced to allow pre-service mathematics teachers greater flexibility in their educational journey (Government of India, 2020).

The assessment procedure in teacher education should be changed, according to NEP 2020. Through portfolio submissions, peer reviews, and hands-on teaching demonstrations, aspiring mathematics teachers undergo a rigorous evaluation process. By guaranteeing that prospective maths teachers in underprivileged areas have access to top-notch teacher preparation, the policy seeks to close the gap between urban and rural areas. Financial aid and scholarships will help candidates from underprivileged backgrounds. The NEP 2020 also encourages HEIs to establish mathematics clubs to promote collaborative learning and interdisciplinary research. These clubs aim to enhance student engagement with mathematics outside the traditional classroom

setting, fostering a community of learners who can share ideas and resources (Government of India, 2020).

The policy's all-encompassing approach offers an unmatched chance to raise the bar for mathematics education in India and develop a new generation of teachers capable of encouraging learners to think critically and pursue lifelong learning. NEP 2020 lays the groundwork for India's strong and vibrant educational ecosystem by coordinating mathematics teacher education with local requirements and international best practices.

1.7 Explanation of Major Concepts Supporting the Study

For a strong foundation for the study, the researcher explained the major concepts that supported the study's objectives. These concepts are integral to the conceptual framework of the study. A conceptual framework aids in first identifying and then clarifying the critical elements of a study, its value, and the need to relate to other features and variables that impact research (Ravitch and Riggan, 2016).

1.7.1 Nature and Philosophy of Integrated Teacher Education Programmes

There are two paths to becoming a teacher in Ghana. One can pursue a specific discipline programme (e.g. BSc Mathematics) and then add a post-graduate diploma/degree in education to become a professional teacher. The other alternative is going for a Teacher Education Programme (TEP), which integrates Subject Content Knowledge (SCK) (e.g. Mathematics), Pedagogical Content Knowledge (PCK) (e.g. Psychology of teaching Mathematics) and Pedagogical Knowledge (PK) (e.g. Curriculum Studies).

The integration is parallel/simultaneous at Ghana's CoE and TEU levels. Pre-service teachers take courses on specific subject areas (Content Knowledge (CK)), education-related areas (Pedagogical Knowledge (PK)) and pedagogical content areas courses (Pedagogical Content Knowledge (PCK)). For example, during the 2nd year of UCC's B.Ed Mathematics programme, pre-service students take Psychological Basis of Teaching and Learning Mathematics (PCK), Special Education (PK), and Further Calculus (CK) simultaneously.

“Knowledge learnt in isolation is rapidly forgotten.” This well-known adage succinctly conveys the value of integration (Singh, 2018). When knowledge is connected with others, it is easier to link them up, which is vital in education since

pedagogical knowledge and content knowledge are to be applied simultaneously in practice. Integration, from the Latin word “*integratus*”, means to bring together the parts of or to render (something) whole. Integration is teaching content to relate or bring together concepts typically taught in different academic departments or courses. According to Singh (2018), “integration in education means coordination in the teaching-learning activities to ensure the harmonious functioning of the educational processes”.

Integration in education is built upon Whitehead’s philosophy. Whitehead believed that “Nothing is in isolation” (Fan, 2004). All things depend upon each other. Everything in this world is in some way connected with every other thing in this world; Everything is part of a whole. Whitehead applied this idea to education. He loved to refer to nature as “alive,” which gave him a special lens through which to see physical and biological research. The students, in his opinion, “are alive.” The mental and physical components of unified experience are present in the body. In this theory, there is no distinction between the body and the mind; both exist simultaneously (Kate et al., 2010). Educators focus on the mental state, including the mind, perception, and reasoning. Teachers deal with a totality rather than a mind, body, cognition, or effect; students bring their entire selves to the circumstance. To put it briefly, Whitehead’s philosophy of organism forms the foundation of integration in education.

Integration in teacher education is essential. It enables pre-service teachers to quickly identify the coordination between content knowledge and pedagogical skills. The ability to identify these integration helps teachers to apply their content knowledge in the classroom with ease.

1.7.2 Mathematics Teacher Education

Mathematics is essential for the academic development of children. Mathematics improves the thinking and analytical skills of learners. It is also necessary for the future professional training of learners. According to ICMI (2022), Mathematics promotes logical thinking and mental rigour and is a valuable method for developing mental discipline. As relevant as mathematics is, training the people responsible for teaching mathematics to learners (mathematics teachers) is equally essential. The process of training professionals responsible for teaching Mathematics at the school level is termed Mathematics Teacher Education (MTE).

MTE, from the Ghanaian Teacher Education perspective, happens at the Colleges of Education (CoEs) and Teacher Education Universities (TEUs). The CoEs are responsible for training mathematics teachers at the basic level (primary and JHS) of school education, while TEUs train mathematics teachers predominantly at the SHS level. It must be noted that some TEUs have programmes that prepare teachers for the basic schools of Ghana, but most of the MEPs at the TEUs train Mathematics teachers for SHS. The UGs MEP (BEd. Junior High School Education (Mathematics)) trains Mathematics teachers for the basic level of school education in Ghana.

The MEPs are predominantly four-year integrated programmes. The integration process is simultaneous. CK, PCK and PK courses are taught to students simultaneously every semester. The integration happens in the same manner at the CoEs and TEUs. At the CoEs, the programme's final year is used for practicum (Off-campus teaching practice). Concerning the TEUs programmes, practicum happens during the seventh semester of the programme. During the 7th semester, students source attachments to the various Senior High Schools for off-campus teaching practice. It must be noted that some students also take their practicum at the basic and COE level.

The MEPs are open to WASSCE, GCE "A" Level and diploma holders. WASSCE holders must have obtained grades of (A1 – C6) in English, Core Mathematics and one of General Science or Social Studies, as well as three elective subjects, including Elective Mathematics (UEW, 2019). For GCE "A" Level holders, the eligibility criteria vary from one institution to the other. Nevertheless, in a general sense, holders must have at least five passes from O'level and two passes from A'level, including Mathematics, whilst diploma holders can apply to slot straight into the third semester. Diploma holders must have read mathematics-related programs at the diploma level. There is also an opportunity for mature candidates. Candidates of a specific age (e.g. 25 and above) are allowed to apply, attend an interview and or write an entrance exam and be offered admission upon passing the interview or entrance exam. To qualify to graduate with a bachelor's degree in mathematics education, candidates must attain at least 120 credits from all courses read and have a CGPA of at least 1.0. The candidates must pass all elective and core courses and settle all financial obligations.

1.7.3 Academic Standard

The standard an institution upholds for its graduates and transactions is essential. High academic standards ensure that institutions make the necessary efforts to give their students the best of everything. Academic standards, such as the complexity of the curriculum and the difficulty of examinations, serve as benchmarks for educational quality and excellence.

Academic is a term predominantly used in the field of education. Academics can be used to represent activities that are undertaken in educational institutions. Activities such as teaching-learning, evaluation processes, seminar organisation, paper presentations and field trips can all be academic activities. IGIGlobal (2022) defines academics as “scholarly activities of a school or university, of or relating to a college, academy, school or higher education institution, especially one for higher education.”

Standard is used in all endeavours. The standard of something can be viewed as its level of quality. In industries, the quality standard of products is the quality of the output of the particular industry. Similarly, standards in education can be seen from a similar point of view as the quality level of the educational activities of the specific educational institution. From the above perspectives, Academic Standards can be seen as the quality standards attached to the various academic activities that an academic institution undertakes. Sharp (2017) defined academic standard as the depth, breadth, and complexity of the information and abilities that a student proves to possess at the end of a programme of study.

Setting standards and living by them is essential for all academic institutions. The standards of an institution become a guide as to the quality of all activities involving the institution. It also urges the institution always to push to improve its activities to meet stakeholders’ expectations. It also becomes the quality benchmark for all activities. More relevant, it reminds stakeholders of the importance of enhancing the institution’s performance within its standards as it advances. Kapur (2019) stipulated that an important goal that requires ongoing attention is raising educational standards. The author further stated that leadership, policies and practices, activities and programmes, cordial terms and relationships, classroom practises, counselling and guidance services, infrastructural facilities and amenities,

constructive feedback, acknowledging viewpoints and perspectives, boosting motivation, pedagogy and evaluation methods are the main strategies that need to be identified in order to improve educational standards.

1.7.4 Curriculum Design, Development and Implementation

The curriculum of an institution is fundamental to the achievement of its goals. It dictates what has to be done to attain an institution's objectives. An academic institution's curriculum design, development and implementation are as significant as the institution itself.

A curriculum is a standards-based sequence of scheduled experiences which allows students to practise and master both academic knowledge and practical learning abilities. The curriculum serves as the primary reference point for all educators regarding what is required for teaching and learning to guarantee that each student has access to challenging academic experiences. A curriculum's design, organisation, and concerns are intended to improve student learning and streamline education (RIDE, 2022). Egan (1978) stipulated that “ at a superficial level, confusion about what curriculum is, and thus what people concerned with it should do, involves arguments about whether curriculum subsumes instruction – and thus whether a student of the curriculum should also be a student of instructional methods – or whether curriculum involves all learning experiences, or refers simply to a blueprint for achieving restricted objectives in a school setting or includes the statement of objectives as well, or also the evaluation of their achievement, and so on”. Gobby (2017) outlined that curriculum should be considered the lived experience of learners in an educational setting and that social, cultural, and political forces influence learners' curriculum experiences. Curriculum design relates to how we arrange the curriculum components. Whatever the underlying curriculum model, all curriculum designs strive to address four curricular components. Why do we begin instruction or goals? What should we teach to achieve our stated goals and objectives? How can we connect certain learning experiences? What have we discovered, and what measures should we take regarding the educational programme, students, and teachers? (Mohanasundaram, 2018).

Designing a curriculum is not a singular activity. It involves a team of experts from different fields. Designing a curriculum involves putting together activities that

are organised to be followed to achieve a particular objective, especially in educational institutions. Subject matter experts, curriculum experts (coordinators, directors, oversight groups), instructional design and development professionals, and teaching employees are usually members of a curriculum design team. Depending on the curriculum, the team may include senior leadership, data and research specialists, organisational development specialists, and information technology specialists. According to Dodd (2020), curriculum designers should consider the following “layers” in the design process.

- (i). “Outcomes: the intended learning or performance result from the curriculum;
- (ii). Content: the topics or information included in the curriculum;
- (iii). Instructional Strategies for how the curriculum is organised, structured, and/or presented to reach a particular goal;
- (iv). Technology: tools used to facilitate curriculum delivery, development, or assessment, whether digital or analogue;
- (v). Data: how metrics and data elements are captured, organised, stored, and represented;
- (vi). Media: the physical or digital assets used to present the curriculum to the learner;
- (vii). Policy: the guiding principles, rules, or regulations that frame the design of the curriculum” Dodd (2020).

The author defined “layers” as the essential variables that good curriculum designers consider when working on curriculum projects and initiatives.

Designing the curriculum is a separate task from its development. After its design, a curriculum should not stagnate but evolve with current developments as time passes. Conditions change with time, employers’ demands change, skills on demand change, and the skills needed for survival change; curriculum experts should continually develop the curriculum to meet current demands. Mohanasundaram (2018) defined curriculum development as a planned, deliberate, organised, and systematic process for bringing about constructive changes in an educational system. Although developing the curriculum may not demand as many experts as its design, it must be done critically and involve all stakeholders of the academic environment. The development process must consider all aspects of the curriculum and ensure that the inputs are per the objectives of the curriculum. Curriculum development refers to

preparing learning opportunities to bring about specific changes in students and assessing the amount to which these changes have occurred (Nicholls and Nicholls, 2019). The authors presented four stages of the development process as follows:

- i. “The careful examination, drawing on all available sources of knowledge and informed judgement, of the teaching objectives, whether in particular subject courses or over the curriculum;
- ii. The development and trial use of those methods and materials in schools are judged most likely to achieve the objectives with which teachers agree;
- iii. The assessment of the extent to which the development work has achieved its objectives. This part of the process may also be expected to provoke new thoughts about the objectives themselves;
- iv. The final element is the feedback on all the experience gained to provide a starting point for further study” (Nicholls and Nicholls, 2019).

Curriculum implementation refers to curriculum specialists’ and topic experts’ ideas and proposals in a classroom or school context (IGIGlobal, 2022). The implementation of the curriculum must be given serious attention as its design and development. At this stage, all the processes and methodologies proposed during the design process are put into action to achieve the objectives of the curriculum. Chaudhary (2015) outlined that Curriculum implementation comprises putting into practice the officially defined courses of study, syllabuses, and disciplines. The author further stipulated that the procedure entails assisting the student in acquiring knowledge or experience. The author also identified factors that influence curriculum implementation: the teacher, the learners, assessment, resource materials and facilities, interest groups, the school environment, culture and ideology, and instructional supervision (Chaudhary, 2015). As indicated above, these factors are critical and must be seriously considered in the implementation process. For example, qualified teachers must be recruited to implement the curriculum effectively. Also, the recruited teachers should be given the necessary resources during the implementation process. For effective curriculum implementation, the above factors must be given attention.

The stages of curriculum implementation are;

Engage Stage: Investigate several areas of the new syllabus to identify and plan for improvements needed for optimal curriculum implementation.

Enact Stage: Teach, assess and report using the new syllabus and evaluate to refine new practices and systems.

Embed: Strengthen and scale to ensure sustainable practices and systems (NSW Government Website – Education, 2022).

These stages, if followed, will help strengthen the curriculum for future use and reflect current education issues.

1.7.5 Evaluation Procedures

Evaluation is essential in every academic environment. An academic curriculum without outlined evaluation procedures will be seen as incomplete. Evaluating an educational process and a programme is vital to the success of an institution. Yambi and Yambi (2020) outlined that the goal of an evaluation is to compare the quality of a performance or work output to a standard. The authors further defined evaluation as evidence of value standards and the specific situations and goals the group or individuals attempt to achieve. Evaluation denotes a broader sense of measuring than traditional exams and examinations. The evaluation emphasises general personality development and the educational program’s key objectives (Howard and Donaghue 2014).

According to Kizlik (2019), evaluation may and should be utilised as an ongoing management and learning tool to improve learning, including five essential components listed below:

- i. “Articulating the purpose of an educational system;
- ii. Identifying and collecting relevant information;
- iii. Ideas that are valuable and useful to learners in their lives and professions;
- iv. Analysing and interpreting information for learners;
- v. Classroom management or classroom decision-making” (Kizlik, 2019).

Evaluation procedures need to be outlined in the institution's curriculum. Teacher educators must be aware of the procedures to evaluate their students and how they will be evaluated at the end of a programme. Most importantly, the evaluation procedures must be towards the achievement of the programme's objectives. The effectiveness of teaching, teaching techniques, strategies, and methods is known through evaluation. Evaluation contributes to improving courses/curricula, texts, and

teaching materials. Through evaluation, accountability to society concerning employment demands and requirements is realised. Also, evaluation helps to satisfy the need to report students' progress to their guardians regularly. Evaluation is a critical component of the educational system; it serves various functions in educational systems, including quality control in education and selection/entry to a higher grade or tertiary level (Disha, 2016).

The MEPs in Ghana aim to produce quality mathematics teachers for the Ghana school system. This cannot be done without appropriate evaluation procedures. There must be a stipulation of evaluation procedure which can access the required skills expected of the graduates of these programmes. Investigating the types of evaluation procedures utilised by the MEPs and their effectiveness in measuring the skills they measure is among the motivations of the study.

1.7.6 Resources Available to the MEPs – Human and Material

Resources available to an educational institution form an integral part of its success. According to Dangara (2016), all human, material, audio-visual school environments and community materials available in an academic environment aiding school administration and simplifying the teaching-learning process are referred to as educational resources. Other necessary items used in schools to facilitate teaching and provide pupils with a deeper understanding of what they are learning are also considered resources. Among the educational resources needed in an institution are teachers, administrative staff, buildings, libraries, books, laboratories, time and computers (Delta and Nwaham, 2023). The necessary materials, such as lecture halls, computer laboratories, teaching-learning materials, teacher educators, administrators, cleaners, etc., form an institution's resources. These resources must be provided correctly for an institution's success.

Human resources constitute the backbone of every institution. The makeup of an institution and the successful completion of all activities depend on the human resources of an institution. The planning, organising, coordinating, controlling, manipulating and maintaining of all other resources depends on the human resource. The success of an institution depends not only on the number of human resources. The quality of human resources is also vital. Human resource managers must ensure

the recruitment of the right people with the right qualifications. The human resources of an educational institution include teachers, administrators, cleaners, and laboratory assistants. The availability of human resources is not only required in school administration but their quality and quantity must be considered if effective and efficient administration is to be guaranteed (Dangara, 2016).

Material resources constitute the tangible part of the resources of an institution. Material resources comprise the classrooms/lecture rooms, staff offices, vehicles, health centres, library, laboratory, cars, student residential facilities, and other items that help the institutions with their activities and procedures. Kapur (2019) states that infrastructure, amenities, facilities, equipment, tools, and equipment are material resources. The author further iterated that it is vital to increase material resources to attain educational goals. Physical resources include school facilities such as classrooms, lecture theatres, auditoriums, typing pools, administrative blocks, libraries, laboratories, workshops, gymnasias, assembly halls, unique rooms such as sickbay, staff quarters, students' hostels, kitchen, cafeteria, lavatory, and so on (Olelewe et al., 2014). Material resources play a significant role in every educational institution. No institution can be without resources such as a classroom/lecture hall and administrative buildings. Teacher educators need teaching-learning materials to enhance concept understanding, especially in the Mathematics classroom. Vehicles are relevant regarding the movement of personnel and other materials and the need for a health facility to safeguard the health of teachers, educators and students alike.

Resources, humans, and materials should be available to MEPs to train pre-service mathematics teachers effectively. The resources must be in the right quantities and quality. Without enough human and material resources, MEPs will struggle to impact their students to the maximum. When the endogeneity of school resources is accounted for, the positive resource impacts become even more significant. Olelewe et al. (2014) stated that the significance of educational resources cannot be overstated; without some relevant materials, functional literacy will continue to elude us.

1.7.7 Learning Culture

An educational institution's learning culture can be defined as how teaching and learning occur within the institution. This includes the shared values, emotions,

and behavioural norms of students who study and research at the school. An institution's learning culture can be evaluated by attentively analysing the impact of environmental factors on learning and how academic activities are carried out. A people's culture is their way of life. It includes a group's morals, procedures, methods, and norms. According to this definition, learning culture is how an educational institution approaches the teaching and learning processes. An educational institution's culture must foster a welcoming and enabling environment for teaching and learning to progress smoothly.

A learning culture is described as a culture that promotes and facilitates learning among its employees (Schmitz et al., 2014). According to Shen and Tian (2012), institutional academic culture consists primarily of academic outlooks, academic spirits, academic ethics, and academic settings. Academic spirits are the concepts and beliefs that emerge and condense after years of academic practice and activity. The culture of an institution influences students' and teachers' attitudes towards various activities in the institution. The institution's culture influences how serious teachers are, how students learn, how practical activities are organised, and how administrators conduct their businesses. A good learning culture constantly questions its techniques and ways of doing things. This ensures ongoing progress and adaptability. Ismail et al. (2022) outlined the significance of fostering a positive and collaborative school culture that enables all school members to collaborate towards common goals, enhancing the school's effectiveness.

Jenert (2011) outlined that learning culture can be viewed as an educational development criterion for higher education institutions. A school that can build and sustain a healthy shared culture understands which parts of culture are vital in creating an effective learning environment and consciously conveys these values to its students (TESS India, 2014).

Positive school culture could be generally defined to include:

- i. "Social climate, including a safe and loving environment where all students feel accepted and appreciated and have a sense of ownership of their school, contributes to students' moral growth;

- ii. A rich, challenging, and exciting curriculum and a powerful pedagogy for teaching create an intellectual atmosphere where students in every classroom are supported and challenged to perform their absolute best and produce quality work;
- iii. Rules and policies that keep all school members responsible for high learning and behaviour standards;
- iv. Traditions and rituals based on shared values honouring and promoting the school's academic and social standards;
- v. Structures for giving staff and students a presence and shared responsibility for problem-solving and making decisions which affect the school environment and their daily lives;
- vi. Methods for effectively collaborating with parents to improve students' academic and character development;
- vii. Norms for relationships and behaviours that create a professional culture of excellence and ethical practice" (Character Education Partnership, 2010).

A good learning culture is essential and should be prioritised. Creating a platform that enables MEP students to participate in international activities is vital. Participating in international seminars, competitions, research, exhibitions, and exchange programmes is critical for students' growth. An essential part of the current academic environment is making such activities an active part of the learning culture of the MEPS.

1.7.8 Academic Leadership Practices

Leadership in academic institutions is relevant to achieving the institution's goals. How an educational institution's leaders effectively steer the affairs of the institution determines the accomplishment of set objectives. The leader's activities will either motivate members to put much effort into the work or demotivate them to approach them. According to Alberto (2015), leadership is the interaction of influence when certain individuals accept someone as their leader in a given environment to attain mutual aims. Day and Antonakis (2008) stipulated that leadership may be an attempt to influence others' actions and behaviours through power. Academic leadership can be seen as an effort to lead a group of individuals within an educational environment to achieve the set objectives of an institution. Therefore, academic

leadership practices can be seen as activities and procedures established by an institutional leader to achieve expected goals.

Leadership styles might differ, but the type of leadership should enhance the achievement of stated goals. Gurung (2014) outlined that faculty and staff in leadership positions must, among other things, be able to manage change, generate consensus and foster collaboration, advance the development of campus faculty and staff, set academic properties, champion programmes, and evaluate faculty effectively and equitably. Leadership practices in academia involve all activities related to leadership within an institution. All stakeholders should feel involved and satisfied with the processes in all these activities. Leadership practices such as selecting leaders for an institution are critical and form the foundation of leadership in any institution. Leadership practices in an institution include the distribution of duties, motivating members, provision of materials, selection of leaders, the delegation of powers, curriculum design, development and implementation planning, etc. The leader must pioneer these activities through a style that suits and is acceptable to all members.

To put it briefly, academic leaders at TEUs are in charge of starting and overseeing new programs, including curriculum design, delivery, review, and compliance; making the most use of teachers; facilitating the appointment of Heads of Units and Unit In-charges, Chairpersons, and Institute Coordinators; facilitating faculty nominations for national and international seminars and conferences; keeping an eye on teacher publications, and more. Academic leaders are expected to engage in all of these activities.

1.7.9 Challenges of Mathematics Teacher Education

All teacher education systems face challenges in the process of preparation of pre-service teachers. Therefore, it is imperative that MEPs of Ghana also face some challenges in training Mathematics pre-service teachers. IGIGlobal (2022) defines a challenge as something that, by its essence or character, serves as a demand to make a special effort, a requirement to explain, defend, or have difficulties in a stimulating activity. Challenges can come from various aspects of the makeup of an academic institution. They could be personnel, infrastructure, administrative, motivational or

financial. Whatever these challenges are presented, they need to be manoeuvred to ensure that an institution reaches its maximum potential.

MTE in Ghana faces various challenges. The ability of the MEPs to attract candidates is a challenge for the MEPs in Ghana. With the low popularity of the teaching profession due to low salaries and almost absent incentives in the teaching fraternity, the best candidates with interest in Mathematics prefer non-educational Mathematics-oriented fields. Although some candidates who reject the MEPs end up in the classroom after their bachelor's, the teaching profession becomes only a stepping stone for them because of the lack of employment in their chosen field of endeavour.

The lack of infrastructure is another challenge faced by the MEPs of Ghana. There is a demand for Mathematics teachers in the public and private sectors of school education. Although this is the situation, the TEUs cannot produce enough teachers for the education system. This is due to the inability of the TEUs to admit more pre-service mathematics teachers due to the lack of required infrastructure. Since university education in Ghana operates a lecture system, most lecture halls are mostly crowded. This puts pressure on infrastructure, and though this is the situation, there is still a shortage of Mathematics teachers at the school level of Ghana's education. This is evidence that, even though the available infrastructure is being risked to compensate for the shortage of Mathematics teachers, the system is still unable to produce enough teachers. "Africa's infrastructural stock and quality is among the least developed in the world, a challenge that significantly hinders economic development" (World Bank, 2011).

There is also the issue of a lack of enough Mathematics teacher educators in the various institutions to train pre-service teachers. This fact cannot solely be attributed to one factor but multiple factors. The reasons behind this can be a lack of enough qualified personnel to be recruited, the inability of the government to recruit enough teacher educators for the MEPs and the lack of motivation for eligible persons to be drafted into the education system. The lack of enough Mathematics teacher educators for the MEPs overburdens the available teacher educators with excessive work schedules. This does not allow the mathematics teachers and educators enough time to ensure the proper methodologies are employed to maximize the benefit of pre-

service mathematics teachers. Several issues challenge staff retention, including poor working conditions, low lecturer participation in decision-making, delayed promotions, insufficient feedback, and a lack of institutional recognition and compensation for diligent work (Amegatsey et al., 2018).

The challenges mentioned above are a few difficulties in training Mathematics pre-service teachers in Ghana. These challenges need to be identified and dealt with as they serve as an impediment to the training system. Teacher educators and administrators of the various MEPs should have a good, sound work environment deprived of many challenges to deliver their maximum best. Identifying these challenges and recommending possible remedies to them is part of the motivation of the present study.

1.8 MODELS OF PROGRAMME EVALUATION

Evaluation is the process that measures the degree to which goals are met (Azziz et al., 2018). Academic programmes are meant to effectively produce products with the needed quality for a specific field of endeavour. Though stakeholders and experts, through various rigorous streamlined procedures, ensure that academic programmes are appropriately set up with the necessary activities for the utmost outcomes, it is still necessary for academic programmes to be regularly evaluated to ensure they serve the purpose for which they were instituted. Programme goals, activities, and results are explained through the evaluation process, which also produces information about their value and merit (Rallis and Bolland, 2004). According to Msila and Setlhako (2013), Good programme evaluation can result in future improvements and project delivery. Programme evaluation models assess the effectiveness, efficiency, relevance, and impact of programmes, projects, policies, or interventions. Several models are used in programme evaluation, each with strengths and weaknesses. Here are some commonly used programme evaluation models

1.8.1 The Logic Model

The Logic Model approach to evaluation pays special attention to the connections made between the programme's components and how those connections relate to the programme's setting, which indicates system theory's influence (Frechtling, 2007). The logic model of evaluation has four components: inputs,

activities, outputs, and outcomes. It helps stakeholders understand the logical connections between programme activities and intended outcomes.

1.8.2 Stufflebeam's CIPP Model

Stufflebeam's Context, Input, Process, Product (CIPP) Model is a comprehensive evaluation framework developed by Daniel Stufflebeam. Its goal is to evaluate programmes' efficacy and quality by looking at four connected parts:

Context Evaluation: This component focuses on understanding the environmental factors surrounding the programme, including the needs, resources, and constraints within the program's operating context.

Input Evaluation: Input evaluation assesses the adequate, appropriate, and effectively utilised resources allocated to the programme, including human, financial, and material resources.

Process Evaluation: Process evaluation focuses on implementing programme activities and procedures.

Product Evaluation: Product evaluation assesses the outcomes and impacts of the programme.

1.8.3 Kirkpatrick's Four Levels of Evaluation

Kirkpatrick's Four Levels of Evaluation is a widely used model for evaluating training and development programmes. The model consists of four hierarchical levels, each focusing on different aspects of programme evaluation:

Level 1: Reaction (or Satisfaction): Participants' responses and degree of satisfaction with the course are assessed at this stage.

Level 2: Learning (or Knowledge): This stage assesses how much of the training program's new information, abilities, or attitudes the participants have picked up.

Level 3: Behavior (or Transfer): This stage assesses how well participants integrate the knowledge and abilities they acquired during the training programme into their day-to-day tasks or employment.

Level 4: Results (or Impact): This stage assesses the training programme's overall effect on the aims and objectives of the organisation.

The researcher has read and taken clues from these evaluation models since the study is assessing the effectiveness of an educational programme. Stufflebeam's CIPP model was of interest and useful to the researcher. The CIPP model is useful for assessing school education quality (Azziz et al., 2018). The researcher out of the information gathered from these model, created a model for the study by concentrating on assessing the programmes' purpose, present status and future direction, academic standards, curriculum design, development and implementation, evaluation procedures, resources, academic leadership practices, learning culture and challenges .

Daniel Stufflebeam created the comprehensive framework known as the CIPP Model, which provides an organised method for evaluating programmes and makes it easier to comprehend their efficacy. Stufflebeam introduced the CIPP model for evaluation in 1983, which consists of four elements: C- Context, I- Input, P- Process, and P- Product (Azziz et al., 2018). The model's basic concepts align with the letters in the acronym CIPP: context, input, process, and product evaluation (Stufflebeam, 2000). It offers a methodical way to evaluate projects, programmes, or policies. Evaluation refers to assessing advancement towards specified goals and objectives (Aziz et al., 2018). Policymakers, programme staff, and service providers can use these evaluations to initiate, develop, and strengthen programmes, meet accountability demands, share effective practices, and contribute to knowledge (Stufflebeam, 2000). Context evaluation explores the demands, difficulties, and opportunities of the programme's immediate surroundings. The process of input evaluation examines programme resources to ensure they support the programme's aims and objectives. Process evaluation assesses the effectiveness of the operating procedures and implementation techniques toward the targeted results. Lastly, Product Evaluation evaluates the program's concrete outcomes and effects to provide insight into its viability and efficacy.

Through a logical assessment of every element, interested parties understand a programme's functioning, facilitating well-informed choices and ongoing enhancement. The CIPP Model's structure enables continuous evaluation and

improvement, guaranteeing that programmes adapt to new demands and difficulties. Applicable in educational environments, public policy endeavours, or organisational development projects, the CIPP Model is a flexible and indispensable instrument for programme assessment and improvement.

Context

The foundational level of the CIPP Model for Evaluation is the "context" component, which offers vital insights into the environment surrounding a policy or programme. The "context" of the CIPP evaluation model contains the implementation programme's objectives and background information (Sofyan et al., 2019). A comprehensive analysis of the social, economic, cultural, and political elements influencing the creation and execution of the programme is required for context evaluation. Evaluators can pinpoint the programme's particular requirements, difficulties, and opportunities by knowing the environment in which it functions. Context evaluation assesses needs and possibilities within a specific context or setting (Stufflebeam and Shinkfield, 2007). Engaging stakeholders is another aspect of this phase that aims to obtain a variety of viewpoints and views. Context evaluation directs resource allocation and decision-making by setting the stage for the CIPP Model's later components. "Context evaluations assess needs, problems, and opportunities as bases for defining goals and priorities and judging the significance of outcomes" (Stufflebeam, 2000). The context component is an important starting point for a complete evaluation considering the broader societal and environmental elements influencing programme performance.

Input

The "input" component of the CIPP Model for Evaluation focuses on the resources dedicated to a programme or policy effort. This phase thoroughly reviews the financial, human, material, and technological resources invested in the programme. According to Stufflebeam (2002), input evaluation involves available and existing resources for achieving goals and meeting needs. Evaluators determine if these inputs are adequate, acceptable, and effectively used to achieve the programme's goals. Input evaluation assists in identifying any gaps or inefficiencies in resource allocation that may impede programme effectiveness. By analysing inputs, stakeholders may decide whether the programme has the requisite infrastructure, personnel, and support mechanisms to meet its objectives.

Additionally, input evaluation provides insights into the program's cost-effectiveness, allowing decision-makers to deploy resources more efficiently. "Input evaluations assess alternative approaches to meeting needs as a means of planning programs and allocating resources" (Stufflebeam, 2000). This component of the CIPP Model ensures that programmes are adequately resourced and positioned for success, setting the groundwork for succeeding stages of review and development.

Process

The "process" component of the CIPP Model for evaluation examines a programme or policy's implementation and operational characteristics. This phase thoroughly assesses the methods, procedures, and activities used to provide services or achieve the targeted results. Evaluators assess programme processes by reviewing whether activities are carried out as planned and according to established protocols. They also consider characteristics such as participant involvement, programme accessibility, and service quality. Process evaluation identifies programme implementation strengths and shortcomings, identifying areas for adjustment to increase effectiveness. "Process evaluations assess the implementation of plans to guide activities and later to help explain outcomes" (Stufflebeam, 2000). By analysing the processes involved in programme delivery, stakeholders can get valuable insights into how effectively the programme works and where changes may be required to improve outcomes. The process review ensures that programmes are carried out efficiently and effectively, opening the path for better service delivery and impact.

Product

The "product" component of the CIPP Model for Evaluation assesses the outcomes and implications of a programme or policy effort. This essential phase entails analysing the programme's tangible results and effects in meeting its objectives. A product evaluation evaluates outcomes and outputs, both short and long-term, intended and unintentional, and focuses on whether or not objectives are met (Stufflebeam, 2003). Evaluators analyse short-term and long-term outcomes, considering both intended and unforeseen repercussions. They examine how successfully the programme has reached its objectives, effectiveness, and sustainability. "Product evaluations identify intended and unintended outcomes to help keep the process on track and determine effectiveness" (Stufflebeam, 2000).

Product evaluation gives significant insights into the programme's outcomes, assisting stakeholders in understanding their broader implications for individuals, communities, and systems. By analysing the programme's outputs, decision-makers may assess its success and identify opportunities for improvement or growth.

Due to its effectiveness and robustness, several researchers have utilised the CIPP models for evaluation (Aziz et al. (2018); Sofyan et al. (2019); Adarayan–Morallos (2018); Sunaryo et al. (2021)). Aziz et al. (2018) evaluated the educational quality at schools in Rawalpindi. The researchers used the CIPP model to assess the quality of Rawalpindi's school system. Sofyan et al. (2019), in their bid to evaluate the 2013 curriculum of the implementation training program in Jakarta – Indonesia, resorted to the CIPP evaluation model. Also, Adarayan–Morallos (2018) evaluated the school-based feeding program at Cangcahipos Elementary School using the CIPP model. The above examples show how widely researchers utilise the CIPP evaluation model.

1.9 RATIONALE OF THE STUDY

The need for quality education is a necessity to drive the developmental agenda of nations. There must be quality teachers for quality education as teachers are the primary implementers of educational policies, and quality teachers result from quality teacher education. To achieve the aim of quality education for all, the government of Ghana and other foreign agencies have funded teacher education reforms on various occasions. There have also been several curriculum reforms and changes financed by the government of Ghana, especially at the school level, to give the Ghanaian populace quality education to meet global educational standards.

Teachers' training at the CoEs and TEUs has its difficulties and challenges. There may be no particular recognised reform for all TEUs. Still, there are always updates and changes in individual universities and the various TEU departments to produce teachers who can deliver as expected in the classroom. Notably, the University of Education, Winneba, beginning with the 2013 completing year batch, initiated the one-semester off-campus teaching practice (internship), which was an update on the previous two-semester off-campus teaching practice aimed at increasing the content knowledge of pre-service teachers. At the University of Education, Winneba (UEW), the first semester of the fourth year is utilised for the “Student

Internship Programme” (SIP), which is otherwise called “Off-Campus” Teaching Practice (Esia-Donkoh, Amihere and Addison, 2015).

Mathematics has always been the centre of all learning. It is essential for an individual’s academic growth, making it a compulsory subject at the elementary and secondary levels of education in almost all countries worldwide. Makondo and Makondo (2020) posited that mathematics encourages logical reasoning and prepares one for the future world, which is why several countries make mathematics a compulsory subject at the O’level (high school), as it is such an essential subject in human existence. Since Mathematics education is linked to MTE, the concern for quality Mathematics teachers worldwide has increased. According to Iwuanyanwu (2021), from primary to post-secondary school levels, educating students in Mathematics requires not only the teacher’s Mathematical expertise but also their talent, methodology of delivery, and, last but not least, how they handle the feedback mechanisms.

Although there has been a realisation of how vital mathematics is, students’ performance has not been as expected. Ansah, Quansah, and Nugba (2020) stipulated that major stakeholders are concerned about the dismal performance of mathematics in Ghana’s SHS. According to the results from the West African Senior Secondary Certificate Examination (WASSCE), particularly in 2015, they showed poor performance in core and optional Science and Mathematics subjects (Ministry of Education, 2018). According to Smith (2021), from data issued by the WAEC, approximately half of the candidates who took mathematics in the WASSCE in 2021 failed. They could not meet the qualifying mark in core Mathematics. 45.89% received D7 to F9. Candidates for higher education should have scores ranging from A1 to C6 in core Mathematics. The results meant that out of 446,352 candidates, approximately 204,831 would be unable to obtain higher education due to weak Mathematics performance. The chief examiners’ report on Mathematics stated a decline in students’ general performance in Mathematics (WAEC, 2021). Abreh et al. (2018) reported that teachers’ inability to complete the syllabus, inappropriate methodologies, and lack of qualified teachers affect students’ mathematics performance. Since students’ performance can be affected by teaching-learning procedures and teaching-learning activities depending on the quality of the teacher, there is a need to investigate the quality of the training given to Mathematics teachers.

A programme's ability to serve its purpose is vital to assessing the quality of an educational programme, especially from the consumers' point of view. This is also more than necessary for teacher education. It is essential to know the quality of the training given to teachers who are supposed to train the future generation of a country. As previous submissions show, Mathematics is vital for students' academic growth. Students' Mathematics performance in the WASSCE has not been as expected. Since the quality of Mathematics teachers affects students' performance, knowing the quality of the training Mathematics teachers receive is necessary to improve the training process. Although there is much research on TE, especially at the CoE level, there is limited research on TE at the TEU level. The researcher has yet to come across any study specifically on the MEPs at the TEUs of Ghana. This study aims to assess the integrated MEPs by public TEUs meant to produce mathematics teachers for the Ghana school system.

1.10 RESEARCH QUESTIONS

1. What is the current status of Mathematics Education Programs at Teacher Education Universities in Ghana?
2. What is the future direction of Mathematics Education Programs of Teacher Education Universities in Ghana?
3. How relevant are the curriculums of Mathematics Education Programs of TEUs to classroom practice?
4. How does curriculum transaction take place in Mathematics Education Programs of Teacher Education Universities in Ghana?
5. How do evaluation processes take place in Mathematics Education Programs of Teacher Education Universities in Ghana?
6. What are the perceptions of the pre-service teachers and teacher educators concerning the learning culture, evaluation procedure, and resources of the Mathematics Education Programs of Teacher Education Universities in Ghana?
7. What challenges do Mathematics teacher educators encounter in the training process?
8. How can the training process of the Mathematics Education Programs in the Teacher Education Universities of Ghana be improved?

1.11 RESEARCH OBJECTIVES

1. To study the Mathematics Education Programs in the Teacher Education Universities of Ghana with respect to their purpose, present status, and future direction.
2. To study the Mathematics Education Programs in the Teacher Education Universities of Ghana with respect to:
 - Academic standards
 - Curriculum design, development and implementation
 - Evaluation procedures
 - Resources at the TEUs – Human and Material
 - Academic Leadership practices
3. To study the learning culture in the Mathematics Education Programs of Ghana's Teacher Education Universities.
4. To identify the challenges encountered in training pre-service Mathematics teachers in Teacher Education Universities.
5. To seek recommendations to improve the training process of the Mathematics Education Programmes in the Teacher Education Universities of Ghana.