

CHAPTER 4

DATA ANALYSES AND INTERPRETATION

4.0 Introduction

Data analysis is one of the procedures that researchers can use once all the data has been gathered to solve issues that have been thoroughly examined (Nasir and Sukmawati, 2023). Data analysis gives a large amount of collected data organisation, order, and meaning (Marshall and Rossman, 1999, p. 150). The data collected from participants using various sources and techniques is presented in this chapter, along with a thorough analysis and interpretation. The organisation of data, analysis, interpretation, and significant results for conclusions are the main topics of this chapter.

Collecting data is often considered the most essential aspect of the research process (Bryman, 2016)). The quantitative and qualitative data analysed and interpreted in this chapter came from surveys, semi-structured interviews, document studies, and observation of lessons, resources, and learning culture. After analysing the data collected with the appropriate statistical tools, the quantitative data collected through surveys and observations was presented in tables, graphs and charts. The data from semi-structured interviews were transcribed, coded, and analysed to create themes. The class observations were also organized and presented in tables for analyses utilizing descriptive statistics (frequency and percentages). The relevant documents to the study's objectives collected from the MEP's departments have been analysed content-wise and interpreted in this section.

The survey questionnaires (pre-service teachers and teacher educators) were checked for accuracy, completeness, and missing information. The data was categorised and analysed based on the study's objectives. Microsoft Excel was used to compile and process the survey data collected from the four MEP campuses to determine frequencies, percentages and means. Microsoft Excel was employed to organize the collected data into frequency tables and stacked graphs for presentation and interpretation. Excel appears to have been designed considering data analysis, as it provides a wide range of features and techniques for organising, manipulating, and summarising just about anything in a worksheet (McFedries, 2022).

In order to conduct the semi-structured interviews and observations of lessons, learning culture and resources, the researcher personally visited each MEP department

of the selected TEUs. The recorded audio files from semi-structured interviews were transcribed into Microsoft Word using Fireflies, a free online transcriber. Afterwards, the researcher reviewed the Word files and compared them with the audio to ensure the transcriber captured the correct information from the audio. The analyses were done according to the types of data collection to ensure consistency and proper flow of the information gathered from the participants for appropriate outcomes. The scheme of analysis is explained in the subsections that follow.

4.1 Scheme of Analysis

The researcher analysed the quantitative and qualitative data collected using the appropriate statistical tools and then presented them in different sections based on the information's source and mode. These sections include document analysis, demographic characteristics of the respondents, academic standards of the MEPs, curriculum design, implementation and development of the MEPs, academic leadership practices of the MEPs, learning culture of the MEPs, challenges encountered in the MEPs, classroom observations, learning culture observations, resource (Material and Human) observations, analyses of qualitative data obtained from pre-service teachers and teacher educators, thematic analyses of open-ended questionnaire (suggestions for improvement of the MEPs), data triangulation and interpretation and major findings of the study. Each component of the study's data was analysed independently, and after each section, the results were presented and explained. Below are the sections on data analysis and interpretation.

4.2 Document Analyses

The researcher collected documents from the departments for analysis. The relevant documents that the researcher could get access to for analyses include:

Semester course outlines: Course outlines of the various courses of different levels were taken from the pre-service teachers for analysis. The researcher decided to take the course outlines from the pre-service teachers instead of the department to ensure that the actual course outlines given out at the beginning of the various semesters were collected for analysis.

Departmental handbook: The handbook of one of the chosen universities (University of Education, Winneba) was taken from the department for analysis. The

handbook contains a description of the department's various programmes and an outline and description of the programmes' curriculums.

Curriculum document: The researcher took the curriculum document of one of the selected TEUs (CKT-UTAS) for analysis. The document contained the MEP run by the departments' structure and description of the various courses that comprise the programme.

4.2.1 Analyses of Semester Course Outlines

During the semi-structured interview of pre-service teachers, it was revealed that the assessment processes are enshrined in the course outlines given to pre-service teachers at the beginning of the semester. The researcher wanted to ascertain the pre-service teachers' claim that evaluation procedures and purposes are divulged to them mainly through their semester course outlines at the beginning of the semester. To achieve this, course outlines of various courses were taken from the pre-service teachers for analysis. The content analyses of the course outlines are presented in this section. The objective of the course outline should guide one's choices on what content should be included (Parkes and Harris, 2002).

Seven (7) course outlines were taken from students of different levels. A list of the course outlines taken for analyses has been presented in Table 4.0.

Table 4.0: Description of Course Outlines Taken for Analyses

Sr. No.	Course Code	Course Title	Teacher Education University	Level of Study
1.	MAT 302	Advance Calculus II	University of Cape Coast	300
2.	PMT 121	Mathematics Curriculum	University of Education, Winneba	100
3.	MATD 121	Geometry 2	University of Education, Winneba	100
4.	MATD 363	Numerical Analyses	University of Education, Winneba	300
5.	ICTD 121	Introduction to Computer Programming	University of Education, Winneba	100
6.	MATD 482	Partial Differential Equations	University of Education, Winneba	400
7.	MAE 303	Methodologies of Teaching Mathematics	CK Tadam University of Technology and Applied Sciences	300

Though the course outlines differ in structure, the general structure of all the course outlines is presented in Table 4.1.

Table 4.1: Course Outline Structure Description

Sr. No.		Description
1.	Course Information	The course information is usually in the first section of the course outline. Information in this section includes the course code, the course title, the number of credit hours to be covered in the course and prerequisites.
2.	Instructors' Information	The section provides detailed information about the teacher educator taking the course. The information in the section includes the instructors' names, designation, office location, office hours, and contact information.
3.	Course Description	The course description can contain the following: A brief history of the programme and the course. The role of the course in the training process, the relevant previous knowledge of the course, the content of the course, etc.
4.	Aims/Objectives/Rationale	This section outlines the objectives /rationale of the course. The section explains and outlines the various skills and competencies learners are expected to exhibit at the end of the course.
5.	Subject Content	In this section, a detailed list of the content of the course is outlined. In some cases, how the various topics are connected to the relevant previous knowledge is indicated. The relevant reference materials are also listed in this section.
6.	Course Schedule	The course schedule outlines the weekly activities to be taken to achieve the objective of the course. The sub-sections of the course schedule include the week ending/date, course topic, learning objective, learning activity, and pre-lesson preparation/reference materials.
7.	Mode of Assessment	The mode of assessment section outlines how the course will be evaluated. The type of assessment, number of evaluations, the grading policies and the marks distribution in the assessment are outlined in the section.

From the analyses of the outlines, the following conclusions were made:

1. The course contents are described, and their relevance to pre-service teachers' professional development is indicated.
2. Relevant previous knowledge is stated in all cases.
3. The objectives of the courses are listed in the course outlines.
4. In some cases, the course outline elaborates on the teaching and learning methods for delivery.
5. The contents to be covered weekly have been elaborated in all the course outlines.
6. Reference materials are stated in all situations.
7. In Most courses (6 out of 7), the outline delineated assessment procedures with timelines, types of assessment, mode of administration, marks distribution, and grading procedures. One of the outlines had scanty information regarding assessment, which only mentioned there would be assignments and quizzes without any detailed information.

4.2.2 Departmental handbook

The researcher wanted to learn more about the MEP curriculum and course structure. The departmental handbook was therefore taken to analyze its content for more information on the MEPs run by the department. The content analyses of the departmental handbook are presented below:

4.2.2.1 Vision and Mission Statement

The vision and mission statements of the department are as described below:

Vision Statement Description: The department's vision is to become one of the best African higher education departments in terms of training quality mathematics teachers with ICT and Economics knowledge.

Mission Statement Description: The department intends to train Mathematics teachers who will able to

- (i). Generate interest in teaching and learning Mathematics and Economics at the School level utilizing ICT tools

- (ii). Conduct research studies in Mathematics Education for knowledge dissemination.
- (iii). Influence Ghana's Mathematics, Economics and ICT education policies.

4.2.2.2 The objectives of the department

From the handbook, nine department objectives have been listed. They are:

- (i). To attract and retain highly qualified lecturers.
- (ii). To improve the academic and professional competencies of staff.
- (iii). To integrate ICT into the teaching and learning of Mathematics and Economics.
- (iv). To enrich the learning environment of students
- (v). To increase the productivity of staff and students in research and problem-solving activities
- (vi). To collaborate with local schools, Ghana Education Service and the Ministry of Education
- (vii). To address problems of mutual interest that directly affect the teaching and learning of Mathematics and Economics
- (viii). To offer performance assessment service and support at the pre-tertiary level
- (ix). To promote gender equity and inclusivity in Mathematics, ICT and Economics Education.

(University of Education, Winneba, 2021, p. 2)

4.2.2.3 Administration

The head of the department is the chief executive officer, who oversees the day-to-day running of the department. The departmental head is in charge of appointing other staff members to positions in the department. The head of the department answers directly to the Dean of Faculty and receives instructions from the Vice Chancellor through the Dean of Faculty. The Vice Chancellor's office is the highest in the university's administration structure.

4.2.2.4 Staff Strength

The department has 23 teaching staff members. Of the 23 staff members, 4 (17.4%) are female. The department also has three (3) supporting staff. Among the supporting staff is a Sr. Administrative Assistant, an Administrative Assistant and a Departmental Assistant. The highest academic qualifications of the teaching staff are shown in Table 4.2.

Table 4.2: Academic Qualification of Departmental Teaching Staff Members

Sr. No.	Academic Qualification	Number of Staff having Qualification	Percentage (%)
1.	Doctor of Philosophy (PhD)	6	26.1
2.	Master of Philosophy (MEd, MA, MPhil)	17	73.9
	Total	23	100

It can be seen from Table 4.2 that 26.1% of the teaching staff holds a PhD degree, whilst 73.9% have master's degrees. In Ghana, to be eligible to teach at the university level, one must have a PhD degree; for candidates with a master's degree, the individual must enrol in a PhD programme after being recruited. Prospective university teachers must fulfil the PhD requirement to work as a lecturer in a Ghanaian university (Owusu, 2023).

The female representation among the teacher educators is very low, with only 6(26.1%) female. This indicates the low representation of the female gender in Science and Mathematics related fields.

4.2.2.5 The 4-Year Undergraduate Programmes

The department runs undergraduate and post-graduate programmes. The undergraduate programmes run by the department include a 4-year Bachelor of Science in Mathematics Education, a 4-year Bachelor of Science in Mathematics with Economics, and a 2-year diploma in Mathematics Education. The post-graduate programmes are MEd Mathematics Education, MPhil Mathematics Education and a PhD in Mathematics Education.

The researcher will analyse the two (2) 4-year undergraduate programmes of the department due to the objectives of the study. The two programmes are meant to train mathematics teachers; the BSc Mathematics Education trains mathematics teachers to be capable of teaching mathematics and competently integrating ICT in the teaching-learning

process. The ICT aspect of the programme equips the pre-service teachers with enough knowledge to teach ICT at the school level. The BSc Mathematics Education with Economics is a combination of Mathematics and Economics. The programme trains graduates to teach Mathematics and Economics after graduation. It also equips learners with ICT integration skills. Table 4.3 and Table 4.4 are the structures of the 4-year undergraduate programmes (BSc Mathematics Education and BSc Mathematics Education with Economics).

Table 4.3: Structure of the BSc Mathematics Education of UEW

Sr.No.	Curriculum Component	Course Code	Courses	Credits Per Semester								Total Credits Per Course	Total Credits
				S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8		
1.0	1. Content Knowledge (Mathematics)	MATD 111	Algebra I	3	--	--	--	--	--	--	--	3	57
1.1		MATD 112	Geometry I	3	--	--	--	--	--	--	--	3	
1.2		MATD 113	Probability and Statistics I	3	--	--	--	--	--	--	--	3	
1.3		MATD 121	Algebra II	--	3	--	--	--	--	--	--	3	
1.4		MATD 122	Calculus	--	3	--	--	--	--	--	--	3	
1.5		MATD 123	Probability and Statistics II	--	3	--	--	--	--	--	--	3	
1.6		MATD 124	Geometry II	--	3	--	--	--	--	--	--	3	
1.7		MATD 231	Trigonometry	--	--	3	--	--	--	--	--	3	
1.8		MATD 233	Calculus II	--	--	3	--	--	--	--	--	3	
1.9		MATD 241	Linear Algebra	--	--	--	3	--	--	--	--	3	
1.10		MATD 242	Vectors	--	--	--	3	--	--	--	--	3	
1.11		MATD 243	Further Statistics	--	--	--	3	--	--	--	--	3	
1.12		MATD 351Ma	Ordinary Differential Equations	--	--	--	--	3	--	--	--	3	
1.13		MATD 352	Introductory Analyses	--	--	--	--	3	--	--	--	3	
1.14		MATD 361	Abstract Algebra	--	--	--	--	--	3	--	--	3	
1.15		MATD 362Ma	Mechanics	--	--	--	--	--	3	--	--	3	
1.16		MATD 363	Numerical Analysis	--	--	--	--	--	3	--	--	3	
1.17		MATD 481	Vector Analysis	--	--	--	--	--	--	--	3	3	
1.18	MATD 482	Partial Differential Equations	--	--	--	--	--	--	--	3	3		
2.0	2. Second Subject (ICT in Mathematics)	ICTD 111	Introduction to ICT Systems and Tools for Mathematics Teachers	3	--	--	--	--	--	--	--	3	18
2.1		ICTD 121	Fundamentals of Computer Programming	--	3	--	--	--	--	--	--	3	
2.2		ICTD 231	Courseware Design and Development Using Multimedia Tools	--	--	3	--	--	--	--	--	3	
2.3		ICTD 241	Computer Applications for Teaching and Learning Mathematics	--	--	--	3	--	--	--	--	3	
2.4		ICTD 351	Introduction to Computer Programming for Mathematics Teachers	--	--	--	--	3	--	--	--	3	
2.5		ICTD 361	Web Technology for Mathematics Teachers	--	--	--	--	--	3	--	--	3	
3.0		PMTD 111	Psychology of Learning Mathematics	3	--	--	--	--	--	--	--	3	

3.1	3. Pedagogical	PMTD 121	Mathematics Curriculum	--	3	--	--	--	--	--	--	3	
3.2	Content	PMTD 231	Methods of Teaching Junior High School Mathematics	--	--	3	--	--	--	--	--	3	15
3.3	Knowledge	PMTD 241	Methods of Teaching Senior High School Mathematics I	--	--	--	3	--	--	--	--	3	
3.4		PMTD 351	Methods of Teaching Senior High School Mathematics II	--	--	--	--	3	--	--	--	3	
4.0	4. School-Based	EDP 351Ma	Research Methods in Mathematics Education	--	--	--	--	3	--	--	--	3	
4.1	Field	EDPD 361	Pre-Internship Seminar	--	--	--	--	--	3	--	--	3	18
4.2	Experience	EDPD 471	Internship	--	--	--	--	--	--	6	--	6	
4.3		EDPD 472	Research Project	--	--	--	--	--	--	3	--	3	
4.4		EDPD 481	Post Internship Seminar	--	--	--	--	--	--	--	3	3	
5.0	5. University	EDC 111D	The School Curriculum, Social Change and National Development	3	--	--	--	--	--	--	--	3	
5.1	Core Courses	GDP 111	Communication Skills	3	--	--	--	--	--	--	--	3	
5.2	(General	EDC 121D	Introduction to Educational Technology	--	3	--	--	--	--	--	--	3	
5.3	Education,	EDC 232D	Principles and Practice of Teacher Education	--	--	3	--	--	--	--	--	3	
5.4	Communication	GPD 233	Introduction to Special Education	--	--	3	--	--	--	--	--	3	30
5.5	Skills and	EDC 241D	Psychology of Human Development and Planning	--	--	--	3	--	--	--	--	3	
5.6	African	EDC 242D	Trends in Education and School Management in Ghana	--	--	--	3	--	--	--	--	3	
5.7	Studies)	EDC 351D	Guidance and Counselling	--	--	--	--	3	--	--	--	3	
5.8		EDC 361D	Measurement, Evaluation and Statistics in Education	--	--	--	--	--	3	--	--	3	
5.9		GDP 122	African Studies	--	3	--	--	--	--	--	--	3	
			Total	21	24	18	21	18	18	9	12		138

Source: 2021 Handbook of the Department of Mathematics Education, University of Education, Winneba.

Table 4.4: Structure of the Mathematics with Economics of UEW

Sr.No.	Curriculum Component	Course Code	Courses	Credits Per Semester								Total Credits Per Course	Total Credits	
				S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8			
1.0		MAEC 111	Algebra	3	--	--	--	--	--	--	--	--	3	
1.1		MAEC 113	Introduction to Probability and Statistics	3	--	--	--	--	--	--	--	--	3	
1.2		MAEC 121	Calculus with Analytic Geometry 1	--	3		--	--	--	--	--	--	3	
1.3		MAEC 231	Calculus with Analytic Geometry	--	--	3	--	--	--	--	--	--	3	
1.4		MATD 232	Introductory Analysis	--	--	3	--	--	--	--	--	--	3	
1.5	1. Content	MAEC 232	Statistical Methods	--	--	3	--	--	--	--	--	--	3	
1.6	Knowledge	MATD 241	Linear Algebra	--	--	--	3	--	--	--	--	--	3	
1.7	(Mathematics	MAEC 351	Vectors with Mechanics	--	--	--	3	--	--	--	--	--	3	45
1.8	and ICT)	MATD 352	Ordinary Differential Equation	--	--	--	--	3	--	--	--	--	3	
1.9		MATD 361	Abstract Algebra	--	--	--	--	--	3	--	--	--	3	
1.10		MATD 362	Numerical Analysis	--	--	--	--	--	3	--	--	--	3	
1.11		MATD 481	Partial Differential Equations	--	--	--	--	--	--	--	--	3	3	
1.12		ICTD 111	Introduction to ICT systems and Tools for Mathematics Teachers	3	--	--	--	--	--	--	--	--	3	
1.13		ICTD 231	Courseware Design and Development in Using Multi-media Tools	--	3	--	--	--	--	--	--	--	3	
1.14		ICTD 241	Computer Application for Teaching and Learning Mathematics	--	--	--	3	--	--	--	--	--	3	
2.0		ECNS 111	Principles of Microeconomics	3	--	--	--	--	--	--	--	--	3	
2.1	2. Second	ECNS 121	Principles of Macroeconomics	--	3	--	--	--	--	--	--	--	3	
2.2	Subject	ECNS 112	Mathematics for Economics I	--	3	--	--	--	--	--	--	--	3	
2.3	(Economics)	ENCS 231	Elements of Microeconomics	--	--	3	--	--	--	--	--	--	3	
2.4		ECNS 232	Mathematics for Economics II	--	--	3	--	--	--	--	--	--	3	
2.5		ECNS 243	Elements of Macroeconomics	--	--	--	3	--	--	--	--	--	3	
2.6		ECNS 242	Economy of Ghana	--	--	--	3	--	--	--	--	--	3	
2.7		MAEC 351	Time Series Analysis	--	--	--	--	3	--	--	--	--	3	39
2.8		ECNS 351	Intermediate Microeconomics	--	--	--	--	3	--	--	--	--	3	
2.9		ECNS 352	Econometrics I	--	--	--	--	3	--	--	--	--	3	
2.10		ECNS 361	Intermediate Macroeconomics	--	--	--	--	--	3	--	--	--	3	
2.11		ECNS 362	Econometrics II	--	--	--	--	--	3	--	--	--	3	
2.12		ECNS 481 Or ECNS	Advanced Economics Theory Or Mathematical Economics	--	--	--	--	--	--	--	--	3	3	

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3.0	3. Pedagogical	PMTD 111	Psychology of Learning Mathematics	3								3	
3.1	Content	PMTD 121	Mathematics Curriculum	--	3	--	--	--	--	--	--	3	9
3.2	Knowledge	PMTD 241	Methods of Teaching Senior High School Mathematics	--	--	--	3	--	--	--	--	3	
4.0		EDP 351	Research Methods	--	--	--	--	3	--	--	--	3	
4.1	4. School-	EDPD 361	Pre-Internship Seminar	--	--	--	--	--	3	--	--	3	
4.2	Based Field	EDPD 471	School Internship Programme	--	--	--	--	--	--	6	--	6	18
4.3	Experience	EDPD 472	Research Project	--	--	--	--	--	--	3	--	3	
4.4		EDPD 481	Post-Internship Seminar (Reflective/Teaching Philosophy and Teaching Portfolio)	--	--	--	--	--	--	--	3	3	
5.0	5. University	EDC 111D	The School Curriculum, Social Change and National Development	3	--	--	--	--	--	--	--	3	
5.1	Core Courses	GDP 111	Communication Skills	3								3	
5.2	(General	EDC 121D	Introduction to Educational Technology	--	3	--	--	--	--	--	--	3	
5.3	Education,	EDC 232D	Principles and Practice of Teacher Education	--	--	3	--	--	--	--	--	3	
5.4	Communication	GPD 233	Introduction to Special Education	--	--	3	--	--	--	--	--	3	30
5.5	Skills and	EDC 241D	Psychology of Human Development and Planning	--	--	--	3	--	--	--	--	3	
5.6	African	EDC 242D	Trends in Education and School Management in Ghana	--	--	--	3	--	--	--	--	3	
5.7	Studies)	EDC 351D	Guidance and Counselling	--	--	--	--	3	--	--	--	3	
5.8		EDC 361D	Measurement, Evaluation and Statistics in Education	--	--	--	--	--	3	--	--	3	
5.9		GDP 122	African Studies	--	3	--	--	--	--	--	--	3	
Total				21	21	21	24	18	18	9	9		141

Source: 2021 Handbook of the Department of Mathematics Education, University of Education, Winneba.

All the courses are three (3) credits except EDPD 471 (Internship), which is a six (6) credit course. The university-level courses are common in both programmes. They are courses made up of general knowledge in education and also courses in African studies. Each student has the option of one African studies course in the programme; the options for the African studies include Governance and Democracy in Traditional Africa, African in the Modern World, African Integration, Africa as the Original Home of Humankind and Early African Civilisation, the Impact of Slavery and the Slave Trade on Africa's Development, Colonialism in British and French Africa and its Impact, the Rise of Nationalism in Africa, Christianity in African, Islam in Africa, and the Military in African Politics. The percentage constituents of the various aspects of the various courses of the BSc Mathematics Education programme are shown in Table 4.5.

Table 4.5: Percentage of Constituents of the Various Courses of UEW (BSc Mathematics Education)

Aspect of the Programme Courses	Number of Courses	Percentage (%)
Mathematics Content Knowledge Courses	19	42.2
Second Subject (ICT in Mathematics)	6	13.3
Mathematics Pedagogical Content Knowledge Courses	5	11.1
School-Based Experience	5	11.1
University Core Courses (General Education, Communication Skills and African Studies)	10	22.2
Total	45	100

Table 4.5 shows the importance the programme places on content knowledge. The content is the basis of the programme. The Mathematics teacher must be equipped with the content to deliver in the classroom. The total credit hours for the programme are 138. The pre-service mathematics teachers emphasised strengthening their pedagogical and subject understanding (Hine, 2015). The ICT courses are meant to equip teachers with enough knowledge for ICT integration in the classroom and teach ICT at the school level if needed. Table 4.6 is a tabular representation of the constituents of the BSc Mathematics Education with Economics departmental courses.

Table 4.6: Percentage Constituents of the Various Courses of UEW (BSc Mathematics Education with Economics)

Aspect of the Programme Courses	Number of Courses	Percentage (%)
Mathematics Content Knowledge Courses	15	32.6
Second Subject (Economics)	13	28.3
Pedagogical Content Knowledge Courses	3	6.5
School-Based Experience	5	10.9
University Core Courses (General Education, Communication Skills and African Studies)	10	21.7
Total	46	100

The BSc Mathematics Education with Economics concentrates on equipping pre-service teachers with enough Mathematics and Economics content to handle the two subjects well after graduation. The two content areas constitute 28 (60.9%) of all the courses. The total credit hours for the programme are 141. The pre-service teachers are also equipped with the ability to integrate ICT tools in their lessons with ICT content courses.

4.2.3 Curriculum Document

The researcher analysed one of the selected universities' (CKT-UTAS) curriculum documents. The document contains the programme description, curriculum structure and course descriptions of the courses that make up the programme. The programme's title is BEd Mathematics Education.

4.2.3.1 Programme Description

The BEd Mathematics Education programme trains pre-service teachers in the teaching of Mathematics. The programme is designed to equip learners with the necessary knowledge and skills to succeed in the teaching profession in Mathematics and other allied professions. The programme also ensures that learners are well-equipped with the necessary ICT skills to survive today's technology-driven society. The programme trains two kinds of Mathematics teachers. Mathematics teachers major in Mathematics and minor in ICT, and those who major in Mathematics and minor in Physics. This implies that those who minor in ICT can teach Mathematics and ICT, whilst those who minor in Physics can teach Mathematics and Physics at the school level after graduation.

4.2.3.2 Aims of the Programme

The programme seeks to:

- (i). “Develop overall and innovative Mathematics teachers who will be able to help learners identify and use the environment for Mathematics learning and simplify mathematics for everyday use;
- (ii). Produce Mathematics Education professionals who can recognise and appreciate the role of Mathematics Education in national development;
- (iii). Produce mathematics education professionals who can use practical approaches, methodologies, and resources to promote interest in learning mathematics in schools” (CK Tadam University of Technology and Applied Sciences, n.d., p. 1).

4.2.3.3 Objectives of the Programme

The programme seeks to achieve the following objectives:

- (i). “Develop practical skills, knowledge and understanding of the ways of teaching Mathematics.
- (ii). Apply the principles and skills of Mathematics in everyday life.
- (iii). Equip student teachers with skills and techniques for motivating students and generating enthusiasm for learning Mathematics through practical activities, exploration and discussions in everyday living.
- (iv). Build skills for using creative, innovative, and transformative approaches and methodologies to promote positive attitudes and competencies for teaching and learning mathematics in their students.
- (v). Train professionals with skills and practical knowledge who can contribute to the development of Mathematics Education through research and development.
- (vi). Train professionals who are competent and confident with the use of basic knowledge and skills in ICT to promote teaching and learning” (CK Tadam University of Technology and Applied Sciences, n.d., p. 1).

The structure of the programme is shown in Table 4.7

Table 4.7: Structure of the BEd Mathematics Education of CKT-UTAS

Sr.No.	Curriculum Component	Course Code	Courses	Credits Per Semester										Total Credits Per Course	Total Credits	
				S1	S2	S3	S4	S5	S6	Semester Break	S7	S8	S9			
1.0	1. Content Knowledge (Mathematics)	MAE 101	Analytical Geometry and Calculus I	2	--	--	--	--	--	--	--	--	--	--	2	61
1.1		MAE 107	Logic and Set Theory	3	--	--	--	--	--	--	--	--	--	--	3	
1.2		MAE 105	Algebra and Trigonometry I	3	--	--	--	--	--	--	--	--	--	--	3	
1.3		MAE 102	Advance Algebra and Calculus	--	3	--	--	--	--	--	--	--	--	--	3	
1.4		MAE 104	Vectors and Matrix Algebra	--	3	--	--	--	--	--	--	--	--	--	3	
1.5		MAE 106	Introduction to Statistics and Probability	--	3	--	--	--	--	--	--	--	--	--	3	
1.6		MAE 205	Vectors and Mechanics I	--	--	3	--	--	--	--	--	--	--	--	3	
1.7		MAE 203	Statistics and Probability	--	--	3	--	--	--	--	--	--	--	--	3	
1.8		MTH 211	Real Analysis	--	--	3	--	--	--	--	--	--	--	--	3	
1.9		MAE 204	Introduction to Abstract Algebra	--	--	--	3	--	--	--	--	--	--	--	3	
1.10		MTH 212	Real Analysis II	--	--	--	3	--	--	--	--	--	--	--	3	
1.11		MTH 311	Differential Equations	--	--	--	--	3	--	--	--	--	--	--	3	
1.12		MTH 321	Real Analysis III	--	--	--	--	3	--	--	--	--	--	--	3	
1.13	MTH	Differential Equations II	--	--	--	--	--	--	3	--	--	--	--	3		

1.14		312 MAE	History of Mathematics	--	--	--	--	--	--	3	--	--	3	
1.15		401 MAE	Statistical Methods I	--	--	--	--	--	--	3	--	--	3	
1.16		403 MAE	Algebra and Trigonometry II	--	--	--	--	--	--	3	--	--	3	
1.17		405 MAE	Analytical Geometry and Calculus	--	--	--	--	--	--	2	--	--	2	
1.18		407 MAE	Problem Solving in Mathematics	--	--	--	--	--	--	--	2	--	2	
1.19		406 MAE	Vectors and Mechanics II	--	--	--	--	--	--	--	2	--	2	
1.20		408 MTH	Mathematical Modelling and Application	--	--	--	--	--	--	--	3	--	3	
1.21		484 CSE 402	ICT for the Mathematics Teacher	--	--	--	--	--	--	--	2	--	2	
2.0	2. Second Subject (ICT/Physic)	PHY	General Physics I Or Introduction to Computer I	3	--	--	--	--	--	--	--	--	3	14
2.1		PHY	General Physics II Or Introduction to Computer II	--	3	--	--	--	--	--	--	--	3	
2.2		PHY	Electricity and Magnetism Or Computer Organization	--	--	2	--	--	--	--	--	--	2	
2.3		PHY	Newtonian Mechanics Or ICT	--	--	--	2	--	--	--	--	--	2	
2.4		PHY	Optics I Or	--	--	--	--	2	--	--	--	--	2	
2.5		PHY	Optics II Or	--	--	--	--	--	2	--	--	--	2	
3.0	3. Pedagogical Content Knowledge	MAE	Psychology of Teaching Mathematics	--	--	--	3	--	--	--	--	--	3	
3.1		202 FCE 301	Curriculum Studies in Mathematics	--	--	--	--	2	--	--	--	--	2	11
3.2		MAE	Teaching SHS Mathematics	--	--	--	--	2	--	--	--	--	2	
3.3		301 MAE	Methodologies for Teaching Mathematics	--	--	--	--	2	--	--	--	--	2	
3.4		303 MAE	Development of Instructional Materials in	--	--	--	--	--	2	--	--	--	2	

		304	Mathematics											
4.0		FCE 206	Educational Research Methods	--	--	--	2	--	--	--	--	--	--	2
4.1	4. School-	FCE 379	School Observation	--	--	--	--	3	--	--	--	--	--	3
4.2	Based Field	FCE 389	On-Campus Teaching Practice	--	--	--	--	--	6	--	--	--	--	6
4.3	Experience	ESM399	Off-Campus Practicum	--	--	--	--	--	--	6	--	--	--	6
4.4		FCE 499	Project Work	--	--	--	--	--	--	--	--	6	6	
5.0		GEN 101	English Language and Study Skills	2		--	--	--	--	--	--	--	--	2
5.1		FCE 101	History and Philosophy of Education	2		--	--	--	--	--	--	--	--	2
5.2		FCE 103	Introduction to Educational Psychology	2		--	--	--	--	--	--	--	--	2
5.3		GEN 102	African Studies	--	2	--	--	--	--	--	--	--	--	2
5.4	5. University	FCE 104	Sociology of Education	--	2	--	--	--	--	--	--	--	--	2
5.5	Core Courses	FCE 102	Principles and Practice of Education	--	2	--	--	--	--	--	--	--	--	2
5.6	(General	CSE 201	IT Basics for the Teacher	--	--	2	--	--	--	--	--	--	--	2
5.7	Education,	FCE 203	Educational Technology and Innovation	--	--	2	--	--	--	--	--	--	--	2
5.8	Communication	FCE 205	Introduction to Curriculum Studies	--	--	2	--	--	--	--	--	--	--	2
5.9	Skills and	FCE 202	Introduction to Guidance and Counselling	--	--	--	2	--	--	--	--	--	--	2
5.10	African	FCE 204	Adolescent Psychology	--	--	--	2		--	--	--	--	--	2
5.11	Studies)	FCE 302	Psychology and Education of Exceptional Individuals	--	--	--	--	--	2	--	--	--	--	2
5.12		FCE 304	Educational Measurement and Evaluation	--	--	--	--	--	2	--	--	--	--	2
5.13		FCE 401	Education and Development in Africa	--	--	--	--	--	--	2	--	--	--	2
5.14		FCE 403	Logic and Critical Thinking	--	--	--	--	--	--	2	--	--	--	2
5.15		FCE 402	Educational Administration	--	--	--	--	--	--	--	2	--	--	2
			Total	17	18	17	17	17	17	6	15	11	6	141

Of the 54 courses, 21 are three (3) credit courses, 30 are two (2) credit courses, and three(3) are six (6) credit courses. The six credit courses are practical: On-Campus teaching practice, school observation and Off-Campus teaching practice. The total credit hours for all the courses is 141.

Out of the 54 courses, 28 (51.8%) are content courses (Mathematical, Physics and ICT content courses). It can be deduced from these statistics that the programme emphasises the content knowledge of the Mathematics teachers. The percentage constituents of the various aspects of the BEd Mathematics Education programme of CKT-UTAS are shown in Table 4.8.

Table 4.8: Percentage Constituents of the Departmental Courses of CKT-UTAS (BEd Mathematics Education)

Aspect of the Programme Courses	Number of Courses	Percentage (%)
Mathematics content courses	22	40.7
Second Area (ICT/Physics)	6	11.1
Mathematics Pedagogical Content Knowledge Courses	5	9.3
School-Based Field Experience	5	9.3
University Core Courses (General Education, Communication Skills and African Studies)	16	29.6
Total	54	100

A comparison of the various aspects of the programme structure of the two analysed curricula of the MEPs of the two TEU departments is presented in Table 4.9 below.

Table 4.9: Comparison of the BSc Mathematics Education, BSc Mathematics Education with Economics of UEW and BEd Mathematics of CKT-UTAS

Sr. No.	Programmes' Aspect	BSc Mathematics Education	BSc Mathematics Education with Economics	BEd Mathematics Education
1	Duration	Four years (8 Academic Semesters)	Four years (8 Academic Semesters)	Four years (9 Academic Semesters)
2	Content Courses	25	28	22
3	Duration of OCTP	Approximately four (4) months (One SHS academic term)	Approximately four (4) months (One SHS academic term)	Approximately two (2) months (During the final year first-semester break)
4	Mathematical Pedagogy Content Courses	5	3	5
5	School-Based Experience courses	5	5	5
6	General Education Courses/Other relevant Courses (e.g. African Studies)	10	10	16
7	Total Number of Courses	39	42	55
8	Total Credit hours	138	141	141

Table 4.9 shows that the programmes are all four-year programmes. Though the three programmes are meant to serve similar purposes, that is, to produce quality professional Mathematics teachers for the Ghanaian school system, there are slight differences between the structures of the programmes depending on the course content. The BEd Mathematics Education of the CKT-UTAS has more courses than the BSc Mathematics Education and BSc Mathematics Education with Economics of the UEW. In all cases, the content courses outnumber the other aspects of the programmes. This is evidence of the importance placed on the content mastery of the graduates of the programmes. It is widely acknowledged that a teacher's subject-related expertise plays a critical role in the quality of mathematics instruction in elementary and secondary schools (Rowland and Ruthven, 2011). The author further indicated that it is a tall order to prescribe topic knowledge beyond the typical school curriculum, but the lack of specification regarding the intended level of efficacy makes it all the more intimidating.

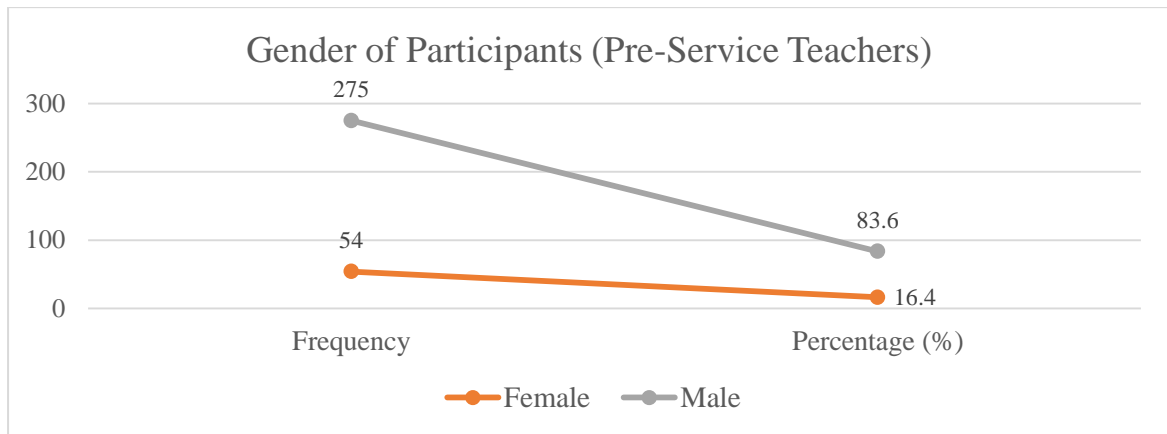
4.3 Demographic Data of the Respondents

The participants were required to respond to questions regarding their demographic characteristics. A full description of participants enables researchers and readers to establish to whom research findings generalise and facilitates comparisons between study replications (Hammer, 2011). Analyses of the responses from the participants are presented in this section.

4.3.1 Demographic characteristics of Pre-service teachers

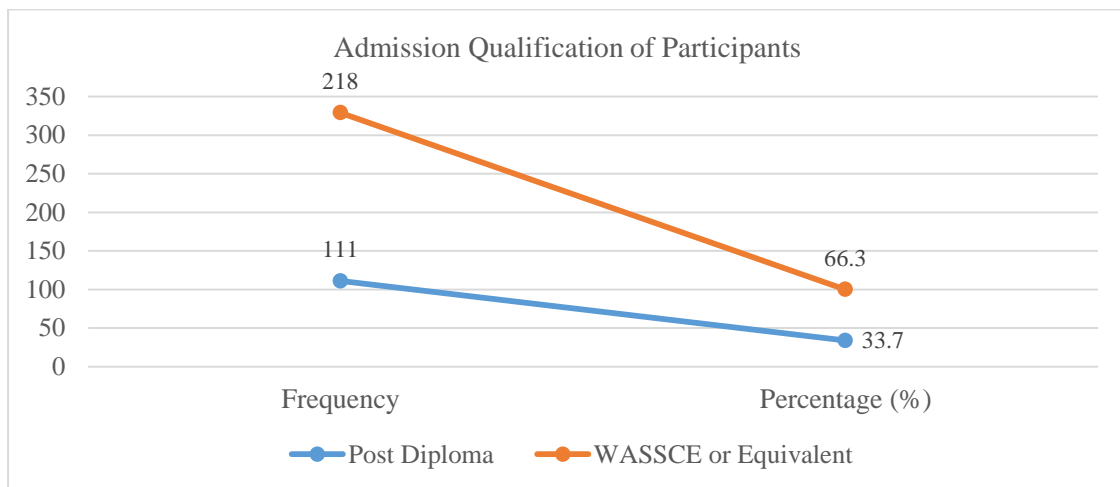
As part of the questionnaire for pre-service teachers, the participants were asked to answer various questions about their demographic characteristics. Among the information taken from the participants were gender, admission qualification, WASSCE aggregate score, grades in elective Mathematics, residential status, and pre-service teachers' decisions after graduation. Figure 4.0 presents the analyses of the participants' responses on their gender distribution.

Figure 4.0: Gender Distribution of Participants (Pre-Service Teachers)



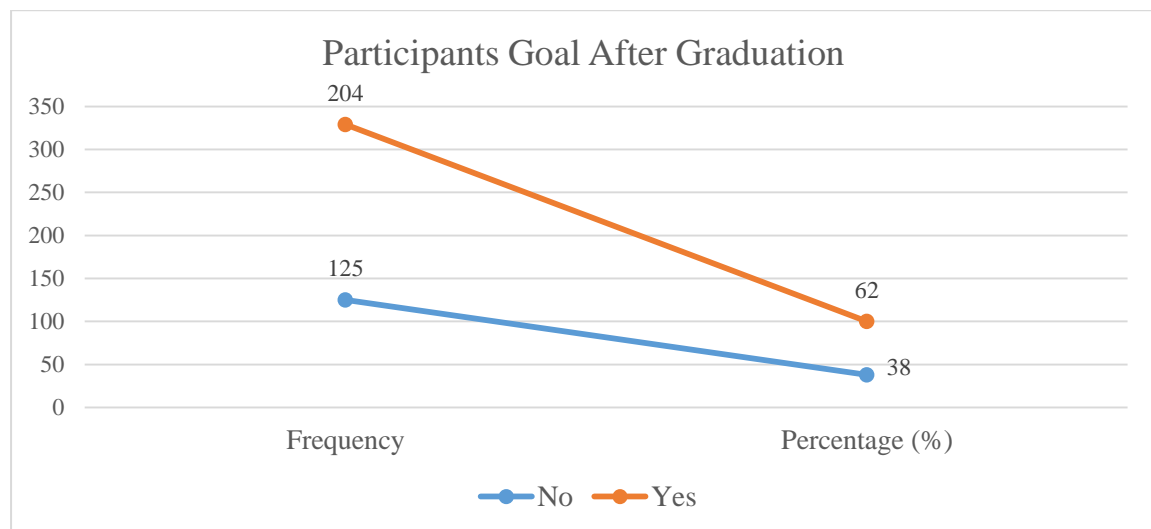
From Figure 4.0, 83.6 % of the respondents are male, whilst 16.4% are female. This indicates the low patronage of the female gender in Mathematics education programmes. This further supports the idea that men in the workplace dominate STEM fields because women are underrepresented in STEM programs. Although more women are working in science and engineering, men still outnumber women in these fields, particularly in higher positions. Further, women are far less likely than men to declare in their first year of college that they plan to study Science, Technology, Engineering, or Mathematics (STEM), and the proportion of women in STEM fields continues to fall as they go through graduate school and enter the workforce (Hill et al., 2010). Figure 4.1 presents the analyses of the participants' responses to their Admission Qualification.

Figure 4.1: Admission Qualification of Participants (Pre-Service)



From Figure 4.1, it can be realised that 33.7% of the candidates gained admission as post-diploma or mature candidates. These students were mostly trained as professional teachers in CoEs, which awarded a diploma in education before being upgraded to 4-year degree-awarding institutions. The remaining participants (66.3%) gained admission as WASSCE or its equivalent holders. These students gain admission into the programmes after completing their SHS education. This indicates that TEUs mostly train new Mathematics teachers and do not retrain already trained ones. It also proves that, though the teaching profession does not receive the recognition it deserves, the Mathematics education programmes offered by universities are marketable. It is necessary to acknowledge the crucial role that educators play in the improvement of education as well as the significance of their contribution to advancing humanity and modern society (UNESCO, 1968). According to NEP (2020), because the current system does not place a high value on teachers, society also does not think highly of them. Figure 4.2 below represents the participants' goals after graduation.

Figure 4.2: Participants Goal after Graduation (Pre-Service)



The participants' responses on their decision to stay in Ghana or travel abroad indicate a cause of the shortage of teachers in Ghana. Most of the respondents would prefer to travel overseas for greener pastures. 204 (62%) participants indicated they prefer travelling abroad to work. International teacher hiring may "cream off" the more competent teachers rather than causing detrimental teacher shortages (Appleton et al., 2006). Figure 4.3 shows the participants' residential status on campus.

Figure 4.3: Participants Residential Status on Campus

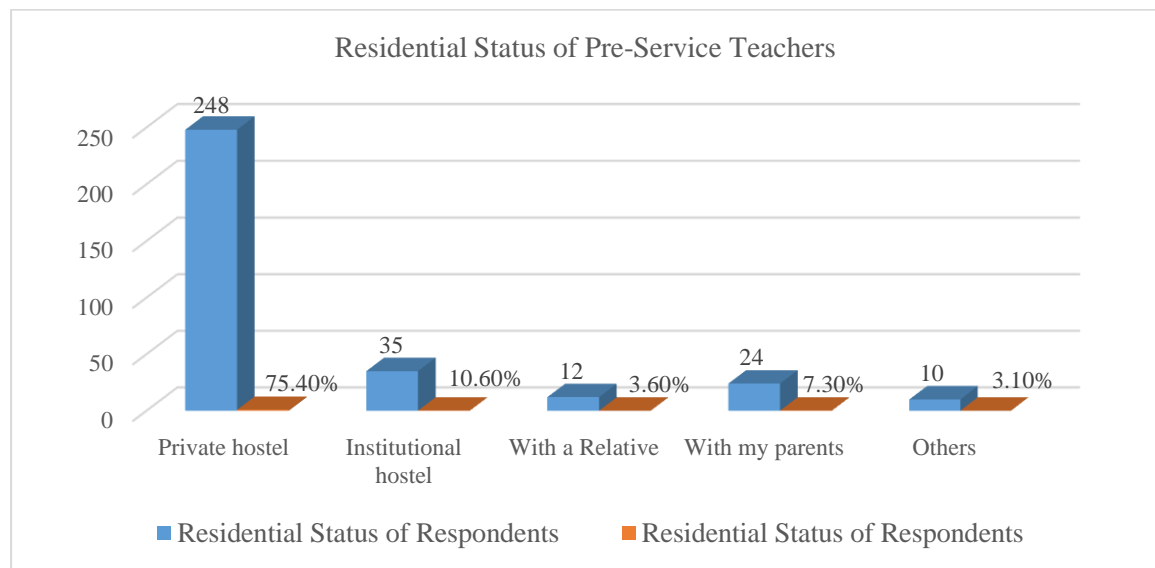
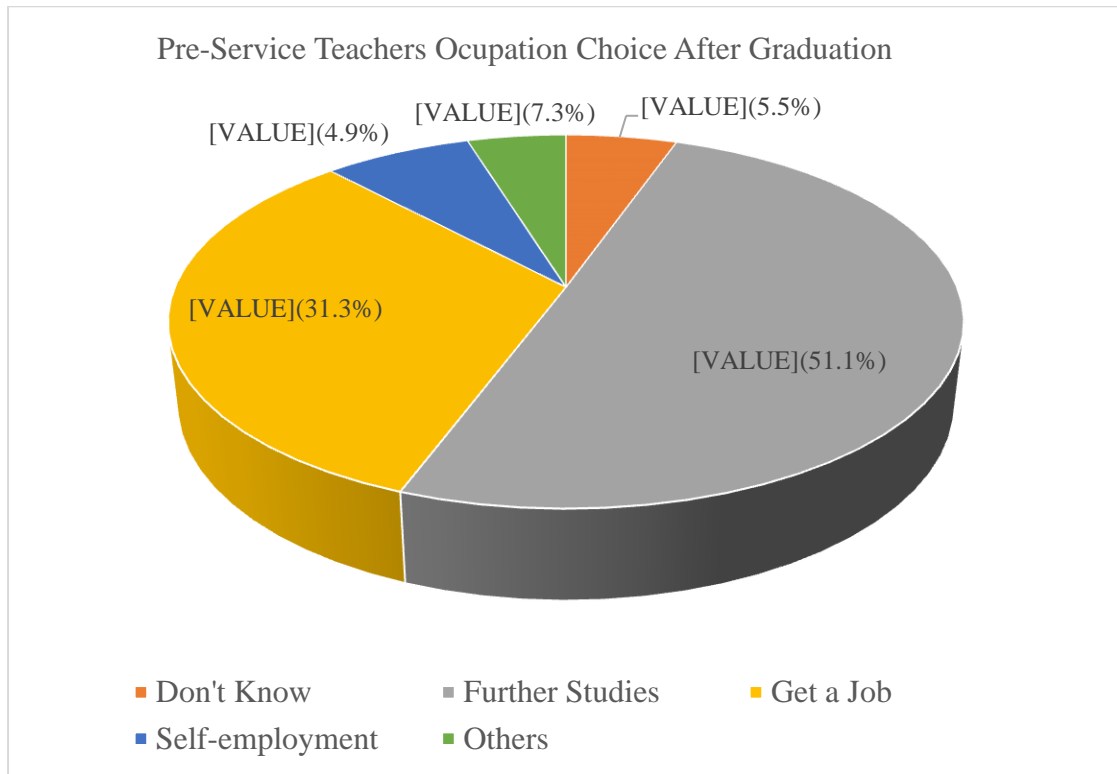


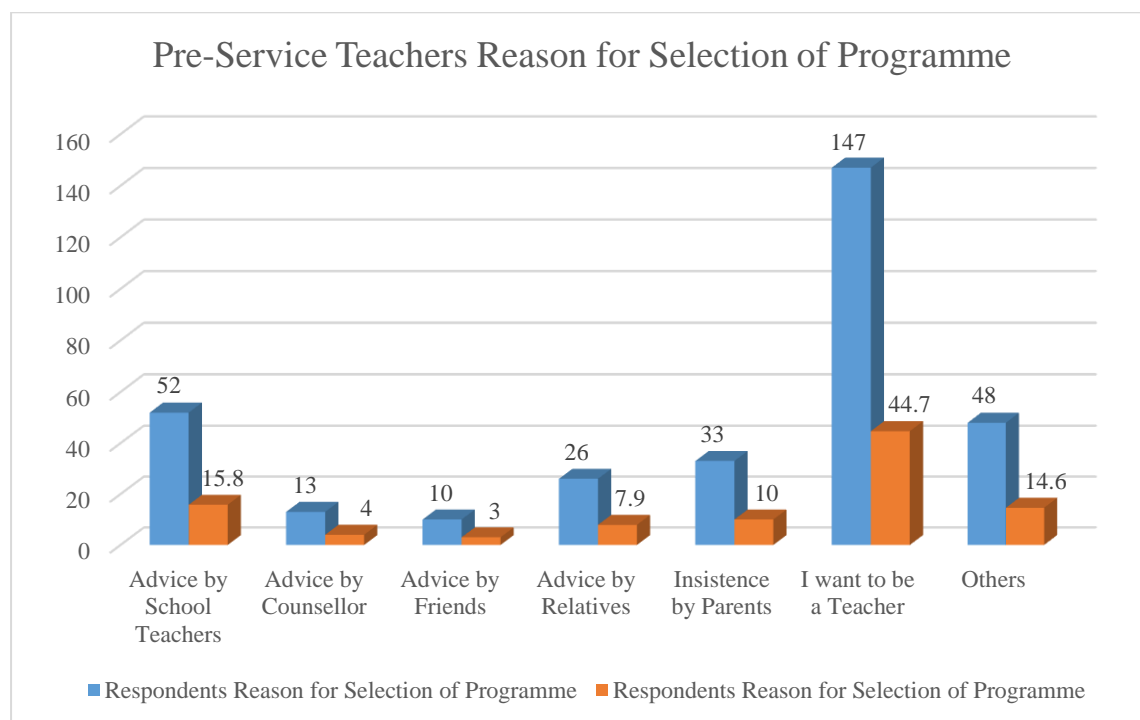
Figure 4.3 shows that most of the participants live outside campus. The majority of the participants indicated that they reside in private hostels. Two hundred and forty-eight (248), representing 75.4% of the respondents, pointed to living in a private hostel. Only thirty-five (35), representing 10.6% of the respondents, indicated residing in an institutional hostel. Research conducted in North America stipulated that students living in residence halls have better GPAs, retain their grades better, can enrol in more credit hours, and are better able to build relationships with campus instructors (Agron, 1997). This indicates that the lack of residential amenities for students in teacher education universities in Ghana can impact their academic performance. Figure 4.4 represents the participants' occupation choice after graduation.

Figure 4.4: Participants Occupation Choice after Graduation



On the respondents' occupation choice after graduation, as shown in Figure 4.4, 168 (51.1%) indicated they would prefer to further their education, while 108(31.3%) wanted to get a job upon graduation. This is positive for the pre-service teachers' professional development and growth after graduation. Figure 4.5 represents the participants' reason for selection of the MEPs.

Figure 4.5: Participants Reason for Selection of Programme



The participants' reasons for selecting the MEPs, as shown in Figure 4.5, show that 44.7% want to be teachers. This indicates the pre-service teachers' love for the teaching profession, regardless of its various challenges. 52(15.8%) of the respondents also indicated selecting the programme due to advice from school teachers. 33(10.0%) also chose the programmes based on parents' insistence. For purely humanitarian or intrinsic motives, most pre-service teachers decide to pursue a career in teaching (Noor et al., 2021).

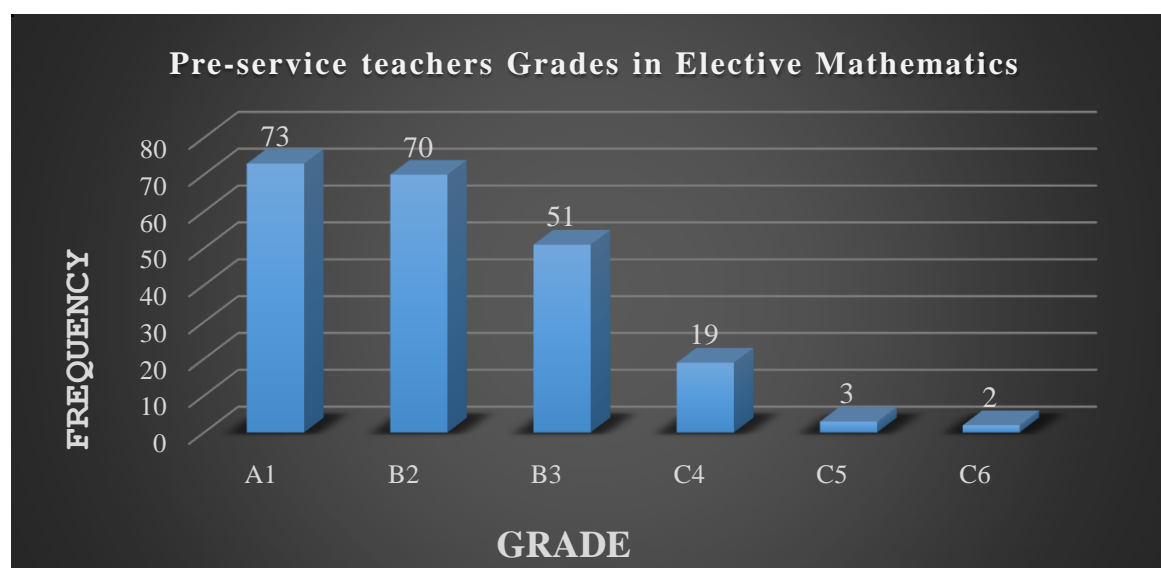
Out of the 329 respondents, 218 (66.2%) were revealed to have had admission using their WASSCE certificates. The respondents were asked to provide information on their WASSCE aggregate and grade scores in Elective Mathematics. Table 4.10 below is the participants' responses on their WASSCE aggregate scores.

Table 4.10: Respondents Qualifying Grades Statistics (Total Frequency = 218)

Grouped WASSCE Aggregate Score	Frequency	Percentage (%)
6 - 9	11	5.0
10 - 19	183	83.9
20 - 29	24	11.0

From Table 4.10, 183(83.9%) out of the 218 participants had grades between 10 and 19, and none had grades exceeding 29. This indicates that most of the pre-service teachers who gained admission with WASSCE certificates had good grades and should be able to meet the programme's academic demands. Figure 4.6 represents the pre-service teachers' grades in Elective Mathematics.

Figure 4.6: Pre-service Teachers' Grades in Elective Mathematics



From Fig. 4.6, The participants' grades in Elective Mathematics range from A1 to C6. At the university level, candidates admitted into the Mathematics education programmes must have had Elective mathematics at the SHS level and obtained at least a grade of C6 in Elective Mathematics. The majority of the respondents had A1 (33.5%), which is a distinction grade. 192(88.1%) of the participants had grades between A1 and B3, indicating that most candidates had very good grades in Elective Mathematics. For entry into post-secondary education, a "C" average on the SSSCE or WASSCE with credits (A-D or A1-C6) in every subject is the minimal university

requirement (U.S. Embassy in Ghana, 2017). Table 4.11 represents the participants' WASSCE aggregate score statistics.

Table 4.11: Participants WASSCE Aggregate Score Statistics

Frequency	218
Mean	14.77
Mode	12
Standard Deviation	3.706

Table 4.11 shows that the mean aggregate score of the respondents who gained admission using the WASSCE certificate is 14.7, and the mode is 12. This indicates that most respondents had grades circling aggregate 14. This reveals that most pre-service teachers had good aggregate scores from their WASCE results. This is positive as it shows that the MEPs can attract academically good pre-service teachers.

4.3.2 Demographic Characteristics of the Teacher Educators

The teacher educators were asked to answer various questions about their demographic characteristics as part of their questionnaire. Among the information taken from the participants were gender, age range, qualification, and teaching experience at the higher education level of the teacher educators. Table 4.12 represents the participants' Gender, Age Range and Qualifications.

Table 4.12: Participants Gender, Age Range and Qualification (Total frequency = 28)

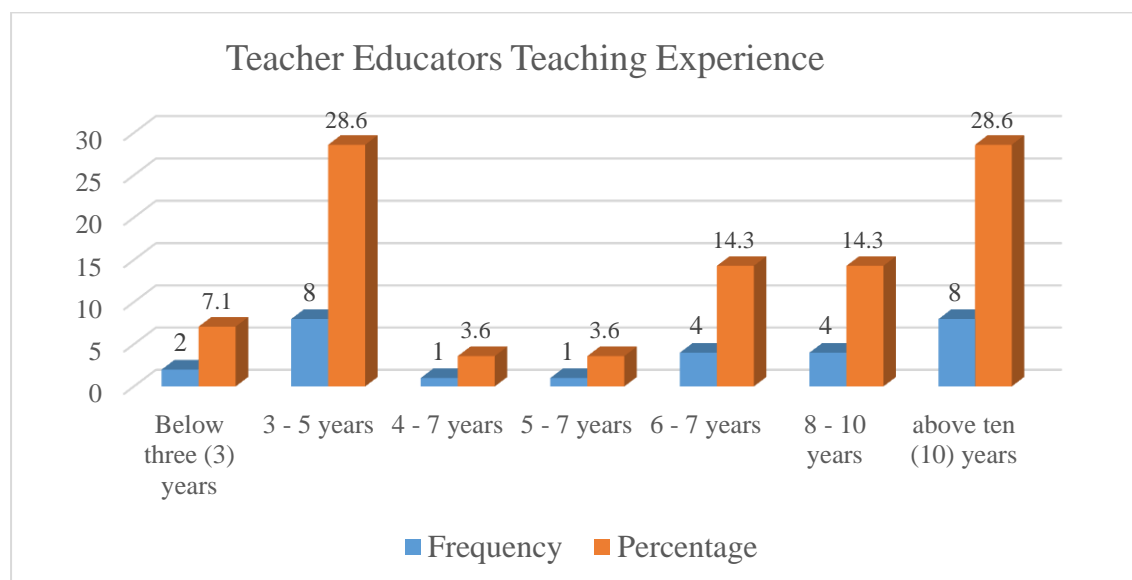
	Frequency	Percentage (%)
Gender		
Female	5	17.9
Male	23	82.1
Age Range of Respondents		
30 - 40 years	12	42.9
41- 50 years	11	39.3
41-50 years	1	3.6
51 - 60 years	2	7.1
Above 60 years	2	7.1
Respondents' Qualification		
Masters (MPhil)	16	57.1
PhD	12	42.9

From the gender distribution of the teacher educators, as shown in Table 4.12, 82.1% of the respondents were male, whilst 17.9% were female. This is evidence that the representation of women at the higher education level and in STEM is low compared to their male counterparts. The graduate-to-PhD pipeline is the first quantifiable explanation for the global under-representation of women in academia (Unesco, 2023).

Table 4.12 shows the age range of the respondents (teacher educators). The table indicates that most respondents fall between 30 and 50 years old. 23(82.1%) out of 28 respondents fall within this range, with 42.9% being 30-40. This indicates that most teacher educators are relatively young, which is good for the long-term progress of the programmes.

From Table 4.12, 57.1% of the teacher educators are masters (MEd, MSc, MPhil) holders, whilst 42.9% are PhD holders. Although an appreciable number of the respondents are PhD holders, this number must increase since the expertise of the teacher educators influences their output in the classroom. As of 2019, Statista reported that, in specialized/professional tertiary institutions of Ghana, the proportion of instructors stood at 112 (PhD) and 246 Masters (Research and Non-Research) (Sasu, 2022). Figure 4.7 represents the participants' teaching experience.

Figure 4.7: Participants Teaching Experience (Teacher Educators)

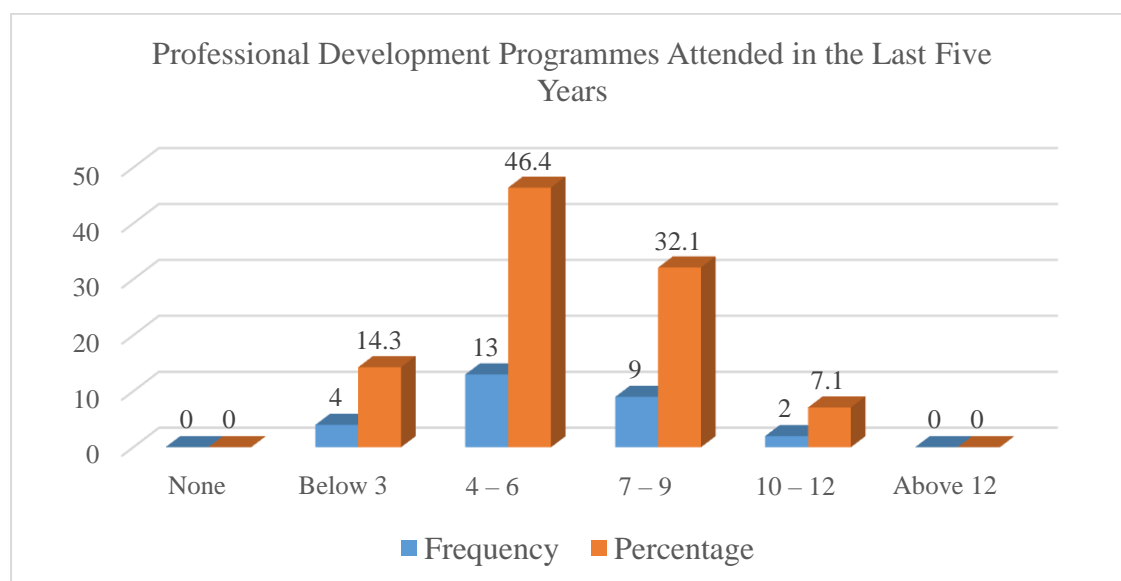


The teacher educators' experience regarding teaching at the higher education level was sorted. Figure 4.7 indicates that 28.6% of the respondents have more than

ten (10) years of working experience at the higher education level. Also, 28.6% have between 3 to 5 years of working experience at the higher education level. Sixteen (16), representing 57.2% of the respondents, have worked at the higher education level between 6 and 10 years. This indicates that many teacher educators have much experience working at the higher education level, which is positive for their experience dealing with the programme. Throughout a teacher's career, experience in the classroom is positively correlated with increases in student achievement; as teachers gain experience, their pupils are more likely to perform well on measures of success other than test scores (Podolsky et al., 2019).

The questionnaire also required the teacher educators to provide information on their professional development programmes attended in the last five years. The participants' responses are represented in Figure 4.8 below.

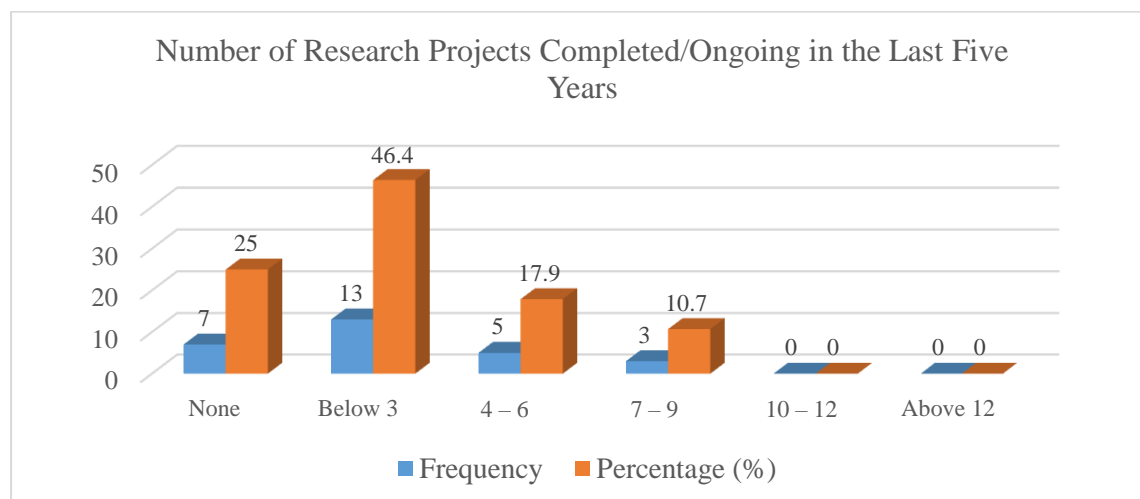
Figure 4.8: Participants Professional Development Programmes Attended in the Last Five Years



From Figure 4.8, 22 (78.5%) respondents have attended 4 to 9 professional development programmes in the last five (5) years. This shows that the teachers' educators are involved more often in professional development programmes, which is positive towards the teacher educators' professional development and training of pre-service teachers. Professional development can make up for deficiencies in instructors' initial preparation and facilitate the transfer of new teachers into their

roles (Education GPS - OECD, 2024). Figure 4.9 represents the number of research projects completed by the participants in the last five (5) years.

Figure 4.9: Participants Number of Research Projects Completed/Ongoing in the Last Five Years



From Figure 4.9, though 7 (25%) of the participants have not been involved in any research project within the last five (5) years, 21 (75%) of them have been involved in a project or more. 8 (28.6%) have been involved in 4 to 9 projects. This indicates the teacher educators' contribution towards enquiries, which also contributes to their research experience and professional development. Table 4.13 represents the participants' articles published in the last five (5) years.

Table 4.13: Participants' Number of Articles Published in Journals in the Last Five Years

Number of articles published in journals in the last five years		
None	0	0.0
Below 3	2	7.1
4 – 6	11	39.3
7 – 9	11	39.3
10 – 12	4	14.3
Above 12	0	0.0

From Table 4.13, the teachers' and educators' contribution to research knowledge seems to be high regarding the number of articles published in the last five years. 15 (53.6%) participants indicated having published between 7 and 12 articles within the last five years. Improving the research output of instructors is essential to raising the level of instruction and institutional reputation (Tuan et al., 2022).

The pre-service teacher and teacher educator questionnaire responses are analysed in the following paragraphs, tables, and figures. Stacked bar and clustered column charts were used to represent the surveyed data. The mean rank ranges were found to be Strongly Agree (4.3–5), Agree (3.5–4.2), Neutral (2.6–3.4), Disagree (1.9–2.6), and Strongly Disagree (1–1.8).

4.4 Academic standards of the MEPs in the TEUs

The respondents were asked questions concerning the academic standards of the MEPs of the TEUs. The analyses of the data on academic standards have been presented in this section. The tables represent the frequencies and means of the responses on each statement, and the stacked bars represent percentages of the frequencies of the responses.

4.4.1 Pre-service teachers' responses on the academic standards of the MEPs

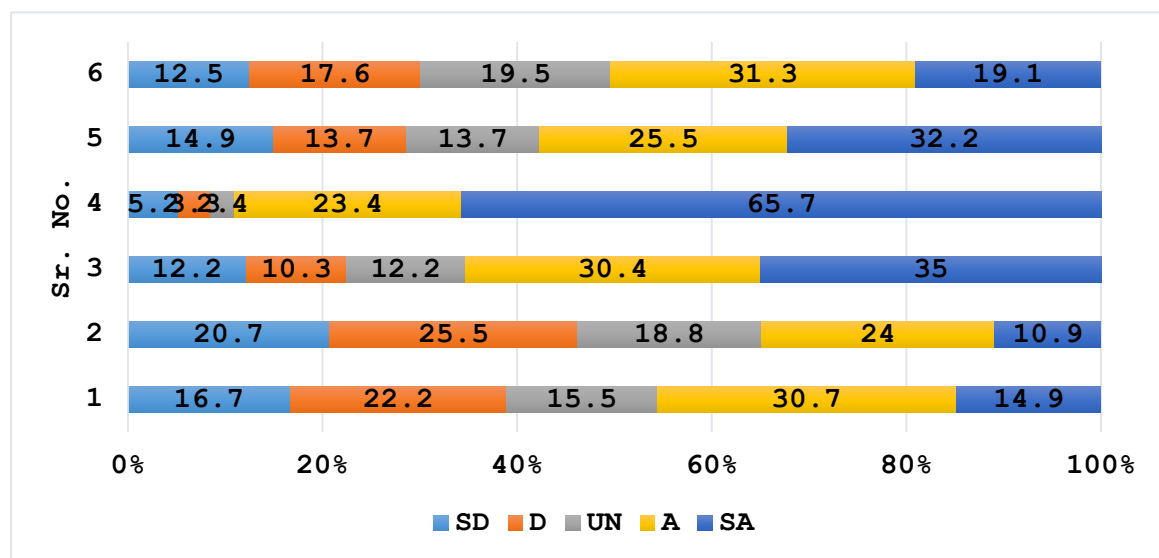
The pre-service teachers were asked questions concerning the academic standards of the MEPs. The participants' responses were analysed regarding academic enhancement activities, learning environment, learning resources, teaching-learning process, and leadership and governance. Table 4.14 represents the preservice teachers' responses to Academic Enhancement Activities in frequencies and means.

Table 4.14: Responses of Pre-Service Teachers on Academic Enhancement Activities (Frequencies and Means)

Sr. No.	Statement	SD Freq.	D Freq.	UN Freq.	A Freq.	SA Freq.	Mean
1	Seminars are organised regularly for students on current Mathematics Education trends	55	73	51	101	49	3.05
2	International collaborative activities (e.g. Exchange programmes) are non-existent in my institution	68	84	62	79	36	2.79
3	Quizzes and other academically competitive activities are organised for students to test themselves with others	40	34	40	100	115	3.66
4	Fresh students are given orientations on the do's and don'ts of the institution	17	11	8	77	216	4.41
5	Pre-service teachers are allowed to evaluate the academic practices of Lecturers	49	45	45	84	106	3.47
6	Academic counselling activities are occasionally organised for students	41	58	64	103	63	3.27

The percentages of the frequencies of the responses on Academic Enhancement Activities are presented in the following stacked bar chart (Figure 4.10).

Figure 4.10: Responses of Pre-Service Teachers on Academic Enhancement Activities (Percentages)



From Table 4.14 and Figure 4.10, on academic enhancement activities, the statement "Fresh students are given orientations on the do's and don'ts of the institution" had a mean of 4.41, indicating that most respondents chose "Strongly Agree" for the statement. It is evident from the percentages between "Agreed" and "strongly agreed" that the statement had a frequency of 293 (89.1%). Also, the statement "International collaborative activities (e.g. Exchange programmes) are non-existent in my institution" had a mean of 2.79, which is within the category of "Undecided". Two other positive statements in the category had means above 3.5 within the "Agreed" response. None of the statements in the category falls within the Disagreed to Strongly Disagreed response. Though three statements had means falling within the "Undecided" response category, all three statements had at least 34% of the respondents opting between "Agreed" and "Strongly Agreed". This shows that most respondents believe the universities are doing enough to organise academic enhancement activities, with some being indecisive about the subject. Students' academic performance is positively improved by enrichment programmes (AL-

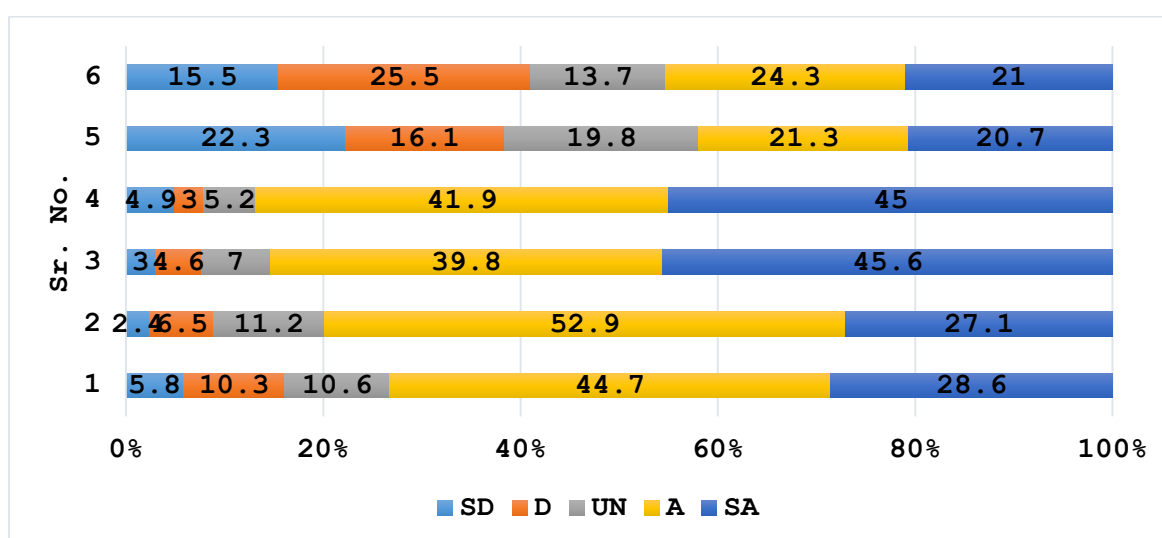
ZOUBI, 2014). Table 4.15 represents the preservice responses to the Learning Environment in frequencies and means.

Table 4.15: Responses of Pre-Service Teachers on Learning Environment (Frequencies and Means)

Sr. No.	Statement	SD Freq.	D Freq.	UN Freq.	A Freq.	SA Freq.	Mean
1	Lecturers maintain an excellent classroom environment for teaching and learning	19	34	35	147	94	3.8
2	Student teacher-educator relationship is cordial	8	21	37	174	89	3.96
3	Collaborative learning is encouraged for students to help each other	10	15	23	131	150	4.2
4	Students are encouraged to ask questions during lessons	16	10	17	138	148	4.19
5	School auditoriums are mostly rented out for non-academic activities, which makes the environment noisy	73	53	65	70	68	3.02
6	Security measures on campus are poor, encouraging encroachment by outsiders during and after classes	51	84	45	80	69	3.1

The percentages of the frequencies of the responses in the Learning Environment are presented in the following stacked bar chart (Figure 4.11).

Figure 4.11: Responses of Pre-Service Teachers on Learning Environment (Percentages)



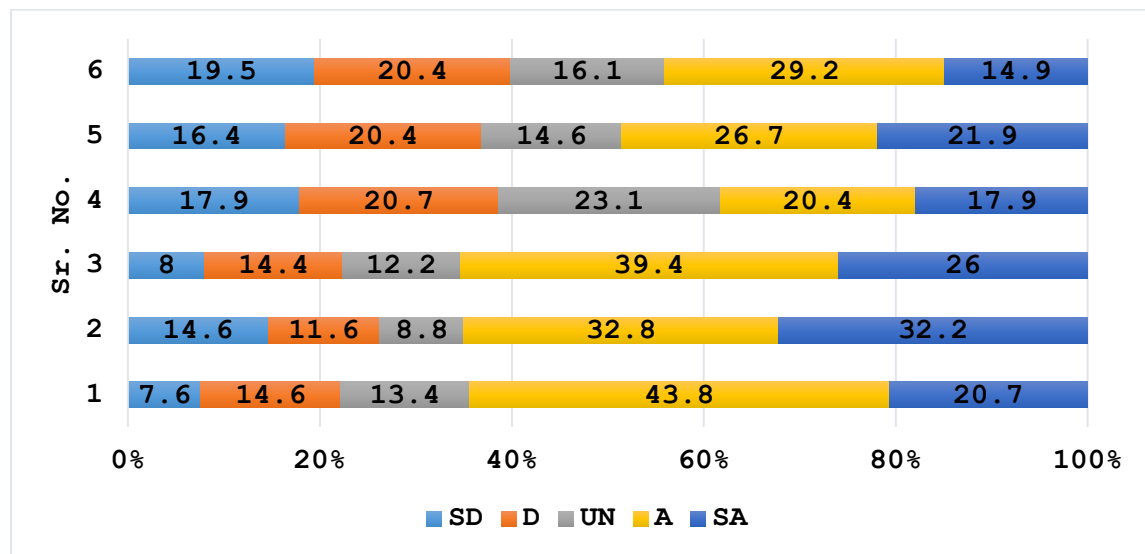
From Table 4.15 and Figure 4.11, four positive statements towards "Learning Environment" had means between 3.8 and 4.2. This shows that all four statements out of six fall within the "Agreed" response range. The statements "School auditoriums are mostly rented out for non-academic activities, which makes the environment noisy" and "Security measures on campus are poor, encouraging encroachment by outsiders during and after classes" had means of 3.02 and 3.10, respectively, which means the majority of the respondents selected "Undecided" for the two statements. The two statements had 138 (42%) and 149 (45.3%) respectively having their responses between "Agreed" and "Strongly Agreed". This indicates that a substantial number of the participants do not favour the two statements. The administration of institutions should provide the security unit with adequate funding and state-of-the-art equipment for a safer learning environment (Ekpoh et al., 2020). Table 4.16 represents the preservice teachers' responses to Learning resources in frequencies and means.

Table 4.16: Responses of Pre-Service Teachers on Learning Resources (Frequencies and Means)

Sr. No.	Statement	SD Freq.	D Freq.	UN Freq.	A Freq.	SA Freq.	Mean
1	Lecturers involve the appropriate teaching-learning materials in lessons	25	48	44	144	68	3.55
2	The department has a library from which to learn.	48	38	29	108	106	3.57
3	The appropriate teaching-learning materials are regularly used to enhance teaching and learning.	26	47	40	129	85	3.61
4	Books in the Library are not current	59	68	76	67	59	3
5	The Wi-Fi on campus is not good enough, which makes accessing materials online difficult	54	67	48	88	72	3.17
6	There is a computer laboratory, well stocked with computers and made accessible to students all the time	64	67	53	96	49	3

The percentages of the frequencies of the responses on Learning Resources are presented in the following stacked bar chart (Figure 4.12).

Figure 4.12: Responses of Pre-Service Teachers on Learning Resources (Percentages)



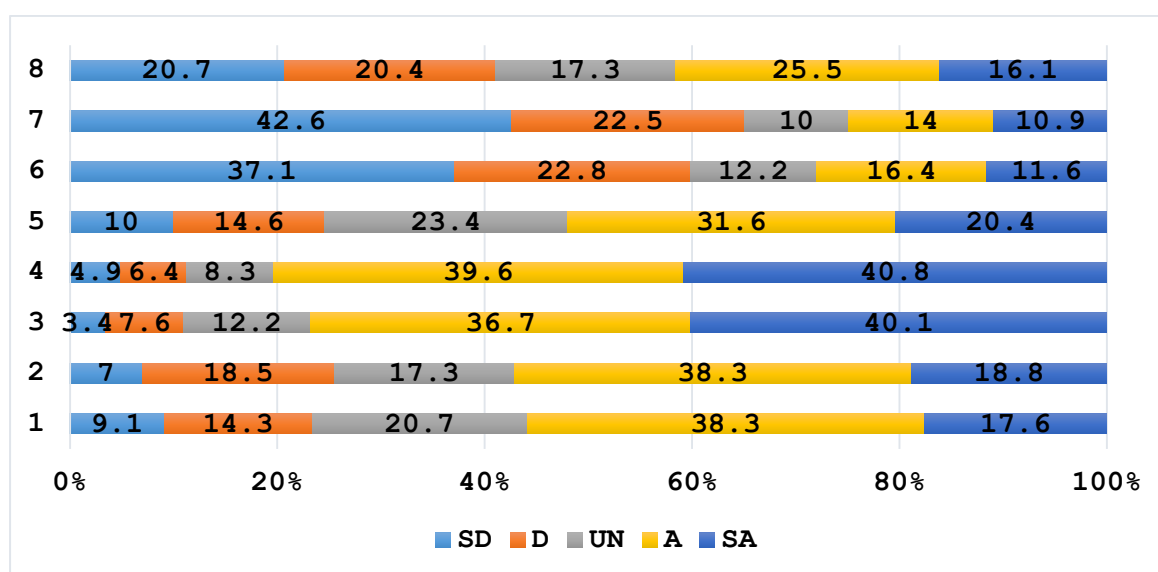
As shown in Table 4.16 and Figure 4.12, on learning resources, three of the statements, "Lecturers involve the appropriate teaching-learning materials in lessons", "The department has a library to learn from", and "The appropriate teaching-learning materials are regularly used to enhance teaching and learning", all had a means of at least of 3.55 which is an indication that most of the respondents agree to the three statements. Though the rest of the statements had means between 3.0 and 3.17, all the statements had percentages between "Agree" and "Strongly Agree" from 38.3% to 48.6%, indicating that most respondents favoured the statements. In addition to making the educational process more engaging and exciting, the goal and function of teaching and learning resources is to promote active learning, the acquisition of new abilities, and the adoption of positive values and attitudes in students (Bušljeta, 2013). Table 4.17 represents the preservice teachers' responses to the Teaching-Learning Process in frequencies and means.

Table 4.17: Responses of Pre-Service Teachers on Teaching Learning Process (Frequencies and Means)

Sr. No.	Statement	SD Fre q.	D Fre q.	UN Fre q.	A Freq .	SA Freq .	Mean
1	Assessment methods are fair and free of bias towards individuals	30	47	68	126	58	3.41
2	Lecturers promptly provide feedback to students in all situations	23	61	57	126	62	3.43
3	Lecturers have good knowledge in their areas of specialisation	11	25	40	120	131	4.02
4	Course objectives are clearly stated and communicated at the beginning of every academic year	16	21	27	129	133	4.05
5	Lecturers are regularly supervised to ensure the right practices are being used for academic activities	33	48	77	104	67	3.38
6	Evaluation processes (Examinations) are relaxed without strict supervision	122	75	40	54	38	2.43
7	Students have the liberty to attend classes when and how they want	140	74	33	46	36	2.28
8	Extra-curricular activities are given equal priority as academic activities	68	67	57	84	53	2.96

The percentages of the frequencies of the responses on the Teaching Learning Process are presented in the following stacked bar chart (Figure 4.13).

Figure 4.13: Responses of Pre-Service Teachers on Teaching Learning Process (Percentages)



From Table 4.17 and Figure 4.13, whilst "Course objectives are clearly stated and communicated at the beginning of every academic year" and "Lecturers have

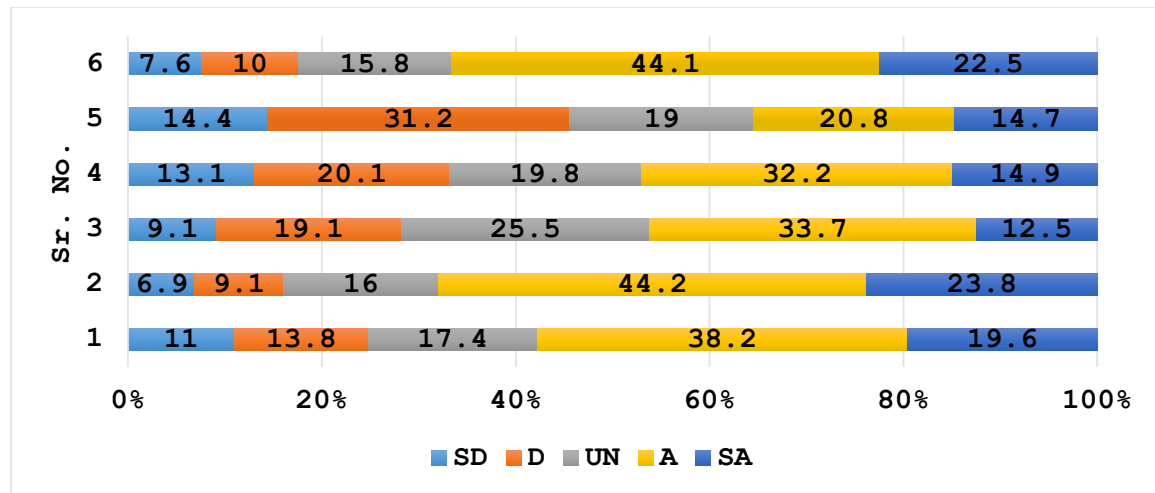
good knowledge in their areas of specialisation" had means of 4.05 and 4.02, respectively, which fall within "Agree" and "Students have the liberty to attend classes when and how they want" and "Evaluation processes (Examinations) are relaxed without strict supervision" had a means of 2.28 and 2.43 respectively. This means most respondents agree with the first two statements and disagree with the last two, with means 2.4 and 2.3. As a fundamental element of educational planning, teaching is pivotal in guiding educational programmes (Tripathi and Kumar, 2018). Table 4.18 represents the preservice teachers' responses on Leadership and Governance in frequencies and means.

Table 4.18: Responses of Pre-Service Teachers on Leadership and Governance (Frequencies and Means)

Sr. No.	Statement	SD Freq.	D Freq	UN Freq	A Freq	SA Freq	Mean
1	Good practices are rewarded to encourage repetition and to serve as an example for others	36	45	57	125	64	3.42
2	The Department ensure that the academic standards of graduating students are top-notch	22	29	51	141	76	3.69
3	Authorities respond promptly to pre-service teachers' agitations about academic issues	30	63	84	111	41	3.21
4	Authorities rarely meet with students to discuss their challenges to offer solutions	43	66	65	106	49	3.16
5	Authorities are unwelcoming and difficult to approach	47	102	62	68	48	2.9
6	Students are involved in decisions through the Student Representatives Council (SRC)	25	33	52	145	74	3.64

The percentages of the frequencies of the responses on leadership and governance are presented in the following stacked bar chart (Figure 4.14).

Figure 4.14: Responses of Pre-Service Teachers on Leadership and Governance (Percentages)



On leadership and governance, as can be seen from Table 4.18 and Figure 4.14, "the department ensures that the academic standards of graduating students are top notch" had a mean of 3.69, "Students are involved in decisions through the Student Representatives Council (SRC)" had a mean of 3.64, and "Good practices are rewarded to encourage repetition and to serve as an example for others" had a mean of 3.42 which indicates the majority of the respondents agree with these three statements. The rest of the statement had means between 2.9 and 3.21, within the undecided range. This indicates that most of the respondents are in favour of the leadership practices in the MEPs of the TEUs. Effective school leadership is crucial to enhance instruction and learning within each school and to provide a link between the school and the outside world (Ndlovu, 2017).

I. HYPOTHESES TESTING

Null Hypothesis: There exists no significant relationship between the male and female pre-service teachers' responses concerning the academic standards of the TEUs of the TEUs.

The scores of the academic standards obtained from the responses of the whole sample ((329 (male: 275, Female: 54)) of the pre-service teachers were tabulated and used to find out the Mann-Whitney U test between the responses of the male and female pre-service teachers. Table 4.19 shows the results of the analyses.

Table 4.19: Results of Mann-Whitney U Test for Male and Female Pre-Service Teachers' Responses on Academic Standards

Statistics	Score	Means	Effect size	Verbal Interpretation
Mann-Whitney U	5914.500	Male = 3.44	0.13	Reject the null hypothesis (significant level is 0.05)
Wilcoxon W	43864.500	Female = 3.61		
Z	-2.364			
Asymp. Sig. (2-tailed)	.018			

From Table 4.19, the asymptotic significance (2-tailed) p -value obtained from the analysis between the male and female pre-service teachers' responses on academic standards is 0.018 ($U = 5914.5$, $Z = -2.364$, Effect Size = 0.13), at a significant level of 0.05. This is an indication that there is a significant difference between the male and female pre-service teachers' perceptions of the academic standards of the MEPs of the TEUs, with a small effect size denoting a limited practical significance.

A mean of 3.44 from the male data indicates a moderately positive response but not strongly so, whilst a mean of 3.61 from the female data reflects a somewhat stronger positive response compared to males.

II. HYPOTHESIS TESTING

Null Hypothesis: There exists no significant relationship between the pre-service teachers of CKT-UTAS, UCC, and UEW's responses concerning the academic standards of the MEPs of the TEUs.

The scores of the academic standards obtained from the responses of the whole sample ((329 (CKT-UTAS: 23, UCC: 150, UEW: 156)) of the pre-service teachers were tabulated and used to find out the Kruskal Wallis H test between the responses of CKT-UTAS, UCC and UEW pre-service teachers. Table 4.20 shows the results of the analyses.

Table 4.20: Results of Kruskal-Wallis H Test for CKT-UTAS, UCC and UEW Pre-Service Teachers' Responses on Academic Standards

Statistic	Score	Means	Effect Size	Verbal Interpretation
Chi-Square	11.967	CKT-UTAS = 3.32	0.18	Reject the Null Hypothesis
df	2	UCC = 3.55		
Asymp. Sig	0.003	UEW = 3.43		

From Table 4.20, the Kruskal-Wallis H test shows that there is a statistically significant difference between the responses of the pre-service teachers from CKT-UTAs, UCC and UEW concerning the academic standards of the MEPs of the TEUs, $\chi^2(2) = 11.967, p = 0.003$ at a significant level of 0.05. This indicates that the perceptions of the pre-service teachers from the three universities about the academic standards are different.

A mean of 3.32 (CKT-UTAS) indicates responses leaning between "Neutral" and "Agree," suggesting a moderately positive response but less so compared to UCC (3.55), reflecting a positive response and UEW (3.43), suggesting a moderately positive response closer to "Agree".

There were significant differences in how pre-service teachers perceived academic standards based on their gender, class, and departments of study (Doğutaş, 2016). At an effect size of 0.18, the effect is small and practically has limited significance. Pre-service teachers rated their pedagogical preparation as "highly prepared" or "well prepared", with no significant gender differences (Khaled et al., 2016).

4.4.2 Teacher educators' responses on the academic standards of the MEPs

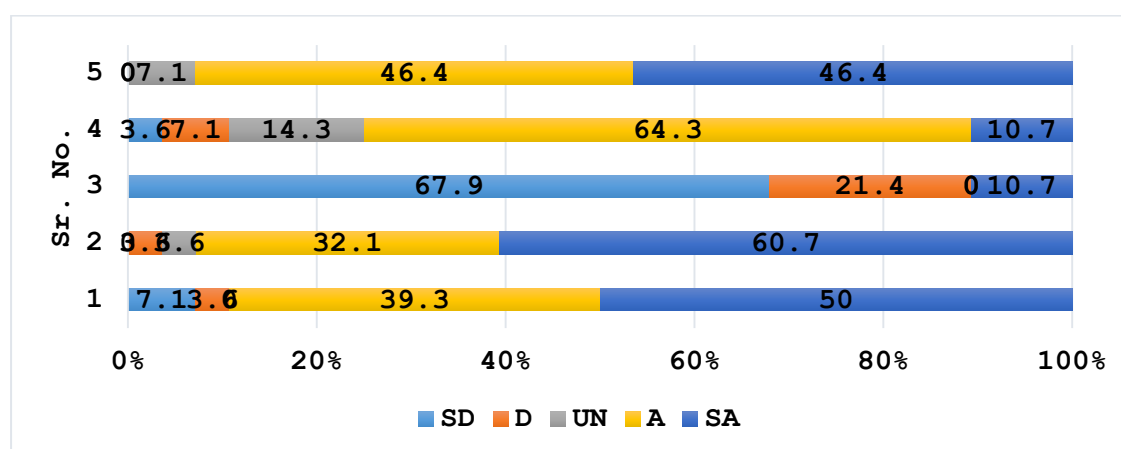
The analysis of the participants' (teacher educators) responses to the academic standards of the MEPs in the TEUs of Ghana are presented below. The analyses are categorised into admissions, staff recruitment and professional development, and teaching-learning activities. Table 4.21 represents the teacher educators' responses to the Admission Process in frequencies and means.

Table 4.21: Responses of Teacher Educators on the Admission Process (Frequencies and Means)

Sr. No.	Statement	SD	D	UN	A	SA	Mean
		Freq.	Freq.	Freq.	Freq.	Freq.	
1	Admission of pre-service teachers is strictly on merit	2	1	0	11	14	4.21
2	Admission procedures are strictly followed per the regulations of my University	0	1	1	9	17	4.5
3	There is biasness in admission processes	19	6	0	0	3	1.64
4	Gender equality is strongly considered in the admission process	1	2	4	18	3	3.71
5	The entry characteristics of pre-service teachers are prioritised to ensure the admission of eligible students	0	0	2	13	13	4.39

The percentages of the frequencies of the responses on the admission process are presented in the following stacked bar chart (Figure 4.15).

Figure 4.15: Responses of Teacher Educators on the Admission Process (Percentages)



From the questions asked on admissions, as shown in Table 4.21 and Figure 4.15, "Admission of pre-service teachers is strictly on merit", "Admission procedures are strictly followed per the regulations of my University", and "Gender equality is strongly considered in the admission process" had means greater than 4.2 indicating the majority of the respondents strongly agree to these statements. On the other hand, most of the respondents "Strongly Disagree" with the statement "There is biasness in admission processes", which had a mean of 1.64. This indicates that the teacher educators believe the right procedures are employed during the admission of pre-

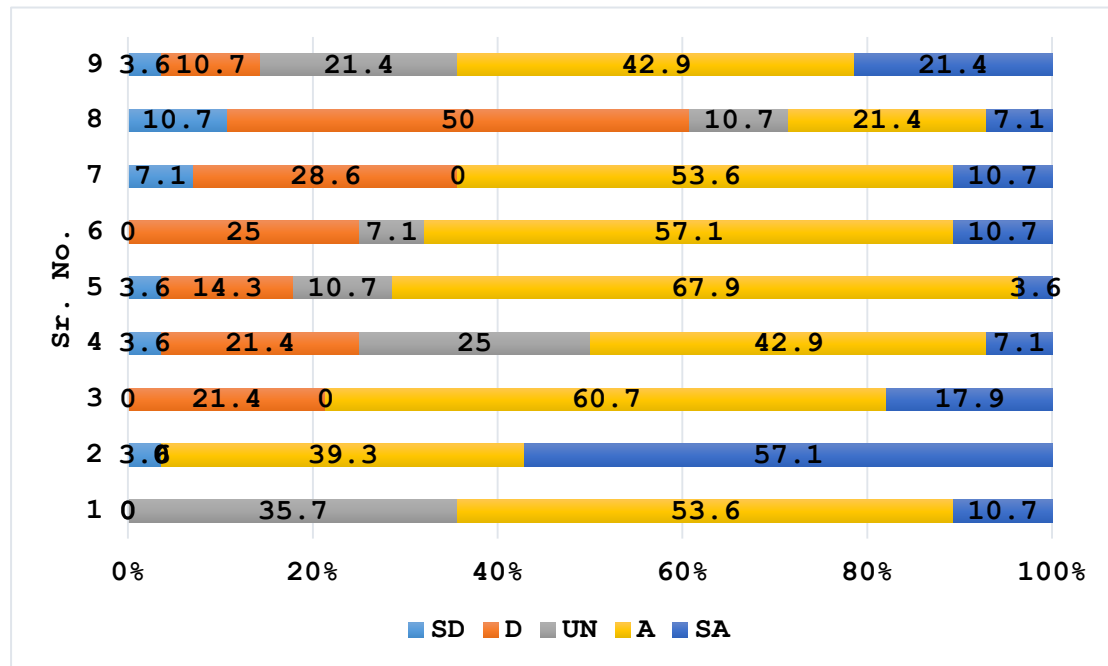
service teachers. Universities must have "fair" student admissions procedures (Pitman, 2016). Table 4.22 represents the teacher educators' responses on Staff Recruitment and Professional Development in frequencies and means.

Table 4.22: Responses of Teacher Educators on Staff Recruitment and Professional Development (Frequencies and Means)

Sr. No.	Statement	SD	D	UN	A	SA	Mean
		Freq.	Freq.	Freq.	Freq.	Freq.	
1	Administrative staff are regularly given in-service training to perform better	0	0	10	15	3	3.75
2	The university advertises vacant positions to attract applications	1	0	0	11	16	4.46
3	Suitable candidates are selected on merit	0	6	0	17	5	3.75
4	The university gives feedback to both successful and unsuccessful candidates after interviews.	1	6	7	12	2	3.29
5	New staff members are trained to ensure better performance	1	4	3	19	1	3.54
6	The institution has sponsorship opportunities for Teacher Educators to upgrade themselves	0	7	2	16	3	3.54
7	Teacher Educators are regularly checked for professional development	2	8	0	15	3	3.32
8	Teacher educators are regularly supervised to ensure the right practices are being used for academic activities	3	14	3	6	2	2.64
9	Conferences and Seminars are regularly organised to keep up-to-date with the current trends in Mathematics teacher education	1	3	6	12	6	3.68

The percentages of the frequencies of the responses on Staff Recruitment and Professional Development are presented in the following stacked bar chart (Figure 4.16).

Figure 4.16: Responses of Teacher Educators on Staff Recruitment and Professional Development (Percentages)



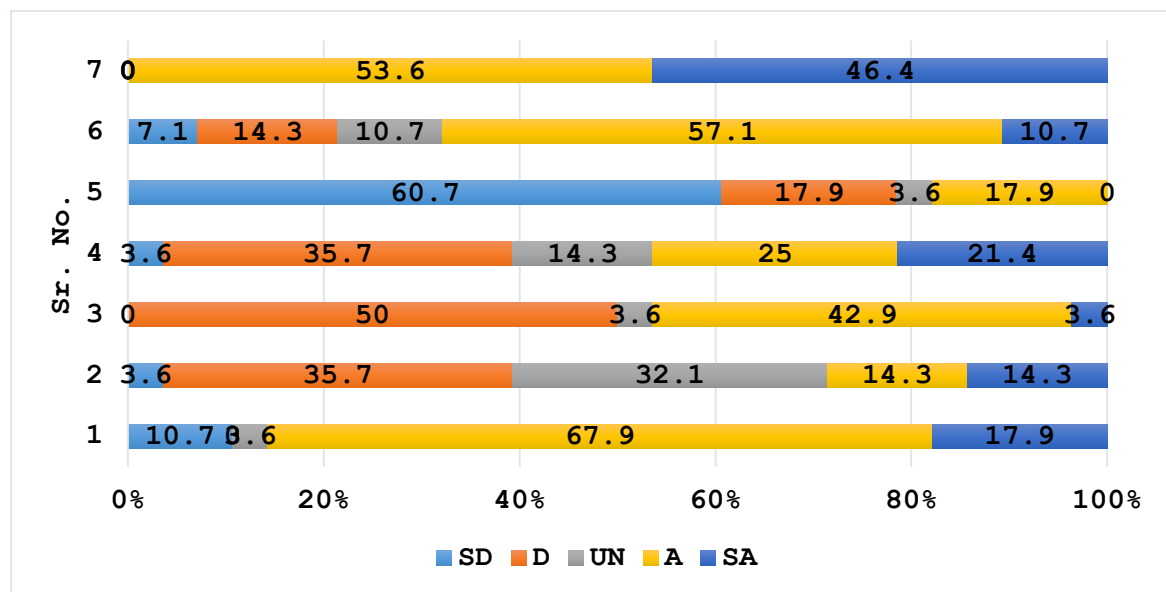
In the category of staff recruitment and development, as shown in Table 4.22 and Figure 4.16, the statement "The university advertises vacant positions to attract applications" had a mean of 4.46, meaning most of the respondents agreed with the statement, whilst the statement "Teacher educators are regularly supervised to ensure the right practices are being used for academic activities" had a mean of 2.64 falling within the Undecided response. Also, 17 (60.7%) disagree or strongly disagree that teacher educators are regularly supervised. This indicates that most of the respondents are not decisive concerning the supervision of teacher educators. This is a concern since supervision is essential when considering upholding education standards. Sustaining supervision is one of the possibilities that can be employed to develop teacher professionalism (Nurulita et al., 2021). Other statements, including "Administrative staff are regularly given in-service training to perform better", "Suitable candidates are selected on merit", and "Conferences and Seminars are regularly organised to keep up-to-date with the current trends in Mathematics teacher education", with mean between 3.68 and 3.75 which shows that majority of the respondents agree to these statements. This is positive for the TEUs since activities concerning these statements are essential for their professional growth and standards. Table 4.23 represents the Teacher Educators' responses to Teaching Learning Activities in frequencies and means.

Table 4.23: Responses of Teacher Educators on Teaching-Learning Activities (Frequencies and Means)

Sr. No.	Statement	SD	D	UN	A	SA	Mean
		Freq.	Freq.	Freq.	Freq.	Freq.	
1	The university ensures teacher educators have good knowledge in their areas of expertise	3	0	1	19	5	3.82
2	There is no recognition system to encourage hardworking teacher educators	1	10	9	4	4	3
3	The Mathematics Education Department is held responsible for the standards of graduating pre-service teachers	0	14	1	12	1	3
4	Extra-curricular activities are given equal priority as academic activities	1	10	4	7	6	3.25
5	There is no monitoring system for pre-service teachers' attendance	17	5	1	5	0	1.79
6	The university administration regularly provides material for teaching and learning	2	4	3	16	3	3.5
7	Evaluation procedures are strictly supervised to ensure pre-service teachers are properly evaluated	0	0	0	15	13	4.46

The percentages of the frequencies of the responses on Teaching Learning Activities are presented in the following stacked bar chart (Figure 4.17).

Figure 4.17: Responses of Teacher Educators on Teaching-Learning Activities (Percentages)



Concerning teaching-learning activities, shown in Table 4.23 and Figure 4.17, "Evaluation procedures are strictly supervised to ensure pre-service teachers are properly evaluated" had a mean of 4.46, an indication that most of the respondents strongly agree with the statement and "The university ensures teacher educators have good knowledge in their areas of expertise" had a mean of 3.82 showing that most of the respondents agree to the statement. The two statements are integral to producing top-notch mathematics teachers, which is positive for the TEUs. Evaluation generates value judgments about students' accomplishments, educational levels, and status as lifelong learners (Ifeoma, 2022). "There is no monitoring system for pre-service teachers' attendance" had a mean of 1.79, indicating that most respondents strongly disagree with this statement. Tracking the attendance of pre-service teachers is very relevant to their professional development.

III. HYPOTHESIS TESTING

Null Hypothesis: There exists no significant relationship between the male and female teachers' educators' responses concerning academic standards in the MEPs of the TEUs.

The scores of the academic standards obtained from the responses of the whole sample of ((28 (male: 23, Female: 5)) teacher educators were tabulated and used to find out the Mann-Whitney U test between the responses of the male and female teacher educators. Table 4.24 shows the results of the analyses.

Table 4.24: Results of Mann-Whitney U Test for Male and Female Teacher Educators' Responses on Academic Standards

Statistics	SCORE	Means	Effect Size	Verbal Interpretation
Mann-Whitney U	37.500	Male = 3.58	0.23	Accept the null hypothesis (The significant level is 0.05)
Wilcoxon W	52.500	Female = 3.44		
Z	-1.204			
Asymp. Sig. (2-tailed)	0.229			

From Table 4.24, the asymptotic significance (2-tailed) *p*-value obtained from the analysis between the male and female teacher educators' responses on academic

standards is 0.229 ($U = 37.500$, $Z = -1.204$, Effect Size = 0.23), at a significant level 0.05. This is an indication that there is no significant difference between the perceptions of male and female teacher educators on academic standards in the MEPs of the TEUs, with a small effect size indicating a limited practical significance.

A mean Male (3.58) indicates responses leaning toward "Agree," suggesting moderately positive responses, whilst Female (3.44) indicates responses falling between "Neutral" and "Agree," showing a slightly less positive response compared to males.

4.5 Curriculum Design, Implementation and Development of the MEPs in the TEUs

The respondents were asked questions concerning the curriculum design, implementation and development of the MEPs of the TEUs. The analyses of the data have been presented in this section.

4.5.1 Pre-Service Teachers' Responses on Curriculum Design, Development and Implementation

The respondents were asked questions concerning the curriculum design, development and implementation of the MEPs. The responses of the participants are presented below. Table 4.25 represents the preservice teachers' responses on Curriculum Design in frequencies and means.

Table 4.25: Responses of Pre-Service Teachers on Curriculum Design (Frequencies and Means)

Sr. No.	Statement	SD Freq.	D Freq.	UN Freq.	A Freq.	SA Freq.	Mean
1	The curriculum is clearly written with its objectives	11	15	28	142	133	4.13
2	The curriculum meets international standards by comparison	6	21	80	134	88	3.84
3	Although an integrated education programme, the curriculum content covers enough content knowledge to enable further studies in pure Mathematical-related areas	13	23	46	144	103	3.91
4	Pedagogical content knowledge is emphasised to equip students with enough skills for classroom delivery	9	11	33	165	111	4.09
5	Evaluation procedures and their purposes are spelt out in the curriculum	9	14	43	162	101	4.01
6	The curriculum coverage is enough for classroom practice	15	32	57	150	75	3.72
7	The content of the curriculum is outdated; it does not address current trends in Mathematics Education	74	81	55	74	45	2.8
8	The curriculum is well organised concerning time frame, evaluation and materials for implementation	11	23	61	154	80	3.82
9	The objectives of the curriculum concentrate on the intended skills to be achieved	10	12	46	175	86	3.96
10	The constituents of the curriculum are in accordance with its objectives	7	11	36	198	77	3.99
11	The role of Lecturers and pre-service teachers are not spelt out in the curriculum	37	86	83	87	36	3.00
12	The curriculum is not crowded. Pedagogical knowledge, pedagogical content knowledge, and content knowledge do not suffer because of this	27	52	92	109	49	3.31

The percentages of the frequencies of the responses on Curriculum Design are presented in the following stacked bar chart (Figure 4.18).

Figure 4.18: Responses of Pre-Service Teachers on Curriculum Design (Percentages)

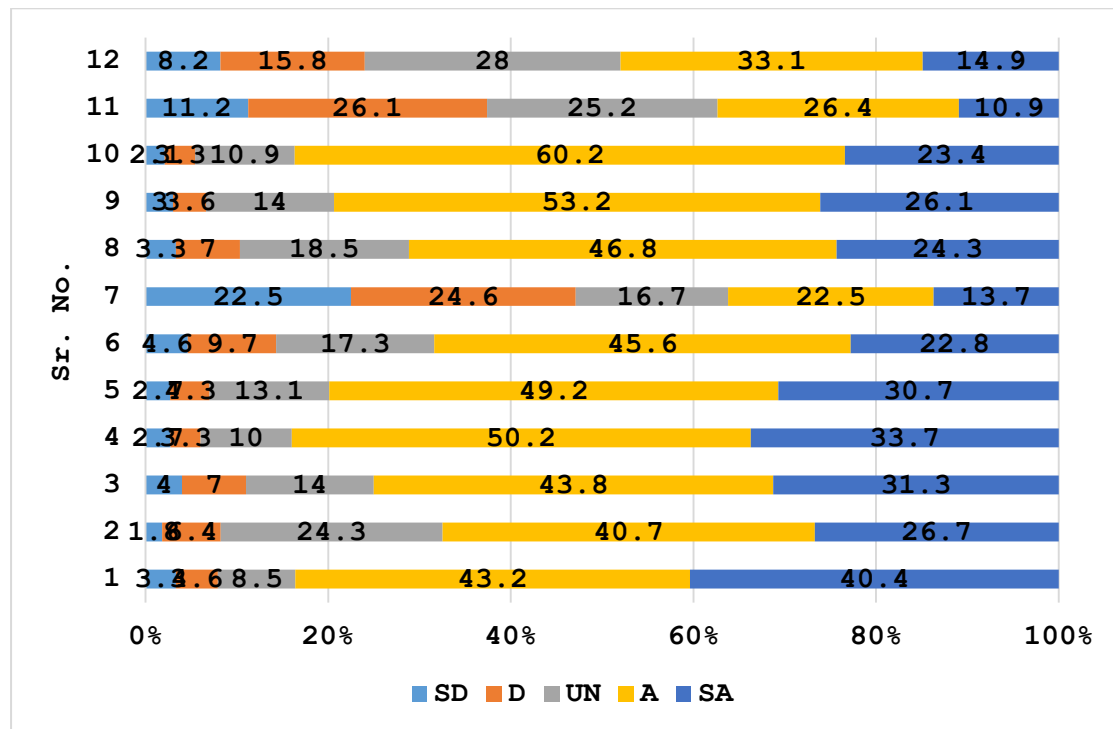


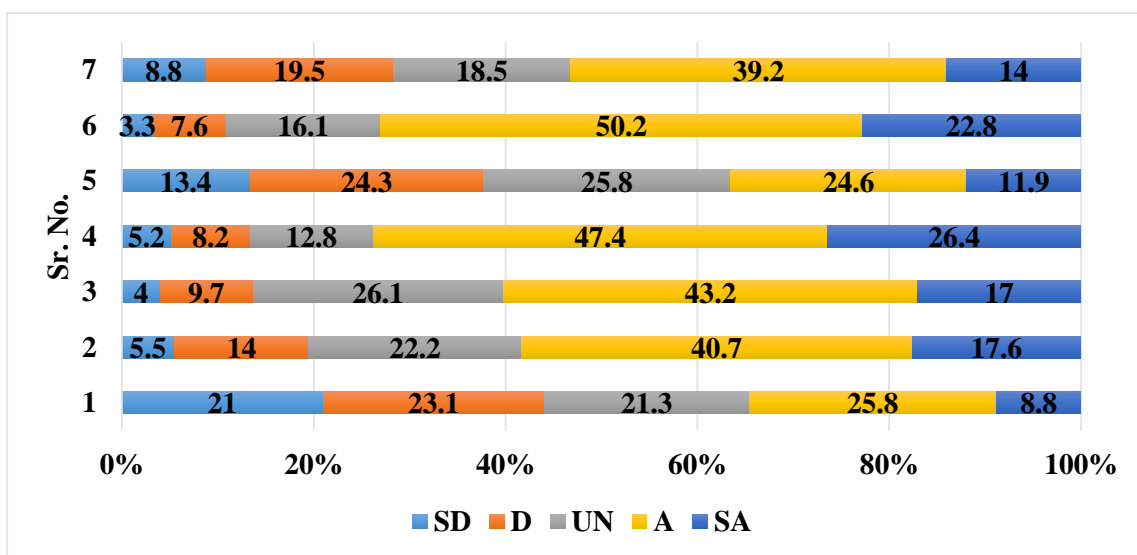
Table 4.25 and Figure 4.18 represent the pre-service teachers' responses to a statement concerning the curriculum design of the TEUs MEPs in Ghana. Table 4.25 shows that most respondents agree with the positive statements about the curriculum design. Statements including "Pedagogical content knowledge is emphasised to equip students with enough skills for classroom delivery", "The curriculum is clearly written with its objectives", and "Evaluation procedures and their purposes are spelt out in the curriculum" had means greater than 4.0 meaning the respondents agree to all these statements. Other negative statements, including "The content of the curriculum is outdated; it does not address current trends in Mathematics Education" and "The role of Lecturers and pre-service teachers are not spelt out in the curriculum", had means of 2.80 and 3.31, respectively, indicating that most of the respondents were undecided regarding these statements. Also, the statement "the content of the curriculum is outdated; it does not address current trends in Mathematics Education" had 155 (57.1%) of the participants disagree or strongly disagree with it. A wide range of other aspects that are influenced by political demands, economic concerns, educational theory growth, and the democratisation of social processes are all included in curriculum design (Grant, 2018). Table 4.26 represents the teacher educators' responses on Curriculum Development in frequencies and means.

Table 4.26: Responses of Pre-Service Teachers on Curriculum Development (Frequencies and Means)

Sr. No.	Statement	SD Freq.	D Freq.	UN Freq.	A Freq.	SA Freq.	Mean
1	Students are allowed to evaluate portions of the curriculum for updating	69	76	70	85	29	2.78
2	Portions of the curriculum are updated occasionally based on current issues in Mathematics Education	18	46	73	134	58	3.51
3	The curriculum has evolved to mimic the international standard with time	13	32	86	142	56	3.6
4	The curriculum is diverse and inclusive of all students	17	27	42	156	87	3.82
5	There is no evidence that the curriculum has been researched, analysed, and evaluated for updating	44	80	85	81	39	2.97
6	The curriculum inspires engaging learning with questioning, analysing, synthesising, and deeper levels of knowledge and understanding.	11	25	53	165	75	3.81
7	The same curriculum has been used over a long period by comparison with the previous years	29	64	61	129	46	3.3

The percentages of the frequencies of the responses on Curriculum Development are presented in the following stacked bar chart (Figure 4.19).

Figure 4.19: Responses of Pre-Service Teachers on Curriculum Development (Percentages)



Concerning curriculum development, from Table 4.26 and Figure 4.19, 44.1% of the respondents disagree or strongly disagree with the statement "Students are allowed to evaluate portions of the curriculum for updating", with a mean of 2.78, indicating that most respondents are undecided. This reveals that the involvement of the pre-service teachers in the curriculum development process is limited. "Portions of the curriculum are updated occasionally based on current issues in Mathematics Education" and "The curriculum has evolved to mimic the international standard with time" had means of 3.50 and 3.61, respectively. This is an indication that most of the respondents agree with these statements. It can be seen that the two statements have 194(58.3%) and 198(60.2%) of the respondents agree or strongly agree with these statements. This indicates that the respondents are positive that the curriculum is updated occasionally. The curriculum should adapt to reflect how knowledge is expanding and how society is changing due to scientific and technological advancements (Mondal and Das, 2021). Table 4.27 represents the preservice teachers' responses on Curriculum Implementation in frequencies and means.

Table 4.27: Responses of Pre-Service Teachers on Curriculum Implementation (Frequencies and Means)

Sr. No.	Statement	SD	D Freq.	UN Freq.	A Freq.	SA Freq.	Mean
1	Lecturers use the right materials during classroom transactions	20	52	39	151	67	3.59
2	Lecturers are knowledgeable about the implementation processes	6	21	44	153	93	3.97
3	There is the right environment for curriculum implementation	14	44	38	162	71	3.71
4	The curriculum provides no provisions for ICT integration in all of its aspects	82	98	39	80	30	2.63
5	The institution has the necessary facilities to promote curriculum transaction	20	42	69	138	60	3.53
6	Evaluation procedures and practices are fair	22	40	54	153	60	3.57
7	Curriculum transactions do not encourage participation in class	67	101	46	72	43	2.77

The percentages of the frequencies of the responses on Curriculum Implementation are presented in the following stacked bar chart (Figure 4.20).

Figure 4.20: Responses of Pre-Service Teachers on Curriculum Implementation (Percentages)

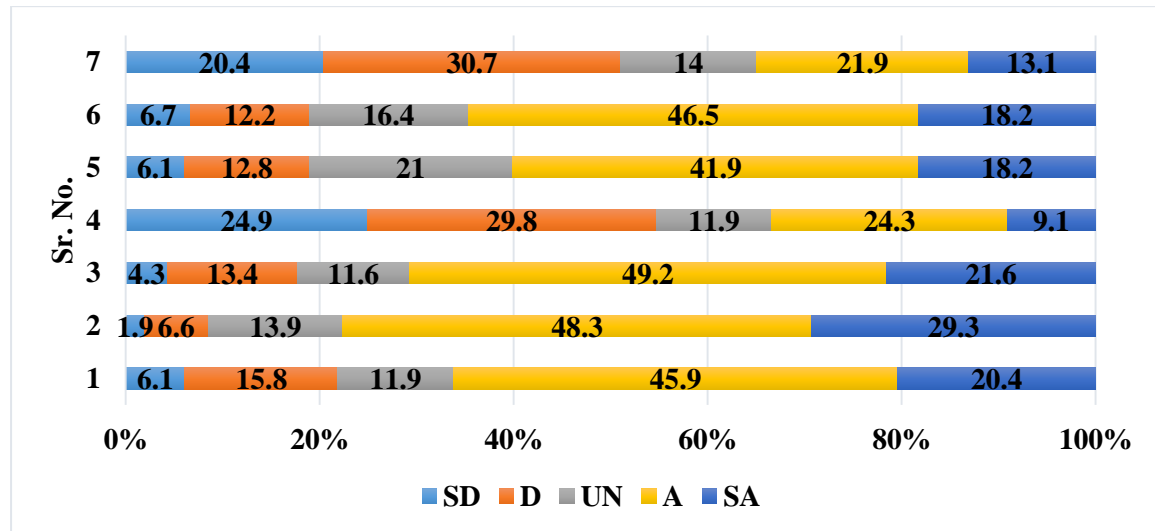


Table 4.27 and Figure 4.20 presents the participants' responses to statements on curriculum implementation. "The curriculum provides no provisions for ICT integration in all aspects" and "Curriculum transactions do not encourage participation in class" had means of 2.63 and 2.77, respectively. The two statements, respectively having 180 (54.7%) and 168 (51.1%) disagreeing or strongly disagreeing with them, indicate that the participants agree that using ICT tools is encouraged in the curriculum. Students can easily understand concepts with the help of ICT (Ennin, 2023). Students' participation in the classroom is essential to their understanding of concepts. In order to absorb, seek out, and apply the skills and knowledge provided in the classroom or during other learning activities, students are required to participate actively and participate fully (Abdullah et al., 2012). All other positive statements towards curriculum implementation, such as "Lecturers use the right materials during classroom transactions" and "Lecturers are knowledgeable about the implementation processes", had means greater than 3.5 but less than 4.2, which shows that most respondents agree. This indicates that the respondents mostly agree that the right procedures are being implemented towards curriculum implementation. Implementing the curriculum is a crucial, challenging, and essential stage of the curriculum (Karakuş, 2021).

IV. HYPOTHESIS TESTING

Null Hypothesis: There exists no significant relationship between the male and female pre-service teachers' responses concerning curriculum design, development and implementation of the TEUs of the TEUs.

The scores of the curriculum design, development and implementation obtained from the responses of the whole sample ((329 (male: 275, Female: 54)) of the pre-service teachers were tabulated and used to find out the Mann Whitney U test between the responses of the male and female pre-service teachers. Table 4.28 shows the results of the analyses.

Table 4.28: Results of Mann-Whitney U Test for Male and Female Pre-Service Teachers' Responses on Curriculum Design, Development and Implementation

Statistics	Score	Means	Effect Size	Verbal Interpretation
Mann-Whitney U	6579.500	Male = 3.49	0.073	Accept the null hypothesis (The significant level is 0.05)
Wilcoxon W	44529.500	Female = 3.61		
Z	-1.324			
Asymp. Sig. (2-tailed)	0.186			

From Table 4.28, the asymptotic significance (2-tailed) p -value obtained from the analysis between the male and female pre-service teachers' responses on academic standards is 0.186 ($U = 6579.500, Z = -1.324, Effect Size = 0.073$), at a significant level of 0.05. This is an indication that there is no significant difference between the perceptions of the male and female pre-service teachers on curriculum design, development, and implementation of the MEPs of the TEUs, with an effect size of 0.073, which indicates limited practical significance.

A mean Male (3.49) indicates responses from males generally lean between "Neutral" and "Agree," reflecting a moderately positive response and a mean Female (3.61) indicates responses from females tend toward "Agree," indicating a slightly more positive response than males.

V. HYPOTHESIS TESTING

Null Hypothesis: There exists no significant relationship between the pre-service teachers of CKT-UTAS, UCC, and UEW's responses concerning the curriculum design, development and implementation of the MEPs of the TEUs.

The scores of the curriculum design, development and implementation obtained from the responses of the whole sample ((329 (CKT-UTAS: 23, UCC: 150, UEW: 156)) of the pre-service teachers were tabulated and used to find out the Kruskal test between the responses of CKT-UTAS, UCC and UEW pre-service teachers. Table 4.29 shows the results of the analyses.

Table 4.29: Results of Kruskal-Wallis H Test for of CKT-UTAS, UCC, and UEW Pre-Service Teachers' Responses on Curriculum Design, Development and Implementation

Statistic	Score	Means	Effect Size	Verbal Interpretation
Chi-Square	7.707	CKT-UTAS = 3.36	0.13	Reject the Null Hypothesis
df	2	UCC = 3.62		
Asymp. Sig	0.021	UEW = 3.56		

From Table 4.29, the Kruskal-Wallis H test shows that there is a statistically significant difference between the responses of the pre-service teachers from CKT-UTAs, UCC and UEW concerning the curriculum design, development and implementation of the MEPs of the TEUs, $\chi^2(2) = 7.707$, $p = 0.021$ at a significant level of 0.05. This indicates that the perceptions of the pre-service teachers from the three universities about the curriculum design, development and implementation are different. At an effect size of 0.13, the effect is small and practically has limited significance.

A mean of CKT-UTAS (3.36) indicates the responses lean toward "Neutral" to "Agree," reflecting moderately positive responses but less favourable than other institutions, with UCC (3.62) indicating their responses leaning toward "Agree," indicating a stronger positive response compared to CKT-UTAS and UEW (3.56) falling between CKT-UTAS and UCC, showing positive responses closer to "Agree."

4.5.2 Teacher educators' responses on the Curriculum Design, Development and Implementation of the MEPs

Below are the analyses of the responses of the participants (teacher educators) to curriculum design, development, and implementation of the MTEPs in the TEUs of Ghana. The analyses are categorised into Curriculum Design, Curriculum Development and Curriculum Implementation. Table 4.30 represents the teacher educators' responses on Curriculum Design in frequencies and means.

Table 4.30: Responses of Teacher Educators' on Curriculum Design (Frequencies and Means)

Sr No.	Statement	SD Freq.	D Freq.	UN Freq.	A Freq.	SA Freq.	Mean
1	Teacher Educators are not involved in the designing of the curriculum	5	11	6	5	1	2.5
2	Experts from other Institutions are invited to contribute to the design process	6	11	5	3	3	2.5
3	Current/international trends in Mathematics Teacher Education are considered in the design process	0	1	2	17	8	4.14
4	The curriculum is designed to reflect the national aims of mathematics education.	0	0	4	13	11	4.25
5	Priority is given to the academic standards of the programme	1	1	1	16	9	4.11
6	There are no measures enshrined in the curriculum to ensure that the academic standards are upheld	4	17	2	5	0	2.29
7	Essential concepts such as ICT integration are highly considered in the design process	0	2	0	18	8	4.14
8	The key skills to be acquired are highly regarded in the design process	0	2	1	20	5	4
9	The curriculum is designed to meet the quality standards of Higher Education regulation bodies of Ghana	0	0	0	15	13	4.46

The percentages of the frequencies of the responses on Curriculum Design are presented in the following stacked bar chart (Figure 4.21).

Figure 4.21: Responses of Teacher Educators on Curriculum Design (Percentages)

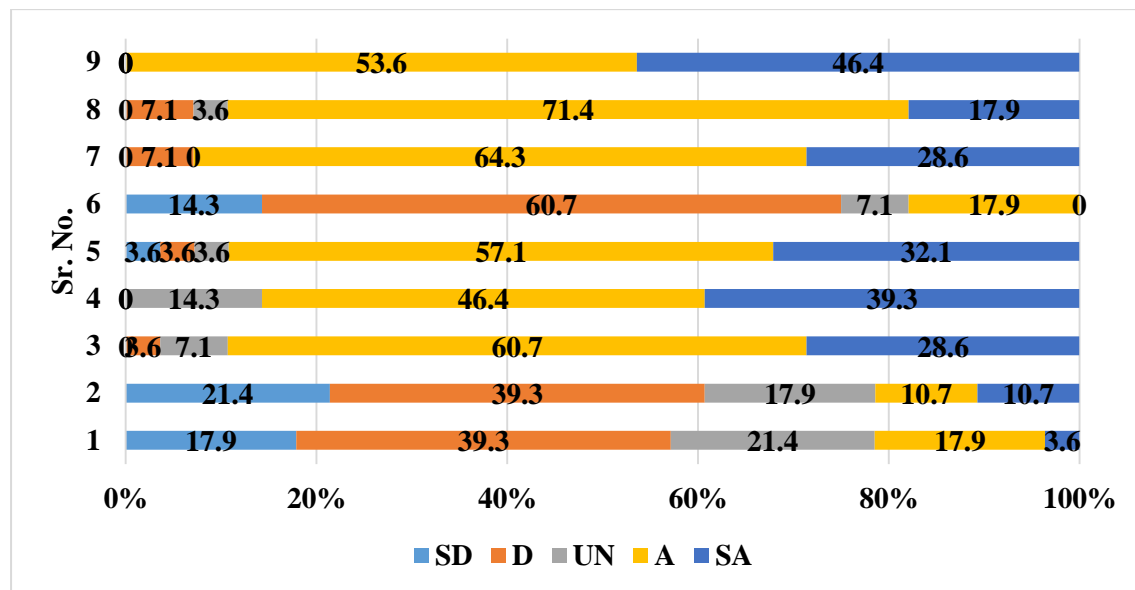


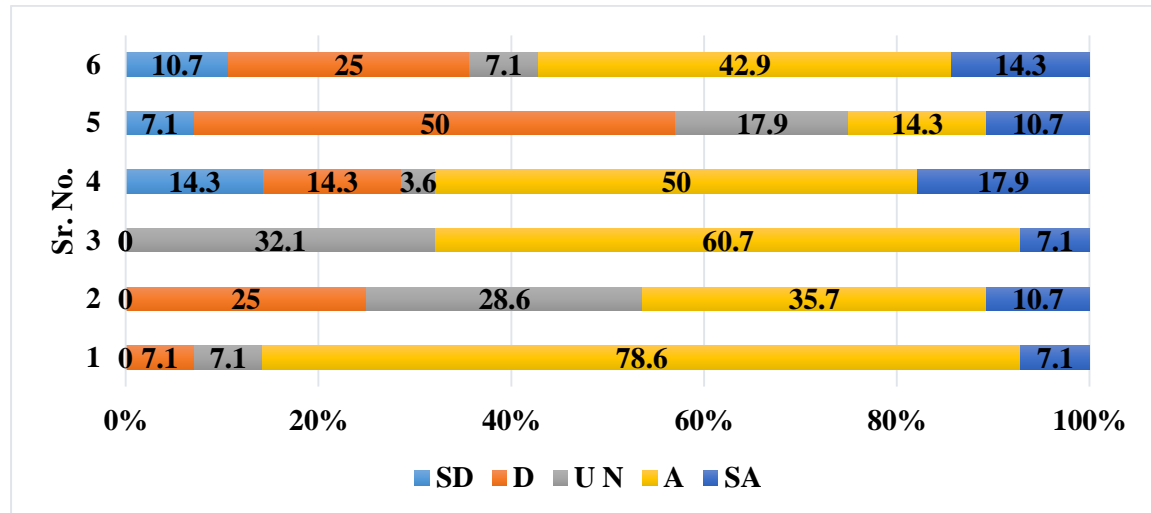
Table 4.30 and Figure 4.21 represent the participants' (Teacher educators') responses on issues concerning the curriculum design of the MEPs of the TEUs of Ghana. Table 4.30 shows that the respondents are generally okay with the design of the curriculums. From the responses, the statements "Teacher Educators are not involved in the designing of the curriculum" and "Experts from other Institutions are invited to contribute to the design process" had a mean of 2.50 each, indicating that most respondents disagreed with them. This reveals that teacher educators are involved in the curriculum design, and no experts are invited to the design process. The teacher educators in the MEPs of the TEUs are experts in their field, which might be why they will not need to invite other experts for the curriculum design process. Since curriculum is the tool for students' development and teachers serve as a mediator between curriculum and students, teachers must be involved as they know the different demands of students and those of educational institutions, businesses, and parents (Jadhav and Patankar, 2013). Also, the curriculum focuses on academic standards, as seen in Table 4.30; the statement "There are no measures enshrined in the curriculum to ensure that the academic standards are upheld" had a mean of 2.29, indicating that most respondents disagree. All other positive statements towards the curriculum design were agreed or strongly agreed to by the participants, with the statements having a mean of at least 4.0. Table 4.31 represents the teacher educators' responses on Curriculum Development in frequencies and means.

Table 4.31: Responses of Teacher Educators on Curriculum Development (Frequencies and Means)

Sr No.	Statement	SD	D	UN	A	SA	Mean
		Freq.	Freq.	Freq.	Freq.	Freq.	
1	The curriculum is regularly updated to meet current trends	0	2	2	22	2	3.86
2	Curriculum experts are occasionally invited to assess the curriculum	0	7	8	10	3	3.32
3	The curriculum is compared to the international community and upgraded to meet international standards to enable graduates to compete on the global stage	0	0	9	17	2	3.75
4	Graduates of the programme are not in any way consulted for their inputs based on their field practising experience in the development process	4	4	1	14	5	3.43
5	The curriculum seldom goes through any evaluation to ensure it is achieving the intended goals	2	14	5	4	3	2.71
6	Other stakeholders outside the institution, such as educational directors and head teachers, are occasionally asked about their assessment of the products of the programme for curriculum improvement	3	7	2	12	4	3.25

The percentages of the frequencies of the responses on Curriculum Development are presented in the following stacked bar chart (Figure 4.22).

Figure 4.22: Responses of Teacher Educators on Curriculum Development
(Percentages)



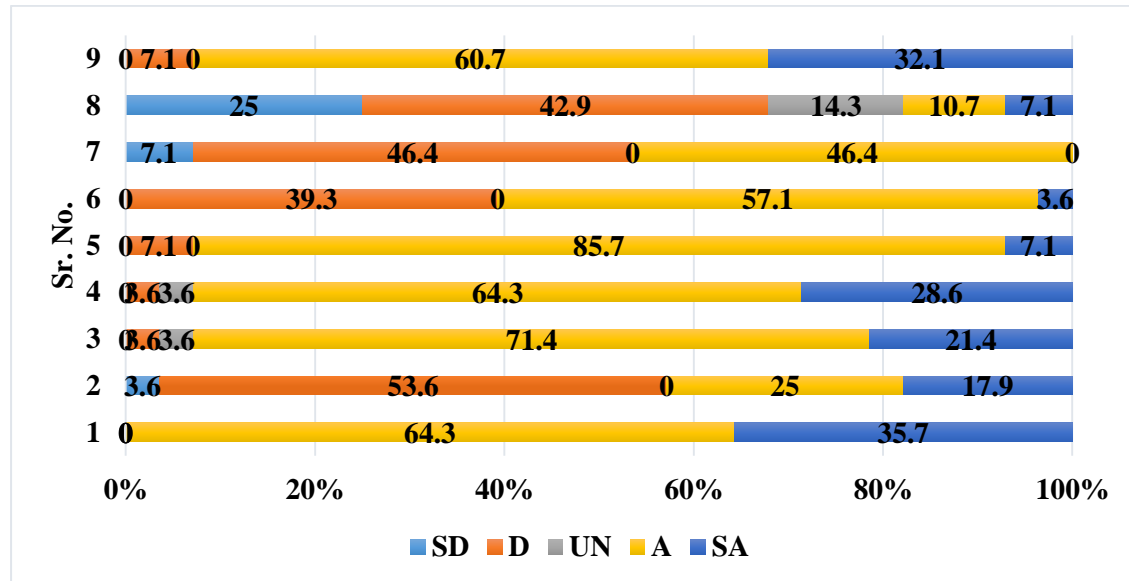
On curriculum development, as shown in Tables 4.31 and Figure 4.22, the statements "The curriculum is regularly updated to meet current trends" and "The curriculum is compared to the international community and upgraded to meet international standards to enable graduates to compete on the global stage" had means of 3.86 and 3.75, respectively. This indicates that most participants agree with the two statements, meaning the curriculum is updated regularly to meet current demands. The statement "the curriculum seldom goes through any evaluation to ensure it is achieving the intended goals" had a mean of 2.71, meaning most participants were undecided. Also, 14(50.0%) disagree with the statement. Teachers must be involved in the development process for the curriculum and educational institutions to succeed (Alsubaie, 2016). The curriculum development should have the following descriptions: planned and systematic, inclusive and consultative, led by curriculum professionals, cyclical in nature and sustainable (Stabback, 2016, p 10). Table 4.32 represents the teacher educators' responses on Curriculum Implementation in frequencies and means.

Table 4.32: Responses of Teacher Educators on Curriculum Implementation (Frequencies and Means)

Sr No.	Statement	SD	D	UN	A	SA	Mean
		Freq.	Freq.	Freq.	Freq.	Freq.	
1	Teacher Educators possess the necessary qualifications and skills to implement the curriculum.	0	0	0	18	10	4.37
2	There is a lack of the necessary materials for classroom curriculum implementation	1	15	0	7	5	3
3	A suitable learning space that supports student understanding of the key skills, concepts, and soft skills is provided	0	1	1	20	6	4.11
4	Emphasis is placed on correct evaluation processes	0	1	1	18	8	4.18
5	The role and style of assessment are defined for measuring the intended skills	0	2	0	24	2	3.93
6	There is a lack of supervision to ensure the appropriate methodologies are used for classroom transaction	0	11	0	16	1	3.25
7	Students are regularly allowed to appraise Teacher Educators' methods	2	13	0	13	0	2.86
8	Teacher educators regularly meet to discuss teaching and learning processes	7	12	4	3	2	2.32
9	Feedback on pre-service teachers' performance is prioritised	0	2	0	17	9	4.18

The percentages of the frequencies of the responses on Curriculum Implementation are presented in the following stacked bar chart (Figure 4.23).

Figure 4.23: Responses of Teacher Educators on Curriculum Implementation
(Percentages)



With respect to the implementation of the curriculum, as shown in Table 4.32 and Figure 4.23, it is evident from the responses that the teacher educators are positive about that. Statements including "Teacher Educators possess the necessary qualifications and skills to implement the curriculum", "Emphasis is placed on correct evaluation processes", "A suitable learning space that supports student understanding of the key skills, concepts, and soft skills is provided" and "Feedback on pre-service teachers' performance is prioritised" with means of at least 4.0 indicating that majority of the respondents agree to these statements. In order to guarantee that the intended outcomes will be realised, curriculum implementation demands a certain level of dedication from the teachers (Palestina et al., 2020). The author further stipulated that Curriculum implementation is the process of putting the curriculum's design into practice in a classroom, signifying the importance of the implementation process. 15 (53.3%) disagreed or strongly disagreed with the statement "Students are regularly allowed to appraise Teacher Educators' methods", and 19 (67.9%) disagreed or strongly disagreed with the statement "Teacher educators regularly meet to discuss teaching and learning processes". This indicates that collaboration among teacher educators is minimal, and most participants say students are not regularly allowed to appraise the performance of teacher educators. If teachers receive the proper kind of support in the form of constructive criticism, they can significantly alter the quality of the entire educational system (Pandey, 2021).

VI. HYPOTHESIS TESTING

Null Hypothesis: There exists no significant relationship between the male and female teachers and educators' responses concerning curriculum design, development, and implementation in the MEPs of the TEUs.

The scores of the curriculum design, development and implementation obtained from the responses of the whole sample of ((28 (male: 23, Female: 5)) of the teacher educators were tabulated and used to find out the Mann Whitney U test between the responses of the male and female teacher educators. Table 4.33 shows the results of the analyses.

Table 4.33: Results of Mann-Whitney U Test for Male and Female Teacher Educators' Responses on Curriculum Design, Development and Implementation

Statistics	SCORE	Mean	Effect Size	Verbal Interpretation
Mann-Whitney U	57.000	Male = 3.49	0.06	Accept the null hypothesis (The significant level is 0.05)
Wilcoxon W	72.000	Female = 3.61		
Z	-0.30			
Asymp. Sig. (2-tailed)	0.976			

From Table 4.33, the asymptotic significance (2-tailed) p -value obtained from the analysis between the male and female teacher educators' responses on curriculum design, development, and implementation is 0.976 ($U = 57.00$, $Z = -0.30$, Effect Size = 0.06) at a significant level of 0.05. This is an indication that there is no significant difference between the perceptions of male and female teacher educators on curriculum design, development and implementation in the MEPs of the TEUs at a small effect size (0.06), indicating limited practical application.

A mean Male (3.49) indicates the responses from males leaning between "Neutral" and "Agree," indicating moderately positive responses, and Female (3.61)

indicates the responses from females lean slightly more towards "Agree," reflecting a somewhat higher positive response compared to males.

4.6 Academic Leadership Practices

The respondents were asked questions concerning the academic leadership practices of the MEPs of the TEUs. The analyses of the data on academic leadership practices have been presented in this section.

4.6.1 Teacher educators' responses on the Academic Leadership Practices of the MEPs

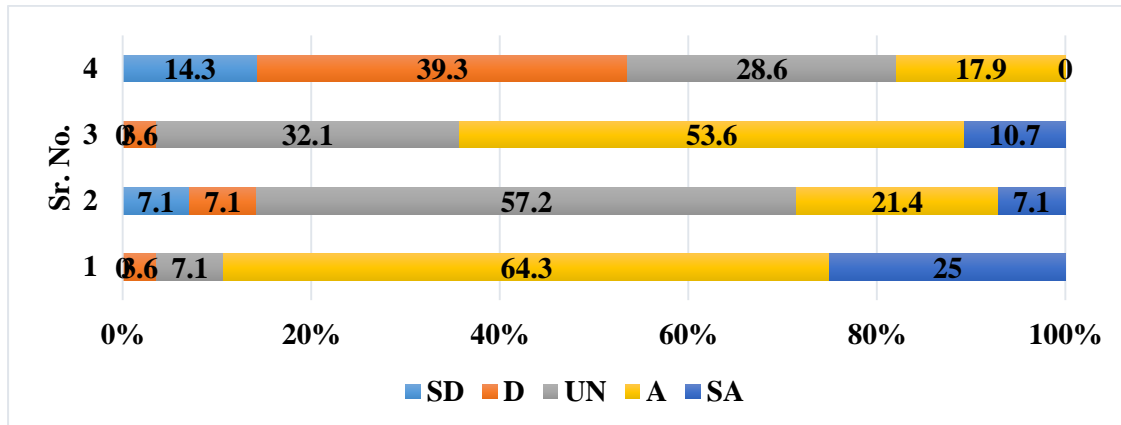
The analyses of the responses of the participants (teacher educators) on the academic leadership practices of the MTEPs in the TEUs of Ghana are outlined below. The analyses have been categorized into four (4): knowledge of leadership, leadership experience, relationship, and professionalism. Table 4.34 represents the teacher educators' responses to Knowledge of Leadership in frequencies and means.

Table 4.34: Responses of Teacher Educators on Knowledge of Leadership (Frequencies and Means)

Sr. No.	Statement	SD Freq.	D Freq.	UN Freq	A Freq.	SA Freq.	Mean
1	Leaders demonstrate positive and high expectations	0	1	2	18	7	4.11
2	Leaders successfully handle conflicts	2	2	16	6	2	3.14
3	Leaders are always up to date with new developments in the field of Mathematics Teacher Education	0	1	9	15	3	3.71
4	Leaders depict signs of lack of knowledge in some situations	4	11	8	5	0	2.50

The percentages of the frequencies of the responses on Knowledge of Leadership are presented in the following stacked bar chart (Figure 4.24).

Figure 4.24: Responses of Teacher Educators on Knowledge of Leadership
(Percentages)



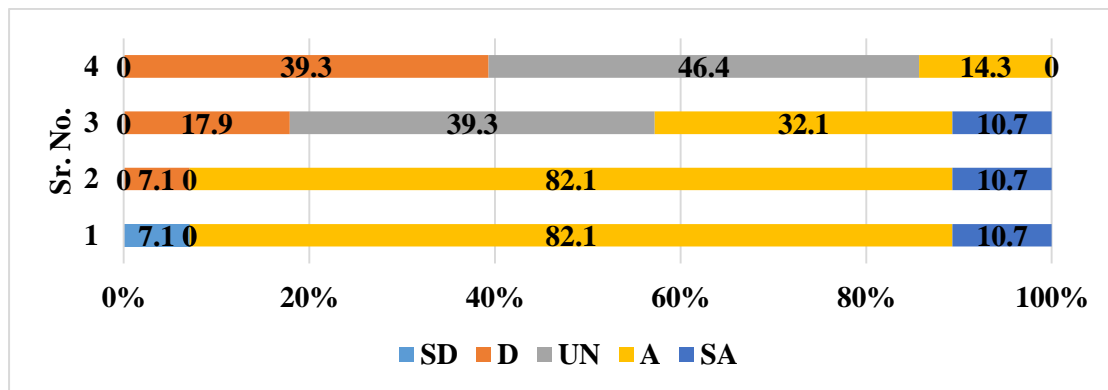
From Table 4.34 and Figure 4.24, on “Knowledge of Leadership”, the statement “Leaders depict signs of lack of knowledge in some situations” had a mean of 2.50, depicting that most respondents were undecided. Though this is the situation, 15 (53.6%) of the responses fall between strongly disagree and disagree. This means the respondents view leadership as knowledgeable enough for their positions. Also, most respondents agree with the statement “Leaders demonstrate positive and high expectations”, with a mean of 4.11 and 18(64.3%) responding to agree with the statement. This shows how respondents rate leadership highly based on their expectations. Education leadership is more significant than other leadership philosophies in the marketplace since educational leaders directly impact students' performances, influencing the nation's market performance (Toker, 2022). Table 4.35 represents the teacher educators' responses on Leadership Experience in frequencies and means.

Table 4.35: Responses of Teacher Educators on Leadership Experience (Frequencies and Means)

Sr. No.	Statement	SD Freq.	D Freq.	UN Freq.	A Freq.	SA Freq.	Mean
1	Leaders generally are aware of all processes involved in the training of pre-service teachers	2	0	0	23	3	3.89
2	Leaders are experienced and have the necessary qualifications as depicted by institutional rules and regulations	0	2	0	23	3	3.96
3	Leaders have enough leadership training and act accordingly, always	0	5	11	9	3	3.36
4	Some leaders lack the required experience a leader should exhibit	0	11	13	4	0	2.75

The percentages of the frequencies of the responses on Leadership Experience are presented in the following stacked bar chart (Figure 4.25).

Figure 4.25: Responses of Teacher Educators on Leadership Experience (Percentages)



Regarding leadership experience, as shown in Table 4.35 and Figure 4.24, the respondents depicted that the leaders are experienced enough. Most respondents agree with the statements “Leaders generally are aware of all processes involved in the training of pre-service teachers” and “Leaders are experienced and have the necessary qualifications as depicted by institutional rules and regulations”, with means of 3.89 and 3.96, respectively. The respondents were undecided concerning the statement “Some leaders lack the required experience a leader should exhibit”, with a mean of 2.75, but 11(39.3%) of the respondents disagreed with the statement, with 4(14.3%) agreeing, meaning most of the respondents are positive regarding the experience of

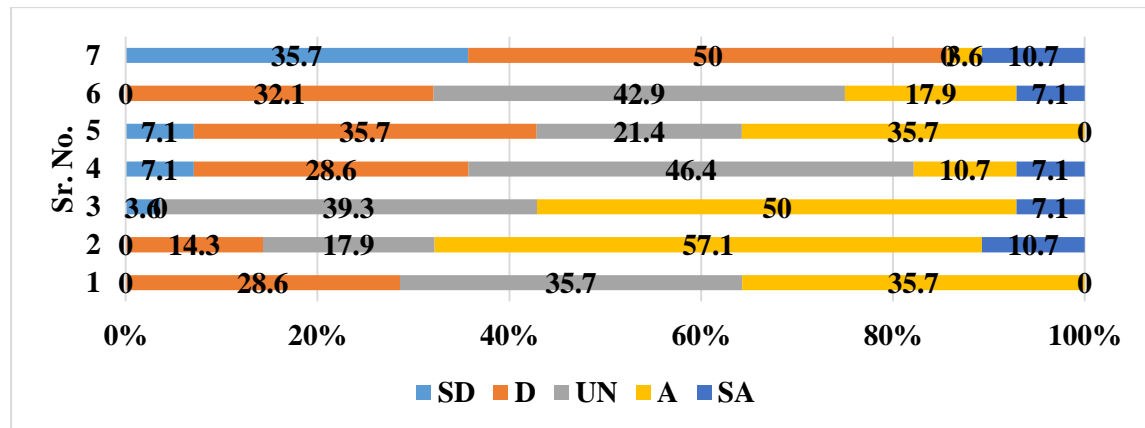
leadership. Academic leaders are expected to make more important daily decisions that influence their institutions' futures (Dumulescu and Muțiu, 2021). Table 4.36 represents the teacher educators' responses on Leadership Relationships in frequencies and means.

Table 4.36: Responses of Teacher Educators on Leadership Relationship

Sr. No.	Statement	SD Freq.	D Freq.	UN Freq.	A Freq.	SA Freq.	Mean
1	Leadership models the values and behaviours that support pre-service teacher and Teacher Educator achievements and collaboration at all levels	0	8	10	10	0	3.07
2	The necessary measures are in place to encourage collaborative leadership and decision-making	0	4	5	16	3	3.64
3	Leaders support creativity, innovation, and appropriate risk-taking in the course of meeting pre-service teachers' needs	1	0	11	14	2	3.57
4	All people are treated equitably by leaders in all situations.	2	8	13	3	2	2.82
5	Leaders treat all members with dignity and respect	2	10	6	10	0	2.86
6	Leaders give members lots of appreciation and support for their contribution	0	9	12	5	2	3.00
7	Leaders treat pre-service teachers with no respect	10	14	0	1	3	2.04

The percentages of the frequencies of the responses on Leadership Relationships are presented in the following stacked bar chart (Figure 4.26).

Figure 4.26: Responses of Teacher Educators on Leadership Relationship



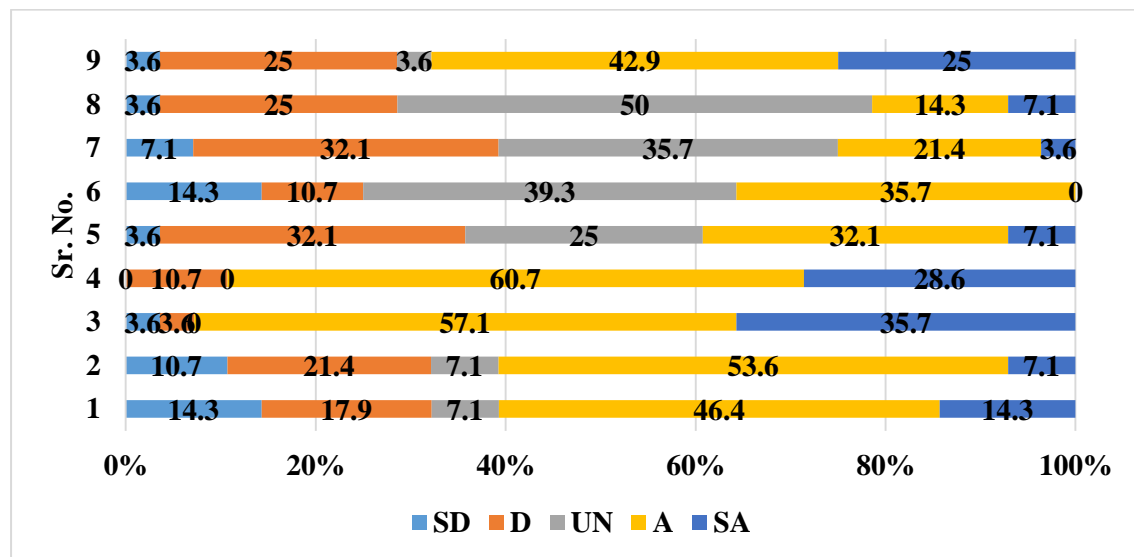
According to the participant's responses on leadership relationships from Table 4.36 and Figure 4.26, though there is an agreement concerning leaders encouraging collaboration, there is no clear decision regarding equality and respect in the treatment of members. Most of the participants agree with the statement “The necessary measures are in place to encourage collaborative leadership and decision-making” with a mean of 3.64, whilst the statement “All people are treated equitably by leaders in all situations” and “Leaders treat all members with dignity and respect” had means of 2.82 and 2.86 respectively. Also, 10(35.7%) disagreed, 10(35.7%) agreed, and 6(21.4%) were undecided with the statement “Leaders treat all members with dignity and respect”. This shows that there was no clear decision regarding equality, respect, and dignity of the treatment of members. The leaders of educational institutions must have a helpful attitude and ensure that every member has equal rights and possibilities (Kapur, 2021). Table 4.37 represents the teacher educators' responses on Leadership Professionalism in frequencies and means.

Table 4.37: Responses of Teacher Educators on Leadership Professionalism (Frequencies and Means)

Sr. No.	Statement	SD	D	UN	A	SA	Mean
		Freq.	Freq.	Freq.	Freq.	Freq.	
1	I am content with the process of selecting leaders for my institution	4	5	2	13	4	3.29
2	All qualified Teacher Educators are given equal opportunities during the selection process	3	6	2	15	2	3.25
3	The leadership selection process is spelt out in the regulations of the institution	1	1	0	16	10	4.18
4	Institutional goals are clearly spelt out	0	3	0	17	8	4.07
5	Leaders pay attention to the academic needs of all members	1	9	7	9	2	3.07
6	When new responsibilities are issued, leadership understands the need to “take things off the plate” and takes appropriate action. People are free to let go of previous obligations.	4	3	11	10	0	2.96
7	Leaders readily accept constructive criticisms	2	9	10	6	1	2.82
8	Leaders establish rules and live by them consistently	1	7	14	4	2	2.96
9	The leadership selection process is followed as stipulated in the regulations of the institution	1	7	1	12	7	3.61

The percentages of the frequencies of the responses on Leadership Professionalism are presented in the following stacked bar chart (Figure 4.27).

Figure 4.27: Responses of Teacher Educators on Leadership Professionalism



As shown in Table 4.37 and Figure 4.27, the professionalism aspect of leadership seems a little not the best; this is because the respondents, according to the statements, show that equal opportunity when it comes to the selection of leaders is not as it should be. Means of 3.29 and 3.25, respectively, for the statements “I am content with the process of selecting leaders for my institution” and “All qualified Teacher Educators are given equal opportunities during the selection process” indicate that the respondents are not certain of the statements. 9(32.1%) participants disagree or strongly disagree with both statements. This means there is doubt regarding the professionalism of the leadership selection process. Since leadership is the foundation of educational institutions' sustainability, practitioners have understood its critical importance (Effah and Osei-Owusu, 2013). The right people must be chosen to lead. The responses also indicate that the institutions' regulations spell out the processes for selecting leaders. The statements “The leadership selection process is spelt out in the institution's regulations” and “Institutional goals are clearly spelt out”, accumulating means of 4.18 and 4.07, respectively, show that the institutions' regulations elaborate the necessary procedures for leadership selection. It must be noted that a substantial number of the respondents believe that the leadership processes are followed as expected. The statement “The leadership selection process is followed as stipulated in the institution's regulations”, with a mean of 3.61 and a percentage of 19(67.9%) of the responses between agree and strongly agree, is evidence of this fact. In the complex climate of today's higher education, exceptional leadership makes the

difference between schools that barely scrape by and those that can genuinely thrive (Ruben et al., 2022).

VII. HYPOTHESIS TESTING

Null Hypothesis: There exists no significant relationship between the male and female teacher educators' responses concerning academic leadership in the MEPs of the TEUs.

The scores of the academic leadership obtained from the responses of the whole sample of ((28 (male: 23, Female: 5)) teacher educators were tabulated and used to find out the Mann-Whitney U test between the responses of the male and female teacher educators. Table 4.38 shows the results of the analyses.

Table 4.38: Results of Mann-Whitney U Test for Male and Female Teacher Educators' Responses on Academic Leadership Practices

Statistics	SCORE	Means	Effect Size	Verbal Interpretation
Mann-Whitney U	57.000	Male = 3.40	0.06	Accept the null hypothesis (The significant level is 0.05)
Wilcoxon W	72.000	Female = 3.43		
Z	-0.30			
Asymp. Sig. (2-tailed)	0.976			

From Table 4.38, the asymptotic significance (2-tailed) p -value obtained from the analysis between the male and female teacher educators' responses on academic leadership is 0.976 ($U = 57.00$, $Z = -0.30$, Effect Size = 0.06) at a significant level of 0.05. This is an indication that there is no significant difference between the perceptions of male and female teacher educators concerning academic leadership in the MEPs of the TEUs at an effect size of 0.06, indicating limited practical applications.

A mean Male (3.40) indicates responses from males tending to fall between "Neutral" and "Agree," indicating a moderately positive perception, and Female (3.43) indicates responses from females are very similar, also falling between

"Neutral" and "Agree," reflecting a comparable moderately positive perception to that of males.

4.7 Learning Culture of the MEPs of the TEUs of Ghana

The participants (pre-service teachers) were asked questions concerning the learning culture of the MEPs of the TEUs. The analysis of the data on learning culture is presented in this section.

4.7.1 Pre-service teachers' responses on the Learning Culture of the MEPs

The participants (pre-service teachers) were asked questions concerning the learning culture of the MEPs. The participants' responses were analysed in the order of learning culture before, during, and after class. Table 4.39 represents the preservice teachers' responses to Learning Culture Before Class in frequencies and means.

Table 4.39: Responses of Pre-Service Teachers on Learning Culture Before Class (Frequencies and Means)

Sr. No	Statement	SD Freq.	D Freq.	UN Freq.	A Freq.	SA Freq.	Mean
1	The institution has a conducive teaching-learning environment	22	50	28	142	87	3.67
2	Students never discuss concepts in groups before class	82	99	49	65	34	2.6
3	Lecturers report early to class	11	47	35	158	78	3.74
4	Students visit the library before class	16	59	89	122	43	3.36
5	Lecturers hardly recommend reading materials as a reference before lessons	72	106	32	77	42	2.73

The percentages of the frequencies of the responses on Learning Culture Before Class are presented in the following stacked bar chart (Figure 4.28).

Figure 4.28: Responses of Pre-Service Teachers on Learning Culture before Class
(Percentages)

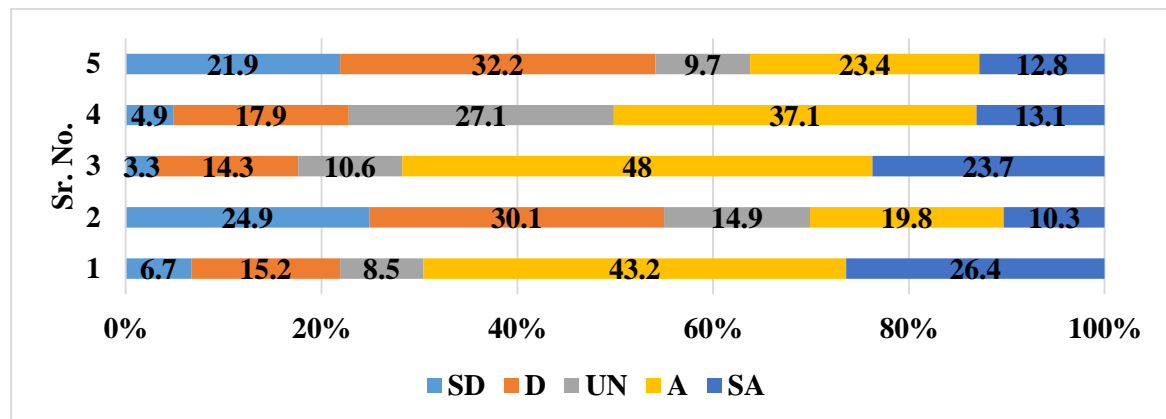


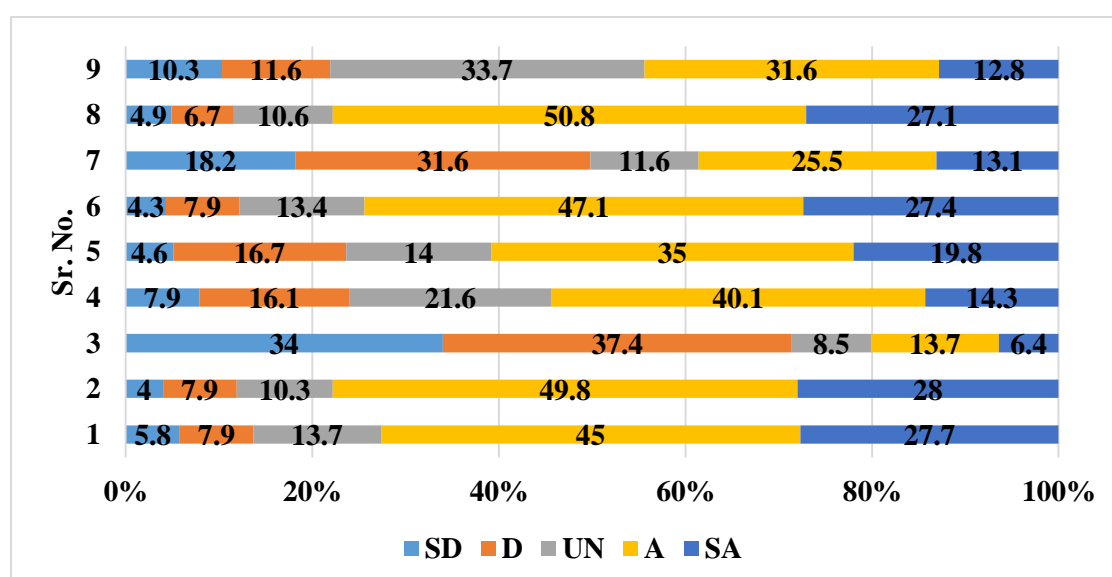
Table 4.39 and Figure 4.28 show that the respondents agree that lecturers recommend materials to students. Although a mean of 2.7 indicates most of the respondents were undecided, 178 (54.1%) disagree or strongly disagree with the statement "Lecturers hardly recommend reading materials as a reference before lessons". 227 (69.6%) of the participants agree or strongly agree that there is a conducive environment for teaching and learning. In addition to retaining students motivated and active in the classroom setting, a conducive learning environment fosters convenience in both teaching and learning (Puteh et al., 2015). Most participants also agree that teacher educators go to class early with the statement "Lecturers report early to class," with a mean of 3.74, whilst 119 (50.2%) agree that students visit the library before lessons. Libraries are crucial to students' academic performance and achievement because they offer a trustworthy and valuable source of knowledge (e Rodrigues and Mandrekar, 2020). Table 4.40 represents the preservice teachers' responses to the Learning Culture During Class in frequencies and means.

Table 4.40: Responses of Pre-Service Teachers on Learning Culture During Class (Frequencies and Means)

Sr. No	Statement	SD Freq.	D Freq.	UN Freq.	A Freq.	SA Freq.	Mean
1	Lecturers encourage students to evaluate their learning	19	26	45	148	91	3.81
2	Activities for an academic semester are followed as communicated at the beginning of the semester	13	26	34	164	92	3.9
3	Objectives of lessons are not communicated	112	123	28	45	21	2.21
4	Teacher Educators invest time in discussing students' performance	26	53	71	132	47	3.37
5	Computer labs are regularly made available to students for ICT integration	48	55	46	115	65	3.29
6	Lecturers are competent in the achievement of programme objectives	14	26	44	155	90	3.85
7	Lecturers teach with less passion	60	104	38	84	43	2.84
8	Students collaborate during academic activities	16	22	35	167	89	3.88
9	Lecturers invite staff from other departments during interdisciplinary activities	34	38	111	104	42	3.25

The percentages of the frequencies of the responses on Learning Culture During Class are presented in the following stacked bar chart (Figure 4.29).

Figure 4.29: Responses of Pre-Service Teachers on Learning Culture during Class (Percentages)



The culture during class is favourable, judging by the participants' responses in Table 4.40 and Figure 4.29. Statements including "Lecturers encourage students to evaluate their learning", "Lecturers are competent in the achievement of program objectives", and "Students collaborate during academic activities" had means of at least 3.8, indicating that the participants agree to the statements. "Lecturers teach with less passion" had a mean of 2.8, falling within the undecided category, but 164 (49.8%) of the respondents disagreed or strongly disagreed with the statement. The responses show cooperation among students and teacher educators, competency in the classroom, and passion for teaching. Acknowledging the indoor school environment as a variable that can positively impact student experiences entails assuming that this environment can be created to enhance student learning and instruction, potentially improving student achievement in the classroom (Choi et al. 2014). Table 4.41 represents the preservice teachers' responses to Learning Culture After Class in frequencies and means.

Table 4.41: Responses of Pre-Service Teachers on Learning Culture After Class (Frequencies and Means)

Sr. No	Statement	SD Freq.	D Freq.	UN Freq.	A Freq.	SA Freq.	Mean
1	There is enough administrative personnel to meet the academic needs of students	37	52	74	123	43	3.25
2	Lecturers make themselves available to assist students with their academic challenges	33	40	53	140	63	3.49
3	Feedback on assignments and quizzes delay	55	94	53	86	41	2.89
4	Students are mostly loaded with assignments	12	73	45	126	73	3.53
5	There are enough Lecturers to meet the academic needs of students	27	58	41	131	67	3.47
6	Students and Lecturers have cordial relationships	16	30	52	168	63	3.71
7	Group discussion is discouraged after lessons	108	82	26	72	41	2.56
8	Students learn more outside the classroom	13	24	34	143	115	3.98

The percentages of the frequencies of the responses on Learning Culture After Class are presented in the following stacked bar chart (Figure 4.30).

Figure 4.30: Responses of Pre-Service Teachers on Learning Culture after Class (Percentages)

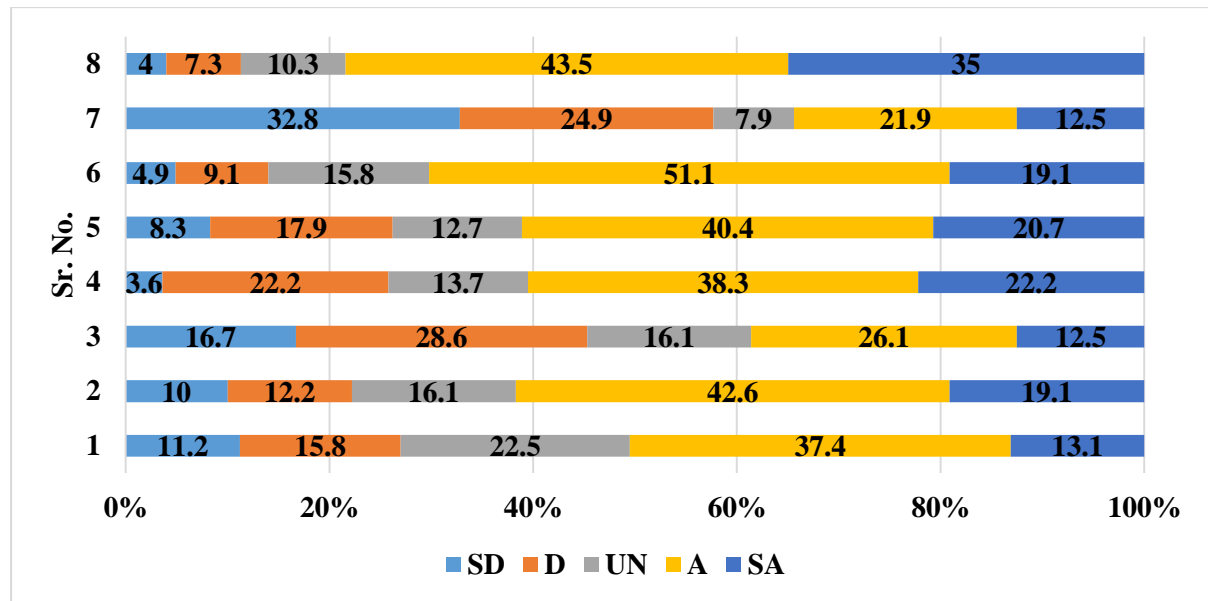


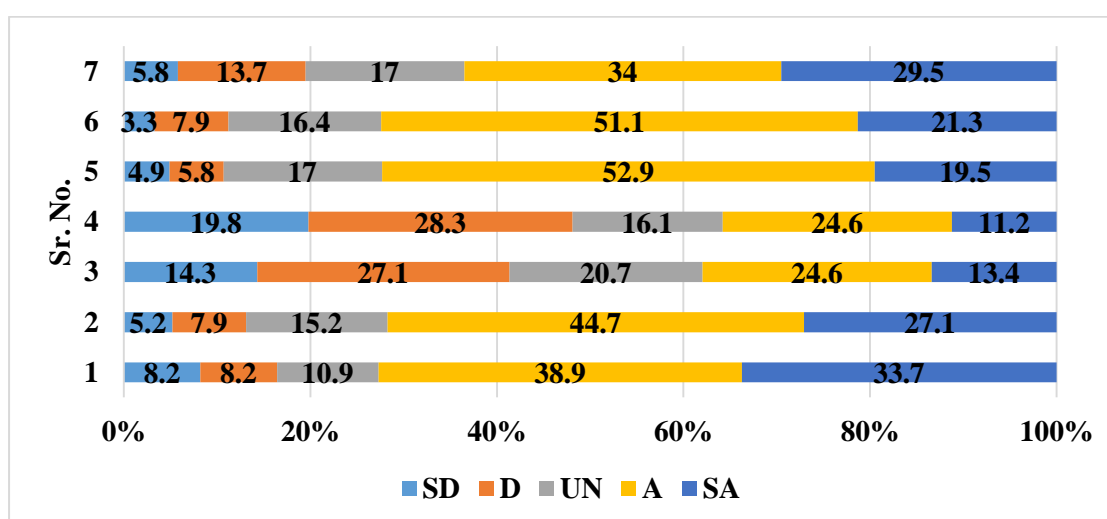
Table 4.41 and Figure 4.30 present the participants' responses concerning the learning culture of the TEUs' MTEPs after class. The responses show that the students learn more after class, and there is encouragement towards group studies. The statements "Students learn more outside the classroom" and "Group discussion is discouraged after lessons" have means of 3.98 and 2.56, respectively, which is a testament to that. The participants agree that there are enough lecturers in the MTEPs, and most agree that teacher educators make themselves available to assist students. The statement "Feedback on assignments and quizzes delay" had a means of 2.89, an indication that the majority of the participants were undecided about the statement; 149 (45.3%) and 127(38.6%) disagreed or strongly disagreed and agreed or strongly agreed respectively with the statement. Many variables, both inside and outside the classroom, impact teaching and learning while also influencing the context (Kirkebæk et al., 2013). Table 4.42 represents the preservice teachers' responses on the Learning Culture During Examination in frequencies and means.

Table 4.42: Responses of Pre-Service Teachers on Learning Culture During Examination (Frequencies and Means)

Sr. No	Statement	SD	D	UN	A	SA	Mean
		Freq.	Freq.	Freq.	Freq.	Freq.	
1	Students are advised to learn for professional development rather than for examination marks	27	27	36	128	111	3.82
2	Evaluation activities are mostly valid and measure students' performance	17	26	50	147	89	3.81
3	Examinations are organised in a somewhat intimidating environment	47	89	68	81	44	2.96
4	Assessment criteria and timings are not communicated earlier to enhance students' preparation	65	93	53	81	37	2.79
5	Programme objectives are considered in the evaluation of students	16	19	56	174	64	3.76
6	Evaluation procedures are of different forms to meet all programme objectives	11	26	54	168	70	3.79
7	Students have a fear of failure in examinations	19	45	56	112	97	3.68

The percentages of the frequencies of the responses on Learning Culture During Examination are presented in the following stacked bar chart (Figure 4.31).

Figure 4.31: Responses of Pre-Service Teachers on Learning Culture during Examination (Percentages)



The participants' responses concerning the culture during examinations, as presented in Table 4.42 and Figure 4.29, show they are generally happy with events during examinations. All positive statements, including "Students are advised to learn for professional development rather than for examination marks", "Evaluation activities are mostly valid and measure students' performance", and "Evaluation procedures are of different forms to meet all program objectives", all had means of at least 3.7, which is an indication that majority of the participants agree with these statements. Since how well students learn is directly influenced by environmental comfort, it is possible to pinpoint the most advantageous environmental aspects of school buildings and take them into account while developing and erecting infrastructure for educational purposes (Villarreal Arroyo et al., 2023)

VIII. HYPOTHESIS TESTING

Null Hypothesis: There exists no significant relationship between the male and female pre-service teachers' responses concerning the learning culture of the MEPs of the TEUs.

The scores of the learning culture obtained from the responses of the whole sample ((329 (male: 275, Female: 54)) of the pre-service teachers were tabulated and used to find out the Mann-Whitney U test between the responses of the male and female pre-service teachers. Table 4.43 shows the results of the analyses.

Table 4.43: Results of Mann-Whitney U Test for Male and Female Pre-Service Teachers' Responses on Learning Culture

Statistics	SCORE	Means	Effect Size	Verbal Interpretation
Mann-Whitney U	6134.000	Male = 3.78	0.11	Reject the null hypothesis (significant level is 0.05)
Wilcoxon W	44084.000	Female = 3.94		
Z	-2.021			
Asymp. Sig. (2-tailed)	0.043			

From the table, the asymptotic significance (2-tailed) p -value obtained from the analysis between the male and female pre-service teachers' responses on learning culture is 0.043 ($U = 6134.00, Z = -2.021, Effect Size = 0.11$) at a significant level of 0.05. This is an indication that there is a significant difference between the perceptions of the male and female pre-service teachers' on the learning culture of the MEPs of the TEUs at an effect size of 0.11, indicating limited practical application.

A mean Male (3.78) indicates responses from males leaning toward "Agree," indicating a relatively positive perception, and Female (3.94) responses from females are slightly higher, leaning towards "Agree" to "Strongly Agree," reflecting a more positive perception compared to males.

IX. HYPOTHESIS TESTING

Null Hypothesis: There exists no significant relationship between the pre-service teachers of CKT-UTAS, UCC, and UEW's responses concerning the learning culture of the MEPs of the TEUs.

The scores of the learning culture obtained from the responses of the whole sample ((329 (CKT-UTAS: 23, UCC: 150, UEW: 156)) of the pre-service teachers were tabulated and used to find out the Kruskal test between the responses of CKT-UTAS, UCC and UEW pre-service teachers. Table 4.44 shows the results of the analyses.

Table 4.44: Results of Kruskal-Wallis H Test for CKT-UTAS, UCC, and UEW Pre-Service Teachers' Responses on Learning Culture

Statistic	Score	Means	Effect Size	Verbal Interpretation
Chi-Square	13.359	CKT- UTAS =3.31	0.19	Reject the Null Hypothesis
df	2	UCC = 3.66		
Asymp. Sig	0.001	UEW = 3.51		

From Table 4.44, the Kruskal-Wallis H test shows that there is a statistically significant difference between the responses of the pre-service teachers from CKT-UTAS, UCC and UEW concerning the learning culture of the MEPs of the TEUs,

$\chi^2(2) = 13.359$, $p = 0.001$ at a significant level of 0.05. This indicates that the perceptions of the pre-service teachers from the three universities about the learning culture are different. At an effect size of 0.19, the effect is small and practically has limited significance.

A mean CKT-UTAS (3.31) indicates responses are slightly below "Neutral," indicating a somewhat less favourable perception compared to the other institutions, with UCC (3.66) indicates responses from UCC are closer to "Agree," suggesting a more favourable perception compared to CKT-UTAS and UEW (3.51) responses from UEW are also above neutral, between "Neutral" and "Agree," reflecting a moderately positive perception.

4.8 Challenges Encountered in the Training of Pre-Service Teachers

The respondents were asked questions concerning the challenges of the MEPs of the TEUs. The analyses of the data on challenges have been presented in this section.

4.8.1 Pre-service teachers' responses on the challenges encountered in the MEPs

The respondents were asked about the challenges encountered in the Mathematics teacher education programmes. The participants' responses were analysed in order of academic, resource, welfare, and economic challenges. Table 4.45 represents the preservice teachers' responses to Academic Challenges in frequencies and means.

Table 4.45: Responses of Pre-Service Teachers on Academic Challenges (Frequencies and Means)

Sr. No.	Statement	SD Freq.	D Freq.	UN Freq.	A Freq.	SA Freq.	Mean
1	The institution does not have a conducive environment for teaching and learning	90	115	35	58	31	2.47
2	Lecturers do not utilise the right teaching-learning materials to enhance concept understanding	79	115	45	72	18	2.5
3	There are not enough Lecturers in my institution	68	101	47	78	35	2.73
4	Lecturers are not knowledgeable enough to handle the programmes' courses	145	103	30	34	17	2.01
5	Evaluation of students is biased	75	98	65	70	21	2.59
6	The curriculum content is not in agreement with the programme's objectives	95	122	55	44	13	2.26
7	It isn't easy securing a school for off-campus teaching practice (internship)	57	94	50	86	42	2.88
8	Supervision during internship on the side of mentors (school practising teachers) is not effective	81	113	43	57	35	2.55
9	Mentors are not trained and struggle to assist students during their internship	58	108	45	76	30	2.72
10	External supervision (supervision by institutional Lecturers) is not effective during internship (OCTP)	95	118	38	56	22	2.37
11	Lecture hours are too lengthy. Students find it challenging to concentrate throughout lectures	58	129	49	56	25	2.56
12	Evaluation processes do not match the programmes' objectives	77	141	41	50	20	2.38
13	There is a lack of cooperation with students from other departments, which is a challenge to cross-disciplinary studies	48	126	54	72	29	2.72
14	Absenteeism on the part of Lecturers is on a high and disrupts academic activities	93	121	51	51	0	2.19
15	Semester course outlines are mostly not completed due to disruptions such as strike actions	35	80	48	112	54	3.21
16	Extra-curricular activities are discriminated against	53	90	61	89	36	2.89
17	There is discrimination towards some students based on factors such as denomination, ethnic group, religion, etc., on the part of some lecturers	93	90	54	61	31	2.53

The percentages of the frequencies of the responses on academic challenges are presented in the following stacked bar chart (Figure 4.32).

Figure 4.32: Responses of Pre-Service Teachers on Academic Challenges (Percentages)

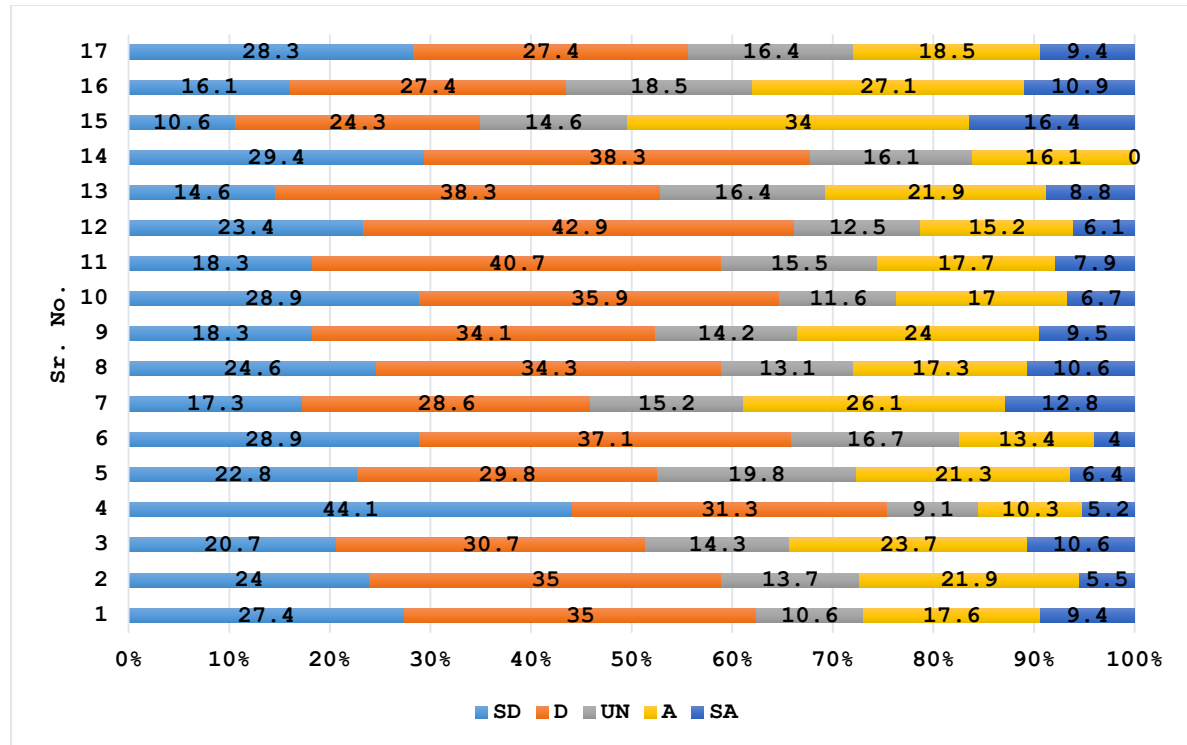


Table 4.45 and Figure 4.32 represent the participants' responses to the academic challenges pre-service teachers face in Ghana's MTEPs. The statement “Semester course outlines are mostly not completed due to disruptions such as strike actions” had a mean of 3.21, with 166 (50.4%) indicating that such situations disrupt academic activities. The responses indicated that the TEUs have a conducive learning environment. The responses show that most participants believe lecture durations are reasonable and help maintain attention span during lectures. The statement evidences this, “Lecture hours are too lengthy. Students find it challenging to concentrate throughout lectures”, with 184 (59%) strongly disagreeing or disagreeing. Also, most participants think internship mentors are adequately trained, and external supervision during internships is ineffective. This is evident from Table 4.36, “Mentors are not trained and struggle to assist students during their internship”, and “External supervision (supervision by institutional Lecturers) is not effective during the internship (OCTP)” having 166 (52.4%) and 213 (64.8) disagreeing or strongly disagreeing with them respectively. Students engage in self-monitoring when they notice changes in their progress towards objectives; this presents a learning challenge that has to be resolved

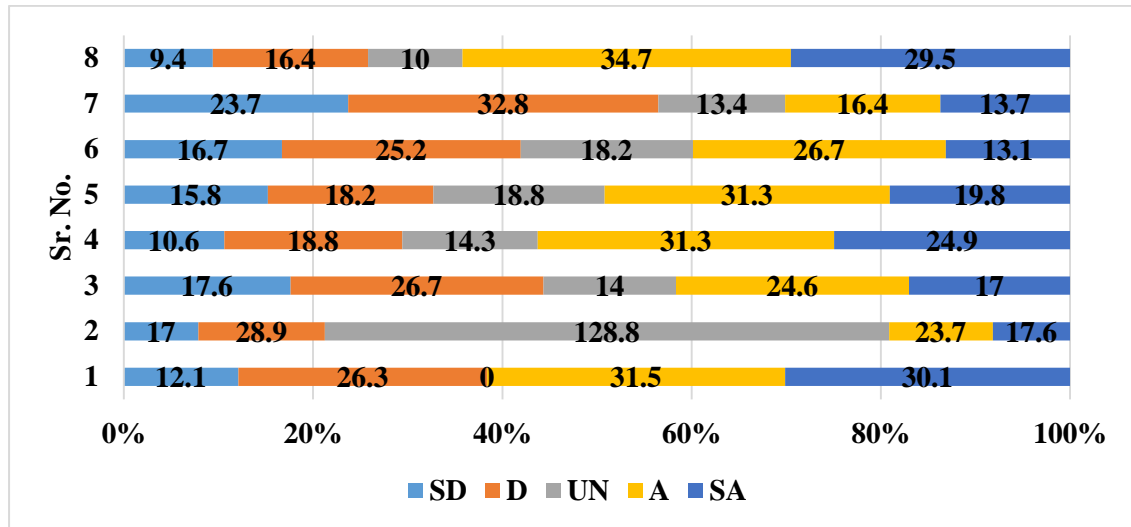
(Hadwin et al., 2019). Table 4.46 represents the responses of the preservice teachers on the Resource Challenge in frequencies and means.

Table 4.46: Responses of Pre-Service Teachers on Resource Challenges (Frequencies and Means)

Sr. No.	Statement	1	2	3	4	5	Mean
		Freq.	Freq.	Freq.	Freq.	Freq.	
1	Lecture halls are not spacious enough for all students	35	76	0	91	87	3.41
2	There is no quality health facility for students	56	95	42	78	58	2.96
3	The school library lacks current materials for referencing	58	88	46	81	56	2.97
4	The computer lab lacks enough computers	35	62	47	103	82	3.41
5	There are not enough sports facilities in my institution	52	60	62	90	65	3.17
6	The guidance and counselling centre is not functioning properly	55	83	60	88	43	2.94
7	My institution does not have a wireless internet facility for surfing the internet	78	108	44	54	45	2.64
8	My institution does not have enough residential facilities for students	31	54	33	114	97	3.58

The percentages of the frequencies of the responses to the resource challenges are presented in the following stacked bar chart (Figure 4.33).

Figure 4.33: Responses of Pre-Service Teachers on Resource Challenges
(Percentages)



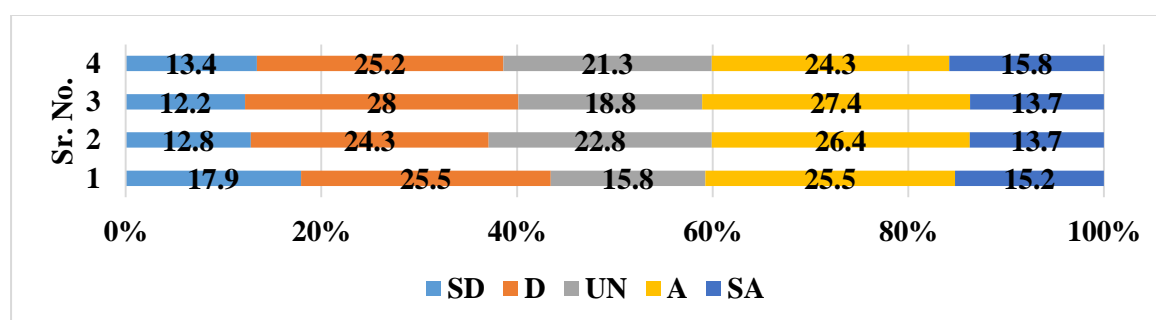
Regarding resource challenges, Table 4.46 and Figure 4.33 responses show that the students face several challenges. Lack of enough lecture halls, computers in the computer laboratory, poor functioning of the counselling centre, and lack of enough sporting facilities. The statements “lecture halls are not spacious enough for all students” and “the computer lab lacks enough computers” had a mean of 3.41 each, indicating the participants agree with these statements. The statement “My institution does not have enough residential facilities for students” has a mean of 3.58, indicating that the participants agree with the statement. Also, 131(39.8%) agree or strongly agree with the statement “The guidance and counselling centre is not functioning properly”. The scarcity of teaching staff at higher education institutions is causing many qualified professors to apply to other universities for better facilities (Saroh, 2023). Table 4.47 represents the preservice teachers' responses to welfare challenges in frequencies and means.

Table 4.47: Responses of Pre-Service Teachers on Welfare Challenges (Frequencies and Means)

Sr. No.	Statement	SD Freq	D Freq	UN Freq	A Freq	SA Freq	Mean
1	My institution's administration is not supportive of helping students secure schools for internship	59	84	52	84	50	2.95
2	The locals in the locality where my institution is are not friendly towards mathematics pre-service teachers	42	80	75	87	45	3.04
3	There is a lack of respect for students due to the low recognition attached to the teaching profession	40	92	62	90	45	3.02
4	The administration is not supportive concerning the needs of students	44	83	70	80	52	3.04

The percentages of the frequencies of the responses to welfare challenges are presented in the following stacked bar chart (Figure 4.34).

Figure 4.34: Responses of Pre-Service Teachers on Welfare Challenges (Percentages)



From Table 4.47 and Figure 4.34, the students have many welfare challenges. Support from the administration seems to be a challenge for pre-service teachers. “My institution's administration is not supportive of helping students secure schools for internship” had a mean of 2.95, which falls within the undecided category of the responses. Also, 135 (41.1%) agree or strongly agree that pre-service teachers lack respect due to the low recognition attached to the teaching profession. 132 (40.1%) agree or strongly agree that the administration does not sufficiently support students’ academic needs. Essential services aimed at advancing the social, mental, emotional,

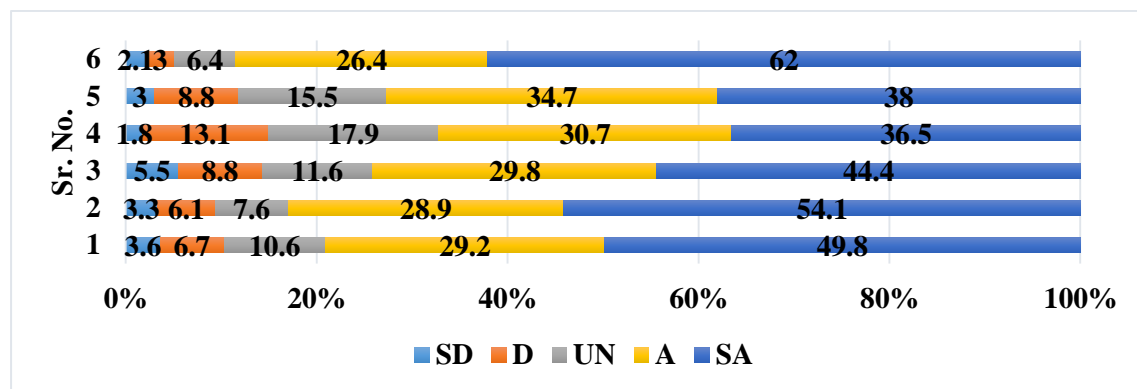
and physical well-being of students enrolled in an institution are included in the category of student welfare services (Sadera et al., 2022). Table 4.48 represents the preservice teachers' responses to economic challenges in frequencies and means.

Table 4.48: Responses of Pre-Service Teachers On Economic Challenges (Frequencies and Means)

Sr. No.	Statement	SD Freq.	D Freq.	UN Freq.	A Freq.	SA Freq.	Mean
1	Living expenditures in and around my institution are on the high side	12	22	35	96	164	4.15
2	Accommodation is expensive in and around my institution	11	20	25	95	178	4.24
3	Securing accommodation on campus is difficult	18	29	38	98	146	3.99
4	Financial obligations towards the programme are on the high side	6	43	59	101	120	3.87
5	Transportation in and around my institution is expensive	10	29	51	114	125	3.96
6	The cost of food commodities is high in and around my institution	7	10	21	87	204	4.43

The percentages of the frequencies of the responses to Economic Challenges are presented in the following stacked bar chart (Figure 4.35).

Figure 4.35: Responses of Pre-Service Teachers On Economic Challenges (Percentages)



It is evident from Table 4.48 and Figure 4.35 that economic challenges are the most pressing of the challenges the students face. All the challenges mentioned in Table 4.39 had mean of at least 3.8; this shows that for all the statements, the participants either agree or strongly agree that they are challenges they face. These

challenges include high living expenditure, expensive accommodation, difficulty finding accommodation for rent, high financial obligations towards the programme, expensive accommodation on campus, and expensive food commodities. Three essential topics in the contemporary discourse around higher education stand out in particular and lend themselves particularly well to economic studies (Clotfelter et al., 2008).

X. HYPOTHESIS TESTING

Null Hypothesis: There exists no significant relationship between the male and female pre-service teachers' responses concerning challenges encountered in the MEPs of the TEUs.

The scores of the challenges encountered obtained from the responses of the whole sample ((329 (male: 275, Female: 54)) of the pre-service teachers were tabulated and used to find out the Mann Whitney U test between the responses of the male and female pre-service teachers. Table 4.49 shows the results of the analyses.

Table 4.49: Results of Mann-Whitney U Test for Male and Female Pre-Service Teachers' Responses Concerning Challenges Encountered

Statistics	SCORE	Mean	Effect Size	Verbal Interpretation
Mann-Whitney U	6586.500	Male = 2.97	0.07	Accept the null hypothesis (significant level is 0.05)
Wilcoxon W	44536.500	Female = 3.10		
Z	-1.312			
Asymp. Sig. (2-tailed)	0.189			

From Table 4.49, the asymptotic significance (2-tailed) p -value obtained from the analysis between the male and female pre-service teachers' responses on challenges encountered is 0.043 ($U = 6586.500, Z = -1.312, Effect Size = 0.07$), at a significant level of 0.05. This is an indication that there is a significant difference between the perceptions of the male and female pre-service teachers on

challenges encountered in the MEPs of the TEUs at a small (0.07) effect size, indicating limited practical application.

A mean of 2.97 (Male) indicates responses from males are closer to "Neutral," indicating a slightly less favourable perception but still generally neutral, and 3.10 (Female) indicates responses from females are slightly above neutral, leaning toward "Neutral" to "Agree," indicating a more favourable perception compared to males.

XI. HYPOTHESIS TESTING

Null Hypothesis: There exists no significant relationship between the pre-service teachers of CKT-UTAS, UCC, and UEW's responses concerning the challenges encountered at the MEPs of the TEUs.

The scores of the challenges encountered obtained from the responses of the whole sample ((329 (CKT-UTAS: 23, UCC: 150, UEW: 156)) of the pre-service teachers were tabulated and used to find out the Kruskal Wallis H test between the responses of CKT-UTAS, UCC and UEW pre-service teachers. Table 4.50 shows the results of the analyses.

Table 4.50: Results of Kruskal-Wallis H Test for CKT-UTAS, UCC, and UEW Pre-Service Teachers' Responses Concerning Challenges Encountered

Statistic	Score	Means	Effect Size (f)	Verbal Interpretation
Chi-Square	10.475	CKT-UTAS = 2.82	0.16	Reject the Null Hypothesis
df	2	UCC = 3.11		
Asymp. Sig	0.005	UEW = 2.90		

From Table 4.50, the Kruskal-Wallis H test shows that there is a statistically significant difference between the responses of the pre-service teachers from CKT-UTAS, UCC and UEW concerning the challenges of the MEPs of the TEUs, $\chi^2(2) = 10.475$, $p = 0.005$ at a significant level of 0.05. An effect size of 0.16 is small, which indicates limited practical application. This indicates that the perceptions of the pre-service teachers from the three universities about the challenges are different. At an effect size of 0.16, the effect is small and practically has limited significance.

A mean of 2.82 (CKT-UTAS) indicates responses from CKT-UTAS leaning closer to "Neutral", indicating a moderately negative or less favourable perception, with 3.11 (UCC) responses from UCC leaning closer to "Neutral" to "Agree", indicating a slightly more favourable perception compared to CKT – UTAS and (2.90) UEW responses from UEW are similar to those from CKT - UTAS, indicating a moderately less favourable or neutral perception.

4.8.2 Teacher Educators' Responses to the Challenges of the MEPs

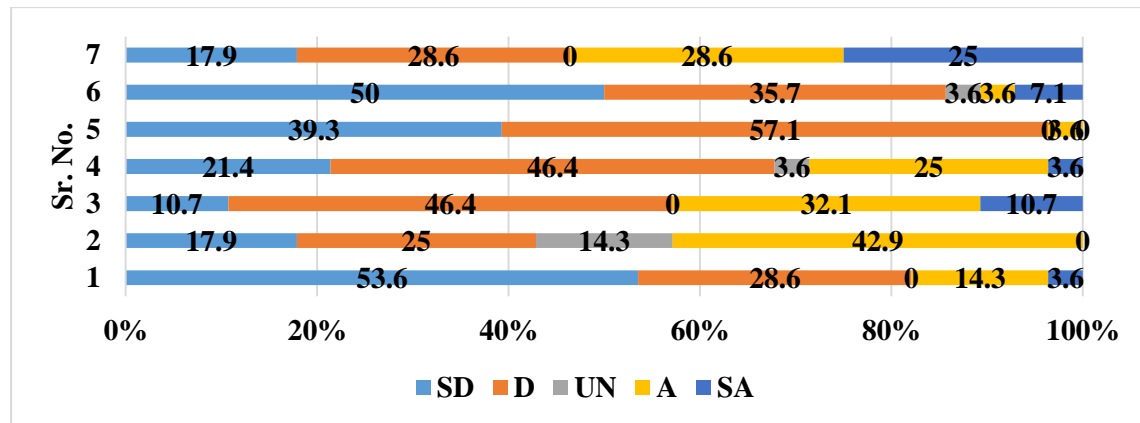
The analyses of the responses of the participants (teacher educators) on the challenges of the MEPs in the TEUs of Ghana are outlined below. The analyses have been categorized into academic, resource, and welfare challenges. Table 4.51 represents the teacher educators' responses to Academic Challenges in frequencies and means.

Table 4.51: Responses of Teacher Educators on Academic Challenges (Frequencies and Means)

Sr. No.	Statement	SD Freq.	D Freq.	UN Freq.	A Freq.	SA Freq.	Mean
1	The curriculum for training is not written correctly with clearly spelt out procedures and evaluation processes	15	8	0		1	1.86
2	There is not enough time to execute the necessary procedures for training pre-service teacher	5	7	4	12	0	2.82
3	There is not enough time to do research for professional development	3	13	0	9	3	2.86
4	The best pre-service teachers academically are not recruited for training	6	13	1	7	1	2.43
5	There is not a conducive environment for teaching and learning	11	16	0	1	0	1.68
6	There is no cooperation between colleagues in my institution	14	10	1	1	2	1.82
7	There are not enough Teacher Educators in my institution, which increases the workload for the few Teacher Educators available	5	8	0	8	7	3.14

The percentages of the frequencies of the responses on Academic Challenges are presented in the following stacked bar chart (Figure 4.36).

Figure 4.36: Responses of Teacher Educators on Academic Challenges (Percentages)



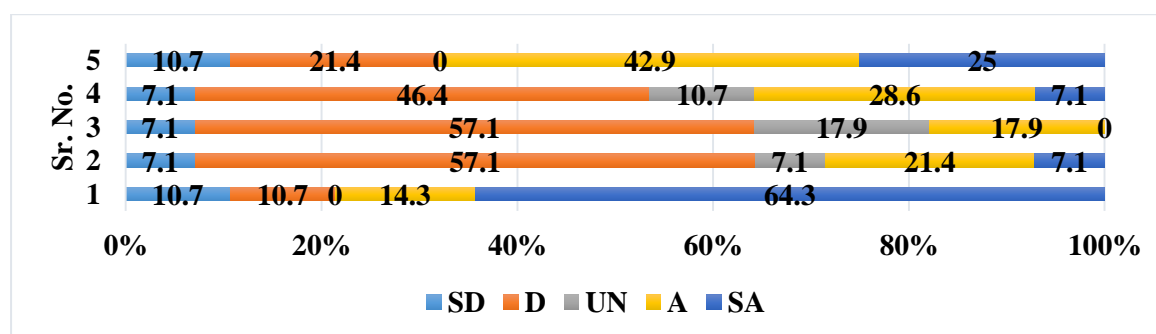
From Table 4.51 and Figure 4.36, though most participants did not overly accept most of the academic challenges mentioned in the statements, some notable ones need to be mentioned. 12(42.9%) of the participants agree or strongly agree that the time allocated for training pre-service teachers is insufficient. Also, 15 (53.6%) of the participants agree or strongly agree that there are not enough teacher educators in the MEPs, which increases the workload of the few teacher educators available. The issue of a conducive environment and cooperation between teacher educators are seen as no challenges. The statements “there is not a conducive environment for teaching and learning” and “there is no cooperation between colleagues in my institution” had means of 1.68 and 1.82, respectively, indicating that most respondents strongly disagree with these two statements. Table 4.52 represents the teacher educators' responses to resource challenges in frequencies and means.

Table 4.52: Responses of Teacher Educators on Resource Challenge (Frequencies and Means)

Sr. No.	Statement	1 Freq.	2 Freq.	3 Freq.	4 Freq.	5 Freq.	Mean
1	There are not enough lecture halls for classroom transactions	3	3	0	4	18	4.11
2	The university/departmental library does not have current books for reference	2	16	2	6	2	2.64
3	Current teaching resources, especially in technology, are not provided on time for academic advancement	2	16	5	5	0	2.46
4	Most of the teaching-learning resources are outdated, damaged or unavailable to Teachers-Educators.	2	13	3	8	2	2.82
5	The necessary tools for ICT integration are not available to Teacher Educators	3	6	0	12	7	3.5

The responses to the resource challenges are presented in a stacked bar chart representing the percentages of frequencies in the following graph (Figure 4.37).

Figure 4.37: Responses of Teacher Educators on Resource Challenge (Percentages)



On resource challenges, as seen from Table 4.52 and Figure 4.37, the statement “there are not enough lecture halls for classroom transactions” had a mean of 4.11, indicating that most participants agreed. The availability of ICT integration tools is also seen as a challenge to the participants, with 18 (66.6%) agreeing or strongly agreeing. Despite advancements in higher education, the system still faces several difficulties, such as inadequate facilities to support science and technology education and limited ICT infrastructure to improve instruction and curriculum

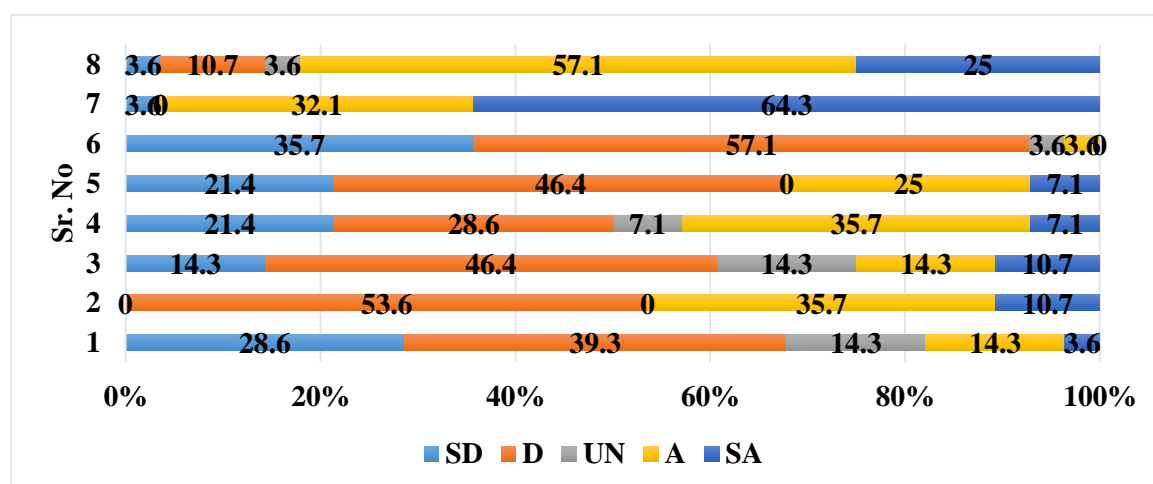
delivery (Atuahene, 2014). Table 4.53 represents the teacher educators' responses to Welfare Challenges in frequencies and means.

Table 4.53: Responses of Teacher Educators on Welfare Challenges (Frequencies and Means)

Sr. No.	Statement	SD Freq.	D Freq.	UN Freq.	A Freq.	SA Freq.	Mean
1	There is a lack of recognition for the Teacher Educators	8	11	4	4	1	2.25
2	There are fewer opportunities for promotion in my institution	0	15	0	10	3	3.04
4	There is an uneven workload in my institution	4	13	4	4	3	2.61
5	There is no reward system for good performance	6	8	2	10	2	2.79
6	There are not enough opportunities for professional development	6	13	0	7	2	2.5
7	There is job insecurity, which makes Teacher Educators unstable	10	16	1	1	0	1.75
8	Remuneration on the job is not enough. Teacher Educators have to engage in other jobs to complement their salaries	1	0	0	9	18	4.54
9	It isn't easy to maintain a balance between work and life situations	1	3	1	16	7	3.89

The percentages of the frequencies of the responses to Welfare Challenges are presented in the following stacked bar chart (Figure 4.38).

Figure 4.38: Responses of Teacher Educators on Welfare Challenges (Percentages)



On Welfare challenges, remuneration and maintenance of balance are seen as challenges by the participants, as shown in Table 4.53 and Figure 4.38. Means of 4.54 and 3.89, respectively, for the statements “Remuneration on the job is not enough” and “It is not easy to maintain a balance between work and life situations” indicate

that most participants strongly agree and agree respectively with the two statements. From their responses, the participants indicated that there are enough opportunities for professional development and job security. 19 (67.8%) and 26(92.8%) disagree or strongly disagree with the statements “there are not enough opportunities for professional development” and “there is job insecurity, which makes Teacher Educators unstable”.

XII. HYPOTHESIS TESTING

Null Hypothesis: There exists no significant relationship between the male and female teachers educators' responses concerning challenges encountered in the MEPs of the TEUs.

The scores of the challenges encountered obtained from the responses of the whole sample of ((28 (male: 23, Female: 5)) of the teacher educators were tabulated and used to find out the Mann Whitney U test between the responses of the male and female teacher educators. Table 4.54 shows the results of the analyses.

Table 4.54: Results of Mann-Whitney U Test for Male and Female Teacher Educators' Responses Concerning Challenges Encountered

Statistics	SCORE	Means	Effect Size (f)	Verbal Interpretation
Mann-Whitney U	57.000	Male: 3.21	0.06	Accept the null hypothesis (Significant level: 0.05)
Wilcoxon W	72.000	Female: 3.14		
Z	-0.30			
Asymp. Sig. (2-tailed)	0.976			

From Table 4.54, the asymptotic significance (2-tailed) p -value obtained from the analysis between the male and female teacher educators' responses on challenges encountered is 0.740 ($U = 57.00$, $Z = -0.30$, effect size = 0.06) at a significant level of 0.05. This is an indication that there is no significant difference between the perception of male and female teacher educators on challenges encountered in the

MEPs of the TEUs at a small (0.06) effect size, indicating a limited practical application.

A mean of 3.21 (Male) indicates responses from males are slightly above "Neutral," indicating a moderately positive perception but still closer to neutral, and 3.14 (Female) indicates responses from females are similarly above neutral, falling between "Neutral" and "Agree," reflecting a moderately positive perception as well.

4.9 Classroom Observation

The researcher conducted observation of the classroom activities of the MEPs of the TEUs. The analyses of the data from the classroom observations have been presented in this section.

4.9.1 Researchers' Observations of Classrooms

The data from the observation of the classrooms were analysed based on the categories on the observation schedule. The categories are Introduction of Lesson, Lesson Presentation, Learner Interaction, Content Knowledge Relevance and Assessment. Table 4.55 represents the outcome of the observation on the Introduction of Lesson.

Table 4.55: Introduction of lesson

Sr. No.	Observation Statement	Not Observed Freq. (%)	More Emphasis Recommended Freq. (%)	Accomplished Very Well Freq. (%)
1	Presented overview of the lesson	3 (20)	2 (13.3)	10 (66.7)
2	The lesson was properly introduced	0 (0.0)	1 (6.7)	14 (93.3)
3	Relevant previous knowledge was identified and swiftly revised	1 (6.7)	9 (60)	5 (33.3)

From the observation, as shown in Table 4.55, it was realised that in most cases, the teacher educators introduced the lessons well. One key part of instructions in class is introducing the content to be covered (Waxman, 1987). They also ensured that they briefly described the lessons' importance and how they link with the pre-service teachers' academic growth. Most teacher educators also linked their lessons to relevant previous knowledge, though much importance was not attributed to some lessons' Relevant Previous Knowledge (RPK). It can be seen from Table 4.43 that the

researchers' observation schedule indicates that in 93.3% of the lessons, the teacher educators introduced the lessons very well, whilst in 33.3% of the lessons, RPK was identified and revised. In 60% of the lessons, the researcher realised that more emphasis was needed concerning RPK for the lessons. Prior knowledge must be engaged before it can influence learning (Brod, 2021). Table 4.56 represents the outcome of the observation on the Presentation of Lesson.

Table 4.56: Presentation of Lesson

Sr. No.	Observation Statement	Not Observed Freq. (%)	More Emphasis Recommended Freq. (%)	Accomplished Very Well Freq. (%)
1	Major/minor points were explained	0 (0.0)	2 (13.3)	13 (86.7)
2	Unfamiliar terms, concepts, and principles were explained	0 (0.0)	4 (26.7)	11 (73.3)
3	Relevant practical examples were used to clarify concepts	2 (13.3)	5 (33.3)	8 (53.3)
4	The right teaching-learning materials were used	2 (13.3)	6 (40.0)	7 (46.7)
5	ICT was integrated into the teaching-learning process	2 (13.3)	3 (20.0)	10 (66.7)
6	Showed all relevant steps in the explanation of concepts	1 (6.7)	1 (6.7)	13 (86.7)
7	Varied explanations were used for difficult concepts	2 (13.3)	0 (0.0)	13 (86.7)
8	Active, collaborative, and cooperative learning are favored over passive learning	0 (0.0)	1 (6.7)	14 (93.3)
9	Students were actively involved in the lesson	0 (0.0)	1 (6.7)	14 (93.9)
10	The lesson was appropriately paced	0 (0.0)	1 (6.7)	14 (93.3)
11	The lesson was presented in a logical sequence	1 (6.7)	1 (6.7)	13 (86.7)
12	The lesson was related to the relevant previous knowledge	1 (6.7)	6 (40)	8 (53.3)
13	Major points were summarized	3 (20)	5 (33.3)	7 (46.7)

From Table 4.56, the lesson presentations were generally good. It was, though, realised that, in most lessons, the teacher educators did not utilize teaching-learning materials to improve the easy understanding of concepts. The integration of ICT was also mainly limited to the use of PowerPoint presentations. This hinders the pedagogical development of pre-service teachers and the easy understanding of

concepts. The use of TLMs by teacher educators is an opportunity for pre-service teachers to learn how TLMs can be effectively used for lesson delivery in the classroom. It can be seen from Table 4.42 that all the key activities during the presentation, including “Major/minor points were explained”, “ Showed all relevant steps in the explanation of concepts”, “ Varied explanations were used for difficult concepts”, “ Active, collaborative, and cooperative learning are favoured over passive learning ”, and “ The lesson was appropriately paced” had percentages above 86% being “Accomplished very well” from the researchers' observations. Table 4.57

Table 4.57: Interaction with Learners

Sr. No	Observation Statement	Not Observed Freq. (%)	More Emphasis Recommended Freq. (%)	Accomplished Very Well Freq. (%)
1	The students were encouraged to ask questions	0 (0.0)	7 (46.7)	8 (53.3)
2	Questions were asked to monitor students' understanding	1 (6.7)	0 (0.0)	14 (93.3)
3	The teacher educator carefully listened to students' questions	0 (0.0)	4 (26.7)	11 (73.3)
4	Students' questions were appropriately answered	0 (0.0)	1 (6.7)	14 (93.3)
5	When necessary, questions and answers were repeated	0 (0.0)	5 (33.3)	10 (66.7)
6	Demonstrates respect for diversity and requires similar respect in the classroom	0 (0.0)	0 (0.0)	15 (100)

represents the outcome of the observation on Interaction with Learners.

Table 4.57 shows that teacher educators interact well with pre-service teachers during lessons. The pre-service teachers were made part of the lessons. The teacher educators were open for the pre-service teachers to ask as many questions as they wanted to clear their doubts. They also invested time in answering the pre-service teachers' questions to ease their understanding of concepts. From Table 4.57, the statements “Questions were asked to monitor students' understanding” and “Students questions were appropriately answered” were very well accomplished with percentages above 93% per the researchers' observations (93.3% each) whilst “Demonstrates respect for diversity and requires similar respect in the classroom” was

100%. This proved that the teacher educators gave equal opportunity to all pre-service teachers regardless of their background. In order to maximise each student's learning and growth and to avoid grade failure, dropout rates, and gradual disengagement, teachers must make sure that their students are actively participating in the learning process (Havik & Westergård, 2019). Table 4.58 represents the outcome of the observation on Content Knowledge and Relavance.

Table 4.58: Content Knowledge and Relevance

Sr. No	Observation Statement	Not Observed Freq. (%)	More Emphasis Recommended Freq. (%)	Accomplished Very Well Freq. (%)
1	The lesson was at the appropriate level for students	0 (0.0)	0 (0.0)	15 (100)
2	Presented appropriate material per the needs of the programme	0 (0.0)	1 (6.6)	14 (93.3)
3	Demonstrated command of subject matter	0 (0.0)	2 (13.3)	13 (86.7)

From Table 4.58, the teacher educators' mastery of the content was also very good. They were on top of their game regarding the content to be delivered. The lessons were planned accordingly, based on their objectives, and presented at the right pace. As seen from Table 4.46, the statements “Presented appropriate material per the needs of the programme” and “Demonstrated command of subject matter” were observed to have been very well accomplished in 93.3% and 86.7% of the lessons. Preservice teachers' comprehension of mathematical concepts should be expanded and deepened by teaching pedagogical knowledge in undergraduate mathematics education (Capraro et al., 2005). Table 4.59 represents the outcome of the observation on Lesson Assessment.

Table 4.59: Lesson Assessment

Sr. No.	Observation Statement	Not Observed Freq. (%)	More Emphasis Recommended Freq. (%)	Accomplished Very Well Freq. (%)
1	The teacher educator assessed the lesson after teaching	7 (46.7)	5 (33.3)	3 (20.0)
2	The assessment measured the objective of the lesson	3 (20.0)	0 (0.0)	12 (80)
3	Pre-service teachers were given assignments after the lesson	8 (53.3)	0 (0.0)	7 (46.7)

From Table 4.59, the assessment of the lessons after teaching was not at the level it was supposed to be. The researcher observed that in most cases, teacher educators refused to assess the class orally or in writing after the lesson. In some cases, the teacher educators refused to even give the pre-service teachers assignments in any form after the class. From Table 4.47, “The teacher educator assessed the lesson after teaching” was not observed in 7 (46.6%) out of the fifteen observed lessons, and in 8 (53.3%) of the lessons observed, the pre-service teachers were not given assignments after the lessons. Assessment is probably the most crucial component in assisting learners in effectively and thoroughly learning (Guo & Shi, 2014).

4.10 Learning Culture Observation

The researcher conducted observations of the learning culture of the MEPs of the TEUs. The analyses of the data from the learning culture observations have been presented in this section.

4.10.1 Researchers Observations of the Learning Culture of the TEUs

With the aid of an observation schedule, the researcher observed the learning culture of the TEUs MEPs. The observation focused on students in the Mathematics education departments. The observation was based on what happens before, during, and after lessons. This was done to have first-hand information on what is happening

in the TEUs. The researcher was a passive observer and did not influence whatever happened. The researcher occasionally tried to get close to students in groups to know what the students were discussing. Table 4.60 represents the outcome of the observation of Learning Culture Before Class.

Not Observer = 1, Rarely Observed = 2, Sometimes Observed = 3, Often Observed = 4, Always Observed = 5

Table 4.60: Learning Culture Before Class

Sr. No	Learning Culture Observation Statement	1 Freq. (%)	2 Freq. (%)	3 Freq. (%)	4 Freq. (%)	5 Freq. (%)
1	Students go to lectures on time	0 (0.0)	0 (0.0)	0 (0.0)	1 (6.3)	15 (93.6)
2	Teacher educators go to class on time	0 (0.0)	1 (6.3)	7 (43.8)	6 (3.8)	2 (12.50)
3	There is a conducive environment for teaching and learning	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	16 (100)
4	Students engage in discussions before lessons	0 (0.0)	0 (0.0)	2 (12.5)	4 (25.0)	10 (62.5)
5	There is cooperation among students	0 (0.0)	0 (0.0)	2 (12.5)	3 (18.6)	11 (68.6)

From Table 4.60, the researcher observed that the students arrived at the lecture halls before lessons. It was also realised that though this is a good practice, it was motivated mainly by the students' eagerness to access a desk since there were mostly inadequate desks in the halls. Before lessons, the students stand in groups to discuss various topics. Though some discussed topics related to the lecture they were about to attend and topics they have studied previously, they also discussed social topics such as social media happenings. As seen from Table 4.48, the statement "Students go to lectures on time", "Students engage in discussions before lessons", and "There is a conducive environment for teaching and learning" was always observed by the researcher 15(93.6%), 10(62.5%) and 16(100%) times respectively by the researcher. The environment was always conducive to teaching and learning. It was also realised that most of the time, the teacher educators arrived late for lectures. Table 4.61 represents the outcome of the observation of Learning Culture During Class.

Table 4.61: Learning culture during class

Sr. No	Learning Culture Observation Statement	1 Freq. (%)	2 Freq. (%)	3 Freq. (%)	4 Freq. (%)	5 Freq. (%)
1	Students engage in group discussion	1 (6.3)	3 (18.8)	1 (6.3)	3 (18.8)	8 (50.0)
2	Appropriate teaching and learning strategies are used to achieve the objectives of lessons	0 (0.0)	1 (6.3)	0 (0.0)	9 (56.3)	6 (37.5)
3	The teacher educator invited another colleague to help with a class	15 (93.8)	0 (0.0)	0 (0.0)	0 (0.0)	1 (6.3)
4	Teacher educators exhibit a social concern	0 (0.0)	0 (0.0)	3 (18.8)	1 (6.3)	12 (75.0)
5	Teacher educators involve students in classroom activities	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	16 (100)
6	Teacher educators encourage cooperation among students	0 (0.0)	0 (0.0)	7 (43.8)	3 (18.8)	6 (37.5)
7	There is a cordial and professional relationship between pre-service teachers and teacher educators	0 (0.0)	0 (0.0)	0 (0.0)	1 (6.3)	15 (93.8)
8	There are adequate opportunities for students to engage in active learning	0 (0.0)	0 (0.0)	5 (31.3)	1 (6.3)	10 (62.0)

During lessons, as shown in Table 4.61, the lessons were mainly taught by the lecture method. Though this was the case, the students were actively involved in all activities during the lesson. The teacher educators used many questions to engage the students in the lessons. Also, the students, on some occasions, were allowed to discuss with their peers in groups to come up with a solution. Students were sometimes called to the board to solve mathematics problems whilst their colleagues watched. The teacher educators respected the opinion of all students in all situations and corrected them appropriately. The students were allowed to be involved in the lesson all the time. It can be seen from Table 4.48 that the statements “Teacher educators involve students in classroom activities”, “students engage in group discussion”, and “there is a cordial and professional relationship between pre-service teachers and teacher educators” were always observed by the researcher 16(100%), 8(50%), 10(62.0) times respectively. The classrooms were lively, and the teacher educators were comfortable interacting with the teacher educators to clear their doubts. Table 4.62 represents the outcome of the observation of Learning Culture after Class.

Table 4.62: Learning Culture after Class

Sr. No	Learning Culture Observation Statement	1 Freq. (%)	2 Freq. (%)	3 Freq. (%)	4 Freq. (%)	5 Freq. (%)
1	Students have a good rapport with students from other departments	0 (0.0)	0 (0.0)	1 (6.3)	5 (31.3)	10 (62.5)
2	Students visit the library regularly	0 (0.0)	0 (0.0)	4 (25.0)	1 (6.3)	11 (68.8)
3	Students meet after class for group discussion	3 (18.8)	0 (0.0)	0 (0.0)	2 (12.5)	11 (68.8)
4	Co-curricular activities are given equal importance	0 (0.0)	1 (6.3)	9 (56.3)	0 (0.0)	6 (37.5)
5	Students can approach teacher educators for assistance	0 (0.0)	0 (0.0)	0 (0.0)	4 (25.0)	12 (75.0)
6	Students of different departments collaborate in academic work	7 (43.8)	4 (25.0)	4 (25.0)	0 (0.0)	1 (6.3)
7	All students respect the diversity of fellow members in the institution (gender, race, culture, language, ethnicity, etc.)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	16 (100)
8	Students learn more outside the classrooms	0 (0.0)	1 (6.3)	4 (25.0)	0 (0.0)	11 (68.8)

As shown in Table 4.62, the researcher also observed that the students learned more after class. The students mainly met in groups after class, especially in the evening, to discuss what they had learned during the day. One student would lead the group as they solve questions while discussing to clear the doubts of the group members. This was observed every day on two of the campuses, but it was hardly observed on one of the campuses that the researcher visited. Upon engaging the students on the topic, it was revealed that they met in their various hostels for such group discussions since the campuses did not have the facilities to aid them in that respect. The students also visited the library regularly after class. The students mostly met at the discussion section to work on assignments as they used reference library materials to guide themselves. The students also visited the teacher educators' offices for assistance if needed. Also, enough attention was given to extracurricular activities. On some occasions, the researcher witnessed academic activities halted to enable all students to attend a sporting activity organized by an institution. From Table 4.49, the statements “students can approach teacher educators for assistance”, “students learn more outside the classroom”, “students visit the library regularly, and students meet after class for group discussions”, and “students meet after class for group discussion”

were always observed 12(75%), 11(68.8%), 11 (68.8%) and 11(68.8%) times by the researcher respectively. Continuous learning is effectively fostered by a strong learning culture (Van Breda-Verduijn and Heijboer, 2016).

4.11 Resources (Material and Human) Observation

The researcher conducted observations of the resources (Material and human) of the MEPs of the TEUs. The analyses of the data from the resources (Material and Human) have been presented in this section.

4.11.1 Resources at the TEUs (Human and Material)

The researcher utilised an observation schedule and used the help of departmental personnel (administrators) to get the needed information regarding resources available to the departments. From the observations, it was generally realised that, in terms of human resources, the departments had enough administration staff to care for the welfare of both teacher educators and pre-service teachers. On the part of departmental office workers, one of the universities claimed to need more to help with the office's work. The other two departments indicated that they had enough workers at their disposal.

Concerning teacher educators, two of the departments had enough, but one of the departments needed more teacher educators. The gender distribution of the teacher educators was heavily in favour of the male gender, as realised in the demographic characteristics of the respondents. The administrators also mentioned recruiting more teaching assistants to help educators dispatch their duties.

Material resources concern the departmental administrators and the observations rightly ascertain the reasons for the concerns. In one of the universities, only five (5) observation items out of thirty-three (33) were said to be enough for the department as were observed. Most of the items on the observation schedule were either not enough or were completely absent. Items including a computer laboratory, mathematical laboratory, departmental library, seminar halls, career support centre, smart boards, recreational centre, student canteen, convention centre, book shop, and banking facility are non-existent in the department. Lecture halls, teacher educator offices, health facilities, sports facilities, lecture hall desks, teaching-learning

materials, students' residential facilities, and staff residential facilities were present but were inadequate for the smooth running of the departments.

In the other two universities, though most of the items on the observation schedule were available to the departments, they were insufficient for the smooth running of academic activities. From one of the universities, ten (10) items on the observation schedule were adequate for operations. The remaining items (23) were present but not adequate. Items such as lecture hall desks, lecture halls, teaching-learning materials, computers for the computer laboratory, and welfare facilities such as medical care for employees and educational facilities for employees were said to be inadequate.

4.12 Analysis of Qualitative (Semi-Structured Interview) Data obtained from Pre-service Teachers and Teacher Educators

The researcher used thematic analyses to analyse the qualitative data collected from the pre-service teachers and teacher educators. The qualitative data included data from semi-structured interviews of pre-service teachers and teacher educators. This section presents the semi-structured interview analyses.

4.12.1 Analyses of the Semi-Structured Interviews of Pre-service Teachers

Pre-service teachers' opinions on evaluation practices in the MEPs of the TEUs of Ghana were sought through semi-structured interviews. The audio data collected during the interviews were transcribed and analysed thematically. Analyses of the data are presented below:

The researcher realised that the interviewees had a fair knowledge of the meaning of evaluation and assessment. All the interviewees gave explanations circling the process of finding out the effectiveness of action in the classroom to find out if the teaching and learning process has been effective enough to accomplish a lessons the objectives. Some of the responses to the definition of evaluation given by the respondents include:

Evaluation means assessment. For example, after delivering a lesson, you need to evaluate the lesson by giving the student some questions to solve on the concept learnt to know whether your lesson objectives have been achieved.

Evaluation is done to ascertain any programme's effectiveness or worth to know the strengths, weaknesses, and problems encountered during a particular programme.

Their responses also indicated that they were made aware of the assessment procedures at the beginning of the semester, primarily through course outlines given to them. The course outlines may be detailed or not, depending on the lecturer who handles the course. Some of the responses that were given were:

At the beginning of the semester, we are given course outlines, which consist of the evaluation process.

For every course, we are given a course manual. The course manual contains what will be done during the semester and how it will be assessed.

They also revealed that the teacher educators utilized different forms and types of assessment within the semester. Tests, quizzes and practical assessment procedures are used for evaluation by the teacher educators. The teacher educators also use summative and formative assessments.

The interviewees were not decisive concerning fairness during examinations. Some of the responses given by the interviewees were:

I am not in a position to say whether assessments are fair or not, but I can say that students' strengths determine their performance in the exams.

Sometimes, you might think your work deserves a better grade, but since marking is subjective, you can receive a lower grade. So yes, there might be a form of bias here to some extent.

Generally, the interviewees' responses indicated that they were happy with the conduct of the internal assessment. Some of the themes that emerged from questions on internal assessments include:

- (i) Internal assessments are organised by teacher educators, mainly with the help of teaching assistants.

- (ii). Internal assessment measures the objectives of the various courses.
- (ii). Feedback on internal examinations is quick. Scores of internal examinations are received mostly within a week.
- (iv) Satisfaction with the outcome of internal assessment as pre-service has the opportunity to correct errors after marking.

Some of the comments concerning satisfaction with internal assessment are:

Concerning satisfaction, I will rate it 70%.

I will rate satisfaction with respect to internal assessment at 80%.

Concerning external examinations, though the interviewees indicated satisfaction with the organization, they were not satisfied with the outcome of external exams. Among the themes that emerged were:

- (i). There is dissatisfaction concerning the outcome of external examinations. Most students are unsatisfied with their grades at the end of the semester.
- (ii). Students are willing to challenge their grades, but the rigorous procedures and fear of victimisation discourage them.
- (iii) The difficulty level of external assessment is satisfactory.

The participants were also satisfied with the assessment during Off Campus Teaching Practice (OCTP). The themes that emerged are:

- (i). OCTP assessment is done by internal supervisors (teachers in attachment schools) and external supervisors (lecturers from the university).
- (ii). Teacher educators discuss the weaknesses and strengths of pre-service teachers after assessment
- (iii). There is satisfaction concerning the assessment of OCTP

The interviewees also indicated that students who engage in malpractices are dealt with according to the regulations enshrined in the student handbook.

4.12.2 Analyses of the Semi-Structured Interviews of Teacher Educators

Three teacher educators were purposefully selected and interviewed on the present status, purpose, and future direction of the MEPs of the TEUs in Ghana. The thematic analysis of the transcribed audio recording of the interviews is presented below:

The three interviewees, one each from one of the selected TEUs, have been teaching in their respective institutions for at least five (5) years. The reason for choosing teacher educators with this background was to give the researcher enough information about the interview subjects.

According to the interview responses, the purpose of the programmes is to train human resources, specifically Mathematics teachers, for the school level of Ghana's education and the Ghana Education Service. The interviewees also indicated that, though the main objective of the programmes is to train graduates for schools, some of the graduates find themselves in non-education sectors due to the programme's structure, which enables graduates to adapt to different situations. Also, the interviewees revealed that the programmes have achieved their purpose, though there is more room for improvement.

Some of the responses to questions about the objective of programmes include:

The core objective of the programme is to train mathematics education professionals for the second circle level of Ghana's education. The objective emanates from a survey carried out in the Northern sector of Ghana. It was realized that there was a lack of enough mathematics teachers in the northern sector of Ghana.

The objectives could be summarized as follows: to provide the needed human resources to feed the pre-tertiary level.

Among the themes concerning this are:

- (i). The programmes aim to train mathematics teachers for the pre-tertiary level of Ghana's education, predominantly Senior High School.
- (ii). The programmes have achieved their purpose of producing top-notch mathematics teachers for the pre-tertiary level of Ghana's education.
- (iii). Tracer studies indicate that graduates of the programmes are performing well in the field.

- (iv) Graduates of the programmes are expected to exhibit high standards of professional characteristics after graduation

The interviewees believe the programmes are doing well, but there is room for improvement. They indicated that the programmes are marketably doing well nationally and internationally.

Some of the responses include:

For a programme, we would wish to achieve more than what we have now, but on the whole, I can say that if I am to grade our achievements, I would say that we have achieved about 80% of our objectives

To say the programme has achieved its main objective means that the rationale of the programme has been met, yes. We are to produce qualified professional mathematics teachers for the pre-tertiary level, and undoubtedly, we have been doing it.

The themes include:

- (i) All the interviewees ranked their programmes as the best in the country.
- (ii) The programmes have international recognition as graduates can gain admission for further studies and employment from foreign countries such as the USA, UK, Canada, Finland, etc.

It was also revealed that the programme graduates thrive in their respective fields and gain the necessary recognition due to their training. Also, it was revealed that, though the programme trains graduates as mathematics teachers, they thrive in non-education sectors due to the training they receive in the programme, especially the ICT content of the programmes.

Some of the responses include:

Yes, some of our students are employed by the GES; in fact, most of them are employed by other institutions. We have been tracking our graduates, and we have an alumni association that interacts with the students association on campus. We have been tracking our students and their performance. Some of the employees we have contacted indicated that the programme graduates are doing well.

Yes, the programme prepares students holistically. The fact that they are mathematics teachers means that whatever they need as mathematics experts, we give it to them at the undergraduate level so they can fit into other aspects of life.

A tracer study was conducted by a group of researchers from our department to look for feedback from our students, and the conclusion was that our students are doing very well in the field.

The themes include:

- (i). Most of the programmes' graduates end up outside the classroom since the programme equips them with enough content to survive in the corporate world.
- (ii). The programmes combine content with pedagogy and ICT integration courses. There is a balance between the content, pedagogy and ICT-related courses.

The participants believe the programmes have a bright future based on their structure and content base. Some of the responses from the participants were:

The programme has a bright future because mathematics is the foundation of every subject.

When the programme started, we did not really consider ICT much, but with the current trend, it will be difficult for anybody in this dispensation to live without the knowledge of ICT, so we have incorporated ICT into the programme.

- (i). The programmes are content base, equipping pre-service teachers with enough content

The interviewees believe that the programmes have a brighter future. They expect the programmes to grow to involve more current trends, especially in the area of ICT, where new trends like robotics can be included in the programme based on research and inquiries.

- (ii). The programmes have a bright future. There is the expectation for the programmes to attract more pre-service teachers who are expected to graduate equipped with the requisite skills to deliver professionally in the classroom.
- (iii). The programmes are research-based. They are based on tracer studies conducted regularly for updating.

The participants also revealed some departments' challenges in dispatching their duties. The challenges were predominantly infrastructure challenges. Some of the responses from the participants were:

Aside from the lack of lectures, we also have a lot of stress attached to the job. We also do not have enough offices for lecturers. We have financial challenges. We are also dealing with infrastructural challenges regarding lecture halls and other amenities.

Our major challenge has to do with infrastructure, such as computer laboratories.

The theme from the challenges are:

There is a lack of resources, especially material resources, in the departments.

4.13 Thematic Analyses of Open-ended Questionnaire (Suggestions for improvement of the MEPs of the TEUs)

Section F of the questionnaire for pre-service teachers and teacher educators required them to suggest measures to put in place to improve the training of pre-service mathematics teachers. The questions were categorised into academic standards, curriculum development and implementation, academic leadership, learning culture, evaluation methods/practices, resources, and suggestions. The responses from the participants were thematically analysed, and the themes from the analyses are presented below.

4.13.1 Suggestions for the Improvement of the Academic Standards of the MEPs of the TEUs of Ghana

1. There should be supervision and training of teacher educators. Teacher educators should be supervised regularly to implement proper classroom practices. There should also be regular training for teacher educators to update them with the necessary current information in the training of pre-service teachers.
2. Lessons should be more practical and student-centred. Practical lessons can present a replica of what happens on the field in the classroom, which can motivate and retain attention in the classroom.

3. Resources are needed, including lecture halls, and enough teacher educators should be provided. The leadership of the TEUs must ensure that all the necessary resources are available to pre-service teachers and teacher educators for maximum learning experiences.
4. Educational activities such as inter-university competitions and international seminars should be regularly organised to give pre-service teachers exposure. Exposure to other education systems through such activities will enhance pre-service teachers' exposure and experience with other education systems.
5. The curriculum should be regularly updated to include more mathematics content and meet international standards. Mathematics content is the basis of the programmes, and there must be enough content for easy application in the classroom after graduation.
6. ICT integration should be a core aspect of the programme's curriculum. The world today revolves around technology; it is, therefore, important that the MEPs are engulfed in technology to equip pre-service teachers with enough knowledge for implementation in the classroom
7. Interviews and entrance examinations should be compulsory for the admission of pre-service teachers. The best pre-service teachers must be recruited for training. The TEUs should involve interviews and entrance examinations in the admission process to recruit the best pre-service teachers for training.

4.13.2 Suggestions for the Improvement of the Curriculum Design, Development and Implementation of the MEPs of the TEUs of Ghana.

1. Pre-service teachers' views should be considered in curriculum development. The TEUs should consider the input of pre-service teachers when developing the curriculum.
2. The curriculum should be regularly updated to meet 21st-century demands. The universities should ensure that the curriculum for training is constantly updated according to the needs of present conditions and societal demands.

3. The curriculum should be practical-based and student-centered. The universities must ensure that pre-service teachers are made the focal point of the curriculum.
4. ICT integration should be enforced in the implementation process. The curriculum design should incorporate and suggest ICT tools for the various course topics to enforce the use of ICT tools.
5. All stakeholders should be involved in the development process. All stakeholders, including head teachers and graduates of the programmes, should be contacted for their insights during the design and development of the curriculum.
6. There should be a balance between content and pedagogy. The curriculum should be designed to sufficiently accommodate pedagogy and content to ensure pre-service teachers have the best experience during their training.

4.13.3 Suggestions for the Improvement of the Academic Leadership Practices of the MEPs of the TEUs of Ghana

1. Regular leadership seminars should be organised for teacher educators and pre-service teachers. Teacher educators and pre-service teachers should be exposed to leadership through seminars and conferences to help them understand their leaders and prepare them for future leadership positions.
2. Pre-service teachers should be made part of decision-making on matters that concern them. Leaders should always involve students when decisions are made that will directly or indirectly affect pre-service teachers. The TEUs can do this through the student leadership on campus.
3. Leaders should maintain cordial relationships with students to make them approachable. Pre-service teachers' ability to fearlessly approach leadership is essential to their professional and academic growth. Pre-service teachers' ability to approach leaders enables them to share their challenges with the leaders to be addressed.
5. Pre-service teachers should be encouraged to take leadership positions to prepare them for the future. Leadership should encourage pre-service teachers

to accept leadership positions as a training ground for preparing leaders for future positions.

6. The selection of leaders should be transparent. The leadership selection process should be done according to the institution's regulations, without external influences and in a bias-free manner.

4.13.4 Suggestions for the Improvement of the Learning Culture of the MEPs of the TEUs of Ghana

1. Group learning should be encouraged to allow high-performing students to help low-performing students. Encouraging group studies enables students to help each other academically and breeds the spirit of cooperation among pre-service teachers.
3. More learning centres (summer hats) should be constructed for group studies. Small group centres with boards and electricity access should be constructed on campus to encourage group studies among pre-service teachers.
5. More emphasis should be put on creating a friendly learning environment. A friendly learning environment breeds cooperation among learners and educators.
6. IT-enabled learning platforms should be inculcated to improve pre-service teacher self-studies. IT-enabled platforms enable learners to learn themselves and at their own pace.

4.13.5 Suggestions for the Improvement of the Evaluation Methods/Practices of the MEPs of the TEUs of Ghana

1. Alternative forms of evaluation should be used. Using different assessment methods helps to get the best out of all students, as some students tend to perform better in some assessment methods than others.
3. Evaluation should be free and fair. The TEUs should ensure that all assessments are devoid of activities that give some students undue advantages.
4. Evaluation should be more practical. Teacher educators should be encouraged to use more practical procedures to assess pre-service teachers.

5. Feedback on assessments should be quick for corrections. Teacher educators must ensure that assessment results are returned to pre-service teachers as quickly as possible for them to be able to learn from their mistakes.

4.13.6 Suggestions for the Improvement of the Resources of the MEPs of the TEUs of Ghana

1. Resources, material (lecture halls, ICT tools, TLMs, library books, etc.) and humans (teacher educators) should be provided for effective academic activities.
2. ICT resources, such as SMART boards and internet facilities, should be provided for integration.

4.13.7 Other Suggestions for the Improvement of the MEPs of the TEUs of Ghana

1. The duration of Off-Campus teaching practice should be increased to improve pre-service teachers' field experience. Off-campus teaching practice serves as a means of offering pre-service teachers practical experience of the things learned from the classroom.
2. The Universities must ensure the mentors assigned to pre-service teachers during OCTP are experienced and trained to guide pre-service teachers. Proper training should be given to school teachers who mentor during OCTP. The TEUs should also monitor the mentors to ensure they guide pre-service teachers as expected.
3. Pre-service teachers should be allowed to select schools of their choice for OCTP. Due to the economic difficulties attached to OCTP, allowing pre-service teachers to choose their schools enables them to deal with these difficulties in their own way.
6. Teacher educators and pre-service teachers should be motivated by introducing incentives, allowances and scholarship opportunities.

7. The curriculum should train pre-service teachers holistically to fit into other sectors outside education. Due to the scarcity of jobs after graduation, training pre-service teachers to fit into other sectors should be essential to the TEUs.

4.14 Data Triangulation and Interpretation

Table 4.63 presents the findings from different data sources for an objective during the study.

Table 4.63: Triangulation of Findings from Different Data sources

Sr. No.	Findings from different data sources	
1.	Academic Standards of the TEUs MEPs	
	Pre-service teachers (Questionnaire)	Teacher Educators (Questionnaire)
	<p>1. The participants agree that the MEPs have suitable academic enhancement activities</p> <p>2. The participants agree that the MEPs have a conducive learning environment for learning of the TEUs</p> <p>3. The participants agree that there are enough learning resources in the MEPs of the TEUs</p> <p>4. The participants agree that the Teaching-learning activities enhance the academic standards of the MEPs</p> <p>5. The participants agree that there are good leadership practices in the MEPs of the TEUs.</p>	<p>1. The participants agree that the admission processes are free, fair and devoid of biases</p> <p>2. The participants agree that the staff recruitment process is good but that supervision of academic activities is poor. Also, the participants are in favour of the staff development measures of the MEPs of the TEUs.</p> <p>3. The participants agree that teaching-learning activities are suitable in the MEPs of the TEUs</p>
2.	Curriculum Design, Implementation and Development of the TEUs MEPs	
	Pre-service teachers (Questionnaire)	Teacher Educators (Questionnaire)
	<p>1. The participants agree that the curriculum design is good for the MEPs of the TEUs.</p> <p>2. Though the participants are positive towards the curriculum development process, it was revealed that students are less</p>	<p>1. The participants agree that the curriculum design is good for the MEPs of the TEUs.</p> <p>2. The participants are positive towards the curriculum development process.</p>

involved in the development process

3. The participants agree that the implementation of the curriculum is good in the MEPs of the TEUs

3. The participants are positive about the curriculum implementation process. They agree that the curriculum is implemented well.

3.

Challenges Encountered in the Training of Pre-Service Teachers

Pre-service teachers (Questionnaire)

Teacher Educators (Questionnaire)

1. Though the participants did not indicate a lot of academic challenges, it was revealed that situations like strike action on the part of teacher educators are rampant and disrupt academic activities

2. The participants indicate resource challenges, including a lack of enough lecture halls, computers in the computer laboratory, poor functioning of the counselling centre, and lack of enough sporting facilities.

3. It was revealed that the participants faced several welfare challenges, including a lack of recognition and lack of support from the administration.

4. The responses indicate that economic challenges are the most pressing of the challenges the students face. Among the economic challenges the participants face are high living expenditure, expensive accommodation, difficulty finding accommodation for rent, high financial obligations towards the programme, expensive accommodation on campus, and expensive food commodities.

1. The participants see the lack of enough time for training of pre-service teachers and the lack of enough teacher educators as the academic challenge of the MEPs of the TEUs.

2. The participants have challenges with resources, including lack of enough lecture halls and unavailability of ICT tools for integration

3. The Challenges indicated by the participants include a lack of opportunities for professional development, low remuneration, and a lack of maintenance of balance between work and life.

4.

Evaluation procedures

Pre-service teachers (Questionnaire)

1. The pre-service teachers understand the concept of evaluation. All the interviewees were able to explain the concept correctly.
2. The pre-service teachers are made aware of the evaluation processes of the various courses at the beginning of the semester.
3. Different forms and types of assessment (Tests, quizzes and practical assessments) are used within the semester.
4. Pre-service teachers are satisfied with the organization of internal examinations.
5. Feedback on internal examinations is quick; scores of internal examinations are received mostly within a week.
6. Pre-service teachers are satisfied with the outcome of internal assessment as pre-service teachers have the opportunity to correct errors after marking.
7. Pre-service teachers are satisfied with the organization of external examinations.
8. Pre-service teachers are not satisfied with the outcome

Analyses of Course Outlines (Document Analyses)

1. The pre-service teachers are made aware of evaluation procedures at the beginning of the semester.
2. The teacher educators utilise different assessment procedures in the evaluation process.
3. The teacher educators recommend reference materials for pre-service teachers.
4. Essential information such as course content, relevant previous knowledge, course objectives, and teaching and learning methods are made available to the pre-service teachers at the beginning of the semester.

of external examinations.

9. Pre-service teachers are satisfied with the assessment of
Off-Campus Teaching Practice (OCTP)

4.15 Major Findings of the Study

The study's major findings are presented below:

Demographic Characteristics Sample

1. Male Dominance: 83.6% of pre-service teachers are male, while 16.4% are female.
2. High-Performing Applicants: The MTE programmes attracts high-performing applicants, with the lowest admission aggregate score being 29.

Status and Future Direction

3. Programmes Doing Well: The programmes are doing well and are up to their mandate, but there is room for improvement.
4. International Recognition: The programmes have international recognition, with majority of the graduates gaining employment and admissions worldwide.

Academic Standards

5. Regular Academic Activities: Academic activities are regularly organized to equip teacher educators and pre-service teachers with current knowledge in mathematics education.
6. Commitment to Professional Development: Teacher educators are committed to their professional development, with 39.1% attending at least seven professional development programmes and 53.6% publishing at least seven journal articles over the last five years.

Curriculum Design, Development, and Implementation

7. Multidisciplinary Curriculum: The curriculum is designed on the principles of multidisciplinary, professionalism, innovation, and ethics, aligning with national goals and priorities.
8. Content Knowledge: The curriculum has enough content knowledge to equip pre-service teachers with the needed knowledge for classroom application.

Evaluation Procedures

9. Satisfaction with Internal Evaluations: Pre-service teachers are satisfied with the evaluation of internal examinations but not with the evaluation of external examinations.

Resources

10. Availability of Learning Resources: Pre-service teachers reported the availability of learning resources for effective academic work.
11. Lack of Basic Resources: Observations revealed that some departments lacked basic resources, such as lecture hall desks and lecture halls.

Academic Leadership Practices

12. Enhancing Teacher Educator Supervision: The findings revealed that the supervision of teacher educators did not meet expected standards. Strengthening this supervision is essential to improving the quality of learning experiences.
13. Dissatisfaction of Leadership Appointment: The analyses revealed that, the teacher educators were not satisfied with the appointment of the leadership of the department and the university as a whole.

Learning Culture

14. Learning Culture: There is generally a learning culture in the MEPs of the TEUs of Ghana that engages students to collaborate and share.
15. Approachable Teacher Educators: Teacher educators are approachable and encourage group discussion among pre-service teachers.

Challenges Encountered

16. Resource Challenges: Pre-service teachers face several resource challenges, including few lecture halls, lack of computers, and poor functioning of counselling centres.
17. Economic Challenges: Pre-service teachers face economic challenges, including high cost of food, high living expenditure, expensive accommodation, and high financial obligations towards the programme.

Suggestions for Improvement

18. **Emphasis on ICT Integration:** Emphasis should be placed on ICT integration. ICT tools, including SMART boards, projectors, computers and educational software, should be provided for easy incorporation by teacher educators and pre-service teachers.
20. **Balance between Content and Pedagogy:** There should be a balance between content and pedagogy. The curriculum should be designed to sufficiently accommodate pedagogy and content to ensure pre-service teachers have the best experience during their training.

Integrated teacher education curricula are unique and offer several advantages for training quality teachers. In integrated teacher education programmes, pre-service teachers are exposed to pedagogical techniques and educational theories early in their academic careers when B.Ed. Components are introduced, facilitating a more progressive and immersive learning environment (Kumar, 2024). The MTE programmes in Ghana's TEUs are integrated four-year programmes with curriculum designs to equip prospective mathematics teachers with CK, PCK, and PK simultaneously. The MTE programmes of Ghana's TEUs represent a transformative approach to mathematics teacher training, focusing on the synthesis of CK, PCK, and PK. This integration is essential for developing well-rounded mathematics teachers who can efficiently navigate and implement different educational strategies in the classroom.

The integrated nature of the MTE programmes ensures that these three important aspects (CK, PCK AND PK) of the training process are inculcated into the pre-service teachers simultaneously, which is an added advantage since classroom activities demand teachers to utilize these skills simultaneously. This system ensures several benefits towards the quality of the training process. Some of these benefits have been discussed in the preceding paragraphs of this study section.

The MTE programmes allow comprehensive training in content knowledge and pedagogy. The programmes combine subject-specific coursework with pedagogical training, ensuring that pre-service teachers are knowledgeable separately in subject areas and methodologies and conversant with marrying these two important aspects in the classroom for quality output. This dual focus allows pre-service

teachers, after completion, to be able to create developmentally appropriate and engaging learning experiences for students at various educational levels NCTE (2024). By grounding teacher candidates in both content and pedagogy, the MTE programmes prepare them to effectively address the complexities of modern classrooms.

One significant advantage of the MTE programmes is the multidisciplinary learning advantages of the system. The integrated curriculum of the programmes allows teacher educators to draw connections between various aspects and the various courses for better understanding and quality output. For instance, a lesson on calculus might incorporate elements of ICT, pedagogical approaches, and social physics, enabling students to understand the topic from multiple perspectives. Multidisciplinary approaches involve learning from different subjects, which might demand the involvement of specialists in those subjects, but the findings revealed that the teacher educators hardly invited other teachers into their lessons. This has the potential to prevent the pre-service teachers from benefiting from the multidisciplinary nature of the programmes' curriculum. According to the NEP-2020, a multidisciplinary education seeks to enhance people's moral, intellectual, emotional, physical, and social abilities (NIC and Prajapati, 2022). This holistic view promotes better understanding and retention of knowledge as students learn to apply concepts across disciplines. Interdisciplinary education is encouraged via integrated teacher education programs, which allow prospective teachers to gain classroom experience while learning more about a subject (Gupta, 2024).

Blended Learning Opportunities are also exposed through the MTE programmes. The programme's curriculum enables teacher educators to blend learning techniques. Traditional classroom approaches are made more vibrant with the involvement of digital resources and experiential learning opportunities through practical activities. This flexibility caters to diverse learning styles and helps students engage with the material meaningfully. For example, integrating technology into lessons allows teachers to utilize interactive tools that enhance student participation and collaboration (Fitzgerald & Evans, 2024).

Curriculum design and development are aspects from which the MTE programmes benefit immensely. The nature of the curriculum creates a thematic

integration pattern, allowing easy understanding of every aspect of the training for pre-service teachers. The emphasis on thematic integration is such that lessons in the various courses are planned to be organized around central themes that connect the CK, PCK, and PK needed to produce quality mathematics teachers. This approach makes learning more relevant and encourages critical thinking as students explore how different aspects interrelate to understand concepts better. Interdisciplinary thematic learning has emerged as a significant educational pathway for training (Ye & Xu, 2023). The thematic nature also encompasses different subjects and courses for greater concept deliberations and understanding. For instance, a project on the application of statistics can encompass scientific principles, ICT applications, and ethical considerations.

The integrated nature of the MTE programmes of the TEUs in Ghana allows for continuous development of the programmes' curriculum. Because of its dynamic character, MTE programmes require constant curriculum development considering societal demands and contemporary educational requirements. Teachers who receive training using this model are prepared to modify their methods in response to student input and new findings in education, guaranteeing that the curriculum is current and valuable. Though this is the situation, the development of the programme's curriculums needs to be executed correctly to produce quality mathematics teachers for current educational needs. This should involve pre-service teachers' inputs, which the study's findings have revealed is not the case. Students gain from curriculum development in the following ways: relevance and practical application, satisfaction of needs and interests, and improvement of critical thinking and problem-solving abilities (Nursaputri and Aisyah, 2024).

By giving pre-service teachers the tools they need to create a vibrant learning environment, Integrated Teacher Education Programmes (ITEP) play a critical role in determining the direction of education in the future. ITEP improves curriculum design and implementation by highlighting the integration of instructional methodologies, multidisciplinary approaches, and topic knowledge. Such programmes are essential in training teachers to meet the varied needs of their students while encouraging a thorough comprehension of interrelated subject matter as education continues to change.