TEACHERS' PROFESSIONAL COMPETENCE, QUALITY OF INSTRUCTION AND CLASSROOM CLIMATE AS PREDICTORS OF SECONDARY SCHOOL STUDENTS' INTEREST AND ACHIEVEMENT IN MATHEMATICS IN IBADAN, NIGERIA

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CERTIFICATION

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DEDICATION

I dedicate this thesis to the Almighty God, who granted me the mental clarity and physical stamina to begin and finish this task, also, to my late Dad, Mr. Olasesan, Lawrence Olalekan, and to my late sister Mrs. Popoola Olakemi (nee Olasesan). Glory be to Almighty God. All praise and adoration belong to Him.

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ABSTRACT

Mathematics is an important subject capable of equipping student in dealing with analytical issues and for gaining admission to read science-related disciplines in higher institutions in Nigeria. However, reports from Teacher Registration Council of Nigeria have shown that Mathematics Teachers (MT) are deficient in professional practice. This study, therefore, was carried out to examine teachers' professional competence (content and pedagogical knowledge), quality of instruction (lesson development, set induction, content presentation, content communication, questioning techniques, and management), and classroom climate (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) as predictors of Secondary School (SS) students' interest and achievement in mathematics in Ibadan, Nigeria

The study was underpinned by the Human Capital Theory, while the correlational design was adopted. Four Local Government Areas-LGAs (Ibadan Southeast, Ibadan North, Egbeda and Akinyele) were randomly selected. The simple random sampling technique was used to select 20 SSs (five from each LGA). Twenty MT participated in the study. A total of 1200 SSII students (60 per school) were randomly selected. The instruments used were Teacher Content Knowledge Test (r=0.85), Pedagogical Knowledge (r=0.79), Quality of Instruction (r=0.77) Observation rating scales, Classroom Climate Inventory, Students' Interest in Mathematics Questionnaire (r=0.87) and Mathematics Achievement Test (r=0.75). Data were analysed using Pearson product moment correlation and Multiple regression at $p \leq 0.05$

Majority (85.0%) of the teachers possessed professional qualification and 90.0% of them had more than 10 years teaching experience. Teacher content knowledge (r=-0.57) had negative significant relationship with students' interest in mathematics, while personalisation (r=0.33), involvement (r=0.18), student-cohesiveness (r=0.36), satisfaction (r=0.68), task-orientation (r=0.47), innovation (r=0.21) and individualisation (r=0.11) had positive significant relationships with students' interest in mathematics. Pedagogical knowledge (r=-0.53) and set induction (r=-0.61) had negative significant relationships with students' achievement in mathematics, while teacher content knowledge (r=0.51) and satisfaction (r=0.68) had positive significant relationship with students' achievement in mathematics. The composite contribution of teachers' professional competence to students' interest was significant ($F_{(2, 17)}$=4.36; Adj. R^2=0.26), accounting for 26.0% of its variance. The composite contribution of teachers' professional competence to students' achievement was significant ($F_{(2; 17)}$ = 5.97; Adj. R^2 = 0.34), accounting for 34.0% of its variance. The composite contribution of classroom climate to students' interest was significant ($F_{(7; 1154)}$ = 86.33; Adj. R^2 = 0.34), accounting for 34.0% of its variance. The composite contribution of quality of instruction to students' interest and achievement were not significant. There was no composite contribution of classroom climate to students' achievement. Teacher content knowledge (β=0.54), pedagogical knowledge (β=-0.10), personalisation (β=0.11), cohesiveness (β=0.07), satisfaction (β=0.36), task orientation (β=0.16) and innovation (β=0.08) made relative contributions to students' interest in mathematics. Pedagogical knowledge (β=-0.42) and set induction (β=-0.80) made relative contributions to students' achievement in mathematics.

Teachers' professional competence and some classroom climate variables enhanced secondary school students' interest in mathematics, while pedagogical knowledge and set induction improved their achievement in mathematics in Ibadan, Nigeria. Mathematics teachers should focus on these factors to improve students' interest and achievement in mathematics.

Keywords: Mathematics teachers content knowledge, Pedagogical knowledge, Classroom climate, Interest and achievement in mathematics

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1.1 Background to the study

Mathematical knowledge is necessary in every element of human life. To efficiently carry out their daily activities, businessmen and women, technologists, scientists, educators, researchers, government officials at all levels, multinational businesses, and others make use of it. The bedrock of science and technology is mathematics, and no country can survive unless a significant section of its population is educated in science-related subjects (Ali and Hassan, 2019; Ogbe and Omenka, 2019). As a result, thinking mathematically can aid a country's economic, technological, and political development.

Many academics have emphasized the importance of mathematics. According to Baker, Bailey, Larsen, and Galanti (2017), mathematics is a critical tool for future progress, and every country that invests in it is investing in its future. The progress of such a country can be considered to be centered on the advancement of mathematical education. Furthermore, it is viewed as one of the most vital disciplines for students' long-term success. This is due to the fact that as a key subject, its applications cut across all aspects of life, including commerce, computer processing, engineering, and music. It is a crucial school subject because it is linked to many academic and professional prospects (Akinsola and Tella, 2001). Mathematics is more than just a tool for calculating numbers; it is also a tool for deciphering structures, relationships, and patterns in order to provide answers to complicated real-world issues (Andaya, 2014). It is a subject that promotes all facets of human endeavour and in the study of many disciplines. The study of mathematics helps develop logical thinking and analytical skills (Okunuga, Awofala and Osarenren, 2020; Amusa, 2020).

Mathematics is one of the most vital subjects that cannot be ignored (Kyari, Obed and Yalwa, 2018; Mazana, Montero, and Casmir, 2019). Also, one of the required subjects in the secondary school education is mathematics. According to Okolo and Kolawola (2021), Fekumo and Omeka (2022), and Ochoche and Oguche (2022), understanding mathematics is necessary for comprehending other subjects in school. Mathematics aids the comprehension of various fields of knowledge. In one way or another, mathematics is used by almost everyone. Mathematical skills are necessary in every field, including science, art, and business.

Many challenges in our daily lives cannot be resolved without the use of numbers and mathematical evidence. Mathematics provides a better grasp of the universe. It aids the development of a person's cognitive capacities. It is a foundational science that required to comprehend many other aspects of human learning and education (Ogbe and Omenka, 2019). As a result, regardless of the course applied for, students are expected to pass the subject in order to get entrance to tertiary institutions.

Increasing students understanding of mathematics is the main objective of teaching mathematics, which will better position them for future learning and active citizenship (Niss and Hojgaard, 2011; Sodangi, Isma'il and Abdulrahaman, (2022); Damrongpanit, 2022). As stated in the Federal Republic of Nigeria, (2013) national policy on education, that teaching mathematics at the senior secondary school level are to: cultivate an interest in mathematics and provide a strong basis for daily life; promote the desire and ability to be accurate to a degree relevant to the task at hand; cultivate and apply logical and abstract thinking; enhance the capacity to recognize problems and resolve it using relevant mathematical skills; give students the foundation in mathematics they need to continue their study. Hence, the primary drive of mathematics education is to promote mathematics learning and to create innovative methods to make interaction during the learning process of the subject more comfortable.

Regardless of the relevance of mathematics in the society, many students have lost interest in the subject either because they perceive the topics to be excessively difficult or are unaware of the professional opportunities in the area. Studies show that as students move from primary to secondary school, their interest in mathematics declines, owing to the erroneous belief that mathematics is a difficult subject (Onwuka, Iweka, and Monseri, 2010; Unodiaku, 2013).

Interest is a major concept and a significant factor of students' successful learning in mathematics. Imoko and Agwagah (2006) define interest as an intellectual care for and curiosity about someone or something. Interest is one of the most essential factor in learning. Any activity in the classroom can only achieve a desirable goal if the student is interested in it. In addition, Oladele (2005) described interest as a persistent desire to focus on and take pleasure in a certain behavior or event. He went on to say that interest is a powerful motivator that should be pursued at all times in order for meaningful learning to occur. One characteristic that is widely considered to affect learning outcomes is interest. In other words, having a keen interest in a subject enhances learning, which produces better outcomes. In the independent notions of mathematics teachers, interest plays a vital part as a helpful aspect.

There is a frequent misunderstanding that mathematics is difficult, boring, abstract, and full of countless volatile theorems that are difficult to understand, which has been repeatedly demonstrated in the literature to be the cause of students' low interest in the subject (Akinsola, 2023; Akunne and Anyanmene, 2021; Themane and Luneta, 2021; Tembe, Anyagh and Abakpa, 2020; Popoola and Adeleke, 2019). According to Schukajlow (2015), secondary school students' enthusiasm in learning mathematics drops year after year. Students become dissatisfied with their education, especially when the teacher merely shows difficulties in abstract forms (Sousa, 2007). If the mathematics teacher wishes to enjoy the class and improve the learning outcome, students' interest in the mathematics cannot be ruled out.

One of the student factors that affects learning and student learning outcomes is interest (Eniayeju and Jibrin, 2012 and Ojo, 2022). When students are learning mathematics, interest is very significant in the classroom. According to Eniayeju and Jibrin, (2012) and Ojo, (2022), students tend to appreciate the subject more as they perform better in it, and vice versa. Regardless of how crucial it is for students to be interested in the learning process, it is sad that interest drops significantly during adolescence and in secondary school. This drop is especially noticeable in mathematics (Frenzel, Watt, Goetz, and Pekrun, 2010; Orpinell, Fournier, Riss, Nagy, Krebs, Frontini, and Tora, 2010). Imoko and Agwagah (2006) revealed that students' performance in mathematics at all levels of schools is significantly affected by their lack of interest in the subject especially among public secondary school students.

The level of students’ performance in public examinations, particularly at the secondary education level, is one of the primary issues confronting Nigeria's educational system. The low performance of secondary school students in public examinations, notably in mathematics, has been documented in studies and articles published in local newspapers for years (Adeyemi, 2008). Students' performance in mathematics in the Senior School Certificate Examination (SSCE) has been fluctuating for few years ago. As a result, working towards maintaining excellent performance in internal and, for the most part, external examinations are essential.

Mathematics education is essential to every person's life, since no nation can develop technologically without putting mathematics in the appropriate position.

According to Kolawole and Ala (2014), mathematics teaching is very significant to all human beings because it is all about getting answers to specific questions. Mathematics' importance in developing adaptable and resourceful graduates needed in the teaching profession and for economic development cannot be overstated. It is a fundamental scientific subject that is required for understanding of the majority of other subjects; no other subject has such a strong presence among the numerous divisions of science. Mathematics, according to the National Council of Teachers of Mathematics (2016), is the core intellectual discipline of technological society. However, it is discouraging that study and information obtained from national examination bodies like the West African Examinations Council (WAEC), the Nigerian owned National Examination Council (NECO) and the National Board for Technical Education (NABTEB) have shown a consistently low performance in this subject.

For instance, table 1.1 shows the breakdown of West African Senior School Certificate Examination Council (WASSCE) mathematics grades of May/June 2011 to 2020 in Oyo State.

Table 1.1. Statistics of students' performance in mathematics at WASSCE (May/June) 2011 - 2020 in Oyo State

Year	**No of candidate examined**	**No. and % of candidates with A1-C6**		**No. and % of candidates with D7-E8**		**No. and % of candidates with F9**	
		No	%	No	%	No	%
2011	46971	7097	15.11	11463	24.41	28411	60.48
2012	41359	13390	32.38	13024	31.49	14945	36.13
2013	43357	13403	30.91	3144	7.25	26810	61.84
2014	45591	14335	31.44	11610	25.47	19646	43.09
2015	54404	12553	23.07	14260	26.21	27591	50.72
2016	40934	16861	41.21	12749	31.14	11324	27.65
2017	24484	17840	72.86	4338	17.72	2306	9.42
2018	32020	23266	72.66	8664	27.06	90	0.28
2019	45812	25304	55.23	12579	27.46	7929	17.31
2020	44430	23922	53.84	12579	28.31	7929	17.85

Source: Science, and technology. planning, research and statistics development of Oyo state ministry of education

Table 1.1 shows that the percentage of candidates who pass with credit is consistently low between years 2011 and 2016. In 2017 and 2018, there was an increase in the percentage of candidates with credit pass in Mathematics while it started decreasing in 2019. According to the aforementioned data, students' performance in mathematics was very poor, not up to 50%, between 2011 and 2016. According to the WAEC Chief Examiners report (WAEC 2014), the council has observed consistent mass failure in the SSCE mathematics examination over the years. In 2017, evidence from the table revealed a stable rise in the percentage of candidates with credit passes. The table showed that from 2017-2018 the average credit pass was above 70%. The best performance was in 2017 with credit pass of 72.81%. However, from 2019, the percentage of candidates with credit passes started to drop again.

Researches showed that students find some aspects of mathematics difficult to comprehend and such aspects include: reading and answering questions from graphs, and inability to apply mathematical principles correctly (Sousa, 2007; Bature and Atweh, 2020). Therefore, the chief examiner (WAEC, 2018-2019) submit that mathematics teachers should endeavour to pay more attention to topics that require drawing of graphs such as trigonometry, graphs, statistical graphs among others. According to them, teachers' competence should be stimulated to teach in schools. Shin and Shim (2021); Filgona, Sakiyo and Gwany (2020); Sabitu, Olosunde and Ajao (2022) also stated that teachers' mathematics competence is important for students' academic success and also for their future career.

Several variables have been identified as being responsible for students poor mathematics performance (Suan, 2014). According to Mezieobi, Nwankwo and Mezieobi (2017), Adzongo and Olaitan, (2019); Usman, (2020) and Ubogu, (2020), there are three major factors among others which are in the lead; these are teachers' professional competence, instructional quality and classroom climate.

The competence of teachers and the quality of instruction, in the opinion of Sardauna and Yusuf (2018), have been the key issues and worries of educators that worked on students' performance in mathematics. Several literatures have revealed that, some of the weaknesses and difficulties that adversely affect candidates' performance include teachers' professional competence that consists of poor knowledge of the subject matter, poor preparation, and poor pedagogical knowledge (Akintola, 2013; Ambe and Agbor, 2014; Guerriero, 2016; Robinson, 2017; Odumosu, Olisama and Areelu, 2018; Olasehinde-Williams, Yahaya and Owolabi, 2018; Akinbode, and Abati, 2019).

Mulder (2012) defines competence as the performance, condition, and standard necessary in instructional procedures. It is sometimes thought of as the capacity to put skills and knowledge to use (Saeed and Mahmood, 2002) and it is a sufficient skill and understanding to teach the student satisfactorily (Guerriero, 2016). Similarly, a teacher's competency effects the values, behaviors, communication, goals, and teaching methods of that instructor (Mulder, 2012). Therefore, having the requisite competence is a set of ability, knowledge, and beliefs that can be used by the teacher to create an effective learning process (Guerriero, 2016), and to succeed in learning and teaching of mathematics, every teacher should possess this competency (Rahman, 2014). It is a common belief that the educational performance of students in schools can be improved upon if competent mathematics teachers teach the students.

The aforementioned weaknesses and difficulties with mathematics bring a lot to the table of teacher who is crucial in the process of the teaching and learning of the subject (Osiesi and Odinko, 2019; Ibrahim, Yew and AbdRazak, 2020; Margaret, Emeka, Jacob and Olatunde-Aiyedun, 2021; Nonyelum, Ogugua and Abah, 2022). Akinsola (2023), reveals that teachers are one of the critical factors that contributed to difficulties with mathematics and noted that teachers are central and they have a major role on students learning in mathematics classroom. Teachers' professional competence (content and pedagogical knowledge) is a common challenge to students' performance in mathematics (Olubukola, 2015; Ram and Shashidhar, 2017 and Yusuf and Araba, 2019). Professional competence is skill that has to do with knowledge mastery. The teacher content and pedagogical knowledge, determine students' achievement in mathematics (Akinsola, 2023).

Content knowledge is the first element of a teacher's professional competence, which is the comprehension of the fundamental ideas and principles underlying the activity in a variety of contexts as well as the connections between them (Olasehinde-Williams *et al.*, 2018; Ntibi, Neji, and Agube, 2020). The importance of mathematics teachers' content knowledge of subject matter and pedagogical knowledge in the educational attainment of the students cannot be over-emphasized. Lots of studies have been carried on teachers' content knowledge and pedagogical knowledge (Baumert, Kunter, Blum, Brunner, Voss, Jordan, Klusman, Krauss, Neubrand, and Tsai, 2010; Kersting, Givvin, Thompson, Sangata, and Stigler, 2012). Teachers' subject-matter knowledge positively affects classroom instruction, making it a crucial consideration for mathematics teachers. The implication is that determining a student's degree of mathematics achievement depends on the professional ability of the teachers.

Pedagogical knowledge of teaching is the second aspect of a teacher's professional competence. Teachers' pedagogical competence is defined as their ability to manage learning, which involves planning, implementing, and evaluating learners' learning outcomes (Amie-Ogan and Etuk, 2020). Both teachers’ subject matter and pedagogical knowledge play important roles in classroom instructional delivery. Without a full grasp of subject matter and pedagogical knowledge, teachers may face difficulty in teaching mathematics effectively. The decisions that teachers make are influenced by their views, knowledge, judgments, and thoughts, which in turn shape their planning and activities in the classroom. According to Eggen and Kauchak (2001); Adegbola (2019), teachers frequently restate content or offer abstract clarifications that are unclear to their students when they lack pedagogical competence. A teacher's ability to successfully use representations and connections, draw on resources, comprehend students' thinking, and clearly explain mathematical topics depends on their understanding of sound pedagogical approaches.

However, secondary mathematics is poorly taught since some mathematics teachers lack subject matter expertise as well as the necessary pedagogical knowledge. Teachers encounter a variety of challenges, including a lack of subject matter mastery and pedagogical competence required to solve particular problems. Mathematics must be taught in a way that is clear, instructive, and enjoyable to students (Sparks and Sarah, 2011). As a result, outstanding education necessitates efficient systems that create an enjoyable learning atmosphere in the classroom, motivated professionals with correct grasp of their subject matter, pedagogical skills, and students who are healthy and eager to learn.

Besides, students’ poor performance in mathematics has also been credited to the teachers’ quality of instruction in secondary school (Oyeniran, 2010; Aborisade and Adebule, 2014; Farayola 2014 and Ugwuanyi, 2014). Insufficient instruction quality is one of the reasons of low academic achievement in the subject (Stuart, 2000). When the quality of instruction is high the information presented will make sense, will be interesting, easy to remember and apply by students. High quality instruction includes elements such as effective questioning and the use of assessment by teachers. The effectiveness of instruction students get in the classroom can be evaluated based on how well or poorly they perform on routine assessments (Ballard and Bates, 2008). The indices of quality of instruction are: lesson development, introduction, content presentation, content communication, questioning techniques, and management (Mezieobi, et al., 2017; Adzongo and Olaitan, 2019; Abdullahi, 2019). These indices have important characteristics that all the indices must be adequate for instruction to be effective.

Effective instruction is more than just effective teaching, and no matter how excellent the teacher, students will not acquire content if they lack the prerequisite knowledge or abilities, encouragement, or time. The amount of knowledge, level of interest, and amount of time that students have may not matter much if the quality of instruction is poor (Adzongo and Olaitan, 2019; Abdullahi, 2019). Each of the variables of the quality of instruction is like a link in a chain, and the chain is only as strong as its weakest link. It may be assumed that the six indices are interconnected, in that improvements in one variable may produce substantially larger learning gains and improvement in learning outcomes. The degree to which the lesson makes sense to students is the most crucial factor in determining the quality of instruction (Adzongo and Olaitan, 2019). Hence, the effectiveness of education is influenced by the students being given clear lesson objectives and a strong link between what has been taught and assessed (Adzongo and Olaitan, 2019).

Another significant factor that is examined in this study is classroom climate. This enhances students' engagement in learning not only teachers' instruction and classroom activities and this is important for student development (Adolphus, Aderonmu, and Naade, 2021). Classroom climate is one of the factors that help students take part and do well in learning outcomes (Reyes, Brackelt, Rivers, White and Salovey 2012). However, classroom climate in mathematics has not yet been thoroughly explored as a special factor. It is a mood or atmosphere formed when teachers and students are learning together in the same class, affecting each member's thoughts, emotions, attitude, learning, and motivation.

Classroom climate is made up of a large number of indices, which are personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation, all of which are a function of the open relationship between teacher and students (Ekpo, Akpan, Essien and Imo-Obot, 2009; Chinelo and Ogbah, 2013; Sinclair and Yerushalmy, 2016; Barr, 2016; Mohammadi, 2020). The open climate of the classroom is a direct function of these relationships. According to Sinclair and Yerushalmy, (2016) as well as Barr, (2016), classroom climate involves the shared perceptions of the students and the teachers. Having classrooms that provide instruction to diverse learners is more important now in this age of accountability and high stakes testing which necessitates an approach that considers the student's interaction with the classroom environment (Nwite and Aja-Okorie, 2017; Omodan, Kolawole and Fakunle, 2018). Furthermore, studies have noted that classroom climate predicts mathematics achievement and has a direct and indirect influence on students' achievement goals (Phan, 2008; Peters, 2013).

The key to raising students' mathematics achievement is being able to create and sustain a favorable classroom climate environment. A positive classroom climate seems to relate, enhance students and broaden the focus in education from academic learning to social and emotional development as well (Fakunle and Ale, 2018; Ndidi, and Effiong,2020; Abubakar, Luka, Isa, Falmata, Shehu, and Abubakar, 2020). Literature revealed that these classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) affect the teaching process which often lead to poor academic performance of students in schools (Mohammadi, 2020). Hence, a clear understanding of classroom climate is important for teachers so that it will improve students' performance in the subjects. Also, emphasis should be laid upon the elements of classroom climate, to improve the students' interest and performance in mathematics. It is the teacher who stimulates students' interest in the subject. With the students' help, teachers foster a positive classroom climate that encourages students to be comfortable and at ease in participating in all kinds of teaching-learning activities.

According to Khayati and Payan, (2014), classroom climate factors affect the students’ interest in the classroom. In another related study, Huetti, (2016); Watt, Carmichael, and Callingham, (2017) submit that classroom climate influence both the emotional and cognitive dimensions of students in mathematics which improves their interest in the subject. Difficulty in understanding mathematics, participating in the classroom lesson, doing and submitting assignments, teacher-student relationship, and classroom climate as well as sharing their ideas also affects the level of student interest. The mathematics teachers must be fully aware of their roles to their students inside the classrooms (Frenzel, et al., 2010; Lazarides and Ittel, 2013; Khayati and Payan, 2014; Azmidar, Darhim, and Dahlan, 2017).

Because the teacher is always the deciding factor in the classroom, (Okeke-James, Igbokwe, Ogbo, Ekweogu and Anyanwu, 2020; Akinsola, 2023) then there is a strong link between teachers' professional competence, quality of instruction, classroom climate and students' learning outcome. Though several studies have been carried out in relation to each of the independent variables and the dependent variable, most of these studies were carried out outside Nigeria and the few that were conducted in Nigeria were outside Oyo State, and in other subject areas different from mathematics. Little or nothing seems to have been done on the extent to which these teachers' professional competence, quality of instruction and classroom climate would predict secondary school students' interest and achievement in mathematics. In the light of this, the study examined teacher's professional competence, quality of instruction, and classroom climate as predictors of secondary school students' interest and achievement in mathematics.

1.2 Statement of the Problem

Mathematics plays important role in shaping how individuals deal with various daily activities. It is a compulsory subject in both primary and secondary school levels. It is also a prerequisite subject for gaining admission to virtually all disciplines in the tertiary institutions in Nigeria. However, the rate of poor performance of students in mathematics in public examinations such as WAEC on yearly basis cannot be overemphasised. Available evidence has shown that students exhibit low interest and poor performance in the subject due to many factors which have motivated many researchers to look into these factors. In addition, available reports show that inability to apply mathematical principles correctly, poor interpretation of questions and teachers' low level of competence contribute to persistent drop in students' performance. Apart from these, literature revealed that many researchers focused largely on instructional strategies and little attention was paid to other pedagogical and classroom factors till date. Also, few studies have established the effects of some of these independent variables (i.e. teachers' professional competence, quality of instruction and classroom climate) on students' achievement but none seems to have done in the area of joint contribution of the independent variables on the dependent variables. Hence, this study investigated the joint contribution of teachers' professional competence components (content and pedagogical knowledge), quality of instruction indices (lesson development, set induction, content presentation, content communication, questioning techniques, and management) and classroom climate indices (personalisation, involvement, students cohesiveness, satisfaction, task orientation, innovation, and individualisation) to senior secondary school students' interest and achievement in mathematics.

1.3 Research Questions

The study answered the following research questions;

1. What relationship exists between teachers' professional competence component (content and pedagogical knowledge) and students':

   i. interest in mathematics?

   ii. achievement in mathematics?

2. What relationship exists among teachers' quality of instruction indices (lesson development, set induction, content presentation, content communication, questioning techniques, and management) and students':

   i. interest in mathematics?

   ii. achievement in mathematics?

3. What relationship exists among classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) and students':

   i. interest in mathematics?

   ii. achievement in mathematics?

4. What is the joint contribution of teachers' professional competence component (content and pedagogical knowledge) on students':

   i. interest in mathematics?

   ii. achievement in mathematics?

5. What is the joint contribution of teachers' quality of instruction indices (lesson development, set induction, content presentation, content communication, questioning techniques, and management) on students':

   i. interest in mathematics?

   ii. achievement in mathematics?

6. What is the joint contribution of classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) on students':

   i. interest in mathematics?

   ii. achievement in mathematics?

7. What is the relative contribution of teachers' professional competence component (content and pedagogical knowledge) on students':

i. interest in mathematics?

ii. achievement in mathematics?

8. What is the relative contribution of teachers' quality of instruction indices (lesson development, set induction, content presentation, content communication, questioning techniques, and management) on students':

   i. interest in mathematics?

   ii. achievement in mathematics?

9. What is the relative contribution of classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) on students':

   i. interest in mathematics?

   ii. achievement in mathematics?

1.4 Scope of the Study

The study was delimited to mathematics teachers and senior secondary school II students in Ibadan, Nigeria. The study examined teachers' professional competence components (content and pedagogical knowledge), quality of instruction indices (lesson development, set induction, content presentation, content communication, questioning techniques, and management), and classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) as predictors of secondary school students' interest and achievement in mathematics in Ibadan, Nigeria.

1.5 Significance of the Study

This research will benefit policy makers and agencies in the education system, particularly when it comes to teaching mathematics in schools. It will assist policymakers in the education sector, such as the Nigeria Educational Research Development Council and the National Mathematical Centre, in developing a policy framework and action plan to propel the sector forward. It will improve academic teaching methods by revealing the most effective ways of impacting pupils with excellent mathematics instruction.

The study will impact all levels of education, from primary to tertiary, by bringing to bear the most cutting-edge methods for assuring successful teaching and learning processes. Students' enthusiasm for learning mathematics will be increased as a result of this study's findings, which will maximize students' interest and achievement in mathematics. The study's suggestions, if followed to the letter, will increase overall mathematics performance on both internal and external examination.

Additionally, this study will fill the gap of dearth of literature in students' interest and achievement in mathematics in Nigeria. Although there have been substantial studies in this area at the international level, this study will help indigenous researches in the discipline of mathematics education. Subsequent researchers will find the outcome of this study useful to them.

Furthermore, teachers in secondary schools will also benefit from the outcome of this study, as it will help them to understand the role of maintaining a classroom climate that promotes a sense of camaraderie in fostering effective teaching and learning experience with the students. It will also help them to understand the relevance of professionally equipping themselves with requisite skills for classroom activities. In all, this study will help teacher on how to best use their pedagogical knowledge and skills to stimulate students' interest and achievement in mathematics.

Finally, the findings of this study will be useful to a variety of stakeholders, including the government, parents, school administrators, higher education management, professional and educational bodies, and others, in adopting appropriate teaching methods that will foster students' achievement in their subjects, particularly mathematics.

1.6 Operational Definition of Terms

Teachers' professional competence: It include the following components:

- **(i)** **content knowledge:** represents teachers' understanding of the subject content taught as reflected by scores obtained from Teacher Content Knowledge Test.
- (ii) **pedagogical knowledge:** is the knowledge needed to make content accessible to students as reflected by scores obtained from Teacher Pedagogical Knowledge Observation rating Scale.

Quality of instruction: It include the following indices:

- **(i)** **lesson development:** the detailed plan that explains teacher's overall lesson objective and intends to measures.
- **(ii)** **set induction:** gaining students attention and give an overview about the lesson topics.
- **(iii)** **content presentation:** this is the way teacher deliver his/her content to the students.

(iv) **communication of content:** this is the way of convey a lesson in the classroom during lesson.

(v) **questioning technique:** a set of methods used by teachers when asking questions.

(vi) **class management:** the actions teachers take to establish and sustain an environment that fosters students' academic achievement as reflected by scores obtained from Teachers' Quality of Instruction Observation rating Scale.

Classroom climate: It include the following indices:

(i) **personalisation: the** action of presenting lesson by the teacher to meet students' learning in the class.

(ii) **involvement:** is the process of engaging students as partners in every facet of the classroom lesson.

(iii) **students' cohesiveness:** creating a bond between students and encouraging students to be committed to their own and their peers' learning.

(iv) **satisfaction:** is an attitude resulting from an assessment of students' educational experience in the classroom lesson.

(v) **task orientation:** getting a students done in the work in the class lesson.

(vi) **innovation:** making changes to everything that does not focus on rules in the classroom lesson.

(vii) **individualisation:** this is when the pace of learning is adjusted to meet the needs of each student by the teacher as reflected by scores obtained from Classroom Climate Inventory.

Students' Interest in Mathematics: This refers to an expression of students' dispositions toward mathematics as reflected by scores obtained from the Students' Interest in Mathematics Questionnaire.

Students' Mathematics Achievement: This refers to the performance of students as reflected by scores obtained from the Mathematics Achievement Test.

CHAPTER TWO
LITERATURE REVIEW

2.1 Theoretical Framework

2.1.1 Human Capital Theory (HCT)

Theodore Schultz proposed the human capital theory in the 1960s as an integrated picture of human behavior and social processes. The core concept underpinning human capital theory is that people's gain of knowledge is a source of economic progress. People's abilities to carry out tasks in ways that contribute value to the creation of societal, personal, and economic value would be enhanced if their skills, competencies, personality traits, and knowledge were developed (Mba, Mba, Ogbuabor and Ikpegbu, 2013). According to the HCT, people spend in training and education with the hopes of earning more money in the future (Tan, 2014). The objective of investing in human capital is not for immediate gratification, but for future monetary and non-monetary benefits. The improvement of students' capacity to learn mathematics will have a far-reaching impact on their performance later in life, and their input will ultimately bring value to the development of Nigerian economic growth. In light of this, human capital is a mode of production that entails the fact that increased investment leads to increased output (Mba *et al*., 2013). Human capital is viewed as an asset to productivity and financial growth, according to the notion, and is obtained through investments in education and skill development (Olaniyan and Okemakinde, 2008). The speed at which a country develops is determined by its human resources, different levels of education, skill, knowledge, abilities and expectancy that students would bring into the classroom in the course of learning mathematics. These would help in the attainment of a level of interest and achievement in mathematics.

McConnell, Brue and Macpherson (2009) reveal that a better-trained and educated person has the capacity to supply a huge amount of productive effort compared with those with less training and education. The wide acceptance of the value of human capital theory so as to increase the performance of the organization is essential; because the existence of the organization is contingent on the skill, ability and knowledge that the students acquire in the classroom while studying mathematics which they bring into the workplace later in life and this is a concept for value creation within the organizational setting.

There are different studies that have shown the significance of human capital theory. According to Olaniyan and Okemakinde (2008), the promotion of human capital would increase the level of economic growth in the society. Therefore, if there is a substantial effort geared towards developing the capacity of students in mathematics in secondary school, it would ultimately enhance their interest and achievement in the subject. This is because in order to maintain good students' character in the examination devoid of examination malpractices during mathematics examinations, human capital theory is of the view that the curriculum must be designed and structured in ways that would optimize the skills, knowledge and capacity of the students in mathematics which invariably would enhance their interests and achievement in the subject. In view of this, Mba *et al*. (2014) opines that it is the human resource of the country and not its material, capital and physical resources that determine the pace, social and economic development. Furthermore, Babalola (2003) asserts that the fundamental reason for human investment is due to the fact that there is a need for the new generation to acquire the relevant knowledge the previous generation had and how the existing knowledge could be used to better improve the performance of the current development in the country.

Human capital theory has been severely criticized by the liberal academicians as a result of its negative connotations with slavery in the 20th century. According to Mill (1909), a philosopher, who criticized human capital theory by saying that people cannot be classified as wealth, but it is the purpose for the existence of wealth (Mill, 1909). This imply that people need to pass through a capacity building that will enhance knowledge and skills of people for national growth and development. However, Schultz (1959) tagged these liberals' sentimentalists by asserting that those who treat human beings as commodity or machine could result in the justification of a slavery. To have a full grasp of HCT, there is a need to understand the principle of methodological individualism, which opines that the root of all social phenomena might be found in the behaviours of individuals. This is consistent with the assumption that human capital formation is naturally undertaken basically by those people who are interested in the maximization of their interests (Tan, 2014). In view of the foregoing, human capitalists do not make attempt of disregarding the non-monetary contributions of education to the secondary school students studying mathematics and the society at large.

The human capital economists also focus on the cultural, social, aesthetic and intellectual benefits of education to the young adults and they referred to this as positive externalities. Another human capital researcher Marginson (1993) stated that the line of assumption in HCT is that an individual acquires skills and knowledge with the aid of training and education and this is human capital. The skills and knowledge are expected to optimize the level of productivity of the secondary school students' interest and achievement in mathematics.

The increase in productivity will be reflected in performance in mathematics in both internal and external examinations in Nigeria and abroad. In consequence, these students would build on this feat in higher institutions of learning and their productivity will be enhanced when they secure opportunities in organizations that require their mathematics skills and competence. This would motivate people to keep investing in education up to the point in which private benefits equate private costs with regards to education. Thus, the logic of HCT is obvious in that training and education enhance human capital causing higher productivity rate and this ultimately increase the living standard of the people (Tan, 2014). Research has made known that quality of the educational structure is determined by the competence of its teaching staff and that a school without good human resources may not be able to achieve the goal and objectives of the educational system (Adeogun and Osifila, 2008; Osiesi and Fajobi, 2019; Ajadi, 2020).

According to Akinsola (2011); Peteros, Gamboa, *et al.*, (2020); Mabena, *et al.*, (2021); Chand, *et al.*, (2021), there are a number of issues that confront secondary school mathematics teaching and learning. These issues have been affecting students' success in their school certificate examinations at the end of their studies, resulting in a decrease in student interest in the subject. Many of these issues, however, have been researched; yet, students' performance at the end of the school program is still far from satisfactory (Akinsola, 2011; Adeniran, 2006). Despite the fact that multiple academics have offered approaches and tactics for teaching mathematics as ways to improve students' mathematics achievement, students' interest in the subject and achievement continue to fluctuate. As a result, increasing students' mathematical proficiency and interest is more than merely a result of bettering the instructional technique (Okebukola, 2007; Adeniyi, 2010; Obanya, 2010; Wong and Wong 2019; Tembe, *et al.*, 2020; Akunne and Anyanmene 2021).

Since education is so important, discussions about education and economic development in Nigeria have increasingly focused on the idea of human capital. Studies have demonstrated that raising educational standards accelerates production and helps to advance technology, which enhances human capital. Human capital was identified by Hargreaves and Fullan (2012) as a fundamental element of teachers' professional competence. The knowledge, abilities, competencies, and experiences of teachers make up their human capital (Hargreaves and Fullan, 2012; Reichenberg and Andreassen, 2018). On the other hand, human capital in education can be viewed as both an input and an output measured against the cumulative knowledge, skills, and abilities that systems at large have produced through a wealth of educational and training opportunities. Teachers who possess and acquire the necessary knowledge and abilities are considered to have high human capital in the teaching profession (Hargreaves and Fullan, 2012). According to Hargreaves and Fullan, a teacher's human capital also includes knowledge of their subject matter and how to teach it, an awareness of their students and how they learn, and the ability to support students from different backgrounds while also displaying emotional and social skills.

2.2 Conceptual Review

2.2.1 Teachers' professional competence

The concept of teachers' professional competence is a well pronounced concept in educational research generally. From the global perspective, professional competence is defined as the mechanisms which are put in place to enhance the knowledge of teachers and instructional practices (Bautista and Ortega-Ruíz, 2015; Alasoluyi, 2021). It is also the procedural and strategised plans fashioned to bring about changes in teachers' attitudes, beliefs, and approaches to teaching and instructional practices. The performance, condition, and standard that must be met in order for competence to be more than merely a job requirement or work activity are defined as competencies (Mulder, 2012). Competence is viewed as the capacity to put information and abilities to use (Saeed, and Mahmood, 2002; Abba and Rashid, 2020). Competence is having the knowledge and abilities necessary to perform a certain task successfully (Guerriro, 2016).

Every position requires a specialized talent, therefore handling a task requires the ability and capacity to complete it successfully and according to plan. But one requirement for a job or position is competence. Competence is a term that refers to a variety of skills that are categorized under knowledge, attitude, and skills to increase performance, according to Wordu and Isiah (2020). It is crucial to the pursuit of greatness by educators. The most important factor in raising student achievement and narrowing the achievement gap is a teacher's competence. A teacher's values, actions, communication, objectives, and instructional methods are influenced by their teacher competence (Mulder, 2012). Thus, teaching competence is a collection of teachers' skills, information, and viewpoints that is also employed to develop an efficient learning process (Guerriro, 2016). Competence can be discussed in this situation in a variety of ways (Kiymet, 2010; Eyo and Nkanga, 2020). This study was restricted to mathematics teachers' pedagogical competence and subject-matter knowledge.

In a definition by, Ololube (2006); Ambe and Agbor, (2014); Adetayo, (2016), competence in teaching simply implies the ability of the teacher to accomplish assigned duties of a teacher, of which teaching is the central part. In the current perspective, competence demands active participation in the communication of knowledge, a process in which the teacher displays mastery of the subject matter (Kanu and Ukpabi, 2007). As for Ayeni (2005), teacher's competence is determined by his methodology, sense of vision, and interest in sharing knowledge. It is a complete notion for human or organizational capabilities (John and Okpara, 2019; Abba and Rashid, 2020; Alasoluyi, 2021). Accordingly, competence may be personal, as in the case of a teacher, or non-personal, as in the case of a team. One rational component that satisfies the performance target for a desired state could be considered to be competence.

As far as authors in the field of health education is concerned, teachers' professional competence is conceptualized by Simkiss, (2011) as the knowledge, skills and attitudes framework which makes the health educators to understand, know, appreciate and be able to discharge their instructional roles as teachers. The author was also of the opinion that success in the health education is no longer measured by the amount of time invested in teaching but the level of teaching impact. As stated by Maryam, and Maryam, (2011) success of educational plans in each country depends on the teachers' professional competencies and professional skills. Therefore, it was argued that the teachers' curriculum should move away from the perspective of being a knowledge curriculum, but to a competency-based framework.

According to Moynihan, *et al.,* (2015) teachers' professional competence in health education are the basic and advanced research skills imbued both in the pre-service, in-service and the continuous responsibilities of the teachers in molding the future health workers. They posited that such training should include domains of assessment, planning and implementation. Whereby, skills in planning, implementing and assessing whole school health promoting activities. Without doubt the skills to plan, implement and evaluate health promoting activities are central to successful and sustainable health education in schools.

In the perspective of Even (1993); Onyilo and Shamo, (2017); Amie-Ogan and Etuk, (2020), maintained that teachers' professional competence is approached from two perspectives of knowledge of subject matter and pedagogical knowledge. The most important domains are knowledge of subject matter and pedagogical knowledge used in teaching a subject and in the teaching and learning process, it involves teachers' competence in delivering the conceptual approach, relational understanding and adaptive reasoning of the subject matter (Filgona *et al*., 2020). These components used together are central in the effective teaching and learning process. Thus, to streamline the review under this subheading, the study focused on these two classifications. Teachers' professional competency is divided in this study into two, namely, knowledge of subject matter and pedagogical knowledge. Knowledge of the subject and pedagogical knowledge, which are the fundamental elements of teaching professional competency in mathematics classrooms and the crucial knowledge effecting student accomplishment, imply that the teacher has a thorough understanding of the subject (Danä and Taniazli, 2018).

In the current perspective, Blömeke and Delaney (2012) classified teachers' professional competence into two main components namely; knowledge of subject matter and pedagogical knowledge. According to Onotere, *et al.*, (2021), a teacher's subject-matter knowledge and pedagogical knowledge abilities are under his control so that he can carry out the behaviors of the cognitive, affective, and psychomotor domains of objectives as much as feasible. Mathematical teachers that are competent in their subject matter know what preparatory information is required to teach a particular topic, what the right examples and homework are, and what kinds of illustrations can be utilized. According to Danä and Taniazli (2018) research, teachers' knowledge of subject matter and pedagogical knowledge were found to be important determinants of students' academic achievement.

2.2.1.1 Content knowledge of subject matter

Conceptually, content knowledge as far as teachers' professional competence is concerned is viewed by Heggart, (2016); Ntibi, *et al*. (2020) as the basic requirement qualifying an individual to teach a concept. The argument of the author is premised on a fact which centred on the teacher being in the possession of the knowledge he or she intends to teach. Certainly, in high schools, where teachers often specialize into one or two subject areas, there is a real emphasis on the subject matter knowledge of the teacher-which is why, the claim goes, that if you want to teach history, you should first learn a lot about history, and if you want to teach mathematics, then you should get a degree in mathematics.

Akpan, Essien and Obot (2008); Ntibi *et al*., (2020) affirmed that one of the most important teacher variables that enhance their success is the mastery of the subject matter. Mathematics teacher should adequately acquaint themselves with the subject matter to be taught. Conferring to Rena (2000), good knowledge of the subject matter helps the mathematics teacher to teach the students properly. Therefore, this leads to the achievement of set objectives and the consequent interest of the students to continue in the learning process in a good classroom climate. This scholar adds that it has been established that there is a high correlation between what teachers know and what they teach. Mathematics teacher's level of knowledge on the subject matter has much impact on the process of achieving the lesson's objectives in the class (Ntibi *et al*., 2020). Teachers without good understanding of subject matter, if he can succeed in deceiving the students, he has only done well in impacting inappropriate information. This is likely to bring problems to the students and consequently to other teachers.

In a definition by Brant (2006), teachers' knowledge of the subject matter is the craft knowledge that is idiosyncratic in nature and equally non-theoretical and thus is part of what makes who the teacher is. Teachers therefore, accepted that there is the need for the teacher to possess a deep understanding of all areas of the knowledge being taught to develop a sophisticated professional expertise. Another significant issue is one of reflection. The reflective process includes reviewing, reconstructing, re-enacting and critically analysing one's own teaching abilities and then grouping these reflected explanations into evidence of changes that need to be made to become a better teacher.

In a similar approach, Shulman and Shulman (2004) define the teachers' knowledge of the subject matter as the professional understanding of the subject knowledge base. It is the possession of accumulation, according to the authors, of the seven bases of the subject knowledge. These include knowledge of educational ends, knowledge of educational contests, knowledge of learners and their characteristics, knowledge of the content of the pedagogy required to properly instruct the subject, knowledge of the curriculum, general pedagogical knowledge and subject content knowledge. The authors identified pedagogical content knowledge as being of special interest: the blending of sound subject knowledge together with an understanding of pedagogy.

In the current perspective, teachers' knowledge of subject matter is conceived as the level of knowledge possessed by the teacher on the subject they teach (Worden, 2015). Thus, the unique nature of teachers' knowledge of content taught is a matter of importance in determining the teaching effectiveness of teachers. While teachers possess expert content knowledge of the major facts, theories, and methods of a particular academic field, they additionally should possess the knowledge of how to represent particular content in pedagogically appropriate ways to particular students' in particular educational contexts. This dynamic integration of knowledge of content, students, pedagogy, and educational contexts is germane and constitutes the unique professional knowledge of teachers.

Teachers' knowledge of the subject is equally viewed from the angle of the teachers' cognition. Such position was held by Shulman and Shulman (2004) and Ellis (2007). The authors were of the view that the cognition level of teachers regarding the subjects they teach could come from the angles of knowledge of common content of the subject as well as the specialised knowledge of the content of the subject. The first, common content knowledge refers to the knowledge that teachers need and use on a regular basis but that is also used in settings outside of teaching. The second category, specialized content knowledge, is a particular kind of content knowledge that teachers possess that is not typically used in other settings. *S*pecialized content knowledge does not directly relate to either a teacher's knowledge of students or of instructional practices. Instead, the authors describe specialized content knowledge as an "unpacked" or "decompressed" form of knowledge. An important aspect of developing knowledge for teaching, then, is not only transforming content knowledge but also unpacking one's content knowledge to make it available for such transformation.

To buttress the importance of teachers' knowledge of subject matter, Ball and McDiamid (1989) contends that subject matter knowledge is an important component for teachers' professional competence which should be emphasized throughout the teaching career of teachers should be incorporated right from the preparation stage of the teachers. The author narrated that if there is any concept to be taken as important and be regarded as a particular preparation of pre-service teachers, there must be a priority for a thorough grounding in something to teach. That subject matter is an essential component of teacher knowledge is neither a new nor a controversial assertion. After all, if teaching entails helping others learn, then understanding what is to be taught is a central requirement of teaching. The myriad tasks of teaching, such as selecting worthwhile learning activities, giving helpful explanations, asking productive questions, and evaluating students' learning, all depend on the teacher's understanding of what it is that students are to learn.

The foregoing, then stipulates that knowledge of subject matter refers to all understandings about the subject content, special skills required to teach the particular subject, professional practice in relation to the subject, awareness and perceptions about the students to be taught, and the production and usage of appropriate teaching aids and style. This concept in this study is the teachers' knowledge of mathematics which is the subject in focus for this study. How the teachers are grounded in the subject is assumed will play a major role in how they will instruct the students, the possession of the required skills to teach mathematics in a way that the students will understand the subject, having a good perception that the students will understanding what is to be taught and production as well as usage of the appropriate teaching style are all conceptually categorized as the teachers' knowledge of the subject matter and not the knowledge of the content of mathematics alone.

Rice (2003) submitted that; mathematics teachers must possess sufficient knowledge in their area of teaching. Any mathematics teacher that does not have the required knowledge of subject matter in his area of teaching cannot be effective in the classroom. Rice (2003), further that it is not difficult for students to notice teachers' inadequate knowledge of subject matter in his teaching area. This leads to students' loss of respect for and confidence in the teacher. As a result, it leads to students' low interest and poor academic performance in the subject. Still on this, Ehindero and Ajibade (2000) showed that the average academic performance of students in five selected subjects correlate and depend significantly on students' perception of teachers' knowledge of subject matter. This result is consistent with previous findings of other scholars such as Akpan *et al*., (2008) and Adediwura and Tayo (2007).

Knowledge of the subject matter is the content knowledge or subject matter knowledge without consideration about teaching the subject matter (e.g. Geography, Mathematics, and English language). It is the body of knowledge and information that teachers teach and that students are expected to learn in a given subject or content area.

This definition aligned with that of (Ozden, 2008) who defined content knowledge as the concepts, principles, relationships, processes, and applications a student should know within a given academic subject, appropriate for his/her organization of the knowledge. Content (subject matter) knowledge constitutes a knowledge domain related to expertise in a particular subject. It includes conceptual and procedural knowledge in the given domain. According to (Niess, 2005), subject matter knowledge is important as it defines and develops the teachers' content of instruction. Content knowledge represents the teacher's understanding of the subject matter taught. According to Shulman (as cited in Kilic, 2009), the teacher need not only understand that something is so, the teacher must further understand why it is so. Thus, the emphasis is on a deep understanding of the subject matter taught at school. Teachers' competence in subject matter does actually influence students' interest in the learning processes in classroom.

2.2.1.2 Pedagogical knowledge

As stated by Even, (1993) teachers' professional competence is approached from two perspectives of knowledge of subject matter and pedagogical knowledge. The previous subheading has treated the knowledge of subject matter. Though, some authors like Shulman (1987); Even (1993); Even and Tirosh (1995); Gess-Newsome, (2013); Adegbola, (2019) among others have inserted pedagogical knowledge as being a subset of knowledge of subject matter, in variance, several other authors disagreed. According to pedagogical knowledge is generally defined as teachers' specialized knowledge that assist the teachers to create an effective teaching and learning environment for all and sundry under the teachers' custody.

The teacher is expected to have certain competence both professional and personal. Professional competences are both academic and pedagogical. Academic competencies are the teacher's knowledge of his subject matter. Pedagogical competency is the art of teaching the subject, observing such principles as teaching from known to unknown, concrete to abstract and from simple to complex (Akpan, 2002). As stated by Osaat, (2004) a competent teacher is a person who is professionally qualified and trained to teach a particular subject, having the necessary qualities or skills and showing adequate skills in the teaching process. Focusing on mathematics, Akinbobola (2004) believed that, a competent mathematics teacher attends workshops and seminars, conferences, has a good classroom control, active communicative skills, suitable knowledge of the subject matter, utilize a variety of teaching strategies and show enthusiasm for teaching.

Teacher pedagogical knowledge encompasses all the cognitive knowledge necessary to create an effective learning and teaching environment (Marzano, and Toth, 2013; Bello, Egunsola and Awak, 2022). The effect of enhancing teacher pedagogical skills is generated gradually toward students, whereas when teachers improve pedagogical skills, student achievement will also increase (Sahana, 2015). The pedagogical knowledge base of teachers includes all the required cognitive knowledge for creating effective teaching and learning environments. Teachers with good pedagogical knowledge can understand students' difficulties in learning mathematics (Tsafe, 2013). The teacher needs to be knowledgeable about the subject's pedagogical competence. As a result, students would essentially learn nothing from the class because the instruction would be inconsistent (Tsafe, 2013). The success or failure in the process of teaching a particular concept lies in the pedagogical knowledge approach adopted by the teacher and ability to guide the students to understand meaningfully the content of the knowledge (Hiebert, 2003).

Ehindero and Ajibade (2000); Bello, *et al*. (2022) established that a mathematics teachers' performance is influenced by the level of his pedagogical knowledge, as different from his knowledge of subject matter. It is to be noted that teachers' pedagogical knowledge is not exactly the same thing as their knowledge of subject matter. However, they are on the other hand closely linked. This is because teachers' mastery and use of pedagogical knowledge in the classroom will indicate the depth of their professional competence in the use of his knowledge of subject matter. The professional competence in the subject matter is an essential basis for the display of effective and good pedagogical skills.

Guerriero (2016) when analysing the opinion of Shulman (1987) concerning the classification of knowledge that a teacher should possessed, where Shulman categorized the teachers' knowledge into seven, of which pedagogical and subject content knowledge were equated to be side by side, Guerriero argued that the general pedagogical knowledge is actually the most fundamental of the knowledge required by the teacher to perform optimally. According to him, the general pedagogical knowledge is those strategies and principles of managing and organizing a classroom that are cross-curricular in nature. The analysis was premised on the fact that the knowledge of the subject matter possessed by teachers will only be useful in the subject being taught. Where in contrast, a teacher may be deployed not for the main aim of teaching his or her specialized subject but organize, manage and mentor students for other activities that are affective or psychomotor domains.

The capacity and readiness to use the mind-set, knowledge, and abilities to best promote learning is known as pedagogical competency (Madhavaram, and Laverie, 2010). Each instructor must possess pedagogical expertise in order to carry out the learning objectives and do each assignment to the best of their ability (Rahman, 2014). Because they can comprehend students' challenges with learning mathematics, pedagogically knowledgeable teachers (Tsafe, 2013). Pedagogical competence, on the other hand, refers to the capacity of a person to use a combination of educational resources, including books, articles, case studies, and technology, including software and hardware, as well as their knowledge, abilities, and experience (Aiken, 1970). In order to maximize the growth of students from multiple perspectives (including intellectual, emotional, and moral elements), teacher pedagogical competency must be implemented (Idrus, and Bakar, 2013). In addition, one of the key factors affecting students' attitudes and performance in mathematics is teachers' attitudes (Henderson, and Rodrigues, 2008). Inappropriate teaching methods and teacher attitudes are the main causes of negative learner attitudes toward mathematics (Philipp, 2007).

The concept of pedagogical knowledge entails the knowledge of classroom management which involves the ability to maximize the quantity of time allotted for instructional purposes, setting and teaching in a pace that is steady, maintaining a clear lesson direction. In addition, it also entails the knowledge of methods of teaching. This teaching methods knowledge is the possession of ability to command different teaching techniques or methods, and knowing how and when to apply each technique or method. Also, teachers' pedagogical knowledge involves the classroom assessment knowledge. This is knowledge of different forms and purposes of formative and summative assessments, as well as knowledge of how different frames of reference (for example, social, criterion-based, individual) impact students' motivation. Another type of knowledge embedded in the pedagogical knowledge is referred to as structure. In this knowledge, the teacher is expected to display the knowledge of structuring of learning objectives and the lesson process, lesson planning and evaluation and finally is the adaptively knowledge which deals with heterogeneous learning groups in the classroom (Guerriero, 2016).

According to Mulholland (2014) in the encyclopaedia of science education, pedagogical knowledge is the knowledge associated to how to teach and is applicable across a range of teaching areas. The term general pedagogical knowledge is sometimes used as a synonym so that a distinction can be made between knowledge of how to teach generally and knowledge of how to teach a particular subject area which is usually referred to as pedagogical content knowledge. Pedagogical knowledge is described as those broad principals and strategies of classroom management and organisation that appear to transcend subject matter. Therefore, inferring from different definitions, pedagogical knowledge is a required general knowledge of teachers that enable them to transform the knowledge of subject matter, the classroom environment, students' perception and behaviour into something meaningful to achieve the ultimate goal of effective teaching and learning.

That is why in the field of mathematics, pedagogical knowledge is seen as pedagogical mathematics content knowledge. This type of knowledge is what Moynihan *et al*. (2015) referred to as the knowledge on and of how to use mathematics specific pedagogical knowledge. The author made a claim that the pedagogical content knowledge is the most preferable as far as mathematics achievement is concerned. This is because it is more specific to the subject matter and belongs to a distinctive body of mathematics knowledge. The author argued further that pedagogical content knowledge then is more specific to the distinctive bodies of knowledge for teaching since it represents the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented and adapted to the diverse interests and abilities of learners, and presented for instruction in mathematics.

Recent research in science subjects pointed towards teachers' knowledge of subject matter and pedagogical knowledge as one of the most influential factors contributing to students' learning and achievement which increase the interest of the student (Gess-Newsome, 2013.). It can be assumed that greater levels of knowledge of subject matter and pedagogical knowledge allow teachers to create learning environments that challenge, and at the same time sustenance students' learning processes. Filgona *et al*., (2020) submits that, without a full grasp of knowledge of subject matter and pedagogical knowledge, teachers may face difficulty in teaching the subject effectively.

Knowledge of subject matter and pedagogical knowledge is critical for the mathematics educators. Teachers should be knowledgeable in the content areas and pedagogy for which they are responsible to teach, without this, the students may face difficulty in their learning (Filgona *et al.*, 2020). Knowledge of subject matter is what is being taught and pedagogical knowledge is how it is being taught. Pedagogical competencies consist of knowledge and skills; successful teaching depends on deep knowledge of subject matter. Therefore, teachers need to improve their knowledge of subject matter and pedagogical knowledge to improve their teaching (Kiymet, 2010). Furthermore, teachers should really bring their students to the objectives to be achieved. Teachers must be able to influence their students. Considering this description, it is important for teachers to be competent (Akhyak and Bakar, 2013).

The traditional essence of schooling irrespective of the category or level is learning. The implication is that, teaching should be at its best always, to achieve the top standards of learning. In the quest at achieving this, the onus lies on the teacher to be adequately prepared with the requisite pedagogical knowledge and skills. Within the purview of mathematics, myriads of factors tend to influence the teaching of the subjects. However, teachers play a central role in the whole exercise. The general assumption the society harbours is that, if a mathematics teacher is well grinded in the subject; such teacher is assumed to be in the most appropriate position to teach the subject. Knowledge of subject matter and pedagogical knowledge implies that, most effective teachers are expected to have deep knowledge of the subjects they teach. On the other way around, when a teacher's knowledge falls below a certain standard, it constitutes a significant impediment to students' learning. It is equally expected of a teacher to have a sound grasp of the content being taught. Asides from this, teachers are also expected to understand the emotional disposition of the students to the content, be able to evaluate the thinking behind students' methods, and identify students' common misconceptions.

Rightful and comprehensive education is the process of taking steps towards the transformation of schools into centers that are learning-inclined (Salzano and Labate, 2016). To carry out this task, teachers must be put in place whereby they are professionally equipped and adequately prepared for effectiveness in the classroom. In this light, the African Union (AU) lay emphasis on the training, professional competency, education, and quality of instruction of teachers, in the quest at giving adequate recognition to some strategies that connect with the education of the teacher such as training, recruitment, promotion of continuous professional competency (CPC) and deployment of quality teachers (who are well prepared) by instilling a sense of commitment and accountability in learners. According to the AU, the member countries should adopt an all-embracing educational method as its essential goal which shall focus on the revival of the teaching profession to improve quality and importance at all levels (African Union Headquarters, 2015). It thus becomes essential for the existence of teachers who would metamorphose into excellent instructors as they take steps in the development of their skills through numerous training, seminars, and other professional development opportunities made available by the government and other relevant bodies in the education sector. Developmental programmes on professional competency of teachers should be made available for as many of the teachers interested in furthering their career path in the teaching profession.

Similarly, Ehindero and Ajibade (2000) submit that teachers' performance is influenced by his pedagogical knowledge about the subject, as not the same as his knowledge of the subject matter. It is to be noted that pedagogical knowledge is not the same thing as knowledge of the subject matter. However, they are all the same closely linked together. This is for the reason that teachers' mastery and use of pedagogical knowledge in the classroom will indicate the depth of their skill in the use of his/her knowledge of the subject matter. The skill in the subject matter is a key basis to display good and active pedagogical skills.

2.2.2 Quality of instruction

Quality of instruction is a concept in teaching and learning process. It is a means by which teachers pass their knowledge across to students and its quality is of utmost importance to what to be achieved in teaching and learning. In the perspective of Akintola (2013), the delivery of quality of instruction in the classroom in any education system is subject to largely on the quality and competence of the teachers. This is so because the teachers are expected to perform the important functions of guiding, directing, evaluating, imparting, asking and answering questions among others for maximum benefits of the learners. The ability of teachers to effectively engage the students in a learning procedure and be able to relay relevant knowledge is measured by the instructional quality of the teacher. As for Sogunro (2017), averred that instruction quality is responsible for the motivation of students in all facets of schooling levels, that without quality instruction, students' motivation to learn recedes. He reported that students claimed in a study that quality of instruction was the raison d’être for their motivation in higher education. The implications of quality instruction for practice (which are anagogical competency, adequate preparation and organization, content and currency of knowledge, technological competency, resourcefulness, and dispositional attributes) can therefore, not be overemphasized.

Even and Tirosh, (1995) attempts to identify and describe quality of instruction and its components were undertaken already in the 1960s. These attempts were followed by extensive research programs on teacher effectiveness in the late 1960s and 1970s. Systemization of results from research on teacher effectiveness on the basis of quality of instruction models led to another boom in research in the late 1970s and 1980s – mainly comprising meta-analyses. Since these efforts were not satisfying with respect to explaining instructional outcomes in general, with the TIMSS study a new attempt was made to investigate instruction and to relate instructional characteristics to students’ achievements. This was mainly because video analysis of lessons became technically possible. Video analyses allowed to record classrooms and analyse instruction in an extensive and thorough manner in multiple iterations.

Chronologically, the concept of quality of instruction has been enjoying attention in the literature. In the perspective of Helmke, Schneider and Weinert (1986), sees quality of instruction as the degree of teachers’ clarity when delivering instruction and usage of structuring cues by teachers. The authors observed that instruction quality is the frequency of teacher cues facilitating comprehension of learning materials (“cues”) and by “clarity.” This according to them is the teacher’s ability to ask clear and understandable questions, namely, by the frequency with which a teacher question directed to the class as a whole or to an individual student or the whole class. Quality of instruction was also attributed from students’ perception of the teachers’ clarity of instruction and appropriateness. Student engagement variables were not restricted to the low-inference measures of observed time-on-task provided by CES; this overt measure was supplemented with covert measures to represent the construct in question more adequately.

Weinert, Schrader, and Helmke, (1989) directed the definition to teaching effectiveness. In their own perspective, the authors defined quality of instruction to mean the teachers’ effective behaviours that are generally implying the achievement of the intended teaching and learning goals which are achieved economically. Quality of instruction is particularly attributed to role definitions and expectations which emphasize academic instruction (i.e., task orientation) and mastery of curriculum;

allocation of time to academic activities; efficient classroom management which minimizes time for non-academic activities and keeps students engaged for most of the time; an appropriate difficulty level of activities which assures consistent success; active teaching rather than allowing students to work on their own.

Sogunro (2017), McNeff (2017), viewed quality of instruction as the opposite of quantity of instruction. It is the new belief that the school day should not be based on length of hours expended on instructing but to improve student achievement. It is the understanding of the importance of quality time in front of kids as against the quantity so that they will learn more. The proponents of such idea opined that if instructional time is reduced, the reduced amount should on teacher collaboration that is focused on improving instruction rather than focusing on quantity, the focus should be on quality of instruction.

Stemming from the above, the concept of quality of instruction of teachers is looked from different perspectives in ages. There is however, a general perception of quality in the instruction rather than spending lots of time in the class without any meaningful impact on the learning outcomes. It is the general view of authors that a sure way of measuring the instruction quality is from how the students perceive the teachers' style. Most studies that have used quality of instruction and learning outcomes have majorly measured it from possession of the adequate cues by teachers which is the function teachers being able to instruct in way that will facilitate students' comprehension of learning materials and the clarity of the instruction itself.

2.2.2.1 Lesson development

Musingafi, Mhute, Zebron, and Kaseke (2015) define a lesson development as a detailed plan that explains one's overall lesson objective and the measures one intends to follow in order to achieve that purpose as efficiently and effectively as possible. When choosing on methodology, teaching strategies, interim objectives, and the type and amount of evidence and clarification assistance, a well-written lesson development assists the lesson plan writer in determining the best options to take. It also aids anyone else entrusted with teaching or modifying the lesson in the future by outlining the full rationale for selecting these options. When the teachers understand why the different elements of a plan are included and when these reasons are sound, the teachers can more easily adopt the process as their own or adapt the plan more coherently both internally and as it relates to other lessons in the curriculum. And, just as importantly, the strategy can also benefit the students immensely because it provides a well-formulated overview for the lesson introduction itself by telling the students exactly what will be covered in the lesson without exposing the lesson itself.

The lesson development plan should be created in such a way that it guides the teacher through the entire lesson, focusing on each component. In this sense, a complete lesson development technique aids the plan writer by requiring him or her to think about questions that are frequently overlooked:

(1) Whether the overall lesson design and sequence of main points and sub-points is the most logical and intuitively acceptable;

(2) Whether the teaching approaches chosen are the most suited for the lesson; and

(3) How much leeway can be used in the presentation before changing the actual goal? Furthermore, it gives a fast-mental summary of the entire class, reducing the need for the instructor to script or slavishly rely on the lesson plan (thus damaging the presentation's spontaneity) (Musingafi *et al*., 2015).

2.2.2.2. Set induction

The first step in a teacher's lesson presentation is to introduce the material. The purpose of set induction is to inform the class that the learning process is about to begin. The teacher should begin the lesson by quickly describing the present topic. This is done to pique students' interest while also stating the lesson's goals and significance (Choy, Thomas, and Yoon, 2017). The set induction of the lecture has a maximum duration of five minutes.

The set induction of lesson serves the following purposes:

i. establish a common ground between the teacher and the pupils,

ii. attract and maintain attention,

iii. summarize the lesson and connect it to the overall progress,

iv. to emphasize the student's advantages, and

v. to guide the student into the subject of the lecture.

While humor may be appropriate, the set induction should be free of irrelevant stories, jokes, or incidents that distract from the lesson objective. It should not contain long or apologetic remarks that are likely to reduce student interest in the lesson. Educators often speak of three necessary elements in the set induction of a lesson: gain attention, motivate, and provide an overview of lesson material. To gain attention, the teacher may relate some incident that focuses on the subject and provides a background for the lesson (Choy *et al*., 2017). Another approach may be to make an unexpected or surprising statement or ask a question that relates the lesson to group needs. At other times, nothing more than a clear indication that the lesson has begun is sufficient. In all instances, the primary concern is to focus student attention on the subject.

The set induction should be used by the teacher to provide specific reasons why the pupils need to learn what they're about to learn. The teacher should make a personal appeal to students and reaffirm their desire to learn throughout this inspiring talk. The attraction could link the learning to a specific need, such as job progress. However, the teacher should cite a practical application for student learning experiences in every case. The desire for this lesson to serve as a foundation for future teachings is often a powerful motivator. Throughout the lesson, this motivational appeal should be maintained. If the teacher simply mentions needs briefly in the introduction, he or she is square-filling rather than motivating.

For most instructional methods, the set induction should provide an overview of what is to be covered during the class period (Choy *et al*., 2017). An overview with a clear, concise presentation of the objective and key objective and key ideas serves as a road map for learning. Effective visual aids can be helpful at this point. A clear overview can contribute greatly to a lesson by removing doubts in the minds of the learners about where the lesson is going and how they are going to get there. Students can be told what will be covered or left out and why. They can be informed about how the ideas have been organized. Research shows that students understand better and retain more when they know what to expect. The purpose of the overview is to prepare students to listen to the body of the lesson.

2.2.2.3 Content presentation

Another idea that may aid in good instructional practices among teachers is their ability to prepare and present subject matter. Cunningham (2009), Dorovolomo, Phan, and Maebuta (2010), Courey, Tappe, Siker, and LePage (2013), Musingafi, *et al*. (2015), Choy *et al*. (2017), and others have stated that lesson preparation and presentation of topic matter is an important aspect of the instructional process. Cunningham (2009), for example, claims that lesson and unit plans are the foundation for all instructional instruction. According to him, the concept of preparation is the teacher's daily agenda.

It is procedure that entails studying, observing, and reflecting upon lessons and lesson plans for many years. It is also the manipulation and adaption of ideas to create a sequential design that reaches each diverse learner. Although, on the spot modifications are almost always necessary while teaching. The author suggested an eight-step model that engages students by building on their knowledge. The design provides many opportunities for teachers to recognize and correct students' misconceptions while extending understanding for future lessons. It's a process that involves spending years studying, watching, and reflecting on classes and lesson plans. It also entails the manipulation and adaptation of ideas in order to build a sequential design that caters to each learner's unique needs. While instructing, however, on-the-spot adjustments are virtually always required. The author proposed an eight-step methodology that engages students by building on what they already know. Teachers can use the design to identify and correct students' mistakes while also extending comprehension for future classes.

Dorovolomo, *et al*. (2010) aimed at investigating if there is a relationship among the lesson planning quality and its successful implementation. In a longitudinal study which was conducted over semester two 2004 to semester one 2006, involving 309 pre-service students in a physical education class. The correlation between the two variables of quality in the lesson plan and its instruction was sought. Using the Statistical Package for the Social Sciences to analyse data, and based on the inferential statistic of the Pearson Correlation and Regression Analysis, there was a positive relationship between the quality of lesson planning and the quality of delivery. This substantiates the important place lesson planning should have in teacher education, considering it as a crucial area of prospective teachers' professional development. Quality lesson planning will, however, not necessarily mean automatic translation into successful implementation, making it imperative that teacher education provides support to student teachers to make informed transition from a lesson plan to its delivery.

In the perspective of Courey *et al*. (2013), an efficient planning of lesson with universal design for learning enable teachers to be able to meet students' individual needs more effectively. The authors in a study that was a comparison of lesson plans by teachers in training schooling in a teacher preparation programme before and after universal design for learning training is presented. After training, teachers in training (n = 45) incorporated more differentiated options and varied teacher strategies based on universal design for learning principles into their lesson plans. One of the outcomes of the study was that the content of the subject being taught was more accessible to all students when lesson is planned before presentation. A variety of changes and options was examined, and examples of commonly occurring choices selected by the teachers in training include their willingness to plan their lessons before presentation. The improved multiplicity of options in lesson planning demonstrates a better understanding of universal design for learning principles; however, teachers need more experience in actually implementing the universal design for learning principles in their classrooms.

As for Musingafi *et al*. (2015), planning to teach should stem from the curricula, syllabi, schemes and plans of lesson in any process of teaching. According to the authors, confusions abound in learning institutions and teachers as well as their students have been found not to be able to distinguish between curriculum and syllabus, thus, this has triggered the researchers to come up with ideas. In the preliminary informal discussion by the authors with seven seasoned teachers and five pre-service student teachers at one of the secondary schools in Masvingo Rural the writers established that most teachers could not distinguish between the term's curriculum and syllabus. Yet they have passed through teachers training programme at college or university. Therefore, the teaching and learning complexity as perceived by the teachers could be a source of failure from both the end of the teachers and students since the philosophy that teaching and learning are highly complex and pervasive phenomena, and therefore in a formal setting they have to be well structured for efficiency and effectiveness. The paper argued that successful formal teaching and learning process, requires proper selection and arrangement of the teaching items or materials. Selection and sequencing of learning content and methodologies thereof take place in the curriculum, syllabus, and scheme of work and lesson plan stages. Thus, the paper argued that the distinction between these educational terms is largely on the degree of generalness, specificity and the stage at which it occurs.

Focusing on mathematics, Choy *et al*., (2017) believed if students' attention is to be ensured in a mathematics class, there must exists a framework which should guidelines how a 'productive noticing' during the planning of mathematics lesson as well as its delivery and review. The authors when positing that enacting the work of diagnostic teaching is challenging, it was suggested in the study that there should be a demand for teachers to pay attention to mathematical details when designing tasks, orchestrating discussions and reflecting on their lessons. The authors recommended a framework called "FOCUS Framework" which will enable the teachers in noticing all about their mathematics class and can be used to characterise teachers' efforts to notice productively during all three phases of diagnostic teaching: lesson planning, delivery and review. Using the two key components of the framework, the focus and it focusing, the study suggested that productive noticing in all the three phases is highly consequential, and illustrated how the FOCUS Framework can be used to analyse a teacher's mathematical noticing.

2.2.2.4 Content communication

According to Ko, Sammons and Bakkum (2016) terms such as 'content communication', 'content communication effectiveness', 'teacher content communication effectiveness' and 'teaching content communication effectiveness' have been used interchangeably in much of the research literature. This reflects the fact that the primary nature of a teacher's work is content communication and that teaching or content communication is generally carried out in the classroom. Part of the confusion is because sometimes the focus is on the teacher's influence on student outcomes, and at other times on the classroom behavior and practices that teachers use to promote better outcomes for students. Teachers' content communication effectiveness is generally referred to in terms of the focus on student outcomes and the teacher behaviours and classroom processes that promote better student outcomes However, some authors viewed teachers' content communication and its effectiveness in a broader sense. They adopt criteria that seek to encompass the duties that are seen to be part of the wider role of teachers in the 21st century because the role of a teacher is rarely restricted to content communication only. In many countries a teacher's work has extended beyond the content communication or pedagogical role in the classroom. He/she may be facilitating his/her colleagues' teaching, engaging in broader leadership roles in the school, enhancing the quality of his/her teaching through his/ her own reflection in professional competence.

It is regarded as the most specific teaching behaviours category which is used as part of the content communication process constantly. Presentations of content communication are necessary for the purpose of procedural and appropriate learning experience structuring for students. According to Darling-Hammond, Flook, Cook-Harvey, Barron, and Osher (2020), there exists content communication skills and processes variety. While there are some broader than others, there are also others with a more complexity in their nature. Some factors which may influence their selection and application include characteristics of student, requirements of curriculum, and methods of content communication. For the purpose of illustrating content communication skills, two examples follow: explaining and demonstrating, and questioning.

Darling-Hammond *et al*., (2020) outlined productive content communication strategies as part of the key factors ensuring quality teaching and learning. In the article, the authors alluded that a productive content communication skill will ensure a meaningful service which builds on prior knowledge of the students and actively engages the students in rich, tasks that are engaging which in turn assist the students in achieving the conceptual understanding of the lesson and transferable skills and knowledge. It also ensures in the teacher the ability to formulate a major learning strategy, thoughtfully interwove with explicit content communication skills, engage the students in a well-designed learning opportunity collaboratively which encourages the students to explain, question, and elaborate their thoughts.

The needed content communication skills required by a teacher according to Won, Liu, and Bukko (2019) includes teaching strategy, directional, and characteristics feedback mechanism skills, skill relating to student-teacher feelings, cooperating teacher feelings skill, skill of application of feedback from students by teacher, programme consideration skills and personality matching. According to the study, the skills must rove around goals (what), relationship (how) and effect (change) in how the teachers are able to impart on the students by bringing out effective results. The qualitative study embarked on by the authors found out that good content communication skill of teachers ensures student engagement in classroom activities; classroom environments are more engaging at the same time effective and application of content-based pedagogies are ascertained.

Rezaeian and Nazari (2012) have earlier canvassed for content communication skill development as part of the needed skills for teachers in training. The authors posited that there is relationship between content communication skills of teachers and working experience. The authors argued is even more needed as teachers in training are being educated so that they will be able to have learned the rudiments while schooling. The concept of the authors was that teachers need to develop their teaching methods inside the class in order to activate students to learn more effectively. The researchers decided to find out if there is any relationship between working experience and need for content communication skills. The data was obtained from more than 31 randomly chosen lecturers through questionnaire from the Faculty of Educational Studies at University Putra Malaysia. From the results, it was concluded that there is no relationship between years of working experience and need for content communication skills.

2.2.2.5 Questioning techniques

In literature, the concept of questioning in the education parlance is well debated and focused. According to Cotton (1988) questioning is same as classroom questioning. Thus, in this study, in order to be well guided and controlled, the concept is reviewed under the phrase "classroom questioning". The term as was early defined by Cotton (1988) is "any sentence which has an interrogative form or function. In classroom settings, teacher questions are defined as instructional cues or stimuli that convey to students the content elements to be learned and directions for what they are to do and how they are to do it".

Yang (2006) considers classroom questioning to be one of the most important aspects of education because the goal is to convey knowledge while also determining whether what has been imparted is adequately understood. According to Yang, education is an activity aimed at improving one's questions in a progressive path. Subject hood, structuredness, and reflectiveness are three key elements of the new educational paradigm (Yang, 2006). Active participation in educational activities causes structural changes in the learner's cognitive process. Furthermore, educational action is a never-ending process that is conducted in a reflective manner. While the author laid emphasis in the importance of questioning in education, it averred that questioning in education has been underestimated and miss conceptualised. The major reason for this has been that most studies on questioning have been heavily dependent on the paradigm of positivism which has narrowed the conceptualization on purpose of questioning in education by teachers.

It is the belief of recent authors that classroom questioning should be redefined due to its importance in educational system. Therefore, Jiang (2014) defined classroom questioning as a sequence involving teacher initiation, student response, and teacher feedback/evaluation. Formative assessment also involves three steps: eliciting, interpreting, and using the evidence. It is worth noting that questioning may not be an assessment tool in all situations. For example, when it is adopted to develop student interest rather than to check learning, questioning is a teaching technique and not an assessment tool. Another example is that even when questioning is aimed at diagnosing learning, if follow-up actions are not taken to facilitate learning, it would be inapposite to label it as a formative assessment strategy.

In a study by Hrastinski, Stenbom, Benjaminsson, and Jansson (2019) on identifying the commonly used direct question types and exploring the effects of using these question types on conversation intensity, approach to tutoring, perceived satisfaction and perceived learning in mathematics, using the individual online synchronous tutoring in mathematics. The empirical data was based on 13,317 logged conversations and a questionnaire. The tutors used a mix of open, more student-centred questions, and closed more teacher-centred questions. In contrast to previous studies, Hrastinski *et al*., 2019 provided a more positive account indicating that it is indeed possible to train tutors to focus on asking questions, rather than delivering content. Frequent use of many of the question types contributed to increased conversation intensity. However, there were few question types that were associated with statistically significant effects on perceived satisfaction or learning mathematics. There are no silver bullet question types that by themselves led to positive effects on perceived satisfaction and learning. The question types could be used by teachers and teacher students when reflecting on what types of questions they are asking, and what kind of questions they could be asking.

Pratama, (2019) outlined an effective questioning session that are required in a classroom environment. In the thesis, levels of questioning were outlined to include "lower-level" and "higher-level" with the justification for the questioning to be used in achieving well-defined goals. Thus, the author posited that lower-level questions are typically to remember, understand, and apply levels of the taxonomy and are most appropriate for: evaluating students' preparation and comprehension, diagnosing students' strengths and weaknesses and reviewing and/or summarizing content. While in higher-level questions, there is the idea to test the ability to analyse, evaluate, or create, and are most appropriate for. This is to encouraging the students to think more deeply and critically, possessing a critical problem-solving mentality, encouraging discussions and stimulating students to seek information on their own.

Pratama, (2019) suggested that steps for planning questions should include the following:

(i) Establish a goal or purpose for your questioning. Your aim should guide you in deciding which tiers of questions to ask.

(ii) Choose the topic for your interrogation. Choose material that is relevant to you rather than trivial. Based on the questions you ask; students will study and learn. Do not lead them astray by focusing on less crucial information.

(iii) Ask questions that require an extended response or at least a "content" answer. Avoid questions that can be answered "yes" or "no" unless you are going to follow with more questions to explore reasoning.

(iv) Write down your primary questions in advance until you've mastered classroom questioning. This is referred to as "scripting." Sort your list into a sensible order (specific to general, lower level to higher level, a sequence related to content). You can be flexible and add or swap extra or better questions for some of your prepared questions if you think of them throughout the questioning process. However, having a list of questions prepared ahead of time will ensure that you ask questions that are relevant to your objectives and representative of the crucial information.

(v) Phrase your questions so that the task is clear to students. Questions such as "what about foreign affairs?" do not often lead to productive answers and discussion. "What did we say about chemical bonding?" is too general unless you are only seeking a review of any material the students remember.

(vi) The answers should not be included in your questions. When you're looking for an answer from the class, avoid using implied response questions. "Don't we all agree that the author of the article overstated the hazards of Agent Orange to enhance his viewpoint?" is not a question that will elicit a positive response from students.

(vii) Try to anticipate possible student reactions while designing your questions. Anticipating student responses should aid your planning by requiring you to examine whether the phrasing is correct, whether the questions are focused on the purpose you want to achieve, and whether you have enough flexibility to allow students to express themselves in their own words. Consider the following options:

(a) What are some typical misconceptions that might lead students to incorrect answers?

(b) Am I asking an open or closed question?

(c) What type of response do I expect from students, a definition? Example? Solution?

(d) Will I accept the answer in the students' language or am I expecting the textbooks' words or my own terms?

(d) What will my strategy be for handling incorrect answers?

(e) What will I do if students do not answer?

2.2.2.6 Management

Among the various concepts emerged more recently in the field of formal education, especially in school education, classroom management has been considered as one of the integrated functions of institutional and functional intervention areas in teaching-learning. In this discourse, different professionals and institutions happen to proclaim different strategies and functional inputs so as to transform classroom as one of the most essential areas of school transformation. The scope of functional coverage of classroom management has expanded significantly these days from the concept of traditional physical structural shape to induction of newer approaches of student participation, learner focused teaching learning, collaborative and cooperative approaches to teaching-learning materials development and implementation, making classroom discourses more socio-ethically sound, and creating appealing classroom infrastructure and rules for teachers, students and also for the parents. In fact, there is no readymade capsule to swallow as the final solution for this issue and there is also no final destiny as the overall concept of classroom and its arrangement has been consistently overhauled globally (Rijal, 2014).

According to Steins, Wittrock, and Haep (2015) classroom management comprised of two factors, teachers' broad knowledge and skills. Knowledge of classroom management is vital and relevant indices in teacher education. The authors sought to determine which classroom management factors are needed most, and whether classroom management is useful for teaching at school? In the longitudinal study, the preservice teachers are included in the study. The study explored the baseline of Classroom Management Knowledge (CMK) of teachers in training and explored the CMK baseline of teachers in training and examined whether CMK which is acquired in a classical seminar can lead to an increase in CMK. The authors validated knowledge of classroom management affected the practical knowledge of teachers in training when facing challenging situations. Finally, it was examined whether knowledge of classroom management in the classroom can be converted into skills at school and there was a significant increase in knowledge of classroom management is acquired through a seminar; but the acquired knowledge is very unlikely to be transferred without an intense, long lasting and supportive training of skills. The relevance of these findings is critically related to teacher education.

This concept is key as far as teaching and learning is concerned (Egeberg, McConney and Price, 2020). The view of teachers about teaching, learning and school environment and experiences are important factors to consider in education. Students and teachers being the central participants in classroom interactions have strong views about how to manage learning and the learning environment behaviours effectively.

The aims of Egeberg *et al*., (2020) was to clarify perspectives of teachers on how they create quality learning environments and gather the teachers' view on various disciplinary interventions, how they perceive challenging students and their efficacy sense for classroom management so as to inform policy and practice in education of the teachers. Using a survey, the authors conducted a 50 secondary school teachers' view on they perceive their classroom and their environment. The interview result found that teachers identified by students as effective in their classroom management provided consistent reports that effective classroom managers build positive relationships with their students, manage their classrooms by establishing clear boundaries and high expectations, and engage students in their learning.

The students' behaviour management is of essential for educational experience success of teachers and students. Without appropriate management of classroom behavior, the educational process of all students is interrupted, resulting in failure to achieve educational objectives, goals, and aims. Research by Sieberer-Nagler (2016) showed that time teachers take away from teaching to correct misbehaviors results in a lower rate of academic engagement in the classroom. From a student's perspective, effective classroom management must include clear behavioural norms and high academic expectations.

Poor classroom management skills can have an impact on teachers' well-being, as well. In 1981, the National Educational Association of the United States reported that more than one-third of surveyed in-service teachers said they would probably not go into teaching if they were again given the opportunity to decide. Two major reasons cited were negative student attitudes and discipline (Wilson, 2014). The lack of appropriate classroom management techniques is probably to blame, at least in part, for the failure to retain teachers in the profession. Classroom management is one of the three most needed skills among experienced high school physics teachers, according to Abrahams, Pancorbo, Primi, Santos, Kyllonen, John, and De Fruyt (2019), with the other two being general teaching skills and problem-solving skills. Not surprisingly, written communication skills, skills associated with using sophisticated lab equipment, computer skills, as well as oral and advanced skills of mathematics are often considered secondary by physics teachers because these skills tend to be learned as part of the teacher preparation process. Unfortunately, classroom management is perhaps a more pressing skill, and while it might be addressed in the teacher education process, it can only be perfected through experience.

2.2.3 Classroom climate

Classroom climate is a term that refers to the mood prevailing in a class, standards, attitudes and tone that teachers and students feel as they are in the classroom. Such climate could be positive or negative. As such, it can become chaotic, hostile, or even be out of control if negative while in a positive classroom environment, teachers and students feel safe, welcoming, respective and supportive of teaching and learning process positively. According to The University of British Columbia (2021), classroom climate is the social, intellectual, physical and emotional environments in which students learn. In such a climate, an avenue for development intellectually and socially is created which enables students in particular to interact with each other so as to impact on their learning and the learning outcomes. These elements of the classroom environment are not mutually exclusive but rather interactive with one another, but instructors may attend to the following aspects of student development and classroom climate to consider how each aspect is related to teaching and learning.

In a related version, Adelman and Taylor (2005) viewed classroom climate as learning environment. The authors posited that terms such as ambience, atmosphere, milieu and ecology are used interchangeably with classroom climate. However, in the definition, classroom climate is the quality of the classroom environment. The authors asserted that it emerges in a somewhat fluid state from the complex transaction of many immediate environmental factors such as social variables, operational, organizational, material, and physical. Both the climate of the classroom and the school reflect the influence of a school's culture, which is a stable quality emerging from underlying, belief systems and institutionalized values, norms, rituals, ideologies, and traditions. And, of course, classroom climate and culture both are shaped by the school's surrounding and embedded economic contexts (country, state, city, neighbourhood and home), cultural, social, and political.

Key concepts related to understanding classroom climate according to Wang, Degol, Amemiya, Parr, and Guo (2020) include safety, orderliness, system maintenance, growth, and change, social system organization, the "Fit" between key learner and classroom variables, social attitudes, competition, cohesion, accountability demands, efficacy, communicated expectations, staff and student morale, curricular and instructional practices, and power, control, guidance, support, and evaluation structures. Rucinski, Brown and Downer (2018) classified classroom climate into three concepts of relationship, personal development and system maintenance.

As far as relationship is concerned, is the nature and intensity of personal relationships within the environment and the extent to which students are involved in the environment and support that help each other. The personal development concept is the basic directions along which personal growth and self enhancement tend to occur while system maintenance and change means the extent to which the environment is orderly, clear in expectations, maintains control, and is responsive to change. The concept of classroom climate implies the intent to establish and maintain a positive context that facilitates classroom learning, but in practice, classroom climates range from hostile or toxic to welcoming and supportive and can fluctuate daily and over the school year. Moreover, due to the fact that the concept is a social psychological construct, different observers may have different perceptions of the climate in a given classroom.

Classroom climate could be measured in terms of the shared perceptions of those in the classroom. Prevailing approaches to measuring classroom climate use teacher and student perceptions, external observer's ratings and systematic coding, and/or naturalistic inquiry, ethnography, case study, and interpretative assessment techniques. Importance of classroom climate is seen as a major determiner of classroom behaviour and learning, understanding how to establish and maintain a positive classroom climate is seen as basic to improving schools. Research suggests significant relationships between classroom climate and such matters as overall quality of school life, teacher burnout, stages of educational reform, principal leadership style, achievement, self'-efficacy, behaviour, student engagement, and social and emotional development (Alam, 2020).

In an instance, studies reported strong associations between achievement levels and classrooms that are perceived as having greater cohesion and goal-direction, and less disorganization and conflict. Research also suggests that the impact of classroom climate may be greater on students from low-income homes and groups that often are discriminated against. Given the nature of classroom climate research, cause and effect interpretations remain speculative. The broader body of research on organizational climate does suggest that increasing demands for higher achievement test scores and reliance on social and tangible rewards to control behaviour and motivate performance contribute to a classroom climate that is reactive and over-controlling (Galos, 2018).

Promoting a Positive Classroom Climate, a proactive approach to developing a positive classroom climate requires careful attention to fostering motivation for classroom learning and teaching, enabling teachers to be effective with a wide range of students, pursuing a curriculum that promotes riot only academic, but also social, and emotional learning, and enhancing the quality of life in the classroom for students and staff. With respect to all this, the literature advocates a healthy and attractive environment that is conducive to learning and teaching, use of a variety of strategies for preventing and addressing problems as soon as they arise, providing instruction and responding to problems in a personalized way, transforming a big, classroom into a set of smaller units that maximize motivation for learning and are not based on ability or problem-oriented grouping, meaningful participation by students and staff in decision making, an array of options for pursuing goals, social support mechanisms for students and staff and a welcoming, caring, and hopeful atmosphere (Good and Lavigne, 2017).

A positive classroom climate induces prompting professional learning and teaching climate for teachers. In classroom climate, learning and teaching climate dominantly pertained to students learning. In fact, classroom is not a learning organization only for students but for teachers too. A substantial body of literature has documented teaching and learning as core domain of classroom climate (Berkowitz, Iachini, Moore, Capp, Astor, Pitner and Benbenishty, 2017). The concept of professional learning and teaching was rooted in teaching and learning domain of classroom climate defined by Berkowitz, et al. 2017. Positive professional learning and teaching climate fosters teachers' engagement in professional learning activities and stimulates their professional development that significantly contributes to teaching practices improvement (Thoonen, Sleegers, Oort, Peetsma and Geijsel, 2011).

2.2.3.1 Personalisation

Several educators have canvassed for personalisation strategy as a means of ensuring each learner is cared for. Authors such as Everard, Morris, and Wilson (2004), Fry, Ketteridge and Marshall (2009), Bennett (2017), Herold (2020) and Department for Education (2021) have affirmed that personalization is often resulting in getting the best out of students. Based on the assertion by Everard *et al.* (2004), personalization will bring change in a problematic student. The authors founded this on the fact that individuals' shortcomings differ based on the fact that there are individual differences in students to take into consideration in a classroom environment. Personalization could be used as a means of trapping and implementing change which is ascribed to problems that necessitate change to the shortcomings of individuals. Not only is personalization of the problems likely to lead to defensiveness but it is also often a misdiagnosis of the true cause. Most organisational defects are attributable to methods and systems.

Just as viewed by Everard, *et al*. (2004), Fry, *et al*. (2009) reveals that personalization is useful strategy in higher education system just as it has been proofed in the lower tiers of education systems. The authors claimed the nature of mathematics and its teaching application requires personalization. The authors suggested that teaching mathematics in the United Kingdom should be tailored towards conservativeness approach. Using such method, the setback experienced where mathematic teachers whose most teaching style only comprise of formal lectures', and where more innovative methods such as personalization are used only 'occasionally' and most assessment strategies rely on formal examinations rather than a wider range of assessment methods will be delimited and learning outcomes in mathematics improved. Thus, according to the authors' assertion, personalization remains a significant standard approach in considering the nature of the discipline mathematics. If mathematics is viewed as a system of ideas that is underpinned by logic and applied to modelling the real world, then it makes sense to offer coherent explanations of this system to students in a personalized approach. Therefore, there are opportunities for students to work through a set of problems or examples so that they can themselves own this body of knowledge, and thus have the natural defaults of lectures and tutorials based around the solution of problems. Mathematics is the science of strict logical deduction and reasoning, a severe taskmaster for both learner and teacher.

As reasoned by Bennett (2017), school leaders such as teachers can create a good culture of optimised behaviour in students using the personalisation approach. When arguing around this assertion, the author was assertive on the fact that when students are personally focused, they tend to imbibe a good culture both academically and socially. The author reported a strong correlation between personalisation and students' learning outcome through improved learning culture. It added that when behaviour in general improves throughout a school, it impacts on students to achieve more academically and socially, staff satisfaction improves, retention is higher, recruitment is less problematic and time is reclaimed for better and more learning. Standards of behaviour remain a significant challenge for many schools, and there are many things that schools can do to improve, one of such is personalized teaching strategy. Teachers alone, no matter how skilled, cannot intervene with the same impact as learning personalization is. The key task for a school teacher is to create a culture personally in student and in such way; students learn to do things around their personal conviction. When there is proper understanding and subscription to personalization of educational approach, the variation in level of students' assimilation of learning will be arrested. Students vary enormously in composition and context and so their challenges are similarly varied. It is therefore impossible to prescribe a set of teaching strategies that will guarantee improvements in all circumstances.

The same position was held by Herold (2020). In his five top trends in special education, the author campaigned for greater personalisation in education system. From the technology point of view, tech industries have identified the concept of personalisation for specials education and are coming up with assistive technologies. Therefore, special students can benefit more from the personalisation drive by tech industries. For example, assistive technologies and features such as screen readers (which "speak" the content that appears on a device) and high-contrast screen settings are being developed. Leading the shift is Google, which has made huge inroads into K-12 with its web-based Chromebook devices and popular G Suite productivity tools. Among the elements that Google touts in those products are a "select-to-speak" feature that allows users to highlight text and have it read back to them; Braille displays to read and edit documents, spread sheets, and slides; and artificially intelligent tools for word prediction and translation that users can adopt via extensions to Google's Chrome web browser. All can be tied permanently to an individual user's account. This all means students using Chrome book can "log into any device running Chrome and enjoy the same accessibility settings and experience without having to go through another onerous set-up process," said Naveen Viswanatha, the lead product manager for Chromebooks for Education.

In the same vein, the Department for Education (2021) suggested that the post-covid19 approach should leverage on the opportunities brought by personalisation. Educating in the United State of America after the post-covid19 is said to be heavily relying on personalisation approach since social distancing is both a norm and legal entity. The government guideline therefore, put teachers on their toes to be aware that children are going missing in class activities, particularly repeatedly, and personalisation can act as a vital opportunity of safeguarding learning possibilities for all students. The use of personalisation will delimit abuse and neglect of students' personalities. Personalisation of teaching and learning strategy will promote sexual consideration and can also be a sign of child criminal exploitation reduction. Personalisation also put into consideration mental health problems, risk of substance abuse, risk of travelling to conflict zones, risk of female genital mutilation or risk of forced marriage. Early intervention is necessary to identify the existence of any underlying safeguarding risk and to help prevent the risks of a child going missing in education. Staff should be aware of their schools or college's unauthorised absence and children missing from education procedures.

2.2.3.2 Involvement

Involvement in class is as important as any education strategy. Class involvement stems from both the teachers and the students. In the definition by Petress (2006), classroom involvement is the opportunity students are given to participate during the teaching and learning process. Such participation involves allowing students to ask and answer enquiries. They are also allowed to brainstorm among fellow students in groups with specific task in focus. Aidinlou and Ghobadi (2012) validated, through a structural equation modelling approach, involvement of students in class activities helps them to improve in language development. The study opined that participation is considered as a way that accordingly, the students appeared actively into the educational process and to help in strengthening teaching and bringing liveliness to the classroom. Therefore, classroom involvement is important for students of English Language Training (ELT).

In the study, Aidinlou and Ghobadi (2012), attempted to determine which factors students find most influential in their oral participation in a foreign language class and its relations with English language development through structural equation modelling using LISREL software data analysis. The derived constructs in the study were factors affecting oral participation and language development by the students. The interpretation of the results obtained showed that there are significant relationships between factors affecting on classroom involvement and also relationships between oral participation and language development. SEM results show that final model based on ELT have proved that ELD was controlled with OP by 65%. Therefore, proposed model of the research can increase the success of ELD studies. Therefore, final model in the study has proved that ELD was controlled by educational factors (EF) more than social factors (SOF) and student factors (SF). The structure of the general model presented should be applicable to students of ELT and second language learning environment. Findings in the study suggested the case study fits the unique criteria of a 'second language' learner.

It has been stressed that if students were allowed to involve in classroom activities, their grades will improve. Offering ten students support strategies to help students learn during classroom session, Imad (2020) suggested that ways by which classroom involvement can be achieved even in the post-covid19 era involves:

(i) Emailing of students to remind them that as a teacher, you are still there for them.

(ii) Telling the students how your schedules are shifting to deal with the new situation. The author states that you can 'humanize' yourself and make it casual and light-hearted.

(iii) Reflecting on the notion of rigor and continue to challenging and supporting your students. As teachers, there should be a balance support and rigor. It is expected that in this era, students need more support than rigor. Therefore, as a teacher, you are expected to establish continuity and reduce the amount of assignment required of them.

(iv) Repeating some of the lessons taught in class, especially for those students who are missing the classroom environment, this will probably help activate their memory of being part of a community and remind them that they are still part of one.

(v) Using hopeful and optimistic language, such as, "When we meet next …" This will help students look forward to coming back to the class.

(vi) Offering students and opportunity to exchange phone numbers and, for those who are interested, help them create a WhatsApp chat group. It can sometimes be difficult for a student to ask for a classmate's phone number.

(vii) Not ignoring the elephant in the room. If possible, talk about COVID-19 and fear. This is an opportunity for the teacher to remind your students to consider the sources of their news and to beware of the large amount of misinformation.

(viii) Remember that students have left behind more than just their classes and academics. On both residential and commuter campuses, there are important spaces where students meet and talk about their non-academic lives, sports, upcoming concerts, recently discovered shows and so on. Consider creating a community discussion board for them to share what is happening in their lives, especially given the stress, fear and strains in these uncertain times.

(ix) Let your students know that you are there for them and that if they need help to reach out to you. Let them know that you are (I hope) in touch with counsellors or mental health experts that can help them should they need to speak to someone.

(x) Most important, asking each of the students how the teacher can help them. The Persian poet Rumi says, “Out beyond ideas of wrongdoing and right doing, there is a field. I’ll meet you there.” Likewise, in times of uncertainty and unknowing, we can create a space where our students’ voice and insights can illuminate the path; we are carving out for them and us (Imad, 2020).

2.2.3.3 Students’ cohesiveness

Bulgaru (2015) advances that the higher the cohesion of a particular group, the greater their efficiency. The study stated further in a situation where peoples’ attitude supports the organization's objectives, in most cases, such objectives are achieved seamlessly. It is believed that the effectiveness of fulfilling the objectives results from the combination of group positive attitude and energy conservation required maintaining group harmony through cohesion. The authors in order to empirically prove this assertion formulated tow hypotheses. In the hypothesis one, it was the assumption that students’ cohesion will not have influence on their development of uniform attitude to learning so that the more students are cohesively attracted to the group, the more influence on them to engage in classroom group activities that leads to knowledge sharing and positive learning outcome. In the second hypothesis, the author sought to determine if there is a relationship between attitudes toward efficiency and cohesion, to determine if this relationship becoming stronger by the existence of group cohesion.

The outcome of the first hypothesis confirmed that as the high level of cohesion was revealed through friendly relations class, students will not leave their classroom and other colleagues do not want them to leave this class; communication exists largely addressing various topics; therefor, students carried out cooperation learning activities. Also, through performance level which was depicted by students’ admittance to having good grades, although these scores are much lower compared to those described by investigators as students would correspond to students with good academic results. The author believed that the case study class has high cohesion level given that an important factor in enhancing positive interpersonal relationships is the individual performance level (most students have grades, similar academic results, hence the obvious closeness between them). This cohesion, doubled by the set of values of the class according to which learning activities are important, but school performance is not important, marks the performance – at individual and group level. The second hypothesis was confirmed because friendships exist in class, students will not leave the class and do not want their colleagues to leave the class, and they communicate often. On the other hand, they have made cooperation activities, even if they were largely binding. Belonging to this class gives feelings of contentment and pride.

There is the notion by Xhimi (2016) that one of the main problems responsible for students' inability to be productive in class is that there is a lack of group cohesiveness. The author opines that since it has been established that cohesiveness brings about productivity, it is that educators device means of developing as strong, efficient and effective cohesion in the school environment. It was based on modelling the students' cohesiveness using simultaneously the Socio-metric Test (ST) for group formation and Picture Apperception Value Test (PAVT) for consonance or social cohesion that Xhimi (2016) carried out the study on the topic Modelling Student Cohesiveness by waving the Socio-metric Test with the Picture Apperception Value Test. The study was based on literature review method, development of a theory, and simulation modelling of students' behaviour. The study shows the way on how classroom cohesion can be integrated using a socio-metric test within a psychometric test for a common purpose of student cohesiveness and their values system in class. It was found that during the simulation modelling, a relevant point emphasis is the role of images during PAVT that serve as a substitute mechanism of questions to be answered. Classroom cohesion was found to activate emotions through the brain visual cortex and anchored student values. Therefore, through the mention procedure, it is possible to understand social cohesion of different small groups of students.

2.2.3.4 Satisfaction

Satisfaction in education can come from any form judging by the stated objectives and expected learning outcomes. When we are pleased with our learning outcome, it means satisfaction in education has been achieved. This assumption was supported by Tremblay, Lalancette and Roseveare (2012). Success in learning outcome was stipulated as the main indices to measure learning satisfaction. The authors claimed that in many nations of the world, countries like Malaysia, Philippines, Indonesia, Brazil, Korea, Japan and Chile have put satisfaction in the front burner for approving new programmes for their higher institutions of learning. For example, the authors claimed that countries in Latin America like Brazil and Chile will only approve new programme to be offered in private universities except their initial programmes are satisfied with by their students. It was the conclusion of the study that student surveys and student satisfaction surveys are commonly used to capture the quality of teaching and learning. They can indeed provide valuable information to determine international level of education scale, providing comparative insights on their strengths and weaknesses as well as an opportunity to benchmark their performance with the achievement of others on a number of criteria. Though some other authors like Bae, *et al.,* (2020), and Pei, *et al.,* (2020) have insinuated that the applicability of satisfaction across national boundaries is delicate, especially for international satisfaction surveys because of cultural sensitivity. In addition, satisfaction is not a measure of learning.

Razinkina, *et al.,* (2018) studied that satisfaction of students as an education quality monitoring element in innovative higher education institution. The author proposed that the topicality of the research is confirmed by increasing students' involvement into the educational process and that not only the teachers and educators participate in the improvement of higher education institution's activity, but teacher – students' participation. There is a new dimension to the issue of monitoring education quality and student satisfaction with higher education. Therefore, the issue of the relationship between such components as cognitive motivation, personal development and student satisfaction with higher education becomes necessary. Aside this, the essentiality to focus on the approach of determining the satisfaction's role in ensuring education quality. Monitoring student satisfaction with education quality has become an integral part of the educational process not only in a number of European universities, which have used this monitoring for decades, but also in African universities, which are interested in education quality improvement. Leading universities in Nigeria, including the university of Ibadan have over the times utilize students' performance and satisfaction in bragging, are implementing policies targeted at increasing student satisfaction with higher education quality. Education quality monitoring as a key element in the system of providing feedback to students contributes greatly to this process.

2.2.3.5 Task orientation

In a classroom setting, task orientation is an important part of teaching effectiveness as it relates to much of time the teacher spends in discharging a designated task. Such designated task involves lessons that involve activities and goals that are programmed to enhance comprehension of values, skills and identified concepts. As a rule, the more uninterrupted minutes spent concentrating on a learning task, the higher possibility of learning success. In other words, students are most likely to learn (improve their comprehension) through their focus on the task. Staying on task requires that the teacher plan for an uninterrupted period of time in which the focus on instruction becomes intensive.

Task orientation is not a simple matter and it relies on many factors. Task orientation must appeal to the students. The first step in task orientation is to capture the attention of students. The second step in task orientation is to keep students' attention and to heighten their interest in the task. Once this is accomplished, natural inclinations of human behavior will drive the lesson to a successful conclusion. While there are many ways to gain student attention, one of the oldest and most effective methods is to open the lesson with a question. For example, we could be beginning our social studies lessons with a typical rhetorical approach designed to start argumentation.

In a New Zealand-based research, Gadd and Parr (2016) studied nine exemplary classroom practice of teachers who engaged primary-age students in the upper writing class to determine if the concept of task orientation will have improvement in their (teachers') instructional strategies. Effectiveness, according to the authors, pertains to teachers being able to generate a positive impact on learners' engagement and academic outcomes. Particular attention was given to the content and organisation of the tasks and activities that teachers required of their students. Analysis of observed teacher practice in relation to learner gains showed actions associated with task orientation to be strongly associated with student progress in writing. Two indicators linked particularly with learner gains in writing. They relate to teachers being able to select and promote learning tasks that are purposeful and challenging for students and to students being involved in the selection or construction of learning tasks. There were relatively high levels of proficiency with regard to teachers being able to select and promote purposeful and challenging tasks but significant operational variability with regard to teachers involving their students in task selection or construction. Classroom illustrations are provided on how effective teachers promote learner involvement in task selection or construction.

Gadd and Par (2016) summarised that:

1. The greater the amount of time that is spent on task, the greater the possibility of effective learning.

2. Some tasks are more important than others, and this importance is established when the teacher designates the amount of instructional time that will be allowed in the fulfilment of the task.
3. Important social studies tasks should be given the greatest amount of instructional time and less important tasks should be given to the least amount of instructional time.
4. Effective teaching demands that instructional time not be wasted, time wasted during class time can never again can be recovered.
5. Students' tasks must be meaningful to them.
6. The means used to open a lesson will often depend on the degree of task orientation.
7. Open your lesson with a challenge, an interesting and provocative question.
8. If students display disinterest, try to another approach, another question, or another challenge. Do not give up!

2.2.3.6 Innovation

Innovation can be broadly thought of as new ideas, new ways of looking at things, new methods or products that have value. Innovation contains the idea of output, of actually producing or doing something differently, making something happen or implementing something new. Innovation almost always involves hard work; persistence and perseverance are necessary as many good ideas never get followed through and developed. Creativity is an active process necessarily involved in innovation. It is a learning habit that requires skill as well as specific understanding of the contexts in which creativity is being applied. The creative process is at the heart of innovation and often the words are used interchangeably. According to Kampylis and Berki (2014): 'Innovation is defined as the thinking that enables students to apply their imagination to generating ideas, questions and hypotheses, experimenting with alternatives and to evaluating their own and their peers' ideas, final products and processes.' Kaufman and Beghetto (2009) developed four categories of innovation which help to reveal the nuances between different levels and types of creativity. They are Big-C creativity (sometimes called 'high' creativity), Pro-c creativity, Little-c creativity and Mini-c creativity.

In an analytical review of the innovation in education field in the United States of America, the authors outlined innovation classification, hurdles to innovation and offered ways to increase the rate and scale of transformations in the education system which are innovation-based. In an extensive literature review by the author, it was asserted that education in the United State of America badly needs effective innovations of scale which is capable of assisting the country's education system to produce the needed high-quality learning outcomes. It was the main focus of the study that educational innovations should be on teaching and learning in both theory and practice, as well as on the learner, parents, community, society, and its culture. The author also posits that application of technology require a solid theoretical foundation based on purposeful, systemic research, and a sound pedagogy. One of the critical areas of research and innovation can be cost and time efficiency of the learning. The review suggested how to create a base for large-scale innovations and their implementation, increase effectiveness of technology innovations in education, particularly online learning and raise time and cost efficiency of education. Innovations in education are regarded, along with the education system, within the context of a societal super system demonstrating their interrelations and interdependencies at all levels. Raising the quality and scale of innovations in education will positively affect education itself and benefit the whole society (Serdyukov, 2017).

2.2.3.7 Individualisation

Generally, individualised teaching is recognized to be an essential response to a number of pedagogical challenges and problems currently discussed with regard to the effectiveness of teaching (Bray and McClaskey, 2015). From the late 1990s, the notion of individualisation has become a guiding principle for educational reform globally. The concept of modernizing global education highlights the need to ensure differentiation and individualisation by using effective teaching methods. Individualised learning is a method of teaching, in which content, instructional technology and the pace of learning are based upon the abilities and interests of each learner.

The principle of individualised learning has become an important aspect of teaching any school subject. All learning is individual, and most importantly, human speech is individual as a product and a process of learning. That is why Stognieva (2015) canvassed for the use of individualization in language teaching. The author contends that speech motivation is individual, i.e. different people react to different stimuli in different ways. Secondly, human speech is individual in terms of content and meaning, and in the way of expressing thoughts and formulating ideas. However, existing resource kits for teaching English, although they are well developed, suffer significant disadvantages. They are designed for the 'average' student and cannot take into account individual characteristics of each student learning a foreign language.

Therefore, the question arises: Is it possible to develop supplementary educational tools, which will correspond to individual characteristics and the needs of the students? If teachers can develop and implement extra training tools, which take into account the individual and personal characteristics of students, such as the pace of progress, the abilities for foreign language acquisition, possible gaps in learning a foreign language, a personalized system of instruction, the way that teaching is structured and managed, the learning process will proceed more effectively. In the paper, it was argued that providing students with individualised learning resources will result in their active participation in the learning process, and contribute to their productivity when learning a foreign language.

Individualised educational resources are described as effective educational tool in universities. Individualised educational resources are a special type of training tool designed for the individualization and personalization of the learning process. To be effective, student innate abilities for foreign language acquisition, their learning strategies and their personality in individual, pair and group work must all be taken into account.

2.3 Empirical review

This section focuses on reviewing the empirical literature that has relationship with the variables in this study. The moratorium for inclusion is that the article to be included here is empirical in nature. The empirical consideration includes quantitative, qualitative, mixed or triangulation method and literature analysis studies. The inclusion criterion for the articles to be considered for reviewing is ten years. Therefore, articles before 2011 will be excluded. The other justification for the exclusion criteria is for the article to an ordinary opinion paper, articles without scientific approach and articles with defective style.

2.3.1 Teachers' professional competence and students' interest in Mathematics

Studies that combined teachers' professional competence and students' interest in mathematics is limited. However, there are few who have combined the variables sparingly. For example, Bonghanoy, *et al.*, (2019) posit that professional competence in mathematics in Philippines should be improved upon so as to ascertain improvement in interest in mathematics among the students. The authors introduced and justified the study based on the complaints from the part of the teachers that most of their training programmes in teaching mathematics have not been fully being put into use due to reasons alluded to restructure in their use of pedagogical ideas, plan of instruction, and materials and complexity in the new teaching experience.

The authors utilised the data gathered qualitatively from focus group discussion and interview of key informants which were three university researchers, twenty-eight secondary school mathematics teachers and two hundred and fifty students. Reports identified that the teachers and students claimed that lack of self and environmental understanding happens to be the prevalent issues leading to the behaviour of the students in cognition and learning of mathematics. The authors thence advised that by applying transformative education strategies in the classroom, improving students' interest and maximising their participation in classroom activities will be attained.

Equally, Joubert, *et al.,* (2012) argued through a meta-analysis of the literature that if teachers of mathematics are made to through professional competence programmes, the dwindling interest of students in mathematics will be increased. Continuous Professional Development (CPD) for mathematics teachers, according to the reviewed literature in the study of Joubert, *et al.,* (2012) were reported to have accounted for effective interest students is having in mathematics. In the study, the author found that an in-depth understanding of the knowledge of mathematics by individual teachers' initiates in students the attitude of looking forward to becoming mathematicians in future. Thus, responses of individual teachers to their CPD develop students' interest in mathematics. The study used an analytical framework to peruse literature to arrive at the conclusion that CPD contributes to students' interest in mathematics.

Yeh, *et al.,* (2019) claimed that in most elementary mathematics classrooms in Taiwan, conventional teacher-led instruction remains dominant. However, the situation has made it difficult for the mathematics teachers to rarely being able to take care of all students. The condition, according to the researchers, has made students to always lag in mathematics class, achievement and interest which were responsible for why most students eventually gave up mathematics learning. In fact, students in Taiwan generally have lower interest in learning mathematics compared to many other regions/countries. For this reason, the study focused on enhancing students' achievement in mathematics and interest since they are the two major problems, especially for those low-achieving students. The study described how a game-based learning environment called Math-Island was designed incorporating the mechanisms of a construction management game into the knowledge maps of the elementary mathematics curriculum. The study experimented with 215 elementary students for 2 years, from grade 2 to grade 3. In the experiment, plus the teacher-led instruction in the classroom, students were focused to learning mathematics with Math-Island using their own tablets at home and school. It was found that there was an improvement in students’ mathematics achievement, especially in the word problems and calculation. Moreover, the achievements of low-achieving students in the experimental school outperformed the low-achieving students in the control school (a control group in another school) in word problems. Moreover, both the low-achieving students and the high-achieving students in the experimental school maintained a rather high level of interest in mathematics and in the system.

Also, in 2019, relationship between mathematics performance and interest in a technology-learning context in Malaysia was established by (Wong and Wong, 2019). It was the initial aim of the study to be preliminarily examining the possibility of interest in mathematics among students leading to performance. The Mathematics Interest Inventory was administered to 40 students to measure students’ interest towards mathematics, while a mathematics test was used to measure students’ mathematics performance. Results of the descriptive statistical analyses revealed that the students were relatively interested in mathematics. Correlational analyses showed that interest was not significantly correlated to mathematics performance among the students. Nevertheless, a significant relationship between interest and mathematics performance was found among students who had lower mathematics performance. The findings of the study pointed to the importance of igniting interest among students with lower mathematics performance given its strong link to mathematics performance. The Interest-Driven Creator theory served as an anchor in the theoretical framework of the study and it was discussed within the context of mathematics learning.

Anigbo and Idigo, (2016) studied the factors militating against Senior Secondary School Students' Mathematics interest. The variables are understudy factor, educator factor, government factor, infrastructural issue, instructional procedure, class size and arithmetic uneasiness. Two principle instruments (FASMRI and MATHRET) developed and face-approved were regulated to 210 Senior Optional School one (SSI) Students in the five chose government funded schools in Enugu and Obollo for Education zones in Enugu State. The dependability coefficient for FASMRI is 0.83 and 0.89 for MATHRET utilizing Split-Half and KR-20/21 methodology individually.

The information gathered was investigated utilizing Pearson Product-second connection measurement and various examination procedures. Results showed that the seven elements were powerful in foreseeing auxiliary school understudies' revenue to learn mathematics. All the more thus, instructor factor, understudy factor, instructional procedure, Mathematics tension and infrastructural issue connect emphatically with the subordinate measure, while class size and government factor correspond adversely with the subordinate measure. On the other hand, the seven components have critical relative consequences for mathematics interest. It is suggested that administration ought to arrange supplemental classes for science educators often from which instructors can be outfitted with different in underlying techniques with which they can use to train understudies viably to upgrade their advantage for science learning.

Azmidar, *et al*. (2017) affirmed that studies have indicated that mathematics interest in students is still low and most of the students have the perception that mathematics is a difficult subject, not a very practical and contains numerous abstract theorems that are very hard to understand. It was also added that the teaching style and learning process used was mechanistic which did not put into consideration the students' needs. Learning is more known as the process of transferring the knowledge to the students. It was suggested that students should be allow to construct their own knowledge with the mental and physical reflection that is done by activity in the new knowledge. The article which was a literature analysis was purposed to examine the Concrete-Pictorial-Abstract approach, theoretically, to improve mathematics interest in students. It was concluded that the Concrete-Pictorial-Abstract approach should be utilized as an alternative to improve mathematics interest in students.

The purpose of study by Anwar, *et al.,* (2019) was to develop a multimedia learning that is based on Spring Presenter which was created to increase students' interest in learning mathematics. This study was based on the ADDIE development model that consist a five-stage procedure of analysis, design, development, implementation, and evaluation. The descriptive quantitative data analysis technique was used. The results showed that the interactive mathematics multimedia learning based on Spring Presenter has fulfilled the requirements to be considered feasible to be used in the learning process and is feasible to be used as learning support media to increase students' interest in learning through varied learning activities.

In a study that described the interest of students in learning mathematics after exposing them to a traditional game guide book with the selection of subjects who have low interest in learning mathematics. The research used a descriptive form with a qualitative approach. The data from the research were the students’ interest in learning. The object of the study included students of class VIII SMP. The data collection techniques used was questionnaires and interviews as data reinforcement from the questionnaire results. The results of this study indicated that the use of traditional game guidebooks in mathematics learning was very effective as seen from the results of the questionnaire on student interest in learning where male students’ interest in learning increases by 79%, while for female students it increases by 82%, and is strengthened by the results of interviews which revealed that most students were happy with the use of traditional game guidebooks and gave positive responses to mathematics learning (Indrawati, 2021).

To connect social mathematics with the development of local wisdom-based learning media with Prezi applications, Choirudin, (2021), conducted a path-analysis study with the aim study to create and develop local wisdom-based learning media with Prezi applications in Social Arithmetic Materials. The study which is a type of research in the Research and Development (RND) category, using development steps and which has been transformed. The development steps were limited to six steps. Among which were results of need analysis, problem identification and data collection, product design results, design product validation, design revision results (Initial Product), small group trial and field trials (Large Group Trial). Local wisdom-based learning media was developed with the application of Prezi on social mathematics material to collecting data on local wisdom on the livelihood of Buminabung residents by taking documentation in the form of photos and information related to the local wisdom put them on the slide Prezi.

The development of local wisdom-based learning media with the application of Prezi on social mathematics material was found to be feasible to use in learning. The assessment of material experts and media experts with an assessment of 80% in the feasible category and 91% in the very feasible category. The results of the trials carried out were small group trials in class VII A with a feasibility percentage of 76% in the feasible category. In the field trials conducted by class VII AMTs Ma’arif 05 Buminabung, the percentage was 79% in the feasible category.

In secondary schools in the Fako division of Cameron, Lawyer (2019) researched how teachers' competence affected students' interest in science. The study's goals were to determine how instructors' knowledge of the material they were to teach affected students' interest in science and the connection between teachers' preparation and competency and students' interest in science. All sixth-grade students and teachers at public, confessional, and lay private schools were the focus of the study. The data was gathered using a standardized questionnaire. 341 respondents made up the sample, who were chosen by straightforward random and purposeful sampling methods. With the use of the Statistical Package for Social Sciences, the acquired data were examined using the Pearson Product Moment Correlation analysis (SPSS). The results indicate that teachers' subject-matter competence greatly influences students' interest in the subject (xy=0.224) and that there is a considerable association between teachers' knowledge and competency (xy=0.214), which is strongly correlated with students' interest. Based on these findings, it is advised that classroom teachers emphasize mastery of the subject matter being taught; they should also emphasize learner interest as a crucial component of teacher competence; individuals with educational achievements should be required to take teacher education courses that will give them pedagogical content knowledge.

In their 2019 study, Fauth, Decristan, Decker, Büttner, Hardy, Klieme, and Kunter look at the connections between elementary science education student results and teacher competence. According to the findings, teacher competency (including pedagogical subject understanding, self-efficacy, and teaching excitement) was strongly correlated with students' interest, whereas self-efficacy was positively correlated with student achievement. These associations were mediated by three aspects of teaching quality (cognitive activation, supportive atmosphere, and classroom management), which speak to the actual teacher-student interactions in the classroom. These findings shed light on the mechanics underlying how teachers affect student performance.

It is evident from the foregoing that students' interest in science is significantly influenced by teachers' competency. The teacher's training and subject matter competence were given particular consideration. It must be acknowledged that teachers learn their subject matter through formal education and that the combination of their ability to teach well and their pedagogic topic understanding creates a competent teacher. It should be highlighted that pedagogical topic knowledge and subject matter expertise are not everything. Given the frequently abstract nature of learning sciences, a learner's interest in those subjects is essential. As a result, the importance of the teacher's role in inspiring students and ensuring that their interest develops and is maintained cannot be overstated.

2.3.2 Teachers' professional competence and students' achievement in Mathematics

Studies abound about how the professional competence of teachers can have effect on students' achievement in mathematics with almost all the studies positive association, relationship, and connection. In a study by McMeeking, Orsi, and Cobb, (2012), the authors sought to find out if achievement in mathematics of middle school students can be affected by the type of professional competence programme offered to teachers. The study included a total of one hundred and twenty-eight (128) middle school mathematic teachers from Colorado in the United States of America who were randomly selected through a balloting system. In the quasi-experimental study research, the teachers were taken through a professional development sequence of content-oriented summer courses and pedagogy-oriented structured follow-up experiences during the subsequent academic year after which their teaching strategies were measured on students using the state of Colorado's mathematics test result of the students they thought. This was achieved by comparing the outcome of teachers who did not participate in the training with those who did. Results showed those students' odds of achieving a score of Proficient or better increased with teacher participation in the professional development programme.

Also, in a PhD study by Parish (2013), there was an affirmation that teachers' professional competence has an impact on students' academic achievement in mathematics. The study which explored the teachers' professional competence impact on achievement of students in mathematics gathered its population from third, fourth and fifth grades mathematics teachers totally two hundred and sixty (260). Teacher participation in professional competence courses was collected for curriculum, instruction, differentiation, assessment, technology integration, and continuous improvement credit types. Achievement data for 8,454 students was used: 2,883 in 3rd grade, 2,752 in 4th grade, and 2,819 in 5th grade. The dependent variable of student achievement was dichotomized at the median: half of the student participants scored above the median and half of the students scored at and below the median. A series of logistic regression models were fit to the data that included examining all main effects and interaction terms among all variables to determine the best fitting model. The results of this study indicate that for 4th grade science, teacher professional competence participation in curriculum, instruction, and differentiation credit strands increased the chances for students to score above the district median on CBAs. The larger number of professional development hours in a variety of credit strands had a negative impact on student achievement in 4th grade science. In 5th grade science, the students whose teacher spent more hours in professional learning for continuous improvement had an increased likelihood of scoring above the district median on CBAs.

Polly, McGee, Wang, Martin, Lambert, and Pugalee (2015) linked professional competence of teacher with their teaching outcome on students' achievement in mathematics. The study which was a survey used questionnaire data to determine the relationships amongst the variables, though observation technique was equally deployed to ascertain how influential is the three-year long participation of teachers in a learner-centered mathematics teachers' competence programme in cohorts. A multi-level data analyses that was conducted affirmed the earlier assumption that that the content knowledge of the mathematics teachers brings about changes in their teaching practices which both had statistically significant effects on student achievement. The study advanced the knowledge base on the influence of content knowledge and teachers' beliefs on student achievement.

In a similar format, Jacob, Hill and Corey (2017) studied the teachers' professional competence programmer's impact on their knowledge of teaching mathematics, instruction and achievement of students they teach. The study is a meta-analysis of a three-year evaluation of a mathematics professional competence programme offered to teachers on commercial basis which have been found to be well-developed for improving the knowledge of mathematics by teachers. The mathematics professional development programme for the teachers was built on four indices of helping the mathematics teachers to learn more about mathematics, understanding how mathematics is learned by the students, using formative method of assessment to develop the need of specific students in terms of what they or do not know, and developing effective instructional strategies which will assist student solve mathematics problems. There were one hundred and five (105) 4^{th} and 5^{th} grades in 19 low-income school teachers who participated in the study who were selected using multi-stage sampling procedure. The selected teachers went through the training programme in a weeklong summer school that is in charge of the training, while a control group referred to as business-as-usual group were left alone. A positive correlation was reported with an evidence of positive impacts on teachers' mathematical knowledge for teaching, and on instructional practice and student outcomes in mathematics when compared with the others that were taught by the teachers without the training.

Equally in the same year, mathematics achievement of students was connected with teachers’ professional competence in a longitudinal study spanning four years by Kutaka, Smith, Albano, Edwards, Ren, Beattie, Lewis, Heaton, and Stroup (2017). The main aim of the study was to ascertain if teachers who went through a professional competence using primarily math, a software developed to train in-service mathematics teachers, will have effect on the outcomes of performance by their students. The learners’ focuses in the study were the kindergarten pupils in the third grade. Two sets of data gathering stages were attained. In the first stage of the analysis, the teachers’ knowledge of mathematics after going the training, their attitudes towards the learning of mathematics and their beliefs about teaching and learning of mathematics were reported to be relatively surpassing the comparison group. The pupils were found to better perform in mathematical activities such as numbers and operations and were equally found to have developed positive attitudes to learning mathematics as well as enjoying student-centered teaching approaches. In the second stage of the analysis, the study reported that the students showed more relative achievements in mathematics in the next summer after the first test more than those in the control group. It concluded that there was a small but positive effect of participation in Primarily Math on student mathematics achievement.

However, in china, the impact of teacher professional competence on students’ achievement in mathematics in Rural China was sought (Lu, Loyalka, Shi, Chang, Liu, and Rozelle, 2017) found to be negatively correlated. The authors claimed that the reason for the study was stemmed from the fact that significant gap have been established between achievement in mathematics by students in the rural china as compared to their counterparts in the urban region. Therefore, in order to close the gap, policy makers in China’s education system brought up training programmes for the in-service mathematic teachers in the rural areas with the mind to upgrade their mathematics knowledge and teaching skills. The author thence decided to ascertain if the national teacher training programme for mathematics teachers has yielded the desired outcome in order to justify the billions of dollars expended for the programme. Using data from eighty-four teachers and three thousand and sixty-six students randomly selected for the study, the authors reported that there was minimum influence of the training on the students' achievement in mathematics. Though, the study reported that the training programme returned a positive association on mathematics teaching knowledge of the teachers, there was no empirical evidence to show that the teachers transform the knowledge convincingly to teaching practices in the classroom. The authors concluded that when the data were taken together, results showed that teachers might have improved their knowledge for teaching from the training, but did not apply what they learned to improve teaching practices or student learning.

Related study in Nigeria by Olasehinde-Williams *et al*., (2018) focused on the knowledge level of teachers as predicting measure of secondary school students' mathematics achievement. In the study, the authors relied on the outcomes in mathematics by students who took the general examinations between 2009 and 2015 with a record of only 40% pass rate as the justification for carrying out the survey. The study thence, investigated the predictive value of Depth of Subject Content Knowledge of Teachers and Pedagogical Knowledge Depth on Students' Academic Achievement in Mathematics. Findings showed that teachers with B.Sc. demonstrated the deepest Depth of Subject Content Knowledge, Depth of Pedagogical Knowledge and Depth of Subject Content and Professional Knowledge. Also, pedagogical and subject content knowledge of teachers were found to be significant predictors of Students' Academic Achievement. Significant differences were observed between the Depth of Subject Content Knowledge and Depth of Pedagogical Knowledge of the English language and mathematics teachers in favour of mathematics teachers. Similarly, students' performance in English language was lower than that of mathematics, though not statistically significant. While the quality of education in mathematics classrooms has been known to be significantly impacted by teachers' subject-matter and pedagogical competence (Mapolelo and Akinsola, 2015). According to Mapolelo and Akinsola, (2015), teachers are important in helping students learn mathematics, and the depth of their subject-matter and pedagogical knowledge affects students' performance.

In public senior secondary schools in Ikot Ekpene and Essien Udim local governments areas of Akwa Ibom state, Amie-Ogan, and Etuk, (2020) looked into the impact of teachers' competence on students' academic achievement. The investigation was guided by two aims and two null hypotheses. In the 19 public senior secondary schools in the Akwa Ibom state local government areas of Ikot Ekpene and Essien Udim, a total of 32,303 students—14,636 males and 17,667 females—were enrolled.

Using Taro Yaman's formula, a sample size of 323 students—154 men and 169 women—was determined. The study used a self-structured questionnaire with a 4-point rating scale of Very High Extent, High Extent, Low Extent, and Very Low Extent that was validated by specialists in the Departments of Measurement and Evaluation and Educational Management. The questionnaire was titled "Influence of Teachers' Competence on Students' Academic Performance Questionnaire." Using a pilot sample size of 10 teachers, the instrument was pre-and post-tested, and the test-retest reliability approach yielded a reliability index of 0.70. The research questions were answered using mean and standard deviation, and the ztest was employed to test the null hypotheses at a 0.05 level of significance.

According to the study's findings, teachers' knowledge of subject matter and pedagogical abilities positively affect their students' academic achievement in public senior secondary schools in Akwa Ibom State's Ikot Ekpene and Essien Udim local government areas. The findings led to the recommendation that instructors be encouraged to pursue both long-term and short-term training to improve the quality of their subject-specific teaching abilities in senior secondary schools. The government should also make sure that a sufficient number of qualified and competent teachers are chosen to work in all senior secondary schools.

Ekperi, (2018), studied the impact of teacher features on students' academic performance in secondary schools in Enugu State, Nigeria. The findings of the study show that teachers' knowledge of subject matter was correlated significantly and positively with students' academic performance. While, Majason in Ekperi, (2018) marked that the mastery of appropriate knowledge is one of the utmost central qualities of the mathematics teacher. The teacher must have a good understanding of the subject matter if he is to control the respect of his students. Ekperi, (2018) considered how teachers' knowledge predict students' achievement in mathematics. The findings show that teachers' knowledge in the subject was significantly correlated to students' achievement in both grades; and improved students' mathematics achievement. The study completes by Baumert *et al.* (2010) which considered teachers' subject matter knowledge and students' performance in mathematics also found a connection between these variables. Mathematics teachers with a developed PCK was establish to create better lessons, which had positive sound effects on the students' performance. A comparable study carried out by Adediwura and Tayo (2007) which looked at the connection between perceptions of teachers' knowledge of subject matter as predictors of academic performance in Nigerian secondary schools found that students' perception of teachers' subject knowledge was considerably correlated to students' performance in the subject.

The impact of teachers' knowledge and competency on students' academic progress was examined in a study by Nyanjom, Yambo, and Ongunya (2021) in Kenya. The academic performance of students in Kisumu County has not been encouraging, and there are differences amongst the sub-counties (Nyanjom *et al.*, 2021). The study was developed using the best practices in teaching and learning. To determine whether correlations and associations exist, Pearson's Product Moment Correlations and Multiple Linear Regressions were used to test the hypotheses. Themes and sub-themes were identified, and the qualitative data were then evaluated continuously before being published in prose. At p-values of 0.125, 0.027, 0.05, and 0.121, 0.033, 0.05, respectively, teaching abilities and assessment competences demonstrated a statistically significant link with students' academic progress. On the other side, Kenya by Kirimi, Jagero, and Gitari (2021) looked at how teacher professional knowledge affected the performance of public secondary schools. The study found a strong correlation between teacher professional expertise, particularly subject-matter knowledge, and student outcomes. Hill and Chin (2018) identified links between teacher student knowledge, teaching, and academic outcomes. Oviawe (2016) found a strong correlation between teacher efficacy and student achievement. This is consistent with research by Kiamba, Mutua, and Mulwa (2018), which shows that teachers' subject-matter expertise affects their students' achievement. According to Gess-Newsome (2013), PCK has a considerable impact on students' learning and achievement. As a result, it follows that if mathematics teachers put sufficient effort into preparation by creating lesson plans, lesson notes, teaching materials, reading widely, and interacting with the students during class times, it will improve teachers' efficiency outcomes.

In a similar study, Cabalo and Cabalo (2019) investigate the teachers' mathematical competencies and personality factors concerning the mathematics students' academic achievement for a year. In terms of teaching-learning methodology, the overall rating for mathematical competence was 3.04, which is considered proficient. More specifically, the group received ratings of 3.07 for planning, 3.09 for implementing, and 2.95 for assessment, all of which were considered proficient. The overall score for the teachers' mathematical knowledge in terms of basic content understanding was 95.96, which is considered above average. The overall character qualities score for the teachers was 3.15, which is considered excellent. Teachers were given a rating of 2.91 for Competence in Personal Traits, 3.32 for Competence in Social Growth, and 3.21 for Competence in Professional Traits. The final grade for the four periodic exams gave the students an overall grade of 57.72, which was considered below average. The student's academic achievement in mathematics and the teaching abilities and personal qualities of their teachers did not significantly correlate. The student's academic success and their teachers' familiarity with the subject matter of mathematics, however, are significantly correlated.

The following conclusions were reached in light of the study's findings: There was no visible relationship between students' academic achievement in mathematics and teachers' professional competencies as teachers or personal characteristics as individuals. The student's academic success and their teachers' familiarity with the subject matter of mathematics, however, are significantly correlated. Teachers of mathematics who are knowledgeable in the subject's theories and concepts have significantly enhanced their students' academic achievement in mathematics.

The effects of teachers' competence on students' academic performance in mathematics were investigated by Oredina and Ebueza in 2020. This study established a link between teachers' proficiency in teaching, research, and extension, students' math performance, and its predictors as a foundation for bettering math instruction. It used a descriptive correlational technique with 151 students majoring in mathematics in the College of Education for the SY 2016–2017 and eight respondents who were mathematics teachers. Data was collected via a questionnaire, and relationships and predictors were identified using Pearson r and regression analysis. The teachers are quite competent at teaching, with a median of 4, but they are also proficient at research and extension, scoring a median of 3 for each. Students who major in mathematics perform very well in a subject, excelling in topics like technology and linear algebra. There is no substantial correlation between students' achievement in mathematics and instructors' competence in education, research, and extension. With y= 93.86 -0.219x1 +0.143x2 +0.181x3 as the regression model, the competence in instruction, research, and extension are not predictors of the performance in mathematics. Students' mathematics performance may or may not be influenced by the teacher's competence in teaching, research, and extension.

The study's conclusions show that mathematics teachers have the instructional competence and skills they need. They possess the necessary research knowledge. They can carry out extension activities. On the other hand, mathematics students demonstrate competence in many areas of math but have only mastered the fundamental knowledge and abilities in other mathematics courses. Thus, the ability of teachers to instruct, do research, and extend knowledge cannot be related to students' academic success. It is not always possible to predict student achievement in mathematics based on teacher competence.

Teachers' pedagogical subject knowledge, professional beliefs, work-related motivation, and self-regulation are all investigated as characteristics of their professional competence in the study by Kunter, Klusmann, Baumert, Richter, Voss, and Hachfeld (2013). It focuses on how these factors affect instruction and subsequent student results. Multiple metrics were used to evaluate teacher competency, instructional quality, student achievement, and motivation in 194 German secondary school mathematics courses that were drawn from a nationally representative sample. In a one-year repeated-measures approach, the impact of instructors' professional competence on student outcomes was estimated. Two-level structural equation models showed beneficial benefits of teachers' teaching zeal, pedagogical content knowledge, and self-control abilities on instructional quality, which in turn had an impact on student results. On the other hand, teachers' overall academic proficiency had no impact on the way they taught. This article's introduction of a multidimensional model of teachers' professional competence appears to be a good starting point for further investigation into the individual teacher quality indicators.

The relationship and level of predictability between teachers' pedagogical knowledge and mathematical proficiency and students' mathematical achievement were examined by Morre and Casocot in 2022. The study indicated that teachers had a high degree of pedagogical expertise, while mathematic proficiency among teachers and student math accomplishment levels were both found to be quite high. Students' achievement in mathematics is not significantly impacted by either teachers' pedagogical knowledge or mathematical abilities. The results demonstrated the value of the surrounding context and the suitability of online platforms in a variety of ways to raise students' mathematical achievement.

Sultan and Shafi (2014) investigate how perceptions of the classroom environment and teacher ability influence how well students perform. The authors used a sample of 500 pupils (250 males and 250 females) from rural Dokota Town, Tibba Sultan Pur, and Mailsi public and private schools. The study's conclusions are as follows. Results indicated that teachers' competence had a substantial impact on students' performance. The relationship between instructors' competency and the classroom setting, however, was not significant. The classroom environment was found to be a non-significant factor for teachers' competence and students' performance in the findings relating to the mediation and moderation effects.

In the setting of Pakistan's Baluchistan province, Begum and Sharjeel's (2020) research focused on the impact of mathematics teachers' proficiency on students' academic achievement. The context of the investigation was chosen Baluchistan cities. In order to create strategies and more effective remedies for this issue, policies and parameter analysis was done rigorously. To learn their attitudes regarding the topic, a sample of N = 280 students (143 male and 137 female students) were interviewed and watched in their classrooms. In several of the schools that were chosen in the Baluchistan sampled cities, head teachers were also questioned. The theories were formed with the aid of a literature review. Through SPSS V 22, the hypotheses were tested. Male and female pupils of primary mathematics in the province were compared on their viewpoints using correlation and t-tests. The study comes to the conclusion that providing these instructors with training and seminars is the only way to keep kids in elementary courses in the province. Students who are inspired by their teachers' support and hard work are inclined to attend school more frequently, as are their parents.

Another study conducted in Nigeria by Agah (2022) looked into the competency of senior secondary school teachers in the Askira/Uba Local Government Area of Borno State in teaching mathematics to students. The study's major goal was to identify the elements that teachers consider when they give lessons in an effort to explain changes in students' academic performance in mathematics over time. In recent years, the success of students in mathematics has drawn the attention of a wide range of stakeholders, raising questions about the subject's presentational skills of teachers. The check list the respondents completed in the questionnaire in order to respond to the study questions was gathered, and the data were then analyzed to obtain descriptive statistics of percentages, averages, and standard deviation. The t-Test was used to test the hypotheses, with a significance level of 0.05. The findings showed a connection between students' academic progress in mathematics and teachers' ability. This is connected to the idea that a teacher's intellectual capacity plays a significant role in the quality of education that students get in the classroom. Outstanding scholastic achievement in mathematics would be considerably aided by a qualified mathematics teacher who possesses the qualities necessary to motivate and cultivate the latent abilities of his students.

Based on the results, the following conclusions were drawn: It is clear that there is a significant relationship between teachers' training and experience and students' mathematics performance, as well as a significant relationship between facilities and effective mathematics teaching and learning, and a significant relationship between teachers' teaching methods and students' mathematics performance. The study thus urges school administrators to, among other things, make sure that mathematics teachers receive the proper orientation on the many aspects of lesson delivery and the significance of facilities and instructional materials during teaching and learning. To help them advance their teaching abilities, they should be required to attend regular seminars, conferences, workshops, and in-service training.

In Saki-West Local Government Area, secondary school students' academic performance was examined in the study by Fehintola (2014) in relation to the academic qualification, professional qualification, content knowledge, instructional quality, evaluation procedures, work value, classroom attendance, and job satisfaction of teachers. When taken together, the eight factors (teachers' academic and professional backgrounds, content understanding, instructional quality, evaluation practices, and worth of their work, classroom attendance, and job satisfaction) accounted for 54.6% of the total variation in academic performance. The independent variables (teachers' academic background, teachers' subject expertise, teachers' instructional quality, teachers' assessment practices, and teachers' work happiness) made a substantial relative contribution to the participants' academic performance as well. Additionally, the greatest substantial relative contribution to the prediction of academic success came from the teachers' subject-matter expertise. However, secondary school students' academic achievement in the examined local government area was not significantly predicted by teachers' professional qualifications, the worth of their work, or their presence in class. The eight independent variables that were taken into consideration in this study teachers' academic background, professional training, subject-matter expertise, instructional quality, evaluation practices, worth of their work, classroom attendance, and job satisfaction had a significant impact on the academic performance of secondary school students in the research area. These results suggest that the instructional quality and subject-matter expertise of teachers are sufficient teacher qualities for outstanding student achievement.

2.3.3 Teachers' quality of instruction and students' interest in mathematics

Whether quality of instruction will influence interest in mathematics by students has been the focus of several studies both in the past and in the present. While authors have approached this from different perspective, the general objective has been to empirical proving the assumption. A study by Lazarides and Ittel (2013) determined if self-concept and interest differ across the patterns of students perceived instructional mathematics classroom quality. The general aim of the study was actually to correlate Instructional Quality and Attitudes toward Mathematics. In the study, the authors utilized a person-centred approach of research which explored how individual differences in the perception of students to instructional quality of their teachers and the level of interest student displays in secondary school mathematics classes and their relations to students' self-concept and interest in mathematics. Data was drawn from four hundred and twenty-five (425) students from high school selected from 10 Berlin schools in Germany with male accounting for 53.2% and female 46.3%. Using latent class analyses (LCA), it was revealed that four distinct patterns of perceived quality of instruction existed. About half of the study's sample 46% had a high likelihood of perceiving an overall low quality in mathematics classes. Those students reported particular low self-concept and interest in mathematics. Compared to male students, female students were significantly more likely to belong that had a high likelihood of perceiving an overall low quality in mathematics classes. The study advised that instruction in mathematics should take into account learners' highly individual ways of perceiving and evaluating their learning environment.

In an attempt to determine whether teachers' perception can influence students' interest in mathematics in Markudi municipality, Ieren and Eraikhuemen (2017) completed a survey in that regard. The study which was principally aimed at examining the different factors that can influence the students' interest and academic performance in mathematics focused on secondary school students. The sampled size of the study included five hundred and twenty-five students and seventy-five teachers. The interest and academic achievement were investigated using indicators such as the quality of the mathematic teachers, instructional materials quality, methods of teaching as well as some other items to determine their level of interest in mathematics. Using descriptive statistics, the effect of different factors on students' interest and achievement was determined. Findings of the study showed that there were many factors that negatively influenced the performance of students in mathematics including the lack of qualified teachers for mathematics, motivational lack, and poor methods of teaching and instructional materials used by the teachers in teaching the subject. Lack of interest on the part of the students or poor attitudes of students towards mathematics was also established. It was recommended that the government should provide more instructional materials to facilitate the teaching of mathematics, mathematics students should be awarded scholarship so as to motivate them study the subject, workshops or seminars should be organized for mathematics teachers so as to help them know the latest development in mathematics and give the students the best in the subject, parents should monitor the progress of their children in mathematics and make sure they provide for them all they need to do good in the subject.

In Toropova, *et al.*, (2019) studied the teachers' role in the area of their characteristics and the students' achievement in mathematics based on the characteristics regarding their instructional quality. Teachers' experience measured by the years of teaching, coursework of the teachers measured by the months used in studying mathematics and the teachers' self-efficacy were the indicators for determining the teachers' quality. Based on confirmatory factor analysis and structural equation modelling, the study found that the teachers who have high self-efficacy beliefs were well rated by their students for possessing high teaching quality and this led to them being motivated to have interest in mathematics. However, this was not reflected in student achievement levels. Instead, with student socio-economic and immigrant background under control, there was a significant positive relationship between coursework in mathematics and student mathematic achievement levels, as well as between student perceptions of instructional quality and achievement. Relations between teaching experience and student achievement followed a non-linear pattern, with the effect of teaching experience increasing up to 19 years and declining afterwards.

Factors leading to poor mathematics performance in Kibaha secondary schools included students' poor background in mathematics poor, mathematics departments were not well-managed, poor teaching environment, and inadequate self-practice. Therefore, the researcher recommended teachers to make assessment on the background of their students so as to decide the best teaching methods that can help students perform better in mathematics and that students should put self-efforts and practice in learning mathematics while future research on individual factors that affects students' learning of mathematics should be conducted. This study was about the factors leading to poor performance in mathematics subject in Kibaha secondary schools. The study was guided by four objectives which examined the influence of cultural backgrounds on students' performance in mathematics, identified the influence of teacher - students' relationship on student's performances in mathematics, determined the nature of school environment where teaching is practiced and examined influence of school management system on teaching and learning process in mathematics. Relevant literature was reviewed on theories and findings that emerged from different authors. The study involved 4 secondary schools, 8 mathematics teachers and 60 students. These were obtained through simple random sampling. Four academic masters and four head of school from four schools were purposely selected. Data collection was done by using questionnaires, interviews, focus group discussions, observations and documentary review (Michael, 2015).

Instructional and teacher quality on students' outcome globally was the crux of a cross-country study by Nilsen and Gustafsson (2016). It examined the criticality of input and process of teachers' quality on students' cognitive outcomes of students particularly on their interest in mathematics. The character of the teachers was regarded as a measure of quality in their teaching and instructional practices which predicts achievement of students. The authors suggested that the relationship may be different across nations. Therefore, the hypotheses investigating these were formulated, applying a multi-level structural equation modelling in grading the students in grade four as well as their teachers. The sample of the population was 205,515 and nest of 10,059 from 47 countries. Results revealed that teacher quality was significantly related to instructional quality and student achievement, whereas student achievement was not well predicted by instructional quality. Certain characteristics were more strongly related to each other in some world regions than in others, indicating regional patterns. Participation in professional development activities and teachers' sense of preparedness were, on average, the strongest predictors of instructional quality across all countries. Professional competence was of particular relevance in Europe and Western Asian/Arabian countries, whereas preparedness played an important role in instructional quality in South-East Asia and Latin America. The ISCED level of teacher education was on average the strongest predictor of student achievement across all countries; this characteristic mattered most in the Western Asia/Arabia region.

To enhance students' interest in mathematics, Ogochukwu (2020) suggested using multimedia presentation technique. Based on the low rate of students applying for mathematics in higher institutions, the study made an attempt to subvert the ugly incident to improve the statistics of enrolment in mathematics in higher institutions. Survey style was adopted in the study comprising 82 students in high schools learning mathematics. Questionnaire was used for data capturing, while data were analysed using frequency counts, means, percentages and standard deviations for descriptive analysis. Also, independent group t-test at midterm, and at the end of the term was used for mean variation while a one-way analysis of variance with a Student Newman-Keuls Multiple Range test was also used to measure early in the term, at midterm, and at the end of the term grade classification (freshman, sophomore, junior and senior) which were the independent variables against the dependent variable of interest in mathematics. Equally, a one-way analysis of variance with repeated measures early in the term, at midterm, and at the end of the term for measuring group activities and a one-sample binomial test between the proportions was also carried out. The results of the examination indicated that students preferred multimedia presentations to the traditional classroom instructional methods. More research effort was suggested to be invested so as to explore students' preference and learning with regards to other instructional methods such as web-based learning and multimedia presentation-assisted instruction. Additional research regarding the influence of multimedia on different types of learning styles should also be investigated to determine how individuals with diverse learning styles benefit from multimedia instruction.

The examination of teaching quality in mathematics in relation to student learning outcomes has become increasingly important following the research reports indicating that early mathematics teaching and learning experiences are critical contributors to students' learning and later achievement in mathematics and other content areas. A study investigated the relationship between the students' mathematics learning outcomes and quality of early mathematics instruction in 73 Pre-K to 3rd grade classrooms in an urban public schools' system. The results suggested that the quality mathematics instruction varies across observed classrooms but mostly mediocre. Limited but significant associations between instructional quality and mathematics achievement were also documented at the classroom level. More specifically, there was a positive significant interaction between quality of mathematics teaching and students' mathematics achievement at the end of the school year in classrooms where ratings of the instructional quality were identified as "high," after controlling for students' pre-test scores and gender (Cerezci, 2020).

Furthermore, an article which explored studies that investigated GeoGebra integration as well as its effectiveness in teaching and learning mathematics. The studies were examined through a literature review by Musset, (2010) on how and why GeoGebra has enhanced students' performance, analytical thinking, their understanding, generalization, representation, logical thinking and abstract thinking. Main construct of the study was collected and analysed derived from 20 studies whose results reported that GeoGebra added values when applied in teaching and learning in different mathematical domains. The reviewed literature identified four domains in Mathematics: Trigonometry, Calculus, Algebra and Geometry that were later studied. Reviewed studies majorly investigated the integration of GeoGebra in Geometry and few studies were found in other mathematical domains. The literature ascertained that students explores independently, the software and acquire mathematical concepts with minimum assistance from the teacher. The results from the reviewed literature, on the one hand, indicated 16/20 or (80 %) of the studies generally showed that GeoGebra is effective in teaching and learning Mathematics since GeoGebra contributed in enhancing students' understanding of mathematical concepts and improved students' interest to learn mathematics. On the other hand, only 4/20 studies or (20%) showed non-effectiveness of GeoGebra since students in both experimental and control groups did not show the difference in their performance after being both given post-tests or an interview. This may indicate that although GeoGebra seems to be largely effective, such effectiveness is dependent on the way it is integrated into the teaching and learning process. Therefore, we recommend that other research should step up investigating why most of the studies were found in the Geometry domain and few in other domains.

The relevance of students' academic interest in mathematics is also a major worry for those involved in education, according to Arthur (2019). The current study uses mathematical facility (MF), mathematics connection (MC), teacher motivation (TM), as well as quality of instruction and availability, to model students' interest in mathematics (SIM) (IQA). 1500 pupils were randomly chosen for the study from 10 senior high schools in the Ashanti area of Ghana; nevertheless, 1,263 of the participants gave the study their complete cooperation. These participants were asked to complete validated self-administered surveys with alpha-reliabilities for SIM, MC, MF, IQA, and TM of 0.74, 0.69, 0.70, 0.699, and 0.68, respectively. According to study results, MC, MF, IQA, and TM account for 71.6% of the variation in students' interest in mathematics. The study also discovered that the availability of mathematics facilities as well as quality of instruction and availability account for about 15% of the heterogeneity in teachers' abilities to relate mathematics to real-world problems. In the end, the study discovered that the availability of mathematics facilities for teaching and learning accounts for 12.4% of teacher quality in mathematics instruction. The study came to the conclusion that teachers' capacity to relate arithmetic to everyday life and the immediate environment, the availability of math resources, teachers' motivation, and teachers’ quality of instruction and availability all had a substantial impact on students' interest in mathematics. The study advised mathematics teachers to consider the impact of these variables and include them into how math is taught in secondary schools.

This study came to the conclusion that the availability of mathematics facilities, connections to mathematics, and teachers’ quality of instruction are related to students' interest in mathematics since these factors account for 71.2 percent of the variation in students' interest in learning mathematics. However, the study discovered an inverse association between the students' enthusiasm in learning mathematics and the availability of mathematics facilities for teaching and learning. The study also came to the conclusion that the availability of mathematics facilities, teachers’ quality of instruction, and availability are also related to mathematics teachers' capacity to relate mathematics to real-world issues, as these two factors account for 14.6% of the variance in mathematics teachers' capacity to relate mathematics to real-world issues and our immediate environment. The study also came to the conclusion that there is a direct correlation between the availability of mathematics facilities and teachers’ quality of instruction and availability of instructors; 12.0 percent of teachers’ quality of instruction and availability may be attributed to mathematics facility availability.

According to the study, mathematics teachers should employ ways to pique students' interest in mathematics because it is a crucial component of their learning and a major factor in performance. In order to increase students' interest in and proficiency in mathematics, mathematics teachers should focus on connecting mathematics to real-world issues as well as other subject areas. The study also advises educational leadership and stakeholders in mathematics education to offer the necessary resources for mathematics teaching and learning, as these factors directly influence the quality of instruction and inspire mathematics teachers to conduct high-quality courses.

2.3.4 Teachers' quality of instruction and students' achievement in mathematics

Teaching quality has been empirically proven to have effect on achievement of students in mathematics. Different studies have approached the issue from dissimilar perspective. For instance, Chi (2015) ascertained to improve mathematics education's quality, two teaching modes were tested to determine which is best. The doctoral thesis used Taiwanese Student as unit of analysis. The data gathering method and techniques for data analysis followed the qualitative style where content analysis perspective was adopted. The methodology in the research was combination of social constructivism and situated learning theories perspective in interpreting the students' learning and growth. Differences in groups of students, control and experimental were found. It was established that the differences were visible in their competencies in mathematics and the autonomy of the students' mathematics learning. Though the study found relationships in the different method adopted as it shown in the learning outcomes of students experimented. However, when compared to the traditional teaching environment there were several challenges such as time use, understanding all classmates' dialogue, mathematical writing ability in explaining and communicating their thinking and more teacher work.

The academic qualification of teachers has been predicted to influence the attitude and academic achievement in mathematics among Adamawa State's senior secondary school students by Filgona *et al*., (2020). The assumption of the authors was that the level of recruitment of teachers who are largely unqualified to teach mathematics has been persisting for so long. The perplexing issue, according to the authors, is the state government's culpability in appointing unqualified teachers, even when it is the standard that the minimum requirement to teach in the secondary schools is certificate in Nigerian Certificate of Education (NCE). The persistence of the problems associated with unqualified teachers was the main reason why the authors beamed the search light on mathematics teaching and learning. The study adopted survey of the correlational type where four hundred teachers and students in equal number. There is a multistage sampling to determine the sample size. The mathematics teachers' qualification checklist (MTQC), Students' Attitudinal Scale in Mathematics (SASIM) and Mathematics Achievement Test (MAT) which were tested and validated using a Cronbach alpha coefficient with SASIM = 0.78 and MAT = 0.77. In the analysis which was based on frequency counts, percentages and linear regression in measuring the null hypothesis. The result showed that it was only the attitude of the students to mathematics that predicted their academic achievement in mathematics. It was also established that teachers' qualification did not predict the achievement of the students in mathematics. It was concluded that the state government in Adamawa and in other states of Nigeria should recruit qualified graduate for the teaching of mathematics.

In the same vein, a doctoral dissertation on constructing mathematical identity in relation to academic achievement in mathematics was studied by Trescott (2020) in San Diego University. The study examined the ninth-grade students' experience from the minority of students in low income high school unlike their counterparts were enrolled in a reform orientated course designed to prepare them to enter the college-going pathway in one academic year. The author sought to raise the understanding the experiences of students in the reform course relating to their identities in mathematics that are being constructed in styles that influence outcomes of the students in mathematics. The study used a mixed method research design, and there was a suggestion in the result section of the study that there was a relationship amongst academic outcomes and the students' mathematical identities. This identity is a result of an inextricably interrelated network of influencing factors which include students' level of confidence in their ability to do mathematics, their grades, teacher/student relationships, and students' fear of being wrong. Due to the interrelated nature of these factors, results suggested that even addressing one of the factors in this network could impact students' willingness to engage in class, alter their mathematical identity in positive ways, and ultimately redirect their academic pathway.

In Ghana, a study which focused on students' performance in mathematics and scaffolding strategy was researched by Edekor (2020). The aim was to investigate how scaffolding strategy can predict the students' mathematics achievement positively. The geographical of the study was situated in the Keta Municipality of Ghana's Volta Region, which was a quasi-experimental in approach and there were 115 Senior Secondary School Two (SSS2) students who were used for the study. An expert validated questionnaire which also generated a Cronbach alpha reliability coefficient of 0.88 was used for generating data for the study. The study equally answered two research questions and hypotheses each. Adjusted mean as well as standard deviation were the methods for analysing the research questions while the analysis of covariance or ANCOVA was deployed to test the hypotheses. It was found that scaffolding learning strategy was responsible for students' high performance in mathematics as against the students who were taught using the traditional method only. The study recommended that mathematics teachers should adopt scaffolding learning strategy in the teaching because it enhances the academic performance of students in Senior High Schools in Ghana. The study also recommended that workshops should be organized by educational bodies to emphasize and enlighten teachers and mathematics educators on the benefits of using scaffolding strategy in the learning and teaching in Senior High Schools in Ghana.

Likewise, in Nigeria, Bature and Atweh (2020), found the teaching methods' impact on academic performance in mathematics among Nigerian secondary school students with focus on Nassarawa local government of Kano State Nigeria. The study practically ascertained the relationships between mathematics teachers' teaching method and the students' performance in mathematics. The descriptive study of the correlational type focused on one hundred and eighty secondary schools' students randomly selected while the systematic random sampling technique resulted into selecting 60 students. The validated questionnaire was the data gathering instrument while the data analysis used were both descriptive and correlational in style. At the end, the study found that most of the teachers' methods of teaching have a great effect on students' academic performance; based on these findings, Student-Centred Method and Teacher-Student Interactive Method were recommended in order to improve students' academic performance. It was concluded that evidence from other studies have shown that a learning environment which is student-centred accounted for the achievement of a higher-level learning outcomes as against the traditional teacher-centred environment.

The study therefore, based on the outcomes, suggested that teaching would be highly effective if the teacher starts to use innovative teaching techniques like the discussion and the demonstration method. Teachers should therefore, learn how to use two or more techniques together during a learning experience so as to achieve the desired objective. Teachers should create an atmosphere conducive to learning in order to enhance the development of students' learning experiences. Teachers should also increase their knowledge of various instructional strategies in order to keep students engaged and motivated throughout the learning process.

Bouzid (2020) further affirmed that the total quality of the secondary school teachers in Geneva influenced the performance of students in the region. The study was motivated by the author's belief that motivation and engagement in mathematics classroom activities have become issues that educators must take with seriousness it deserves since researchers have continually been examining and analysing their understanding of the criticality of the two in increasing learning outcomes and as well developing ways to developing the best approach. In the study, the author claimed that the motivation of students brings lots of impact on how they learn as well as their intention to participate in classroom activities.

Bouzid (2020) therefore, surveyed the Geneva mathematics teachers' and mathematics students' classroom engagement and motivation to determine learning outcomes in mathematics for teachers who have been trained through the International Baccalaureate (IB) high level course in mathematics. The author interviewed a teacher and two students in the teachers' geometry class (Geometry Semester 2) as well as observing one classroom teaching session in the Geometry Semester 3 and 2 respectively. It was found after the analysis of the two different classes that the same teachers' classes provided insight that the students were motivated and engaged in the different classes, and that the teacher utilized students' engagement and motivation technique in both of the classes. The Geometry Semester 2 class was found to be quieter and less-participatory class when compared with Geometry Semester 3 class. In addition, the students in the two Geometry classes shared stated that they were comfortable and confident in their beliefs, capabilities, and attitudes with doing and learning mathematics. The IB Math Higher level class on the other hand, reflected a different classroom environment due to a smaller class size and the IB program's curriculum which the IB Math Higher level student expressed what kind of opportunities that it provides as well as how it impacted his own beliefs and attitudes about learning and doing mathematics. Overall, the research and data results have shown that teachers should recognize the need to teach in respect to highly engaging and motivating students to learn and do mathematics, which can also impact the students' mathematics experiences positively. So, understanding what levels of motivation and engagement can exist in a mathematics classroom and working towards maintaining or increasing such levels can produce positive results in both mathematics experience and achievement.

The quality of teacher-child relationships and exposure to mathematics teaching were investigated as potential determinants of fifth-grade students' mathematical achievement in Ottmar, Decker, Cameron, Curby, and Rimm-Kaufman (2014) study. The sample consisted of 657 of the kids that were included in the NICHD-SECC longitudinal research. The findings show that more exposure to mathematics instruction was related to higher fifth grade mathematics achievement for both calculations and applied problems assessments, even after controlling for student demographic characteristics. However, there was no main effect for improved instructional quality. Additionally, findings show that more exposure to mathematics teaching predicted better mathematics achievement in schools where worse instructional quality was detected. Discussion of the results takes into account the various facets of mathematics instruction as well as the potential compensatory value of exposure to instruction in subpar classes.

In order to better understand formative assessment, Pinger, Rakoczy, Besser, and Klieme (2018) examined how a formative assessment intervention interacted with various facets of overall instructional quality. In a quasi-experimental study design, twenty instructors used a curriculum-integrated formative assessment tool in their ninth-grade mathematics classes, whereas fifteen teachers participated in the control group (n = 361) and fifteen teachers in the intervention classes (n = 498 pupils). The intervention had no effects on the evaluated elements of overall instructional quality (process-oriented instruction, teacher-student relationship, effective use of instructional time). But multilevel regression studies showed a relationship between the intervention, process-orientation, and efficient utilization of class time. Our results imply that implementing formative assessment tools does not appear to be sufficient regarding changes in overall instructional quality, but that an intervention with specific materials and instructions can counteract the effects of instructional quality, promoting students' achievement in classes with lower levels of process orientation and a less efficient use of instructional time.

The quality of monitoring and constant evaluation technique was the focus of the study carried out in Ondo state, Nigeria. Ajibade and Ajibade (2020) argued that there are myriads of challenges to Nigerian education system including poor performance of students in both internal and external examinations. Having identified this, the Ondo State Government instituted a quality assurance agency with the mind to improve the Ondo State students’ performance in core subjects particularly in the external examinations. The study focused on English Language and Mathematics. Using the descriptive research technique, the study answered three research questions from three hundred students randomly selected while there were 20 teachers/school administrators who participated in the study. Results show that students' performance in the core subjects was slightly above the average, though they performed better in English Language ($X = 27.5$; $SD = 3.24$) than Mathematics ($X = 26.5$; $SD = 2.91$). The Agency was reported to be highly effective in systematic monitoring and evaluation of school curricular and co-curricular activities. Its positive impact was evidenced by improved WASSCE ranking where the State moved up from 33rd position (in 2009) to 7th position (in 2016). The Agency's activities have a significant and positive effect on students' academic performance, $F (2, 299) = 16.27$, $p < 0.05$. Based on the findings, it was concluded that the effect of monitoring and evaluation on student's academic performance is positive, vital and noteworthy. It is recommended that other governments in Nigeria are strongly encouraged to replicate this quality education assurance agency in their States.

The study by Gichuru and Ongus (2016) sought to determine the association between teacher effectiveness and students' math performance on the primary 6 national tests in private schools in Rwanda's Gasabo District between the academic years of 2012 and 2014, inclusive. The target group included 1240 primary 6 students, 31 head teachers from all of the 31 private primary schools in Rwanda's Gasabo District, and 1346 respondents, of which 75 were math teachers. 63 mathematics teachers, 28 head teachers, and 302 students made up the final sample size, which was determined using Yamane's condensed formula for calculating sample sizes from the entire population. Multistage random sampling was used to choose the sample size. The five teacher traits of preparation, experience, communication, practice in the classroom, and preparedness were examined. Correlational comparative research design was used in the study. Data collecting tools included questionnaires and interview instructions. Frequencies, percentages, standard deviations, weighted averages, and multiple regression analysis were used to analyze the data. With the aid of content analysis, interview guides were examined. Statistical Package for the Social Sciences Version 21.0 (SPSS V.21.0) software was used to analyze quantitative data. This study found that teachers who use good teaching strategies outperform those who use inadequate strategies in terms of student achievement. Furthermore, teachers with greater classroom experience have an impact on students' performance than recent graduates. The communication skills of teachers also correlate with improved student achievement. In schools where teachers were dedicated to their work, had a positive attitude toward mathematics, prepared thoroughly before classes, used a lot of resources that were pertinent to teaching, and actively involved their students through evaluation and assessment, arithmetic performance improved.

The focus of Nnaji, Eze, and Madu (2020), was to assess the mathematics students' achievement and their emotional intelligence. The authors also premised their reason for carrying out the study on the dwindling level of students' outcome in mathematics in the national and regional examinations. It was the opinion of the researchers to that if the students' characteristics to education are improved upon; their performance in mathematics will improve. The study was situated in Enugu State, Nigeria while the questioning and hypotheses techniques were used in answering the objectives of the study. There were four thousand, eight hundred and twenty-five senior secondary school two students in the study from twenty-five government-owned secondary schools. Through random sampling technique; a sample of four hundred and eighty-three students were selected. Youth version of emotional quotient inventory (EQ-i2.0) and a mathematics achievement test (MAT) were used for data collection. Data were analysed using multiple linear regressions to answer the research questions, and test null hypotheses at 0.05 level of significant. The results revealed that there was a significant positive correlation between the components of emotional intelligence and students' achievement in mathematics and the components, singly and jointly, contributed significantly to the variation in students' achievement in mathematics.

Anderson (2020) sought to find out the effect of growth mind-set instilled by mathematics teachers on students and their performance of students in algebra at Minnetonka Middle School East. The study was an action research, which experiment the variables through surveys, classroom observation and assessment in a triangulation method design. The author created and administered lessons to students on growth mind-set with how the lessons can guarantee that the thought process of the students in mathematics can be improved. The population for this action research study was a select group of eighth grade students enrolled in a suburban middle school located in the Midwestern United States. The sample includes 22 eighth graders that are enrolled in an Algebra Support class. The author summarized that the study has restructured the way teachers now teach Algebra in the study area after the outcomes of the study was revealed to them since it was found that the improvement in the thought process of the student accounts for their improved performance. The author concluded that changing the mind-set of the students can make them become better learners and mastering new skills such that when teachers take as a critical skill that can be used in mathematics. Study canvassed for a consistent lesson on brain development, moving away from a fixed mind-set, and changing the way students are spoken to in order to change the wrong notion on mathematics. The data further showed that student mind-set can be changed in a very short period of time while more changes come with more time. With a few adjustments and additional lessons, effective model to successfully teach students about growth mind-set should be improved upon.

Abdullahi and Sirajo (2020) investigate the impact of resource factors and instructional quality on Nigerian secondary school students' mathematics performance. The findings of this paper's numerous empirical reviews revealed that there was a substantial association between resource factors and the quality of instruction in the country. This paper also discovered that there was a substantial association between the quality of instruction and the academic achievement of Nigerian secondary school pupils in mathematics, based on several empirical reviews. The study discovered a link between instructional quality and student academic achievement across the country. Finally, the article discovered that there is a link between resource variables, instructional quality, and secondary school student's academic achievement in mathematics in Nigeria.

Based on the outcomes of the study by Yahaya and Fassasi (2012) and the various empirical reviews. Nigerian secondary school students do not achieve a 50% academic achievement in mathematics. This suggests that mathematics performance among Nigerian secondary school students has been low and has not improved recently. The availability of resource variables in secondary schools in Nigeria will have a significant impact on the quality of instruction that will improve academic achievement in mathematics. This suggests that the quality of instruction can increase students' academic performance in mathematics and that the availability of resources, among other things, can improve the quality of instruction. Nigerian secondary school student's academic success in mathematics is influenced by the quality of instruction provided by available resources that would improve performance in mathematics. This means that before the quality of instruction can have a positive impact on academic performance in mathematics, the requisite resources must be accessible. Nigerian secondary school student's academic success in mathematics is influenced by both the availability of resources and the quality of instruction. This also suggests that the availability of both resource considerations and the quality of instruction will lead to improved academic achievement in mathematics among Nigerian secondary school students.

This study by Adeniyi, Ogundele, and Odetola (2014) seeks to determine the impact of teacher instructional quality elements on students' mathematics achievement. The study took into account the following teacher characteristics: experience, training, motivation, interest satisfaction, and instructional methods. Through the use of questionnaires created for teachers and students, the study's findings were gathered. The data were analyzed using regression analysis and analysis of variance (ANOVA). It was discovered that all of the teacher's attributes included in the study influence student achievement in Mathematics by a substantial amount. According to the study's conclusions, teachers' experience, teaching methods, classroom management skills, motivation, contentment, and interest all play a significant role in how well their student perform in mathematics.

The analysis demonstrates that teachers' teaching quality of instruction and their capacity for maintaining classroom management have an impact on student's academic progress, and the researchers advise the following in light of their findings. Therefore, it is important to encourage teachers who lack teaching credentials to enroll in education courses to develop effective teaching strategies. Finally, the government ought to immediately recognize teaching as a legitimate vocation. This would improve the quality of those entering the field. It is important to promote the appointment of qualified teachers to government jobs. A practicing classroom teacher should only be eligible for certain specialized positions, such as the commissioner of education in any state.

Since research reports have shown that early mathematics teaching and learning experiences are essential for students' learning and later achievement in mathematics and other content areas, (Cerezci, 2020), examining the quality of mathematics instruction in relation to student learning outcomes has assumed increasing importance. In 73 Pre-K to 3rd grade classrooms in an urban public-school system, the goal of this study is to look into the relationship between early mathematics instruction quality and students' learning outcomes in mathematics. At the classroom level, there were a few, but substantial, links between mathematics achievement and instructional quality. In classrooms where ratings of the instructional quality were defined as "high," after adjusting for students' pre-test scores and gender, there was a positive significant interaction between quality of mathematics teaching and students' mathematical achievement at the end of the school year.

According to Okolocha and Onyeneke's (2013) findings, business studies teachers were ineffective at adhering to some time management, classroom management, and preparation and delivery of lesson notes for the best achievement of instructional goals and improved students' academic achievements and, as a result, employability. Among other things, it was advised that business studies instructors make an effort to view time and class management as well as good lesson note preparation as real tools for effective engagement, mastery, and development of necessary skills. While determining that all respondents have the same notion and perceptions of set induction in science education, Mohammadi, (2020) found this to be the case. The methods of in-service teachers and pre-service teachers differ in that the former chose to utilize questioning for their set induction while the latter preferred to use visual set induction. Teachers are aware of the benefits of set induction and how crucial it is to incorporate it into the teaching and learning process since it affects how engaged students are throughout the course. A teacher uses the three to five minutes of set induction necessary for early exposure to pique students' interest in the learning process to be carried out and also serves as a key introduction to the lesson.

Intisar and Ya-Fei (2019) looked into the connection between eighth-graders' mathematics proficiency in Oman and Taiwan and their teachers' quality of instruction. The research topic looked at the impact of teacher quality of instruction on student accomplishment in Oman and Taiwan as determined by the measurable variables (teacher qualification, teaching techniques, and professional development). The connection between teacher effectiveness and eighth-grade mathematics student achievement in both nations was investigated using Ordinary Least Square (OLS) statistical analysis. The findings demonstrate that indices of teacher quality of teaching in Taiwan and Oman have a favorable effect on eighth-graders' mathematical achievement. However, factors including student characteristics, school conditions, and teacher quality of instruction that affect student accomplishment in both countries vary. The results of the study advocate increasing possibilities for participation in pedagogically and content-focused professional development and support policy interventions aimed at enhancing teacher quality.

The study's findings, which are discussed in the paper, show that teaching indicators in Yusof, Zulkipli and Majadul (2022) have a favorable effect on eighth-graders' mathematical achievement. Depending on the educational setting, student characteristics, and school conditions, teacher quality of teaching variables that affect student accomplishment in both nations differ. This study therefore advises increasing possibilities for participation in content- and pedagogically-focused professional development, as well as supporting policy interventions aimed at improving teacher quality of instruction. The findings also suggest looking into how such in-service training is conducted and how the information learned there is applied in actual classroom settings. This study's shortcoming is that teacher quality of instruction could not simply be determined by quantifiable factors. The classroom environment and instructors' extracurricular activities are two examples of elements that boost student achievement but cannot be assessed. In addition to the quality of the teacher's instruction, a number of other factors, including the makeup of the class, parental support, school culture, and the availability of learning tools, can affect how well students are taught and how well they learn. As a result, student learning, social, emotional, and intellectual growth and engagement should be prioritized over test scores when evaluating a teacher's quality of instruction.

2.3.5 Classroom climate and students' interest in Mathematics

In the perspective of Brezavšček, Jerebic, Rus and Znidarisic (2020), when stating the factors influencing achievement in mathematics has established a positive correlation between classroom climate and mathematics achievement among students. That is, as the condition of classroom climate increases positively so also is the students' achievement in mathematics. As for Poudel (2020), the author who sought to find out the interest in mathematics among ethnic group of Nepal opined that mathematics has become the base for modern civilization and that as such, it becomes impossible to have any advancement in all the branches of knowledge if mathematics is not well understood in any nation. He equally added that interest of Nepal students in mathematics is poor as declines are being recorded daily.

Poudel (2020) thence, conducted a study which is a survey of the descriptive type with a sample of three hundred and sixty-five students who were respondents randomly selected. The study utilized mathematics interest survey which was filled by above the grade twelve students. Various factors influencing the interest in mathematics were discovered. These include mathematical learning disability, financial constraint, distraction, parental attention and guidance, and the lack of fundamentals. Lack of parental attention and guidance and fundamental knowledge on mathematics were the most dominating factors for responsible for losing interest in mathematics. Likewise, it was found that only 0.8 % ethnic group students were interested in studying mathematics. In fact, students in Nepal generally have lower interest in learning mathematics. Thus, how to enhance students' mathematics interest becomes a major problem, especially for the ethnic group students. Therefore, teachers are encouraged to variant the way of teaching in order to gain interest in mathematics for all the students in Nepalese schools and colleges.

According to Chan-Anteza (2020), the existence of a well-managed conducive classroom will have effect on how students perform in their academic activities. In the meta-analysis study, the author claimed that there is the need to extract the themes on research papers that focuses on classroom climate as it affects learning. Thus, a literature review using meta-analysis to extract the research themes as the outcomes of the reviewed articles was conducted. Though, there volumes of work in the area, the researcher only selected twenty-six studies which were relevant. The study utilized a meta-synthesis in order to establish a reliable evidence base for recommendation. To ensure that the review was systematic, the researcher carried out steps as recommended. A combination of coding and thematic analysis was used to analyse data. The researcher used the thematic analysis to understand the research questions in the present study on managing a conducive classroom environment. Structured course curriculum, empowered students, flexible classroom setting and enabled teachers are the themes that emerged in the study. Structured course curriculum tells about the organized instructional objectives, content, materials and process for evaluating learning. Empowered students are motivated to engage in their education when their voices are heard and when they are seen as knowledgeable co-participants and decision makers capable of contributing related to their learning. Flexible classroom setting is space wherein learners can choose from different seating or standing options, locations within the learning space and the size group with which to work. Enabled Teachers are updated on ICT applications, language proficient, value-laden and constructivist educator that positively impacts student's academic success. As a result, the study was able to come up with the quadratic elements of a conducive classroom environment. With all these elements, the researcher can conclude that a conducive classroom environment of the 21st century is attained and can facilitate students learning.

Reddy and Fadiji (2020), chronicled the South Africa students' educational aspirations and role home and school are playing. Based on an extensive combing of the literature in the study area, the study proposed there exists an abundant research in the research area. Thence, there is the need for South African government to beam more research look in this area since little attention is being given to the level of aspirations of the South African students educationally. The study was based on a bio-ecological systems theory of development, the role of gender was explored, as well as socio-economic status which was measured by school and home factors. School climate, and parental involvement in determining the educational aspirations of the students. The national representative sample of eleven thousand, nine hundred and sixty-nine (11,969) was used as the sample size with the mean scores of 5,248 for female and 15.7 years for mean age. Based on the Trends in International Mathematics and Science Study (TIMSS) and the statistical analysis technique of structural equation modelling (SEM), the study investigated the relationships between parental involvement, school climate and learner educational aspirations. Findings showed that students from low socio-economic status (SES) homes and schools had lower educational aspirations and positive relationships between both positive and negative school climate and learner aspirations was found. Surprisingly, parental involvement did not have any influence on shaping learner aspirations. The findings indicate a need to improve educational resources at schools as well as the school climate, as schools' matter for learners in low-income countries. Furthermore, it is important to inform learners of the requirements for tertiary education, so that they develop more realistic aspirations.

Also, in South Africa, same authors, Fadiji and Reddy (2021) empirically studied the predictors of achievement in mathematics using school and individual factors as the independent variables with learner aspirations as the mediating role. In the study, the aim was to examine the relationship between self-efficacy, resources of the school, positive school climate and achievement in mathematics being mediated by aspirations of the learners. The population was similar to the earlier study in 2020 and structural equation modelling was used for data analysis. Findings from the structural equation modelling in addition to good fit indices revealed that self-efficacy, learner aspiration and school resources were positively related to mathematics achievement. However, there was an unexpected negative relationship between positive school climate and achievement. Learner educational aspirations mediated the relationship between positive self-efficacy, positive school climate with achievement. In order to improve educational achievement, interventions must include both the school and individual factors where interactions between positive self-efficacy and aspirations contribute to improved learner achievement.

Benavides-Varela, Callegher, Fagiolini, Leo, Altoè, and Lucangeli, (2020) found the digital-based learning intervention effectiveness on children with mathematical learning difficulties when a meta-analysis of the literature was conducted. The purpose was to conduct a meta-analysis of the empirical literature evidence about the digital based leaning intervention effectiveness among students who have difficulties in understanding mathematics. Therefore, the authors investigated the school level of the respondents and whether the software instructional approaches were decisive modulated factors. A systematic search of randomized controlled studies published between 2003 and 2019 was conducted. A total of 15 studies with 1073 participants met the study selection criterion. A random effects meta-analysis indicated that digital-based interventions generally improved mathematical performance (mean ES = 0.55), though there was a significant heterogeneity across studies. There was no evidence that videogames offer additional advantages with respect to digital-based drilling and tutoring approaches. Moreover, effect size was not moderated when interventions were delivered in primary school or in preschool.

In the same vein, the effectiveness of digital-based interventions for children with mathematical learning difficulties was analysed meta-analytically (Callegher, and Altoè, 2020). Data were collected from studies included in the meta-analysis to evaluate the effects of digital-based interventions for children with mathematical learning difficulties compared to control conditions in group-designed randomized controlled trials. Literature search, inclusion criteria and coding procedure are described. PRISMA flow-chart is reported to summarize the literature search and coding of all the relevant characteristics of the primary studies is made available. This allowed for other researchers to easily access to the information needed to evaluate the studies and to use these data in future meta-analyses. However, researchers are highly recommended to refer to the original papers in order to check studies suitability to their own criteria. Moreover, in the supplemental material all the information needed to reproduce the meta-analysis results is reported together with the R code syntax. Data and supplemental material are available online.

In this section of review, cognitive perspectives to be able to develop appropriate tools for educational action in the mathematics classroom were discussed from the point of view of the climate of the classroom. In affirming that classroom climate is influencing the way students achieve in the mathematics classroom, the section reviewed empirical studies and found that the assertion was correct empirically. In the various past studies reviewed, the main findings and the on-going ones, it has been established that the studies are using specific new designs based on the theoretical approaches deployed and practical tools. The socio-cultural perspective such as the environment and peoples' perception approaches are showing how it has allowed unveiling previously unseen mechanisms in action in the mathematics classroom. Building on these findings, there were suggestions that combining cognitive and social dimensions to study students' mathematical learning profiles from a socio-cultural perspective will go a long way in improving their interest in mathematics and as well achievement. Finally, the review revealed how effective promoting a healthy mathematical classroom culture can be right from the beginning of classroom instruction to testing period. Therefore, recent studies have shown that with educational material and implementation strategies that are well-designed from a socio-cultural point of view and used in the first two years of primary school, it was indeed possible to reduce children's negative interest for mathematics.

In summary for this section, Baccaglini-Frank (2021) abridged studies that focused on students' mathematical discourse bringing all that have been studied before 2020. In this study, the author therefore, canvassed that the mathematical discourse has heralded the interactions of digital environment in GeoGebra which can be constructed using virtual objects that codifies mathematical signifiers which can be interacted with. The virtual objects can there become simulators which make can now serve as dynamic interactive mediators (DMI). The DMI according to the author influences the development of mathematical discourse in learners, bringing the opportunity of after class discussions. In establishing the above assumption, the author analysed the discourse developed through two dyads of students in response to an unfamiliar interview question. One dyad came from a class in which GeoGebra was not part of classroom practice and included students who, according to the teacher's evaluation, were standard-to-high achieving. The other dyad was from a generally demotivated and low-achieving class in which GeoGebra had become part of classroom practice. The analyses, focused especially on the low-achieving dyad, are guided by the question of how DIMs shaped these students' discourse. According to the analysis, these students ended up succeeding where standard-to-high-achieving peers did not. Moreover, the detailed analysis of the ways in which the DIMs supported this dyad's learning showed mechanisms that may be general rather than specific to this one case. This suggests that appropriate integration of DIMs into the teaching and learning of high school algebra can be beneficial for low-achieving students.

The classroom climate and students' academic interests were examined by Ezike (2018) as potential predictors of success in senior secondary chemistry. It used correlational design. Participants included 208 SS II students from ten public secondary schools in Ibadan, Oyo State, Nigeria, that were chosen at random. Instruments include the Chemistry Achievement Test (r = 0.85), the Students' Academic Interest Scale (r = 0.81), and the Classroom Climate Students' Questionnaire (r = 0.76). At the.05 alpha level of significance, four null hypotheses were evaluated. Data analysis methods employed included multiple regression analysis and Pearson product moment correlation. The findings indicated a strong correlation between the classroom environment and academic achievement, as well as between students' academic curiosity and success in Chemistry. The combined effect of the learning environment and academic interest was substantial. Though student academic motivation was a better predictor of achievement than the classroom atmosphere. The predictor variables are active correlates of achievement in chemistry, according to the conclusion. Therefore, it was advised that all hands should be on deck to create learning-friendly school and classroom environments, and that parents and instructors should design activities to foster and maintain students' attention.

2.3.6 Classroom climate and students' achievement in Mathematics

This section of review and next ones will focus on the role being played by the nature of classroom in determining the students' success in mathematics from the angle of achievement and interest. As earlier averred in the conceptual review section, classroom, its climate, management, control, ambience, environment and etcetera plays major role in determining how students behave in the class and how that affects their academic performance. As also been established in the literature review under the conceptual model, the classroom climate is the generality of all around the class including the classroom environment, the furniture, teaching aid and facilities, the teacher, the ambience, the students themselves, among other things.

The predictive association among classroom climate, student's literature and attitudes for the evaluation of a K-5 mathematics programme was researched by (Fraser and Fisher, 1982). In actuality, the article described a one-year study of one hundred and fifty 5th grade students whose teachers partook in a professional development programme titled Project SMILE (Science and Mathematics Integrated with Literary Experiences). Purposely, the study determined the level at which the classroom implementation of the Project SMILE has influenced the classroom environment, either positively or negative and this on attitudes of student toward reading, writing and mathematics. To accomplish this, firstly, a series of professional development workshops with the teachers were facilitated and, subsequently, these teachers were asked to utilize the strategies with their students in their elementary school classes. The research represents one of the relatively few studies that have employed learning environment dimensions as criteria of effectiveness in the evaluation of educational innovations. The study supported previous researches methodologically; these researches were those that successfully combined quantitative and qualitative methods of data collection. The learning environment and attitude scales showed a satisfactory internal consistency reliability as well as discriminant validity while the actual form of most learning environment scales was capable of differentiating between the perceptions of students in different classrooms. The SMILE implementation was found to indicate an impact positively on the students whose teachers participated in the in-service programme in that student' attitudes to mathematics and reading improved and there was congruence between students' actual and preferred classroom environment on the scales of satisfaction and difficulty. In addition, previous studies were replicated in that students' satisfaction was greater in classrooms with a more positive learning environment, especially in terms of student cohesiveness. The qualitative data-gathering methods were used to construct a case study of the mathematics classes of a teacher who attended the SMILE professional development. This case study supported and illuminated the results from the questionnaire survey concerning the effectiveness of Project SMILE in terms of student attitudes and classroom environment.

In a study by Brezavšček, *et al*. (2020), the article investigated the major factor that influences the achievement of social sciences university students' mathematics in

Slovenia. Three categories of variables were derived as a conceptual model taken into account the students' attitude towards mathematics and anxiety to mathematics, how the students engage in learning activities, and attitude of students toward involving technology in mathematics learning. Data were collected for seven consecutive academic years and analysed using Structural Equation Modelling (SEM). The study found that there was a very high coefficient of determination for mathematics achievement (0.801), showing that the variables "Perceived Level of Math Anxiety", "Perceived Usefulness of Technology in Learning Mathematics" and "Self-Engagement in Mathematics Course at University". When taken together, explains 80.1% of the total variance. The study concluded that teaching in secondary school is a crucial determinant of achievement and success in mathematics at the selected universities. Therefore, it becomes necessary to distinguish best methods for secondary school math teachers that will assist them to give students a better entry-level knowledge for universities. These methods will, hopefully, also improve the level of mathematics self-confidence, as well as lower the level of math anxiety, which all considerably affect the performance of students in university mathematics.

In Zambia, Sintema (2020) surveyed COVID-19 pandemic's effect on students of secondary school mathematics achievement. The data for the study was gathered using semi-structure interview to three professors who were the Mathematics Departmental Heads in of the Natural Sciences Department, and one science teacher via mobile phone conversations. The findings indicated that there is likely to be a decrease in the percentage of students passing math tests if the COVID-19 epidemic is not contained in the shortest possible time due to the hostile classroom environment heralded by the COVID-19 restrictions. The study summarized that, though previous researches have shown that during COVID-19 students from all over the world have had to adapt to the new conditions of universities, which can consequently have an impact on their academic performance.

To finding the teaching-learning environment's effect on achieving the mathematics classroom's effectiveness, Pua and Macutay (2020) completed a survey of the descriptive type. The publications' aim was an assessment of the teaching-learning environment as a means of educational change at the Main Campus of the Isabela State University in relation to students' success in mathematics. The data collection instrument was a structured questionnaire and the collected data were extracted, tabulated and categorized, to generate the required information for the data analysis. The outcomes indicated that students preferred the deep approach to teaching and learning as well as studying because it indicated positive and significant correlation mathematics success among the students. The elements of the learning experiences that have been shown to be strongly related to mathematics achievement are organization and structure, teaching and learning, and participation of teachers which belong to the overall classification of classroom climate. Therefore, the involvement of the tutor and the learner is of utmost importance for the mathematics classroom to be successful. The instructor should enable the learners to conduct deep learning and research approach as well as pay attention to the structure and organization of mathematics, the use of varied tools and teaching methods, as well as being active in the research and learning of the students. At the other hand, to produce better academic success in mathematics, students need to have true interest, sincere understanding and positive emotions. Future studies should examine the degree to which the teaching/learning environment promotes learning and study strategies and experiences in achieving high-quality success in mathematics using questionnaire and interview methods that include teachers and students of various subjects and levels.

In Saudi Arabia, student learning engagement and the effects of support from mathematics teachers was the crux of the study by Alrajeh and Shindel (2020). The study was carried out investigating the influencing factors of student engagement in mathematics classrooms by ascertaining the relationship among sexual orientation, the impacts of characteristics of teacher such as years of experience, instructional support, organizational factors, and emotional status of students on student engagement in mathematics classroom. Data were taken from the Consortium for Political and Social Research. The study involved teachers of mathematics and was a longitudinal study that spanned three years for data collection and observation. Data were collected first hand through student–teacher surveys and classroom observations. ANOVA, t-test, and partial correlation were used to analyse the relationships among the study independent variables and the dependent variables based on the responses from the participants. There was week relationship between instructional support and student engagement after controlling for organizational support and emotional. However, instructional support continued to significantly influence student engagement. In addition, results showed a significant difference in student engagement attributed to the teacher’s gender. Results revealed the interaction between gender and years of experience significantly influenced student engagement, which was in favour of female teachers.

In Nigeria, Ejoh (2020), in a doctoral thesis focused on the Influence of Mathematics Teachers' Technology Use on Secondary Students' Motivation, Attitude, and Achievement in Nigeria. The author stated that there was an affirmation that Nigerian students are not completing their secondary school education with good grades in mathematics and also without the required mathematics skills that will enable them to make gainful employment and economic self-reliance. He posited that this may be responsible to possibly due to a lack of technology use in mathematic classroom. Therefore, the study suggested that if technology is introduced in the classroom, there may be an improvement, thus, the influence of technology use in math classrooms on students' motivation, attitude, and math achievement in Nigeria need to be well researched so as for the phenomenon to be well understood.

The study which was guided by the technological, pedagogical, and content knowledge (TPACK) theoretical framework, was an ex post facto, and a causal-comparative study with the purpose of comparing the differences in students' motivation, attitude, and achievement scores between students in math classrooms with low technology use and students in classrooms with high technology use in 3 private secondary schools in Nigeria. All secondary level math students (N = 398) completed the Motivational Strategies for Learning Questionnaire and Attitude towards Mathematics Inventory. Of those, the 72 graduating students who completed the West African Secondary School Certificate of Examination served as the sample for math achievement. Mann-Whitney U tests showed motivation, attitude, and math achievement scores were all significantly higher ($p = 0.00$) for students taught in high technology use classrooms than in low technology use classrooms, indicating technology integration had a positive influence. Findings suggest that with heightened technology integration in math classes, positive social change can occur as students may be more likely to gain the math skills necessary for enhancing their future employment opportunities and economic self-reliance. With these superior outcomes, positive economic growth and development in Nigeria may be enhanced over time.

Classroom climate was responsible for students' failure in mathematics in Zimbabwe. According to VaraidzaiMakondo and Makondo (2020) the causes of poor academic performance in ordinary level mathematics focusing on Mavuzani High School, Zimbabwe were empirically proven. The study was set up to determine the causes of poor academic performance in Mathematics at ordinary level. To achieve this, a case study was adopted which targeted one high school in Masvingo Province of Zimbabwe. Participants were purposefully chosen and only those learners doing O'level mathematics were selected from the ordinary level group of 250 students. Teachers who taught mathematics at O'level were also targeted. The information was gathered through the use of questionnaires, document analysis, interviews and observation. The questionnaire helped the researchers to have a wider view on the research problem. They were also physically administered by the researchers and this facilitated the return rate of 100%. The results showed that teaching methods, pupils, teachers and parents' negative attitudes towards mathematics, lack of teaching experience by some teachers and instability of teachers and lack of adequate resources are some of the causes of poor academic performance in mathematics at ordinary level. A number of recommendations have been made which include motivation of students and staff development workshops.

Akinyele Local Government Area of Oyo State junior secondary school pupils' perceptions of the impact of the classroom environment on academic progress in mathematics were examined by (Oni, 2020). The study was conducted using a survey-based descriptive research design. With the help of inferential statistics like the independent t-test and multiple regression, as well as descriptive statistics like frequency count, mean, and standard deviation, the data were studied. According to the study's findings, the majority of respondents felt that their classrooms were adequately ventilated, bright, and equipped with charts to improve math learning. Some of the responders, however, argued that their classrooms had adequate seats and a comfortable seating arrangement. Additionally, according to the results of the Levene's test for equality of variance, there is no discernible difference in junior secondary school students' perceptions of the classroom environment based on their gender (t-value=0.125, df=158, $p>0.05$). This suggests that a student's perception of the classroom environment is unaffected by whether or not they are male or female. The outcomes also demonstrate that the predictors and the criterion variable have a linear relationship. The government and other education stakeholders should work together to provide additional educational facilities for schools in order to improve students' academic progress in mathematics, according to one of the recommendations.

The learning environment is incredibly important for students' academic success in mathematics. There is no question that learning elements including furniture, ventilation, lighting, classroom layout, and classroom atmosphere (noisy or calm) will favorably impact students' academic success in mathematics. The findings indicate that the predictors and the criterion variable have a linear relationship. This suggests that secondary school instructional facilities should be a top priority for the state's and the country's education stakeholders. The academic performance of pupils in mathematics is thought to be improved by a supportive classroom environment and accessible school amenities.

In this study by Meremikwu and Ibok (2020), students in senior secondary school (SS2) in Calabar, Cross River State, Nigeria, had their mathematics performance and classroom environment assessed. Two hypotheses regarding the impact of two classroom variables, class size and instructional materials, on students' academic attainment in mathematics were tested using an ex-post facto quasi-experimental research approach. The analysis's findings showed that, among SS 2 students in Calabar, Nigeria, class size and the availability of instructional facilities had a substantial impact on students' academic achievement in mathematics. Based on these findings, it is advised that the government improve funds for creating favorable learning environments with small class sizes. Public schools should have access to instructional materials for teaching mathematics.

This study has demonstrated that the utilization of instructional materials and small class sizes have a favorable impact on students' learning outcomes in mathematics. Because they were in their typical classroom setting, which was characterized by big classes and a lack of teaching materials, the students in the control arms of our study and others underperformed. The results show a lack of resources in the educational system, which has a negative effect on mathematics teaching and learning in particular. Increased public school financing will be necessary for the provision of instructional resources, which will be extremely difficult given the global economic crisis. Making your own teaching resources is something that parents, teachers, and students should be encouraged to do. This may be able to lessen the impact of diminishing resources brought on by COVID-19's effects on the economies of numerous low- and middle-income nations. The Federal Republic of Nigeria, (2013) prescribes maximum class sizes of 20, 30, and 40 for pre-primary, primary, and secondary schools, respectively. A program to reduce class sizes would involve expensive interventions, such as the building or remodeling of classrooms and the purchase of equipment. Rotating students to teach them in small groups and providing virtual electronic learning platforms and materials via radio, television, and the internet are two creative, affordable approaches to reducing the negative impacts of big class size in public schools.

In the Gwer-East Local Government Area of Benue State, Naakaa, Abah, and Atondo (2019) investigated the impact of school environmental variables on students' performance in junior secondary school mathematics. The research used an expo-facto methodology. Out of the 3,482 JSS II students in the Gwer-East Local Government Area of Benue State, Nigeria, a sample of 120 JSS II students from 10 different schools was selected. Data were gathered using the validated 20-item Influence of Environmental Variables on Students Performance Questionnaire (IEVSPQ). In order to respond to the four research questions posed for the study, mean and standard deviation were used. The study's findings make it clear that factors including proximity to a noisy environment, classroom size, library amenities, and power supply have a significant impact on students' performance in junior secondary school mathematics. This is so that the child's school experience can't be seen in isolation from contextual factors. The factors in the child's school environment have an impact on them, which encourages them to perform in accordance with the desired academic goals.

Usman and Madudili's 2019 study looked at how the learning environment affects students' academic performance in Nigeria. In the fight to find a permanent solution to the persistently subpar educational results for students, the learning environment as a variable that influences students' academic outcomes either favorably or unfavorably has received very little attention. All of the research under consideration demonstrated a notable relationship between the classroom setting and students' academic success in the Nigerian and international educational systems. The effectiveness of the teaching and learning process as well as the academic success of students are believed to be guaranteed by a learning environment with usable and accessible facilities. As a result, there is a pressing need for the government and key players in the education sector to step up their efforts to create welcoming environments that are learner-centered, knowledge-centered, assessment-centered, and community-centered. In these environments, all of the essential elements of a model learning environment would be mobilized to ensure that school administrators, teachers, and students all perform at their highest levels for the benefit of society.

A study on the relationship between psychosocial classroom environment factors and academic achievement in mathematics among secondary school students in

Jalingo Education Zone of Taraba State, Nigeria, was conducted in 2021 by Matsayi, Adamu, and Menchak. The researchers developed one research question and one hypothesis to direct the investigation. The chosen study design was a descriptive survey. The Jalingo Education Zone's target population of 4,144 JSS II students from fifty (50) public secondary schools was used. By employing a straightforward random sampling method (hat and draw) without replacement, a sample of 436 JSS II students was chosen. Data were gathered using the MCESQ (Mathematics Classroom Environment Scale Questionnaire) and the first-term JSS II (Junior Secondary Class II) Mathematics Internal Examination Results. The split-half method's Cronbach Alpha coefficient (r= 0.80 and 0.86, p.001) was utilised to evaluate the instrument's dependability. The study issue was addressed using a two-tailed test, while the hypothesis was addressed using an ANOVA. The findings suggested a connection between students' perceptions of the psychosocial classroom environment and mathematical academic ability.

On the basis of the results of the data analysis, the following conclusions were drawn:

1. The students had a strong perception of the psychosocial contextual elements that influenced their success in math.

2. The psychosocial classroom environment characteristics and students' performance in math had a direct, positive link.

3. In the Jalingo Education Zone of Taraba State, perception of the psychosocial classroom environment is a predictor of mathematics achievement among other things.

4. There is a strong and significant correlation between students' perceptions of the psychosocial classroom environment.

5. Despite some students' perceptions of the psychosocial classroom scale being somewhat high, they nonetheless have an immediate favorable impact on performance. As a result, the psychosocial aspects of the learning environment in the classroom may be to blame for the low math success of pupils in Taraba State's Jalingo Education Zone.

The impact of the learning environment on students' academic progress in mathematics at the senior secondary school level was examined by Shamaki in 2015. Thus, the study looked into a few aspects of the learning environment and how they can affect students' academic success in mathematics. In Potiskum LGA, Yobe state, 337 SS II pupils were randomly chosen from a population of 1682 kids. The t-test and descriptive statistics were both used in the data analysis. The results indicated that, at the 0.05 level of significance, there was a significant difference between the mean performance of students taught in a perfect learning environment and that of students taught in a dull learning environment. The research findings were examined with an eye on raising academic accomplishment in mathematics as well as the standard of the learning environment. The study claims that a student's academic success is determined by a number of factors in addition to IQ. This supports the notion that a variety of aspects of the learning environment are always linked to students' academic progress (Lizzio, Wilson and Simons, 2002). By recognizing that the learning environment has a significant impact on students' academic progress in mathematics, it concurs with Frenzel, Pekrun and Goetz (2007). Therefore, it can be said that the learning environment is a crucial critical aspect in determining students' academic progress.

In their 2018 study, Riaz and Asad looked at how students' opinions of the learning environment in the classroom affected their performance in mathematics classes at the secondary level. The study's findings showed that while involvement, personal relevance, and emphasis on understanding were key predictors of the classroom learning environment and students' academic progress, investigation and autonomy had the opposite effect. The researcher suggests that the low achievers' active participation may have a more positive impact on their learning. The following conclusions were reached based on the study's findings: Students' academic success in mathematics is adversely connected with the subscales "Investigation" and "Equity." Research carried out by Salle, George, McCoach, Polk and Evanovich (2018) backed up this as well. The subscale "autonomy" has very little bearing on children' academic success in mathematics. The strongest association between the learning environment in the classroom and students' academic achievement is found on the subscale "Involvement." Students' academic success is significantly influenced by the subscales "Involvement," "Emphasis on Understanding," and "Personal Relevance." With the exception of the subscale "Investigation," where average students evaluate their classroom learning environment better than fail students, high achievers in the subject of mathematics perceive it better than fail and average students.

Education scholars have come to recognize the value of classroom climate as a malleable element for enhancing academic achievement, according to a study by Longobardi, Pagliuca, and Regoli in 2022. In order to evaluate the impact of a few parameters connected to the classroom atmosphere on the academic performance of Italian students in the tenth grade, we used data gathered by the Italian Institute for the

Evaluation of the Educational System (INVALSI) in this context. To highlight the impact of several important aspects of school climate (student conduct and parental participation) on academic performance and their role in the correlations between student socioeconomic status and accomplishment, a multilevel Bayesian structural equation model (MBSEM) is used. The key findings indicate that while parental involvement does not seem to have a significant impact on students' performance, disciplined behavior, on the one hand, directly influences the level of competence of the students, and, on the other hand, it partially mediates the effect of socioeconomic background.

The results of the estimation of a Multilevel Bayesian Structural Equation Model (MBSEM) suggest that policies intended to prevent or reduce bullying and truancy behaviors among students have direct implications for educational achievement; when other characteristics (such as regional differences and differences in the composition by gender and migrant status) are taken into account, schools with better disciplinary climates score significantly higher. Our results indicate that the direct impact of socioeconomic status on school performance slightly decreases due to the mediation of classroom climate, which occurs, for the most part, through disciplinary behavior. Programs that successfully deal with disruptive, intimidating, and violent behaviors in the school can also have an impact on educational equity.

These findings indicate that the disciplinary component of school atmosphere might be viewed as a key motivator for Italian students' academic achievement. Even though climate-based policies don't necessitate extensive and challenging structural transformations, the debate on this issue is still in its infancy in Italy, thus spending time and money to provide targeted data and empirical studies is essential for policy formulation and school improvement.

Students' academic success in the classroom may be impacted by a wide range of educational, psychological, social, cognitive, organizational, and physical factors (Gentova, and Madrigal, 2020). Students' perceptions of their learning environment have an impact on how they behave and perform in class. The lack of local literature is largely due to the fact that the concept of classroom atmosphere has not been thoroughly studied. In order to analyze the level of the classroom climate in terms of rules, instruction, evaluation, student interactions, attitude, and culture. Additionally, it evaluated whether there is a substantial difference amongst assessors when they are grouped by designation. Additionally, it establishes the relationship between junior high school students' academic success and classroom atmosphere in an Antique public school. In order to evaluate, compare, and correlate the classroom climate of a public school in Antique for the 2019–2020 academic year, the descriptive–comparative and correlational methodologies were used. 358 pupils and 116 teachers from a stratified random sample participated in the study. The Alliance for the Study of School Climate's standardized Classroom Climate Inventory (CCI) was used to create the data (ASSC). On the other hand, the student's academic performance throughout the first and second quarters of 2019-2020 was determined using secondary data. The Mean, Standard Deviation, Mann Whitney U test, and Spearman rank correlation were used to evaluate the data.

The results showed that there is a positive climate in the classroom. The results showed a substantial difference in the level of classroom atmosphere in terms of discipline, learning assessment, attitude, and culture when the groups were made according to the designation. When the assessors were grouped by designation, there was no discernible change in how the students interacted. Academic achievement and the environment of the classroom did not significantly correlate. The presence of a positive classroom atmosphere suggests that the general tone, standards, and attitude are supportive of learning. When assessors are grouped according to designation, the difference in the severity of the classroom climate suggests that teachers have a more positive perspective related to their experiences. Additionally, the lack of a correlation between classroom atmosphere and academic success suggests that there are other elements involved in students' academic performance.

Lo, (2010), looked at students' perceptions of the instructional and other aspects in a learning environment that truly benefit them. It demonstrated the significance of the roles played by the student, instructor, and course by connecting particular features of student satisfaction to perceived learning. We investigated whether student satisfaction characteristics are related to perceived learning as reported by students in two portions of a general education course taught at a research institution in spring 2009. The study found that all of these satisfaction criteria were linked to higher levels of perceived learning, as determined by students' hopes for academic success. While Dhaqane and Afrah (2016) looked into the impact of students' levels of satisfaction on their academic achievement, they also looked into the connections between academic performance and other aspects. According to the study, there is a significant correlation between student satisfaction and academic achievement. The study also discovered that happiness encourages academic success. El-Hilali, Al-Jaber, and Hussein's (2015) study looks at the variables that affect students' pleasure, as well as their aptitude for learning and achievement. The findings show that students' satisfaction is influenced by the college's reputation, academic program, and teaching techniques. Participation, satisfaction, instructional strategies, and programs all had an impact on students' ability to learn and absorb information. The only aspect of service quality that directly affects pupils is tangibles. Students with high GPAs have also demonstrated greater accomplishments and contentment.

This study by King'oina, Kadenyi, and Mobegi (2017) examined the relationship between school atmosphere and students' academic achievement in public primary schools in Kenya's Marani Sub-County. The goals of this study were to assess the current climate in public primary schools in the Sub-County and discover how it affects students' academic performance. The survey used a descriptive design for the investigation. The intended audience consisted of 317 Standard 64 public elementary schools, 64 head teachers, and 64 chairpersons of the boards of management. The technique of stratified random sampling was employed to choose the respondents' categories and schools. There were 95 Standard samples. Eight teachers, 19 head teachers, and 19 BoM chairs, or 30% of the target population, were present. The instructors, head teachers, and BoM chairpersons were surveyed, and interviews were scheduled. At the County Director of Education Office in Kisii County, document analysis was done to help determine the average student results on the KCPE exam. While qualitative data was organized into categories and interpreted based on themes obtained from research objectives, quantitative data was evaluated using descriptive statistics (frequencies, percentages, and means).

The study found that there were insufficient teaching and hygienic facilities in schools, poor student-teacher relationships, and insufficient support for teachers to attend programs to develop their capacity, and little participation by teachers and students in decision-making in schools. However, the survey also discovered that although while most schools had the fundamental tools for teaching and learning, including pencils, chalks, exercise books, manilla paper for producing charts, and textbooks, their students' academic performance was appalling. According to the study, a supportive school environment that would enable both teachers and students to excel in the teaching and learning processes required adequate physical facilities and material resources, positive interpersonal relationships among stakeholders, sufficient regular teacher development programs, and active involvement of teachers and students in decision-making. The survey also discovered that, with mean scores of 2.33 and 231.76 respectively, instructors' overall responses to questions about school atmosphere and Standard Eight students' academic performance were poor. The findings also showed a direct correlation between student academic achievement and mean instructor responses to school atmosphere, and vice versa. The study found that the academic performance of students was adversely affected by the unfavorable school climate. According to the findings, it was advised that schools be encouraged to build enough physical facilities, work to create a healthy and child-friendly learning environment by cultivating warm student-teacher relationships and embracing participatory decision-making, and make sure that teachers' professional development is improved.

Through the use of country-level longitudinal data, the study sought to determine the causal relationships between various factors of teacher quality and school atmosphere and mathematical achievement (Gustafsson, and Nilsen, 2016). Structural equation modeling methods were used to evaluate data from 38 nations that took part in TIMSS 2007 and TIMSS 2011 using both latent and manifest variables. The analyses concentrated on factors of teacher quality (educational background, teaching experience, and primary academic field of study, as well as professional development and self-efficacy) and a feature of classroom climate known as the emphasis on academic performance in schools (SEAS). The outcomes demonstrated that the teachers' degree of education had an impact on students' math performance. It was also discovered that professional development has quite significant effects on student accomplishment. According to self-reports of readiness for teaching in several subject areas, teacher self-efficacy was found to have a somewhat favorable but negligible relationship with student achievement. Student achievement was unaffected by the teacher's traits, years of teaching experience, or primary academic discipline. Only the components expressing parental support for student accomplishment and kids' desire to perform well were strongly connected to student achievement, indicating that SEAS did not meet the standards of unidimensional. The results for OECD and non-OECD nations were comparable and could not be distinguished.

Although the study's primary data consists of over 400,000 pupils who were all viewed just once, it is based on 38 observations that were observed twice. Despite these variations, the findings of some analyses of the country-level data and the findings of analysis of the student-level data are in agreement. For instance, this is true in regards to how professional growth affects student accomplishment. The outcomes of analyses of data at the country level, however, are different for several variables than those of analyses that were the subject of earlier studies. The most obvious instance of this is SEAS, which was discovered to be multidimensional in the country-level analysis and whose components were associated to accomplishment in remarkably varied ways. To fully understand the significance of this finding, more investigation is required.

2.4 Appraisal of the Reviewed Literature

This study reviewed related literature on teachers' professional competence, quality of instruction and classroom climate on students' interest and achievement in mathematics, conceptually, empirically and theoretically. The review exposed the fact that the variables of concern in this study have been widely used in the literature, however, there are gaps identified. Some similar studies have been conducted in other parts of Nigeria, hence, there is lack of this type of study in the southwest of Nigeria and while few that were based on secondary schools used the variables sparingly, therefore, there is the need to focus on senior secondary schools and expand the variable scope to accommodate the independent and the dependent variables of this study.

Though, studies have been carried out in relation to each of the independent and dependent variables of this study, most of these studies were outside the country or outside the southwest part of Nigeria and the few that were conducted in Nigeria were outside Oyo state, and in other subject areas, which is the gap, this study bridged. Hence, there is the need to empirically prove some of the findings of the studies under a particular scope. Some studies also focused on a particular grade, like the study from the United State of America while some also focused on primary schools in certain regions. Therefore, the gap for the current study is justified in the sense that it will add to the body of literature in the area.

The review also identified some studies which only focused on one variable as against the combination of all the variables together. Therefore, the gap for the current study is to include all the independent variables of this study which will validate the current assumptions which have not been earlier proven and as such the identified gaps in the literature will be filled by this current study. The reseracher also found differences between the variable scope of the reviewed articles and the variable scope of this study which must be filled as the gap. While teachers' professional competence, quality of instruction and classroom climate on students' interest and achievement in mathematics have not been jointly tested, this study focuses on these variables jointly in secondary schools within the Ibadan, Nigeria.

CHAPTER THREE

METHODOLOGY

3.1 Research Design

The study adopted correlational survey research design. It is correlational in the sense that data was collected from a large population for the purpose of analysing the relationships between variables. This study investigated the teachers' professional competence componence, quality of instruction and classroom climate on secondary school students' interest and achievement in mathematics in Ibadan, Nigeria.

3.2 Variables of the Study

Two categories of variables are outline in this study. These are the independent and dependent variables.

Independent Variables:

1. These are the teachers' professional competence:
   a. Content knowledge.
   b. Pedagogical knowledge
2. The teachers' quality of instruction:
   a. Lesson development
   b. Set induction
   c. Content Presentation
   d. Content communication
   e. Questioning techniques
   f. Management
3. The classroom climate:
   a. Personalisation
   b. Involvement
   c. Students cohesiveness
   d. Satisfaction
   e. Task orientation
   f. Innovation
   g. Individualisation

Dependent Variables: The learning outcomes at two levels:

1. Interest in mathematics and
2. Achievement in mathematics.

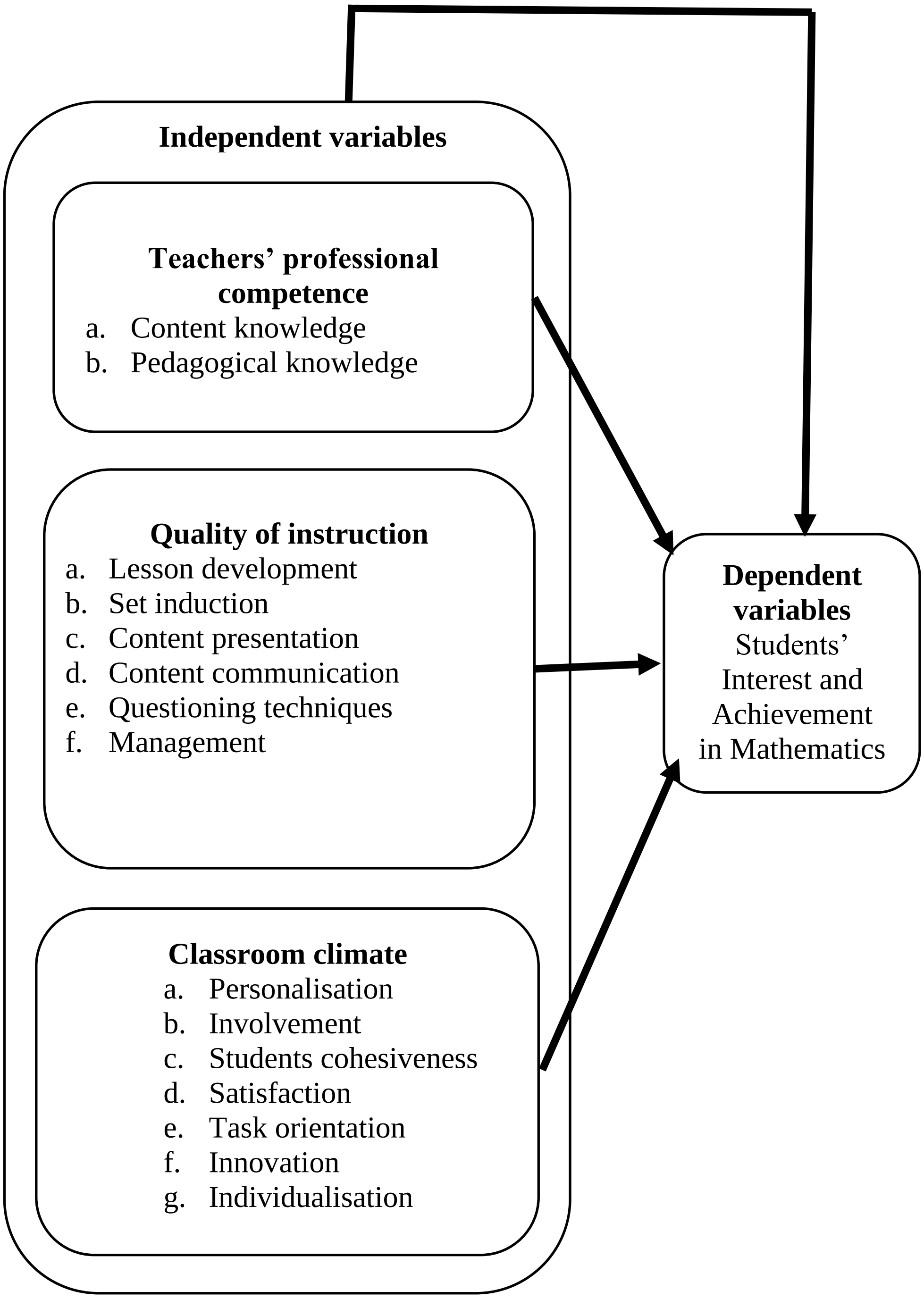

Fig. 3.1: Variables in the study

3.3 Population of the Study

The participants in this study is a population sample of mathematics teachers and all public senior secondary school II students in Ibadan. Secondary school III students were not used because they are finalists and they are pre-occupied with preparing for their external examinations, while the secondary school 1 students have not achieved sufficient command of the subject to provide relevant results.

3.4 Sample and Sampling Techniques

The sample was drawn from public secondary schools in the four Oyo state post primary teaching service commission zones in Ibadan.

The four zones are:

i. Ibadan zone 1 (Ibadan Southeast and Ibadan Southwest LGA)
ii. Ibadan zone 2 (Ibadan North, Ibadan Northeast and Ibadan Northwest LGA)
iii. Ibadan zone 3 (Egbeda, Ona-Ara and Oluyole LGA)
iv. Ibadan zone 4 (Lagelu and Akinyele LGA)

One local government area was chosen from each zone using a simple random sampling technique (balloting), making a total of four local government areas. The following criteria were used purposefully to select the participating schools:

i. The mathematics teacher had completed the term's work as at the time of data collection.
ii. The mathematics teacher must have been teaching mathematics continuously for the past five years because of the teaching experience.
iii. The secondary school II students in the schools had completed their senior secondary school I mathematics scheme of work at the time of data collection.
iv. The senior secondary school II had a qualified mathematics teachers teaching them.

From the schools that met these criteria, five public secondary schools were randomly (balloting), selected from each of the selected local government areas making a total of 20 schools. In each of the selected schools, sixty (60) SSS II students were randomly selected from science, art and commercial classes (i.e. 20 students from each group) by balloting. The mathematics teachers teaching the selected students in each school participated in the study. In all, a total of twenty (20) mathematics teachers and one thousand two hundred (1200) students participated in the study while one thousand one hundred and sixty-two (1162) questionaires collected back from the students that participated in the study.

3.5 Instruments for data collection

Six research instruments were used in this study. These are:

1. Teacher Content Knowledge Test (TCKT).
2. Teacher Pedagogical Knowledge Observation Scale (TPKOS).
3. Teacher Quality of Instruction Observation Scale (TQIOS).
4. Classroom Climate Inventory (CCI).
5. Students' Interest in Mathematics Questionnaire (SIMQ).
6. Mathematics Achievement Test (MAT).

3.5.1 Teacher Content Knowledge Test (TCKT)

This was self-designed to assess the mathematics teacher content knowledge. However, a test blueprint was drawn from the Bloom's taxonomy of educational objectives and specifically with the three levels of cognitive domain recommended by the Education Testing Service of United State of America and used in Nigeria by Okpala and Onacha (2011). These are knowledge, understanding and thinking.

An initial pool of 15 items was developed. The items were subjected to face and content validity by submitting copies to the researcher's supervisor and two experts in the field. The experts were requested to determine the suitability of the test for the target population in terms of face, content and clarity of the items. Ten items survived scrutiny. The 10-item test was then trial tested on 3 senior secondary schools' II mathematics teachers in three public schools in Ogun State. The result was used to calculate the average item difficulty of the test. Items with difficulty level of 0.4 – 0.7 were selected; others with difficulty level above 70% and below 40% were discarded for being too difficult or too easy respectively. Five of the items with extreme (high or low) difficulty indices were removed leaving a total of 5 items in the test. Its reliability index was determined using Kuder-Richardson formula 20 (KR-20) with a reliability index of 0.85 and an average item difficulty value of 0.63. Table 3.1 shows the test blueprint of the Teacher Content Knowledge Test.

Table 3.1. Test Blueprint for Teacher Content Knowledge Test (TCKT)

Content Area	%	Knowledge	Understanding	Thinking	Total
Simplification of Algebraic Equation	20	------	--------	1(a), 2(a)	2
Variation	10	------	1(b)	-------	1
Mensuration	10	5(b)	------	------	1
Surd	10	2(b)	------	-------	1
Sequences and series	10	-------	4(b)	-------	1
Logarithms	10	4(a)	------	------	1
Coordinate Geometry	10	------	5(a)	------	1
Statistics and Probability	20	3(b)	-------	3(a)	2
Total	100	4	3	3	10

3.5.2 Teacher Pedagogical Knowledge Observation Scale (TPKOS)

This is a 10-item instrument adapted and modified from teacher pedagogical knowledge observation scale comprising 15 items which was originally developed by Beck, McKeown, Hamilton and Kucan, (1997) to measure teacher pedagogical knowledge. Section A consist personal information about mathematics teachers like school location and code. Section B consist variables such as pedagogical knowledge which consists of 10-items. The statements were rated on a five-point scale of 1= Poor, 2= Fair, 3= Good, 4= Very Good, 5= Excellent

The instrument was trial tested in two schools in Ogun state. The researcher examined the mathematics teacher pedagogical knowledge observation sheet. The first data that were collected, the researcher estimated the inter observers' agreement between observer-pairs using the pairwise observation method. Two observers simultaneously performed observations in one classroom. The researcher counted the number of codes in a specific category that each observer used; and correlate these counts with one another. The reliability coefficient of the instrument was calculated using Inter-rater reliability measure; the instrument yielded an average reliability index of 0.79

3.5.3 Teacher Quality of Instruction Observation Scale (TQIOS)

The instrument was adapted and modified from rating scale developed by Institute of Education, University of Ibadan used by Adegoke, (2007) and Ogundare, (2019). Data on teachers' instructional quality were obtained by direct systematic observation and scores were obtained from Teacher Quality of Instruction Observation Scale (TQIOS). Also, the instrument was used to measure teachers' quality of instruction in the public senior secondary schools. The purpose of this observation is to find out how individual teachers can use their knowledge of subject matter in mathematics to teach the study participants. Of prime importance during lesson observations in this study is how teachers display their knowledge of subject matter on the topics and at the same time ensuring that the learners are able to internalise the content during lessons. It consists of six indices expected to measure the quality of instructional of the teacher while he/she is teaching. The variables are:

- Lesson development
- Set induction
- Content presentation
- Communication of content

- Questioning techniques
- Management

Each of these major indices is clearly spelt out with items for easy scoring of any skill exhibited by the teacher. It consists of two sections.

Section C consists of classroom background records like school location, teacher qualification, teaching experience, topic and date of observation. Section D consists 34 items. The statements are rated according to degree of occurrence. Scores are 1, 2, 3, 4 and 5.

The instrument was trial tested in two public senior secondary school in Ogun State. First, from the data that were collected, the researcher estimated the inter observers' agreement between observer-pairs using the pairwise observation method. Two observers simultaneously performed observations in one classroom. The researcher counted the number of codes in a specific category that each observer used; and correlate these counts with one another. The reliability coefficient of the instrument was calculated using Inter-rater reliability measure; the instrument yielded an average reliability index of 0.77: lesson development = 0.78, set induction = 0.83, content presentation = 0.85, content communication = 0.80, questioning techniques = 0.79 and management = 0.81.

3.5.4 Classroom Climate Inventory (CCI)

This is a 35 items instrument adapted and modified from the Revised Classroom Climate Inventory (CCI) developed by Fraser, Treagust and Dennis, (1986) from Western Australian Institute of Technology to measure perceived psychological learning environment. It consists of two sections; section A consist demographic information of the students. Section B consists of 35 items based on variables related to mathematics classroom climate as perceived by students. The statements were rated on a four-point Likert scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). Scores are 4, 3, 2, 1, for SA, A, D and SD respectively for positively worded items, while reverse was the case for negatively worded items.

The original 45 items instrument has reliability index of 0.70 from which 40 item instrument was adapted and given to the researcher's supervisor and experts comprising of mathematics lecturer, an educational psychologist, and two expert in the field for review in terms of content, relevance, scope of coverage, language of presentation, clarity of expression and overall adequacy in order to align them to the objectives of this study.

Based on their comments, some of the items were modified while three were removed, 37 items survived the experts' scrutiny. The 37 items instrument was trial tested in selected secondary schools in Ogun State using fifty (50) students who would not be part of the main investigation in order to revalidate the instrument. After 2 items have been deleted from the corrected item-total correlation column, leaving 35 items, the reliability coefficient of the CCI was established with Cronbach Alpha measure and the instrument yielded a reliability index of 0.77: personalisation= 0.78, involvement = 0.77, student cohesiveness = 0.75, satisfaction = 0.78, task orientation=0.85, innovation =0.87 and individualisation = 0.77.

3.5.5 Students' Interest in Mathematics Questionnaire (SIMQ)

This is a 13 items instrument adapted and modified from the Mathematics Interest Inventory comprising 27 items which was originally developed by Stevens and Olivárez (2005). It was used to measure students' interest in mathematics. It consisted of positive and negative statements concerning liking of and enthusiasm for mathematics and confidence in mathematical ability and knowledge. Section C consisted of 13 statement items. The statements were rated on a four-point Likert scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). Scores are 4, 3, 2, 1, for SA, A, D and SD respectively for positively worded items, while reverse was the case for negatively worded items.

The original 27 items instrument has reliability index of 0.76 from which 20 item instrument was adapted and given to the researcher's supervisor and experts comprising of mathematics lecturer and an educational psychologist for review in terms of content, relevance, scope of coverage, language of presentation, clarity of expression and overall adequacy in order to align them to the objectives of this study. All of the experts were lecturers in public universities in Nigeria.

Based on their comments, some of the items were modified while two were removed, 18 items survived the experts' scrutiny. The 18 items instrument was trial tested in selected secondary schools in Ogun State using fifty (50) participants who would not be part of the main investigation in order to revalidate the instrument. Five items deleted from the corrected item, leaving 13 items and the reliability coefficient of the SIMQ was established with Cronbach Alpha measure and the instrument yielded a reliability index of 0.87 which is categorised as highly reliable according to Cohen, Manion, and Morrison (2007).

3.5.6 Mathematics Achievement Test (MAT)

This instrument was self-designed to measure the students' achievement in mathematics based on the senior secondary school II scheme of work. However, a test blueprint was drawn from Bloom's taxonomy of educational objectives and specifically the three levels of cognitive domain recommended by the Education Testing Service of United State of America and used in Nigeria by Okpala and Onacha (2011). These are knowledge, understanding and thinking.

An initial pool of 45 items was developed. The items were subjected to face and content validity by the researcher's supervisor and experts comprising of mathematics lecturer and an educational psychologist. The experts were requested to determine the suitability of the test for the target population in terms of content and clarity of the items. Twenty -five items survived for the study. The 25-item test was then trial tested on 30 senior secondary school II students in a public senior secondary school in Ogun State. The result was used to calculate the average item difficulty of the test. Items with difficulty level of 0.4 – 0.7 were selected; others with difficulty level above 70% and below 40% were discarded for being too difficult or too easy respectively. Five of the items with extreme (high or low) difficulty indices were removed leaving a total of 20 items on the test. Its reliability index was determined using Kuder-Richardson formula 20 (KR-20) with a reliability index of 0.75 and an average item difficulty value of 0.61. Table 3.2 shows the test blueprint of the Mathematics Achievement Test.

Table 3.2. Test Blueprint for Mathematics Achievement Test (MAT)

Content Area	%	Knowledge	Understanding	Thinking	Total
Indices	15	10	---	13, 3	3
Logarithms	20	15,14	4	9	4
Sequence and Series	05	---	---	8	1
Linear and Quadratic Equations	10	---	---	12,11	2
Sets and Probability	30	18,7	17,16	6,5	6
Logical reasoning	20	20,1	19,2	---	4
Total	100	7	5	8	20

3.6 Training of Classroom Observers

Seven research assistants who were classroom teachers' currently teaching mathematics were trained for five days. The training consisted essentially of discussions, familiarisation of the observers with the instruments, followed by extensive practice and home-work on the use of the instruments. These observers were taught the definitions of the codes in the Teacher Pedagogical Knowledge Observation Scale (TPKOS) and Teacher Quality of Instruction Observation Scale (TQIOS) so as to be sufficiently proficient in the interpretation of the codes. All observers were subjected to five practice sessions to allow them practice in a realistic setting. The observers visited different five senior secondary school II and observed the mathematics teacher in the classroom during teaching.

Formal checks on the observers' agreement began on the second day of the training and repeated on subsequent days. Toward the end of each day, the researcher compared the observers' frequencies. The standard of comparison of discrepancy did not `exceed 5%. By the end of the fifth day, the observers had achieved an acceptable level of accuracy obtained from Teacher Pedagogical Knowledge Observation Scale (TPKOS) and Teacher Quality of Instruction Observation Scale (TQIOS)

3.7 Procedure for Data Collection

The researcher obtained letters of introduction from the department of science and technology education, faculty of education to the principals of the selected schools. After permission has been sought, the instruments (Teacher Content Knowledge Test, Classroom Climate Inventory, Students' Interest in Mathematics Questionnaire and Mathematics Achievement Test) were administered on the sample by the researcher and the trained research assistants. This was followed by classroom observation of teaching and learning activities of the teachers by the researcher and the trained research assistants. All the instrument given to the teachers were collected back after completion, while only 1162 of the instruments given to the students were retrieved. Data collection procedure lasted for eight weeks.

3.8 Methods of Data Analysis

The Pearson Product Moment Correlation (PPMC) was used to answer research questions one to three, to determine the relationship between the teachers' professional competence, quality of instruction, classroom climate and students' interest and achievement in mathematics. Research questions four to nine were answered using multiple regression analysis to examine the joint and relative contributions of the teachers' professional competence, quality of instruction and classroom climate to students' interest and achievement in mathematics. Decision was taken based on 0.05 level of significance.

CHAPTER FOUR

RESULTS AND DISCUSSION

This study examined teachers' professional competence, quality of instruction indices and classroom climate indices as predictors of secondary school students' interest and achievement in mathematics in Ibadan, Oyo State, Nigeria. The results of the findings and discussion are presented in this chapter based on the research questions raised.

4.1 Demographic Information

Table 4.1. Demographic Characteristics of the mathematics teachers

Characteristics		Frequency	Percentage(%)
Academic Qualification			
	NCE	2	10
	HND	3	15
	B.Ed./BSc.	10	50
	M.Ed./M.Sc.	4	20
	Ph.D.	1	5
	TOTAL	20	100%
Teaching Experience			
	1-5 years	1	5
	6-10 years	1	5
	11 years and above	18	90
	TOATL	20	100%

Table 4.1 presented the demographic characteristics of mathematics teachers. As seen, majority (85.5%) of the teachers possessed professional qualification. In terms of teachers teaching experience, most (90.0%) of them had more than 10 years teaching experience.

4.2 Answering of Research Questions

Research question 1a: What relationship exists between teachers' professional competence components (content and pedagogical knowledge) and students' interest in mathematics?

Table 4.2. Correlation Matrix showing the relationship between teachers' competence components and students' interest in mathematics

Variables	Students' Interest	Content Knowledge	Pedagogical Knowledge
Students' Interest	1		
Content Knowledge	-0.574*	1	
	0.008		
Pedagogical	-0.267	-0.300	1
Knowledge	0.255	0.198	
Mean	46.3	44.42	33.35
STD.D	11.19	3.44	5.00

* denotes significant at $p<0.05$ level of significance

Table 4.2 revealed that there was a negative significant relationship between teachers' content knowledge ($r = -0.57; p<0.05$) and students' interest in mathematics. There was a negative, weak significant relationship between pedagogical knowledge ($r = -0.27; p>0.05$) and students' interest in mathematics. This implies that teachers' pedagogical knowledge had relationship with students' interest in mathematics.

Research question 1b: What relationship exists between teachers' professional competence components (content and pedagogical knowledge) and students' achievement in mathematics?

Table 4.3. Correlation Matrix showing the relationship between teachers' competence components and students' achievement in mathematics

Variables	Students' Achievement	Content Knowledge	Pedagogical Knowledge
Students' Achievement	1		
Content Knowledge	0.505* 0.023	1	
Pedagogical Knowledge	-0.530* 0.016	-0.300 0.198	1
Mean	13.74	44.2	33.35
STD.D	1.22	3.44	5.00

* denotes significant at $p<0.05$ level of significance

Table 4.3 revealed that there was a positive significant relationship between teachers' content knowledge and students' achievement in mathematics ($r = 0.51$; $p<0.05$). The table further revealed that pedagogical knowledge ($r = -0.53$; $p<0.05$) had a negative significant relationship with students' achievement in mathematics.

Research question 2a: What relationship exists among teachers' quality of instructions indices (lesson development, set induction, content presentation, content communication, questioning techniques and class management) and students' interest in mathematics?

Table 4.4. Correlation Matrix showing the relationship among teachers' quality of instructions indices and students' interest in mathematics

Variables	Students' Interest	LD	SI	CP	CC	QT	CM
Students' Interest	1						
LD	0.044	1					
	0.852						
SI	-0.216	-0.067	1				
	0.360	0.780					
CP	0.134	0.342	0.355	1			
	0.575	0.140	0.124				
CC	0.164	0.311	0.189	0.440	1		
	0.491	0.182	0.426	0.052			
QT	0.120	0.182	-0.180	0.065	0.182	1	
	0.613	0.443	0.447	0.786	0.443		
CM	0.061	-0.099	0.366	-0.167	0.293	0.257	1
	0.797	0.678	0.112	0.482	0.209	0.273	
Mean	46.3	35.5	14.25	12.65	17.15	12.7	17.9
STD.D	11.19	6.67	2.43	1.69	4.17	1.87	3.11

* denotes significant at $p<0.05$ level of significance

LD= lesson development, SI= set induction, CP= content presentation,

CC= content communication, QT= questioning technique, CM= classroom management

Table 4.4 showed a non-significant relationship among teachers' quality of instructions indices; lesson development ($r = 0.04$; $p>0.05$), set induction ($r = -0.22$; $p>0.05$), content presentation ($r = 0.13$; $p>0.05$), content communication ($r = 0.16$; $p>0.05$), questioning technique ($r = 0.12$; $p>0.05$) and classroom management ($r = 0.06$; $p>0.05$) and students' interest in mathematics. This imply no relationship exist among teachers' quality of instruction indices and students' interest in mathematics.

Research question 2b: What relationship exists among teachers' quality of instructions indices (lesson development, set induction, content presentation, content communication, questioning techniques and class management) and students' achievement in mathematics?

Table 4.5. Correlation Matrix showing the relationship among teachers' quality of instructions indices and students' achievement in mathematics

Variables	Students' Achievement	LD	SI	CP	CC	QT	CM
Students' Achievement	1						
LD	0.083	1					
	0.727						
SI	-0.608*	-0.067	1				
	0.004	0.780					
CP	-0.290	0.342	0.355	1			
	0.216	0.140	0.124				
CC	-0.098	0.311	0.189	0.440	1		
	0.680	0.182	0.426	0.052			
QT	0.046	0.182	-0.180	0.065	0.182	1	
	0.848	0.443	0.447	0.786	0.443		
CM	0.011	-0.099	0.366	-0.167	0.293	0.257	1
	0.963	0.678	0.112	0.482	0.209	0.273	
Mean	46.3	35.5	14.25	12.65	17.15	12.7	17.9
STD.D	11.19	6.67	2.43	1.69	4.17	1.87	3.11

* denotes significant at p<0.05 level of significance

LD= lesson development, SI= set induction, CP= content presentation,

CC= content communication, QT= questioning technique, CM= classroom management

Table 4.5 revealed a negative, significant relationships between set induction ($r = -0.61$; $p<0.05$) and students' achievement in mathematics. These imply that set induction had a negative relationship with students' interest in mathematics. Lesson development ($r = 0.08$; $p>0.05$), content presentation ($r = -0.29$; $p>0.05$), content communication ($r = -0.18$; $p>0.05$), questioning technique ($r = 0.05$; $p>0.05$) and classroom management ($r = 0.11$; $p>0.05$) were not related to students' achievement in mathematics. Hence, five of the quality of instructions indices were not related, while one (set induction) was related with students' achievement in mathematics.

Research question 3a: What relationship exists among classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation and individualisation) and students' interest in mathematics?

Table 4.6. Correlation Matrix showing the relationship among classroom climate indices and students' interest in mathematics

Variables	Interest	Personalisation	Involvement	Cohesiveness	Satisfaction	Task Orientation	Innovation	Individualisation
Interest	1							
Personalisation	0.328*	1						
	0.000							
Involvement	0.176*	0.248	1					
	0.000	0.000						
Cohesiveness	0.357*	0.275	0.272	1				
	0.000	0.000	0.000					
Satisfaction	0.542*	0.382	0.284	0.477	1			
	0.000	0.000	0.000	0.000				
Task Orientation	0.465*	0.317	0.300	0.455	0.628	1		
	0.000	0.000	0.000	0.000	0.000			
Innovation	0.206*	0.238	0.051	0.252	0.142	0.211	1	
	0.000	0.000	0.081	0.000	0.000	0.000		
Individualisation	0.109*	0.095	0.145	0.163	0.284	0.291	0.260	1
	0.000	0.001	0.000	0.000	0.000	0.000	0.000	
Mean	13.75	14.83	13.66	14.64	15.96	15.14	14.03	13.31
STD.D	2.71	2.94	2.86	3.12	3.10	2.76	2.66	2.12

* denotes significant at p<0.05 level of significance.

Table 4.6 revealed a positive, significant relationships between students' personalisation, ($r = 0.33$; $p<0.05$), involvement ($r = 0.18$; $p<0.05$), cohesiveness ($r = 0.36$; $p<0.05$), satisfaction ($r = 0.68$; $p<0.05$), task orientation ($r = 0.47$; $p<0.05$), innovation ($r = 0.21$; $p<0.05$), and individualization ($r = 0.11$; $p<0.05$), and students' interest in mathematics. This implies that students' personalisation, involvement, cohesiveness, satisfaction, task orientation, innovation and individualization were all positively related to students' interest in mathematics. Hence, all the indices contributed in sustaining students' interest in mathematics.

Research question 3b: What relationship exists among classroom climate indices (personalization, involvement, students' cohesiveness, satisfaction, task orientation, innovation and individualisation) and students' achievement in mathematics?

Table 4.7. Correlation Matrix showing the relationship among classroom climate indices and students' achievement in mathematics

Variables	Achievement	Personalisation	Involvement	Cohesiveness	Satisfaction	Task Orientation	Innovation	Individualisation
Achievement	1							
Personalisation	0.025	1						
	0.387							
Involvement	0.046	0.248	1					
	0.119	0.000						
Cohesiveness	0.046	0.275	0.272	1				
	0.113	0.000	0.000					
Satisfaction	0.068*	0.382	0.284	0.477	1			
	0.021	0.000	0.000	0.000				
Task Orientation	0.053	0.317	0.300	0.455	0.628	1		
	0.072	0.000	0.000	0.000	0.000			
Innovation	0.000	0.238	0.051	0.252	0.142	0.211	1	
	0.989	0.000	0.081	0.000	0.000	0.000		
Individualisation	0.052	0.095	0.145	0.163	0.284	0.291	0.260	1
	0.077	0.001	0.000	0.000	0.000	0.000	0.000	
Mean	13.75	14.83	13.66	14.64	15.96	15.14	14.03	13.31
STD.D	2.71	2.94	2.86	3.12	3.10	2.76	2.66	2.12

* denotes significant at $p<0.05$ level of significance

Table 4.7 revealed a positive significant relationship between students' satisfaction ($r = 0.68$; $p<0.05$), and students' achievement in mathematics. The table further revealed that no relationship exists among personalization ($r = 0.03$; $p>0.05$), involvement ($r = 0.05$; $p>0.05$), cohesiveness ($r = 0.05$; $p>0.05$), task orientation ($r = 0.05$; $p>0.05$), innovation ($r = 0.00$; $p>0.05$) and individualization ($r = 0.05$; $p>0.05$) and students' achievement in mathematics. It implies that six of the classroom climate indices had no relationship, while one (students' satisfaction) had relationship with students' achievement in mathematics.

Research question 4a: What is the joint contribution of teachers' professional competence components (content and pedagogical knowledge) to students' interest in mathematics?

Table 4.8. Multiple Regression Analysis showing the joint teachers professional competence components on students' interest in mathematics

Sources of Variance	Sum of Squares	Df	Mean Square	F	Significant
Regression	805.900	2	402.950	4.357	0.030*
Residual	1572.300	17	92.488		
Total	2378.200	19			
R = 0.582					
R^2 = 0.339					
Adj R^2 = 0.261					
Std. Error of the Estimate = 9.61708					

* denotes significance at $p<0.05$

Table 4.8 indicated that there was significant joint contribution of teachers' professional competence components (content and pedagogical knowledge) to students' interest to mathematics ($F_{(2;17)}$=4.36; Adj R^2=0.26; $p<0.05$). This implies that teachers' professional competence components (content and pedagogical knowledge) when taken together jointly contribute to students' interest in mathematics. The table also revealed a multiple regression coefficient (R) of 0.58, which means that the teachers' professional competence components variables have a joint positive, low significant relationship with students' interest in mathematics. The table further revealed a multiple regression adjusted (R^2 = 0.26), implying that 26% of the variance in the dependent measure (students' interest in mathematics) was accounted for by the joint contribution of content and pedagogical knowledge variables while the remaining 74% may be due to other factors and residuals not under investigation in this model.

Research question 4b: What is the joint contribution of teachers' professional competence components (content and pedagogical knowledge) on students' achievement in mathematics?

Table 4.9. Multiple Regression Analysis showing the joint teachers professional competence components on students' achievement in mathematics

Sources of Variance	Sum of Squares	Df	Mean Square	F	Significant
Regression	11.650	2	5.825	5.966	0.011*
Residual	16.598	17	0.976		
Total	28.248	19			
R = 0.642					
R^2 = 0.412					
Adj R^2 = 0.343					
Std. Error of the Estimate = 0.98812					

* denotes significance at $p<0.05$

Table 4.9 indicated that there was significant joint contribution of teachers' professional competence components (content and pedagogical knowledge) on students' achievement in mathematics ($F_{(2;17)}$ = 5.97; Adj R^2 = 0.34; $p<0.05$). This implies that teachers' professional competence components (content and pedagogical knowledge) when taken together jointly contributed to students' achievement in mathematics. The table revealed a multiple regression coefficient (R) of 0.64, which means that the teachers' professional competence components variables have a joint positive, low significant relationship with students' achievement in mathematics. The table further revealed a multiple regression adjusted (R^2 = 0.34), implying that 34% of the variance in the dependent measure (students' achievement in mathematics) was accounted for by the joint contribution of content and pedagogical knowledge variables while the remaining 66% may be due to other factors and residuals not under investigation in this model.

Research question 5a: What is the joint contribution of teachers' quality of instructions indices (lesson development, set induction, content presentation, content communication, questioning techniques and classroom management) and students' interest in mathematics?

Table 4.10. Multiple Regression Analysis showing the joint contribution of quality of instruction indices on students' interest in mathematics

Sources of Variance	Sum of Squares	Df	Mean Square	F	Significant
Regression	395.452	6	65.909	0.432	0.845
Residual	1982.748	13	152.519		
Total	2378.200	19			
R = 0.408					
R^2 = 0.166					
Adj R^2 = -0.219					
Std. Error of the Estimate = 12.34986					

* denotes significance at p<0.05

Table 4.10 indicated that there was no significant joint contribution of quality of instructions indices (lesson development, set induction, content presentation, content communication, questioning techniques and class management) to students interest in mathematics ($F_{(6;13)} = 0.43$; $p>0.05$). This implies that quality of instructions indices (lesson development, set induction, content presentation, content communication, questioning techniques and management) when taken together had no joint contribution to students' interest in mathematics.

Research question 5b: What is the joint contribution of teachers' quality of instructions indices (lesson development strategy, set induction, presentation of content, communication of content, questioning techniques and classroom management) and students' achievement in mathematics?

Table 4.11. Multiple Regression Analysis showing the joint contribution of quality of instruction indices on students' achievement in mathematics

Sources of Variance	Sum of Squares	Df	Mean Square	F	Significant
Regression	13.486	6	2.248	1.979	0.142
Residual	14.762	13	1.136		
Total	28.248	19			
R = 0.691					
R^2 = 0.477					
Adj R^2 = 0.236					
Std. Error of the Estimate = 1.06562					

* denotes significance at $p<0.05$

Table 4.11 indicated that the joint contribution of quality of instructions indices (lesson development, set induction, content presentation, content communication, questioning techniques and classroom management) to the prediction of students achievement in mathematics was not significant ($F_{(6;13)}$ = 1.98; $p>0.05$). This implies that quality of instructions indices (lesson development, set induction, content presentation, content communication, questioning techniques and classroom management) when taken together had no joint contribution to students' achievement in mathematics.

Research question 6a: What is the joint contribution of classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation and individualisation) to students' interest in mathematics?

Table 4.12. Multiple Regression Analysis showing the joint contribution of classroom climate indices on students' interest in mathematics

Sources of Variance	Sum of Squares	Df	Mean Square	F	Significant
Regression	14878.730	7	2125.533	86.326	0.000*
Residual	28414. 041	1154	24.622		
Total	43292.771	1161			
R = 0.586					
R^2 = 0.344					
Adj R^2 = 0.340					
Std. Error of the Estimate = 4.96208					

* denotes significance at $p<0.05$

Table 4.12 indicated the joint contribution of classroom climate indices (personalization, involvement, students' cohesiveness, satisfaction, task orientation, innovation and individualisation) on students' interest to mathematics was significant ($F_{(7;1154)} = 86.33$; Adj $R^2 = 0.34$; $p<0.05$). This implies that classroom climate indices (personalization, involvement, students' cohesiveness, satisfaction, task orientation, innovation and individualisation) when taken together jointly contribute to students' interest in mathematics. The table revealed a multiple regression coefficient (R) of 0.59, which means that classroom climate indices variables have a joint positive, low significant relationship with students' interest in mathematics. Table 4.11 further revealed a multiple regression adjusted ($R^2 = 0.34$), implying that 34% of the variance in the dependent measure (students' interest in mathematics) was accounted for by the joint contribution of personalization, involvement, students' cohesiveness, satisfaction, task orientation, innovation and individualisation variables while the remaining 66% may be due to other factors and residuals not under investigation in this model.

Research question 6b: What is the joint contribution of classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation and individualisation) to students' achievement in mathematics?

Table 4.13. Multiple Regression Analysis showing the joint contribution of classroom climate indices on students' achievement in mathematics

Sources of Variance	Sum of Squares	Df	Mean Square	F	Significant
Regression	59.698	7	8.528	1.160	0.323
Residual	8487.422	1154	7.355		
Total	8547.120	1161			
R = 0.084					
R^2 = 0.007					
Adj R^2 = 0.001					
Std. Error of the Estimate = 2.71197					

* denotes significance at p<0.05

Table 4.13 indicated that the joint contribution of classroom climate indices (personalization, involvement, students' cohesiveness, satisfaction, task orientation, innovation and individualisation) to the prediction of students achievement in mathematics was not significant ($F_{(7;1154)}$ = 0.32; $p>0.05$). This implies that classroom climate indices (personalization, involvement, students' cohesiveness, satisfaction, task orientation, innovation and individualisation) when taken together had no joint contribution to students' achievement in mathematics.

Research question 7a: What is the relative contribution of teachers' professional competence components (content and pedagogical knowledge) on students' interest in mathematics?

Table 4.14. Multiple Regression Analysis showing relative contributions of teachers' professional competence components to students' interest in mathematics

Model	Unstandardized Coefficients		Standardized Coefficient	T	Sig.
	B	Std. Error	Beta (β)		
(Constant)	-23. 790	37. 508		-0.634	0.534
Content Knowledge	1.763	0.672	0.542	2.263	0.018*
Pedagogical Knowledge	-0.235	0.467	-0.104	0.622	0.048*

* denotes significance at p<0.05

Table 4.14 revealed the relative contributions of teachers' professional competence components; content knowledge ($\beta = 0.54$; $t = 2.26$; $p<0.05$) and pedagogical knowledge ($\beta = -0.10$; $t = 0.62$; $p<0.05$) were both significant in the prediction of students' interest in mathematics This implies that teacher's knowledge of the content and pedagogical knowledge relatively contributed to students' interest in mathematics**.**

Research question 7b: What is the relative contribution of teachers' professional competence components (content and pedagogical knowledge) on students' achievement in mathematics?

Table 4.15. Multiple Regression Analysis showing relative contributions of teachers' professional competence components to students' achievement in mathematics

Model	Unstandardized Coefficients		Standardized Coefficient	T	Sig.
	B	Std. Error	Beta (β)		
(Constant)	11.197	3.854		2.905	0.010
Content Knowledge	-0.135	0.069	0.380	1.951	0.068
Pedagogical Knowledge	1.102	0.048	-0.416	-2.133	0.048*

* denotes significance at p<0.05

Table 4.15 revealed that the relative contributions of teachers' professional competence components; content knowledge ($\beta = 0.38$; $t = 1.95$; $p>0.05$) was not significant to the prediction of students' achievement in mathematics, while pedagogical knowledge ($\beta = -0.42$; $t = -2.13$; $p<0.05$) was significant to the prediction of students' achievement in mathematics This implies that while teacher's pedagogical knowledge relatively contributed to students' achievement in mathematics, teacher's content knowledge did not**.**

Research question 8a: What is the relative contribution of teachers' quality of instructions indices (lesson development, set induction, content presentation, content communication, questioning techniques and classroom management) to students' interest in mathematics?

Table 4.16. Multiple Regression Analysis showing relative contributions of teachers' quality of instructions indices to students' interest in mathematics

Model	Unstandardized Coefficients		Standardized Coefficient	T	Sig.
	B	**Std. Error**	**Beta (β)**		
(Constant)	35.922	34.548		1.040	0.317
LD	-0.147	0.476	-0.088	-0.309	0.763
SI	-2.197	1.577	-0.476	-1.393	0.187
CP	2.406	2.392	0.364	1.006	0.333
CC	0.123	0.864	0.046	0.143	0.889
QT	-0.334	1.740	-0.056	-0.192	0.851
CM	1.039	1.273	0.289	0.816	0.429

* denotes significance at $p<0.05$

LD = lesson development, SI = set induction, CP = content presentation, CC = content communication, QT = questioning techniques, and CM = classroom management

Table 4.16 revealed the relative contributions of teachers' quality of instructions indices; lesson development (β = -0.09; t = -0.31; p>0.05), set induction (β = -0.48; t =-1.39; p>0.05), content presentation (β = 0.36; t = 1.01; p>0.05), content communication (β = -0.05; t = 0.14; p>0.05), questioning techniques (β = -0.06; t = -0.19; p>0.05) and classroom management (β = 0.29; t = 0.82; p>0.05) were not significant to the prediction of students' interest in mathematics. This implies that teachers' quality of instructions indices did not relatively contribute to students' interest in mathematics**.**

Research question 8b: What is the relative contribution of teachers' quality of instructions indices (lesson development, set induction, content presentation, content communication, questioning techniques and classroom management)) to students' achievement in mathematics?

Table 4.17: Multiple Regression Analysis showing relative contributions of teachers' quality of instructions indices to students' achievement in mathematics

Model	Unstandardized Coefficients		Standardized Coefficient	T	Sig.
	B	Std. Error	Beta (β)		
(Constant)	17.344	2. 981		5.818	0.000
LD	0.021	0.041	0.113	0.500	0.625
SI	-0.403	0.136	-0.802	-2.964	0.011*
CP	0.061	0.206	0.085	0.297	0.771
CC	-0.030	0.075	-0.103	-0.403	0.693
QT	-0.139	0.150	-0.213	-0.926	0.371
CM	0.163	0.110	0.415	1.483	0.162

* denotes significance at $p<0.05$

LD = lesson development, SI = set induction, CP = presentation of content, CC = communication of content, QT = questioning techniques, and CM = class management

Table 4.17 revealed the relative contributions of teachers' quality of instructions indices; set induction (β = -0.80; t = -2.96; p<0.05) to the prediction of students' achievement in mathematics was significant. While the relative contributions of lesson development (β = 0.11; t = 0.50; p>0.05), content presentation (β = 0.09; t = 0.30; p>0.05) content communication (β = -0.10; t = -0.40; p>0.05), questioning techniques (β = -0.21; t = -0.93; p>0.05) and classroom management (β = 0.42; t = 1.48; p>0.05) to the prediction of students' achievement in mathematics were not significant. This implies that set induction was the only index that relatively contribute to students' achievement in mathematics (80%).

Research question 9a: What is the relative contribution of classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation and individualisation) to students' interest in mathematics?

Table 4.18. Multiple Regression Analysis showing the relative contribution of classroom climate indices on students' interest in mathematics

Model	Unstandardized Coefficients		Standardized Coefficient	Rank	T	Sig.
	B	Std. Error	Beta (β)			
(Constant)	16.363	1.320			12.397	0.000
Personalization	0.220	0.056	0.106	3rd	3.955	0.000*
Involvement	-0.054	0.055	-0.025		-.984	0.325
Cohesiveness	0.132	0.056	0.068	5th	2.357	0.019*
Satisfaction	0.716	0.065	0.363	1st	10. 931	0.000*
Task Orientation	0.362	0.071	0.164	2nd	5.075	0.000*
Innovation	0.181	0.060	0.079	4th	3.040	0.002*
Individualization	0.001	0.075	0.000		0.008	0.994

* denotes significance at $p<0.05$

Table 4.18 revealed the relative contributions of teachers' classroom climate indices; personalisation ($\beta = 0.11$; $t = 3.96$; $p<0.05$), cohesiveness ($\beta = 0.07$; $t = 2.36$; $p<0.05$) satisfaction($\beta = 0.36$; $t = 10.93$; $p<0.05$), task orientation ($\beta = 0.16$; $t = 5.08$; $p<0.05$) and innovation ($\beta = 0.08$; $t = 3.04$; $p<0.05$) were significant in the prediction of students' interest in mathematics, while involvement ($\beta = -0.03$; $t = -0.98$; $p>0.05$), and individualisation ($\beta = 0.00$; $t = 0.99$; $p>0.05$) were not significant to the prediction of students' interest in mathematics. This implies that classroom climate indices of personalization, cohesiveness, satisfaction, task orientation and innovation relatively contributed to students' interest in mathematics. However, involvement and individualisation did not contribute relatively to students' interest in mathematics**.**

Research question 9b: What is the relative contribution of classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation and individualisation) to students' achievement in mathematics?

Table 4.19. Multiple Regression Analysis showing the relative contribution of classroom climate indices on students' achievement in mathematics

Model	Unstandardized Coefficients		Standardized Coefficient	T	Sig.
	B	Std. Error	Beta (β)		
(Constant)	12.244	0.721		16.972	0.000
Personalization	-0.001	0.030	-0.001	-0.036	0.971
Involvement	0.022	0.030	0.023	0.736	0.462
Cohesiveness	0.015	0.031	0.017	0.493	0.622
Satisfaction	0.037	0.036	0.042	1.039	0.299
Task Orientation	0.005	0.039	0.005	0.132	0.895
Innovation	-0.023	0.033	-0.023	-0.712	0.476
Individualization	0.049	0.041	0.038	1.198	0.231

* denotes significance at $p<0.05$

Table 4.19 revealed the relative contributions of teachers' classroom climate indices; personalisation (β = -0.001; t = -0.04; p>0.05), involvement (β = 0.02; t =0.74; p>0.05), cohesiveness (β = 0.12; t = 0.49; p>0.05) satisfaction (β = 0.42; t = 1.04; p>0.05), task orientation (β = 0.01; t = 0.13; p>0.05), innovation (β = -0.02; t = -0.71; p>0.05) and individualisation (β = 0.04; t = 1.20; p>0.05) were not significant to the prediction of students' achievement in mathematics. This implies that classroom climate indices did not relatively contribute to students' achievement in mathematics**.**

4.3 Discussion of Findings

4.3.1a Teachers' professional competence component and students' interest in mathematics

Investigation into the relationship between teachers' professional competence components (content and pedagogical knowledge) and students' interest in mathematics revealed that, teachers' content knowledge had negative significant relationships with students' interest in mathematics. This is consistent with earlier findings. Lawyer (2019) found that teachers' subject content knowledge has a significant impact on their students' interest in the mathematics. In addition, Fauth *et al*. (2019) found that a significant correlation between students' interest in the subject and teachers' subject-matter knowledge. This reveals that for students to be equipped with the required competence with regards to content knowledge, the interest of the students is very crucial. However, McConnell, *et al*. (2009) reveal that teachers' content knowledge enhanced students' interest in a subject and this contributed value to the society and economic. This is in tandem with human capital theory that people's abilities to carry out tasks in ways that contribute value to the creation of societal, personal, and economic value would be enhanced if their skills, competencies, personality traits, and knowledge were developed (Mba *et al*., (2013). In essence, the ability of the teachers to ensure that students acquire the requisite knowledge in mathematics will add value to the students, and the society at large.

In addition, Heggart (2016); Ntibi *et al*. (2020); Akinsola (2023) affirmed that knowledge of subject content qualify a teacher to teach a concept. Teachers' competence in subject matter influence students' interest in the learning processes in classroom (Ozden, 2008; Niess, 2005). Being able to make teaching and learning processes interesting for students during mathematics class is one of the most crucial of being a teacher. This implies that students would not be distracted easily and they would be excited when teacher introduce a new topic. Therefore, if teachers want to engage students and improve their performance, they must consider students' interest when selecting a new topic.

4.3.1b Teachers' professional competence component and students' achievement in mathematics

Analyses of the relationship between teachers' professional competence components (content and pedagogical knowledge) and students' achievement in mathematics revealed that, the teachers' professional competence components (teachers' content and pedagogical knowledge had a significant relationships with students' achievement in mathematics. This is in with earlier findings. Polly, *et al*. (2015); Jacob, *et al*. (2017); Olasehinde-Williams *et al*. (2018); Fauth *et al*. (2019); Baumert *et al*. (2010); Hill and Chin (2018); Kiamba *et al*. (2018) revealed that teachers' subject content knowledge and pedagogical knowledge has a significant influence on their students' achievement in mathematics. In addition, Lu, *et al*. (2017); Cabalo and Cabalo (2019) revealed a significant relationship between teachers' content knowledge and students' achievement in the subject. This reveals that for students to be prepared with the essential ability that they needed with respects to pedagogical knowledge and knowledge of subject matter, the achievement of the students is much important in the mathematics classroom. However, Babalola, (2003), said that teachers' knowledge of subject matter and pedagogical knowledge enhanced students' achievement in the subject and this contributed a better value to the nation in general.

Also, this result is consistent with the findings of Fehintola (2014); Amie-Ogan and Etuk (2020) who found out that teachers' content knowledge and pedological skills had a significant relationship on students' achievement in public senior secondary school. Also, Adediwura and Tayo (2007) and Ekperi, (2018) found that teachers' knowledge of subject influence performance of students in the class. Teachers' content knowledge is one of the most important components of teachers' professional competence and a good teacher must have a foundational understanding of content (Agah, 2020; Akinsola, 2023). This reveal an indication that for competent and successful teaching of mathematics, it is necessary that teachers have great understanding of everything that students need to know both within and outside of the classroom.

In addition, Akpan *et al*. (2008); Ntibi *et al*. (2020) affirmed that teachers' content knowledge and pedagogical skills enhance student success in a subject. Good knowledge of the subject matter and pedagogical knowledge helps the mathematics teacher to teach the students properly (Rena, 2000). Also, Tan, (2014) assert that knowledge of the subject matter and pedagogical knowledge enhance teachers' productivity rate and this ultimately increase the students' performance in the subject. Being able for mathematics teacher to have a student's better achievement in the subject during mathematics class is one of the most vital of being a teacher and this contributed value to the society and the economics of the country. However, the results also differ from those of Oredina and Ebueza (2020) found no relationship between students' mathematics achievement and teachers' content knowledge. Therefore, it can be inferred from the facts obtained in the study that knowledge of subject matter and pedagogical knowledge influence students' mathematics achievement, and this should primarily be taken into consideration during teaching and learning process. Any mathematics teacher that does not have the required content knowledge and pedagogical knowledge in the area of teaching cannot be effective in the classroom (Rice, 2003).

4.3.2a Teachers' quality of instruction indices and students' interest in mathematics

Analyses of the relationship between teachers' quality of instruction indices (lesson development, set induction, content presentation, content communication, questioning techniques, and classroom management) and students' interest in mathematics revealed that, teachers' quality of instruction indices (lesson development, set induction, content presentation, content communication, questioning techniques, and classroom management) did not significantly show a relationship with students' interest in mathematics. The analyses disclose that there is no significant relationship among teachers' quality of instruction indices and students' interest in mathematics. This is not consistent with the earlier findings. Toropova *et al*. (2019) found a significant relationship between teachers' quality of instruction indices (lesson development, set induction, content presentation, content communication, questioning techniques, and classroom management) and students' interest in mathematics. In addition, Arthur (2019) found a significant correlation of teachers' quality of instruction indices (lesson development, set induction, presentation of content, communication of content, questioning techniques, and class management) and students' interest in mathematics.

Consequently, mathematics teachers should employ ways to improve students' interest in mathematics because interest of student is crucial in learning. In order to increase students' interest in and proficiency in mathematics, mathematics teachers should encourage students to express their ideas, use entire class time to teach effectively, stimulate students' interest and relate subject content to real-life situation. The teachers need to speak in a way that the students understand, communicate subject content in precise and clear terms, and monitor students' participation. All these would directly influence the teachers' quality of instruction indices. This implies that student would have interest to learn more about mathematics and this would help them in future.

4.3.2b Teachers' quality of instruction indices and students' achievement in mathematics

Analyses of the relationship between teachers' quality of instruction indices (lesson development, set induction, presentation of content, communication of content, questioning techniques, and classroom management) and students' achievement in mathematics revealed that, set induction out of the six quality of instruction indices that were investigated had significant relationship with students' achievement in mathematics. This is in harmony with earlier findings. Yahya and Fassasi (2012) found that teachers' set induction has a significant relationship influence on students' achievement in mathematics. In addition, Okafor and Anaduaka, (2013), found a significant correlation between students' achievement in the subject and set induction. This reveals that set induction stimulate students' achievement in mathematics. However, Yusof *et al*. (2022) make known that set induction gives teachers advantages and enhanced students achievement in the subject and this contributed a great value to the immediate environment and economic.

The finding is however not in harmony with that of Okolocha and Onyeneke, (2013), who found out that there was no significant relationship between students' academic achievement and set induction in social studies. In essence, the set induction should be used by the teacher to provide specific reasons why the student needs to learn what they're about to learn. This is to enhance students' success while also attract and maintain attention of the student (Choy *et al*., 2017). Therefore, set induction serve as a foundation for future teachings and it is a powerful stimulus and if teachers want to engage students improve their achievement in the subject, they must consider set induction during teaching and learning process.

4.3.3a Classroom climate indices and students' interest in mathematics

Analyses of the relationship between classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) and students' interest in mathematics revealed that, the whole indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) have significant relationships with students' interest in mathematics. This is consistent with previous findings. Chan-Anteza, (2020); Poudel (2020); Fadiji and Reddy (2021) found that personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation had a significant relationship with students' interest in other subjects. In addition, Everard *et al*. (2004), Fry *et al*. (2009), Bennett (2017) and Herold (2020) found that there was a significant correlation between personalisation and students' learning outcome. Also, Gadd and Parr (2016) found a significant correlation between students' task orientation and achievement with student progress in English writing. In essence, task orientation captures the attention of students, keep students' attention and to heighten their interest in the task given in the class.

However, Everard *et al*. (2004), Fry *et al*. (2009), Bennett (2017), Herold (2018) and Department for Education (2021) have affirmed that personalization help in getting the best out of students and bring change in a problematic student. In essence, personalization could be used as a means of implementing change which is ascribed to problems that necessitate change to the shortcomings of individuals. When students are personally focused, they tend to imbibe a good culture both academically and socially. Also, classroom involvement is the opportunity students are given to participate during the teaching and learning process (Petress, 2006). Such involvement includes allowing students to ask, answer questions and to brainstorm among fellow students in the class with specific task in focus. This implies that involvement is considered as a way that accordingly, the students appeared actively into the teaching process and to help in strengthening teaching and bringing liveliness to the classroom. Therefore, classroom involvement is important classroom climate indices for students during teaching and learning process.

Similarly, students' cohesiveness is an important classroom climate index that enhance positive interpersonal relationships is the individual performance level. Xhimi (2016) opines that students' cohesiveness brings about productivity in the classroom. However, Xhimi (2016) assert that, one of the main problems responsible for students' inability to be productive in class is that there is a lack of group cohesiveness. The process of teaching and learning involve great relationship between the teacher and the student(s). It can therefore be said that classroom climate indices are good factor that help to improve students' interest in mathematics. A good classroom climate psychological learning environment for mathematics teachers is needed to boost their teaching which in turns will enhance students learning and interest in mathematics (Berkowitz *et al*., 2017; Thoonen, *et al*., 2011). This implies that classroom climate indices enhance teaching and learning to be effective and support students' interest in the subject. Therefore, if teachers want to improve students' personalisation, involvement, cohesiveness, satisfaction, task orientation, innovation, and individualisation, they must consider students' interest in the subject during learning process in the classroom.

4.3.3b Classroom climate indices and students' achievement in mathematics

The results revealed that, out of the seven classroom climate indices that were investigated, only student' satisfaction has significant relationship with students' achievement in mathematics. Personalisation, involvement, students' cohesiveness, task orientation, innovation, and individualisation did not significantly correlate with students' achievement in mathematics. This is in harmony with the study conducted by El-Hilali *et al*. (2015) who found that students' achievement significantly related to students' satisfaction. It is also in consonance with the findings of Dhaqane and Afrah, (2016) who found a strong association between the students' satisfaction in the classroom that promotes students' academic achievement. In addition, the findings are in agreement with the study of Lo, (2010) who found that there was a significant relationship between students' satisfaction and students' performance in general education.

This is also in line with the findings by Fraser and Fisher (1982), who found that students' satisfaction was greater in classroom with a more positive learning environment significantly related to achievement of students in mathematics. This reveals that for a student to gained a required knowledge with regards to students' satisfaction, the achievement of the students is very necessary. However, Tremblay *et al*. (2012) asserts that when students are pleased with their learning outcome, it means satisfaction in teaching and learning process has been achieved and this contributed important value to the general society and economic development in the country. In essence, for students to be satisfied with their learning in the mathematics classroom, teachers need to be knowledgeable about the classroom climate psychological learning environment most importantly students' satisfaction. This implies that students' satisfaction is a crucial critical aspect in determining students' academic progress. Consequently, in order for teacher to promote effective teaching and learning of mathematics, the students' satisfaction in the classroom are pertinent indices that must be considered and this would help the students' success in the subject.

4.3.4a Joint contribution of teachers' professional competence components (content and pedagogical knowledge) to students' interest in mathematics

The study reported that the teachers' professional competence component (content and pedagogical knowledge) had significant joint contribution to students' interest in mathematics. Teachers' professional competence components both content and pedagogical knowledge is good in sustaining students' interest in mathematics. This is in agreement with earlier findings. Peiris *et al*. (2022) found a joint contribution between teachers' content knowledge and pedagogical knowledge and students' interest in English Language. This reveals that for students to be equipped with the required skills in a subject with regards to teachers' content knowledge of subject matter and pedagogical knowledge, the interest of the students is very crucial. However, Olaniyan and Okemakinde (2008) asserts that the promotion of teachers' content knowledge and pedagogical knowledge by various agencies would increase and enhance the students' interest in a subject and this automatically contributed to the nation productivity and economic. In view of this, the ability of the teachers to acquire the content and pedagogical knowledge in mathematics will add value to the students, and the society.

Similarly, Osiesi and Fajobi, (2019); Ajadi, (2020) reveal that students' interest is determined by the teachers' content knowledge and pedagogical skills. Also, teachers need to be knowledgeable in the content and pedagogy, without this, the students may face difficulty in their learning (Filgona *et al*., 2020). This implies that knowledge of subject matter is what being imparted and pedagogical knowledge is how it is being taught and successful teaching will depend on deep knowledge of subject matter. Therefore, teachers need to improve their knowledge of subject matter and pedagogical knowledge to enhance teaching and learning process. In consequence, students would build on this in tertiary institution and also students' productivity will be enhanced when they secure opportunity in organisation that require their mathematics skills and competence.

4.3.4b Joint contribution of teachers' professional competence components (content and pedagogical knowledge) to students' achievement in mathematics

The findings of this study have revealed that teachers' professional competence components (content and pedagogical knowledge) had a significant positive joint contribution with students' achievement in mathematics when taken together. This is consistent with earlier findings. Peiris *et al*. (2022); Olasehinde-Williams *et al*. (2018) found that teachers' professional competence component (knowledge of subject matter and pedagogical knowledge) jointly contributed significantly to students' achievement in English Language. In addition, Ekperi, (2018) found out that there was a joint significant contribution of teachers' content knowledge to students' academic performance in Geography. Furthermore, Fehintola, (2014) found out that teachers' content knowledge of subject matter jointly contributed significantly to the students' success in social studies. This reveals that teachers' content and pedagogical knowledge are most important attributes of the teachers' competence which enhances student achievement in a subject.

However, Gess-Newsome, (2013) pointed that teachers' content knowledge of subject matter and pedagogical knowledge as one of the most influential factors contributing to students' achievement. In addition, Mba, (2013) opine that teachers' content knowledge enhanced students' performance in a subject and this contribute value to the society and economic. In essence, it can be assumed that greater levels of knowledge of subject matter and pedagogical knowledge allow teachers to create learning environments that challenge, and at the same time sustenance students' achievement. Therefore, it is statistically established that to increase the outcome of the students, professional competence component of the teachers should be improved and the achievement in mathematics is a very vital way of granting economic value to the individual. A good knowledge of subject matter and pedagogical knowledge is a vital requirement for effective teaching because a teacher must know adequately, what he wants to teach, otherwise he will not perform satisfactorily.

4.3.5a Joint contribution of teachers' quality of instruction indices (lesson development, set induction, presentation of content, communication of content, questioning techniques, and class management) to students' interest in mathematics

The findings of this study have revealed that teachers' quality of instruction indices (lesson development, set induction, presentation of content, communication of content, questioning techniques, and class management) had no joint contribution to students' interest in mathematics. However, Sogunro (2017), asserted that instruction quality indices are responsible for the drive of students in secondary school, that without quality instruction, students' interest to learn withdraws. This reveals that students claimed in a class that quality of instruction is the reason for their progress to tertiary education. The implications of quality of instruction indices for practice can therefore, not be overemphasized.

4.3.5b Joint contribution of teachers' quality of instruction indices (lesson development, set induction, presentation of content, communication of content, questioning techniques, and class management) to students' achievement in mathematics

The findings of this study have disclosed that teachers' quality of instruction indices (lesson development, set induction, presentation of content, communication of content, questioning techniques, and class management) had no joint contribution to students' achievement in mathematics. This is not consistent with earlier findings. Kunter *et al*. (2013) found that teachers' lesson development, set induction, presentation of content, communication of content, questioning techniques, and management jointly contributed to students' achievement in mathematics in another subject. In addition, Fehintola, (2014); Bature and Atweh (2020) found that teachers' instructional quality indices in teaching have a composite significant contribution on students' academic performance in social science.

4.3.6a Joint contribution of classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) to students' interest in mathematics

The findings of this study have disclosed that classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) had significant joint contribution to students' interest in mathematics. This finding points to the position of classroom climate indices on teaching and learning progresses. This finding supported that of Ezike, (2018) who found a composite contribution of classroom environment climate (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) to students' interest in Chemistry. This indicates that there is statistically significant relationship between the independent variable and the dependent variable and their composite contribution is significant (Ezike, 2018). In the light of the present finding, it could be concluded that classroom climate indices of independent variables have a joint contribution on students' interest to mathematics and these should be proactively taken care of during learning-teaching processes.

Based on the students' responses, teachers allowed them to express their opinions in the class, teacher moves around the classroom to talk with students which help them to be actively involved in the learning process and this will contribute vale to the society, personal, and economic productivity. This implies that teachers don't dominate any class discussion and the teachers give them opportunity to pursue their particular interest in mathematics class which help them (students) to have good success in their academic performance.

4.3.6b Joint contribution of classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) to students' achievement in mathematics

The findings of this study have revealed that classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) had no joint contribution to students' achievement in mathematics. This finding contrast that of Matsayi *et al*. (2021) who found a significant composite contribution classroom climate (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) to students' achievement in another subject. The finding did not also agree with that of Ekpo *et al*. (2009), that there is jointly significant contribution of classroom climate indices to students' achievement in Social Studies. This implies that, all the classroom climate indices may or may not contribute to the students' achievement to mathematics despite the fact that they are vital in the teaching and learning processes. This indicate that teachers need to continue to encourage each student who is having trouble with the subject, be friendly and teachers should have time to listen to students in the class which would help teachers to create and sustain better classroom climate.

4.3.7a Relative contribution of teachers' professional competences components (content and pedagogical knowledge) to students' interest in mathematics

It was discovered in this study that teachers' content and pedagogical knowledge made significant relative contribution to students' interest in mathematics. Teachers' content and pedagogical knowledge are predictors of students' interest in mathematics with teachers' content knowledge of the subject matter taking the lead followed by teachers' pedagogical knowledge. This is consistent with the findings of Anigbo and Idigo (2016) who found a relative influence between teachers' content and pedagogical knowledge and students' interest. The findings also corroborated that of Peiris, *et al*. (2022) who found a relative significant contribution of teachers' professional competence component to students' interest in English Language. This reveals that the interest of the students is very crucial in the teaching and learning process in the mathematics classroom with regards to teachers' content and pedagogical knowledge.

In addition, Shulman and Shulman (2004) express the teachers' content knowledge as the expert understanding of the subject knowledge base. While, teacher pedagogical knowledge involves all the intellectual knowledge necessary to create an active learning and teaching environment (Marzano and Toth, 2013; Bello *et al*., 2022). However, McConnell, *et al*. (2009) opine that teachers' content knowledge of the subject matter and pedagogical knowledge enhance students interest in a subject and this contributed better value to students skill, ability and knowledge that they acquire in the classroom while studying mathematics which they bring into the workplace later in life and this is a concept for value creation within the organizational setting. This implies that, teacher needs to be knowledgeable about the subject's matter and pedagogical. Therefore, the success or failure in the process of teaching a particular concept lies in the knowledge of subject matter and pedagogical knowledge method adopted by the teacher and ability to guide the students to understand meaningfully the content of the knowledge.

4.3.7b Relative contribution of teachers' professional competence components (content and pedagogical knowledge) to students' achievement in mathematics

Teachers' pedagogical knowledge according to the findings of this study made significant positive relative contribution to students' achievement in mathematics while teachers' content knowledge did not predict students' achievement in mathematics. This finding is in accord with Kunter *et al*. (2013) who discovered that teachers' pedagogical knowledge was linked to better learning support for students. Also, the finding is in line with that of Peiris *et al*. (2022), who indicated that teachers' pedagogical knowledge competence component was relatively contributed to students' achievement in English Language.

However, the finding is not in agreement with that of Fehintola, (2014); Olasehinde-Williams *et al*. (2018), who found out a relative contribution of teachers' content knowledge to students' achievement in the subject while teachers' pedagogical knowledge did not contribute significantly to the prediction. The study concluded that teachers' content knowledge is the most potent contributor to academic performance of secondary school students. This shows that when a teacher communicates clearly and focuses on specifics, not just right and wrong in mathematics class, students would be engaged in the teaching-learning process and this would improve students' performance in the subject. It is also indicating that when teacher breaks the task down when students are struggling in the class, and draw their attention to an idea in order to mark its importance, student would determine to concentrate in the class and this would also help them in achieving a good success in mathematics.

4.3.8a Relative contribution of teachers' quality of instruction indices (lesson development, set induction, presentation of content, communication of content, questioning techniques, and classroom management) to students' interest in mathematics

Analyses of the relative contribution of teachers' quality of instruction indices (lesson development, set induction, presentation of content, communication of content, questioning techniques, and classroom management) to students' interest in mathematics revealed that, the whole factors (lesson development, set induction, presentation of content, communication of content, questioning techniques, and classroom management) were not significant to the prediction of students' interest in mathematics. This means that, lesson development, set induction, presentation of content, communication of content, questioning techniques, and management had no relative significant contribution to students' interest in mathematics.

This indicate that if teacher gives quality instruction, the student may or may not have interest in the subject and when a teacher announces a new topic in the subject, students may or may not feel excited. This means that teacher need to put more effort to encourage and monitor students' participation, allow wait-time to boost low-performance students to answer questions, and this will help in stimulating students' interest in the class which will inspire student to express their ideas.

4.3.8b Relative contribution of teachers' quality of instruction indices (lesson development, set induction, presentation of content, communication of content, questioning techniques, and classroom management) to students' achievement in mathematics

It was discovered in this study that set induction made significant relative contribution to students' achievement in mathematics while lesson development, presentation of content, communication of content, questioning techniques, and class management are not predictors of students' achievement in mathematics. However, they are essential factors. This finding supports that of Pinger, *et al*. (2018), who found that there are no statistically relative significant effects between the teachers' lesson development, presentation of content, communication of content, questioning techniques, and class management and students' achievement.

However, this result of the study is not in consonant with the findings of Gichuru and Ongus, (2016) who found a relative contribution between the teachers' communication of content skills and students' performance in mathematics. The finding is also in contrast with that of Fehintola, (2014), who found a significant positive relative contribution between teachers' quality of instruction and students' performance. Based on the observation carried out in the study, it was observed that most teachers start lesson on time, start from known to unknown and also communicate the focus of the lesson. With all this set induction to improve the students' academic achievement, mathematics teachers also need to encourage students to express their ideas, evaluate lesson adequately, relate subject content to real-life situation and present content step by step. The ability of teacher to effectively engage the student in a learning procedure and be able to relay relevant knowledge is measured by the instructional quality of the teacher which on the way round improves students' achievement. Also, Bouzid, (2020), asserted that secondary school students' performance in mathematics is influenced by teachers' quality of instruction.

4.3.9a Relative contribution of classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) to students' interest in mathematics

Personalisation, students' cohesiveness, satisfaction, task orientation and innovation according to the finding of this study made significant positive relative contributions to students' interest in mathematics while involvement and individualisation did not significantly predict students' interest in mathematics. Personalisation, students' cohesiveness, satisfaction, task orientation and innovation are predictors of students' interest to mathematics with satisfaction taking the lead followed by task orientation and personalisation, followed by innovation and then students' cohesiveness, while involvement and individualisation are not predictors of students' interest to mathematics though they are also important factors. This finding corroborated the findings of Ezike, (2018), who found that personalisation, students' cohesiveness, satisfaction, task orientation and innovation) had a relative contribution which was statistically significant in senior secondary school Chemistry.

However, according to Kampylis and Berki (2014), innovation is defined as the thinking that enables students to apply their imagination to generating ideas, questions and to evaluating their own and their peers' ideas, final products and processes. This shows that when a mathematics teacher shows a good knowledge and control over nearly all the classroom climate indices measured in this present study, students would actively participate in the teaching and learning process and this would improve students' interest to mathematics. Based on the students' response, their mathematics class was always interesting and they enjoy going to mathematics class. Also, their teachers use new and different ways of teaching once in a while and new activities for students in the class.

4.3.9b Relative contribution of classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) to students' achievement in mathematics

Analyses of the relative contribution of classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) revealed that, the whole factors (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) had no significant prediction to students' achievement in mathematics. This means that, though personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation are important factors, they had no relative significant contribution to students' achievement in the subject. This finding disagreed with that of Ezike, (2018), who found that classroom climate (personalisation, students' cohesiveness, satisfaction, task orientation and innovation) had a relative significant contribution to academic achievement in Chemistry.

Personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation are not predictors of students' achievement in mathematics. This implies that classroom climate may or may not affect the students' achievement in the subject. Classroom climate indices are major determiner of classroom behaviour and learning. Teacher needs to understand how to establish and maintain a good classroom climate as a basic in improving students' achievement in mathematics. For teacher to promote a better classroom climate learning environment, this requires careful attention by the teachers in order to foster classroom teaching and learning and enable teachers to be effective with students in the classroom.

4.4 Summary of Findings

The summary of findings are as follows:

1. Teacher content knowledge have negative significant relationships with students' interest in mathematics while teachers' pedagogical knowledge has non-significant relationship with students' interest in the subject.
2. Teacher content knowledge have positive significant relationships with students' interest in mathematics while teachers' pedagogical knowledge has negative significant relationship with students' achievement in the subject.
3. All the teachers' quality of instruction indices (lesson development, set induction, content presentation, content communication, questioning techniques, and class management) did not have significant relationship with students' interest in mathematics.
4. One (set induction) out of the six quality of instruction indices have negative significant relationships with students' achievement in mathematics while lesson development, content presentation, content communication, questioning techniques, and class management did not have significant relationship with students' achievement in mathematics.
5. All the classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) have positive significant relationship with students' interest in mathematics.
6. One (student' satisfaction) out of the seven classroom climate indices has positive significant relationships with students' achievement in mathematics while personalisation, involvement, students' cohesiveness, task orientation, innovation, and individualisation did not have significant relationship with students' achievement in mathematics.
7. There was a significant joint contribution of the two teachers' professional competence components (content and pedagogical knowledge) to the prediction of students' interest in mathematics.
8. There was a significant joint contribution of the two teachers' professional competence components (content and pedagogical knowledge) to the prediction of students' achievement in mathematics.
9. There was no significant joint contribution of the teachers' quality of instruction indices (lesson development, set induction, content presentation, content

communication, questioning techniques, and class management) to the prediction of students' interest in mathematics.

10. There was no significant joint contribution of the teachers' quality of instruction indices (lesson development, set induction, content presentation, content communication, questioning techniques, and class management) to the prediction of students' achievement in mathematics.
11. There was a significant joint contribution of the seven classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) to the prediction of students' interest in mathematics.
12. There was no significant joint contribution of the classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) to the prediction of students' achievement in mathematics.
13. All the teachers' professional competence components (content and pedagogical knowledge) have significant relative contribution to the prediction of students' interest in mathematics.
14. Teachers' pedagogical knowledge out of the two teachers' professional competence component has significant positive relative contribution to the prediction of students' achievement in mathematics.
15. There was no significant relative contribution of the teachers' quality of instruction indices (lesson development, set induction, content presentation, content communication, questioning techniques, and class management) to the prediction of students' interest in mathematics.
16. One (set induction) out of the six teachers' quality of instruction indices has relative significant contribution to the prediction of students' achievement in mathematics.
17. Five (personalisation, students' cohesiveness, satisfaction, task orientation and innovation) out of the seven classroom climate indices have significant relative contributions to the prediction of students' interest in mathematics.
18. There was no significant relative contribution of the classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) to the prediction of students' achievement in mathematics.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This section presents the summary of the study, conclusion and recommendations based on the results of the findings.

5.1 Summary of the Study

The study examined teachers' professional competence component (content and pedagogical knowledge), quality of instruction indices (lesson development, set induction, content presentation, content communication, questioning techniques, and class management), and classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) as predictors of secondary school students' interest and achievement in mathematics in Ibadan, Oyo State, Nigeria. The study was delimited to senior secondary school II students and their mathematics teachers in twenty schools (20) in Ibadan metropolis, Oyo State. The study answered nine research questions and decision were based on 0.05 level of significance. The study adopted correlational research design. The variables in the study include: the independent variables; teachers' professional competence, quality of instruction and classroom climate, while the dependent variables are students' interest and achievement in mathematics.

The participants in this study included all public secondary school II students in Ibadan, as well as their mathematics teachers selected from twenty secondary schools. The sample was drawn from public secondary schools in the four Oyo state post primary teaching service commission zones in Ibadan. One local government area was chosen from each zone using a simple random sampling technique, making a total of four local government areas. Five public secondary schools were randomly selected from each of the selected local government areas. In each of the selected schools, sixty (60) SS II students were randomly selected from science, art and commercial classes (i.e. 20 students from each group). The mathematics teachers teaching the selected students in each school participated in the study. Six research instruments were used in this study. Data collection procedure lasted for eight weeks. Data collected were analysed using Pearson Product Moment Correlation (PPMC) and multiple regression analysis.

5.2 Conclusion

The study investigated the influence of teachers' professional competence components, quality of instruction indices, and classroom climate indices on secondary school students' interest and achievement in mathematics in Ibadan, Oyo State, Nigeria. Based on the findings in the study, it could be concluded that teachers' professional competences (content and pedagogical knowledge) and some classroom climate indices (such as personalisation, students' cohesiveness, satisfaction, task orientation and innovation) influenced secondary school students' interest in mathematics, while pedagogical knowledge of the teachers' professional competences component and set induction of teachers' quality of instruction improved their achievement in mathematics in Ibadan. Mathematics teachers ought to pay attention on these factors (content and pedagogical knowledge, personalisation, students' cohesiveness, satisfaction, task orientation, innovation and set induction) to improve students' interest and achievement in mathematics. . Students' interest in and success in mathematics would be hampered if teachers lacked the necessary understanding and application of these factors.

5.3 Recommendations

Based on the findings from the study, the following recommendations are made:

1. To teach all students according to today's standard and improve their performances, mathematics teachers need to have good mastery of their content knowledge so they can help students, relate one idea to another and address misconceptions.
2. To ensure student success in the subject, mathematics teachers should have the knowledge of the various pedagogical knowledge and be able to use them to teach students so as to impart knowledge.
3. Teachers, particularly mathematics teachers, need to improve on their content and pedagogical knowledge. There is need to bring up-to-date the two components so as to be current in relevant information.
4. To gain students' attention, interest and prepare them into a state of readiness, mathematics teachers need to improve their set induction during teaching process.
5. In order to increase students' interest in and proficiency in mathematics, mathematics teachers should encourage students to express their ideas, use

entire class time to teach effectively, stimulate students' interest and relate subject content to real-life situation.

6. The teachers need to speak in a way that the students understand, communicate subject content in precise and clear terms, and monitor students' participation so that it will influence students' interest in mathematics.
7. To enhance teachers' quality of instruction in teaching, teachers should take time to plan and carefully prepare their lessons before going to the classroom in order to be able to handle successfully any problems that may arise during the path of the lesson.
8. Mathematics teachers needs to pay more attention to the classroom climate indices such as students' personalisation, cohesiveness and satisfaction, task orientation, innovation so that there will be a good relationship between the teacher and student.
9. In the effort to strengthen teaching-learning processes among mathematics teachers in Ibadan, the impact of teachers' professional competence on students' interest and achievement needs to be strengthened and given proper consideration.
10. Educational administrators should formulate means to recognise and tackle weaknesses in teachers' content and pedagogical know particularly mathematics teacher.
11. Educational officers should make provision for mathematics teachers to update their content and pedagogical knowledge through seminars, conferences, workshops and in-service trainings.
12. Teachers' content and pedagogical knowledge should be clearly included on the plan of educational officers and policy-makers during training and re-training of mathematics teachers.
13. There should be a periodic assessment of teachers' content knowledge of subject and pedagogical knowledge by the relevant authorities (educational agenceies and policy makers). This will force teachers to deliberately seek and acquire relevant current knowledge and skills in their areas of specialisation.

5.4 Educational Implications of the Study

The issue of inconsistent student learning outcomes in mathematics may not be resolved by just improving teaching methods and techniques; rather, teachers' professional competence component (content and pedagogical knowledge), set induction and some classroom climate variables (personalisation, students' cohesiveness, satisfaction, task orientation, and innovation) should also be taken into consideration to enhance students' interest and achievement in the subject.

Teachers of mathematics should equips themselves with professional competence, good set induction, and a better classroom climate learning environment in order to influence students' interest in and success in mathematics. This would significantly increase the effectiveness of whatever instructional strategies they use to teach mathematics.

The results of this investigation have demonstrated the extent to which the teachers' professional competence components (content and pedagogical knowledge), teachers' quality of instruction indices (lesson development, set induction, presentation of content, communication of content, questioning techniques, and class management) and classroom climate indices (personalisation, involvement, students' cohesiveness, satisfaction, task orientation, innovation, and individualisation) influenced students' interest and achievement in mathematics.

This finding has implications for future mathematics educators, educational psychologists, curriculum designers, policy makers, researchers, as well as organizations that oversee professionals in the field and the government. In order to significantly affect students' interest in and accomplishment in mathematics, these bodies should work hard to incorporate stronger professional competency components into their impacts through training and re-training of mathematics.

The findings of this study highlight the necessity for mathematics teachers to have subject-matter expertise and pedagogical knowledge abilities suitable for the responsibilities ahead. A positive attitude is necessary to control and acclimate oneself to the content knowledge and pedagogical knowledge abilities required to teach well, as well as being prepared to change and adapt to any changing circumstance in the classroom. Additionally, when creating programme requirements, teacher training programmes must consider the instructor's subject-matter expertise and pedagogical understanding. This is because these factors may help to increase or decrease students' achievement in and interest in mathematics.

To increase students' success in the subject, mathematics educators need to figure out how to trace these variables. The possibility of mathematics learning is in jeopardy if mathematics teachers lack the competence and confidence in their subject-matter knowledge and pedagogical abilities necessary to develop quality of instruction skills that translate into effective mathematics teachers. For this reason, educational supervisory bodies need to pay more attention to increasing and developing teachers' quality of instruction skills that are associated with better teaching of the subject. It is necessary to increase awareness and comprehension of the many relationships among variables that can predict students' academic interest in and success in mathematics learning.

Teachers of mathematics must be mindful of how their pedagogical skills and subject-matter expertise are displayed throughout teaching-learning activities. Teachers of mathematics should be trained to act in these situations with good enthusiasm for the subject's content and pedagogical implementation, as doing so would improve students' mathematical competencies and a teacher lacking in these would greatly harm the subject's teaching and learning. Therefore, it is essential that educational supervisory authorities consider both the subject matter and pedagogical competence in the teaching of the mathematics when employing mathematics teachers.

At secondary school level, this ought to be the norm. This suggests that before they are given the tasks to teach, mathematics teachers should be proficient in the subject's content and pedagogically prepared; having sufficient acceptable knowledge of these variables. To provide students with more tools and to increase their achievement in mathematics as well as their interest in learning the subject, it is crucial that mathematics teachers have access to essential teacher preparation programmes, in-service training, and sufficient professional development opportunities. To satisfy the needs of each student, subject-content knowledge and pedagogical considerations must be taken into account. Mathematics educators can be proactive in establishing a better fit for each student by accepting knowledge of the subject matter and pedagogical profiles.

A qualified teacher with experience in providing good set induction should be in charge of the students starting in secondary school in order to guarantee high academic achievement and interest. If these things were done, they would significantly improve students' enthusiasm in learning; boost their academic achievement, and lower examination misconduct in national public exams like NECO and WASSC.

5.5 Contributions of the Study to the Body of Knowledge

The research has made the following contributions to the body of knowledge:

1. The study has established that teachers’ content knowledge of subject matter and classroom climate psychological learning environment influenced students' levels of interest in mathematics.
2. The study has established that teachers’ pedagogical knowledge influenced students' achievement in mathematics.
3. It was also established that classroom climate influenced students' achievement in mathematics.
4. The study has affirmed that pedagogical knowledge contributed to students’ achievement in mathematics.
5. The study has found that personalisation, students' cohesiveness, satisfaction, task orientation and innovation contributed to students’ interest in Mathematics.
6. The study has affirmed that set induction influenced students’ achievement in mathematics.
7. The study has made a significant contribution to knowledge by providing empirical data for later researchers in the fields of mathematics education and other closely connected to sciences.

5.6 Suggestion for Further Studies

Additional research was suggested in the following areas:

1. Since this study was conducted in one of the country's states within a geopolitical zone, it should be repeated in more states inside additional geopolitical zones.
2. Other variables that were not taken into account in this investigation, such as school location and circumstances, teacher gender, year of experience, and qualifications, could also be included in the study.
3. The study might be repeated in other fields of science.
4. This study might be repeated with additional participants and more public secondary schools.
5. Finally, in the study carried out to enhance students' learning outcomes in mathematics, the independent factors of this study may be used as moderators.

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APPENDICES

APPENDIX I

UNIVERSITY OF IBADAN, IBADAN

FACULTY OF EDUCATION

DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION

Teacher Content Knowledge Test (TCKT)

Instruction: Answer all questions **Time:** 30 minutes

1. (a) Solve $\frac{2(1-5x)}{3}$ - $\frac{4(1-3x)}{7}$ = 12

   (b) y α $\frac{x}{z}$, y = 24, when x = 16 and z = 3

   i. find the relationship between x, y and z

   ii. find x when y = 36 and z = 9

2. (a) Solve the simultaneous equation

   3x + 2y = 5

   4x – 5y = 22

   (b) Simplify $\sqrt{2} + \frac{2}{\sqrt{2}} - \frac{3}{\sqrt{8}}$

3. (a) The following shows the distribution of test scores in a class.

Score	1	2	3	4	5	7	8	9	10
No	1	1	5	3	K^2+1	6	2	3	4

   If the mean score of the class is 6, find the:

   (i) Value of K

   (ii) Median score

   (b) The probability that Yinka, Pelumi and Dami will pass an examination are: $\frac{2}{3}$, $\frac{5}{8}$, and $\frac{3}{4}$, respectively. Find the probability that (a) the three (b) none of them (c) Yinka and Pelumi only will pass the examination

4. (a) Simplify $\frac{1}{2}\log_{10} 25 - 2\log_{10} 3 + \log_{10} 18$

   (b) The 1^{st} and 54^{th} terms of an arithmetic progression are 7 and 166 respectively. Find the common difference of the A.P.

5. (a) Find the equation of a straight line whose gradient is $\frac{1}{4}$ and passes through the point (2,-6).

   (b) Calculate the length of an arc which subtends an angle 90˚at the centre of a circle of radius 14cm. Take π = $\frac{22}{7}$

APPENDIX II
Marking Guide for Teacher Content Knowledge Test (TCKT)

1. (a) $\frac{2(1-5x)}{3} - \frac{4(1-3x)}{7} = 12$

Multiply through by the LC.M of 21

$21 \text{ x } \frac{2(1-5x)}{3} - 21 \text{ x } \frac{4(1-3x)}{7} = 21 \text{ x } 12$

7 x 2(1-5x) – 3x4(1-3x) = 21 x 12

14(1-5x) – 12(1-3x) = 252

14 – 70x – 12 + 36x = 252

36x – 70x = 252 + 12 – 14

-34x = 250

$x = \frac{-250}{34}$

$x = -7\frac{12}{34}$ or $-7\frac{6}{17}$

(b) (i) $y \; \alpha \; \frac{x}{z}$; $y = \frac{kx}{z}$; $24 = \frac{k X 16}{3}$

16k = 3 x 24 ; 16k = 72

$k = \frac{72}{16}$; k = 4.5

(ii) $y = \frac{4.5x}{z}$; $36 = \frac{4.5x}{9}$

Cross multiply

$\frac{4.5x}{4.5} = \frac{36 X 9}{4.5}$

$x = \frac{36X9}{4.5} = 72$

2. (a) 3x + 2y = 5 ----------(i)

4x – 5y = 22 --------- (ii)

Multiply equation (i) by 5 and equation (ii) by 2

5(3x + 2y = 5) = 15x + 10y = 25 -------(iii)

2(4x – 5y = 22) = 8x – 10y = 44 ------- (iv)

Add equation (iii) and (iv)

15x + 8x + 10y – 10y = 25 + 44

23x = 69

$x = \frac{69}{23}$

x = 3

Substitute for x into equation (ii)

3x + 2y = 5

3(3) + 2y = 5

9 + 2y = 5

2y = 5 – 9

$\frac{2y}{2} = \frac{-4}{2}$

y = -2

(b) $\sqrt{2} + \frac{2}{\sqrt{2}} - \frac{3}{\sqrt{8}}$; $\sqrt{2} + \frac{2}{\sqrt{2}} - \frac{3}{\sqrt{4X2}}$

$\sqrt{2} + \frac{2}{\sqrt{2}} - \frac{3}{2\sqrt{2}}$; $\frac{4+4-3}{2\sqrt{2}} = \frac{5}{2\sqrt{2}}$

$\frac{5}{2\sqrt{2}} \text{ x } \frac{\sqrt{2}}{\sqrt{2}} = \frac{10\sqrt{2}}{4 X 2} = \frac{5\sqrt{2}}{4}$

3.

X	F	F(x)
1	1	1
2	1	2
3	5	15
4	3	12
5	$K^2 + 1$	$5(K^2 + 1)$
7	6	42
8	2	16
9	3	27
10	4	40
Total:	$25 + K^2 + 1$	$155 + 5(K^2 +1)$

(i) Mean = $\frac{\sum fx}{\sum f}$; $6 = \frac{155 + 5(K^2 + 1)}{25 + K^2 + 1}$; $6 = \frac{155 + 5K^2 + 5}{26 + K^2}$

$6 = \frac{160 + 5K^2}{26 + K^2}$ Cross multiply

$6(26 + K^2) = 160 + 5K^2$

$156 + 6K^2 = 160 + 5K^2$

$6K^2 - 5K^2 = 160 – 156$

$K^2 = 4$

$K = \sqrt{4}$; $K = 2$

(ii) Median = 5

(b) Pr (Yinka will pass) = $\frac{2}{3}$; Pr (Yinka will not pass) =1 - $\frac{2}{3}$ = $\frac{1}{3}$

Pr (Pelumi will pass) = $\frac{5}{8}$; Pr (Pelumi will not pass) = 1 - $\frac{5}{8} = \frac{3}{8}$

Pr (Damilola will pass) = $\frac{3}{4}$; Pr (Damilola will not pass) = 1 - $\frac{3}{4} = \frac{1}{4}$

(i) Pr (the three will pass) = Pr ($Y \cap P \cap D$) = $\frac{2}{3} \times \frac{5}{8} \times \frac{3}{4} = \frac{5}{20}$

(ii) Pr (none will pass) = Pr ($Y^c \cap P^c \cap D^c$) = $\frac{1}{3} \times \frac{3}{8} \times \frac{1}{4} = \frac{1}{32}$

(iii) Pr (Yinka and Pelumi will pass) + Pr (Damilola will not pass)

Pr ($Y \cap P$) + Pr (D^c)

$= \frac{2}{3} \times \frac{5}{8} + \frac{1}{4}$

$\frac{5}{12} + \frac{1}{4} = \frac{8}{12} = \frac{2}{3}$

4. (a) $\frac{1}{2}\log_{10} 25 - 2\log_{10} 3 + \log_{10} 18$

$\frac{1}{2}\log_{10} 5^2 - 2\log_{10} 3 + \log_{10} 2 \times 3^2$

$\frac{1}{2} \times 2 \log_{10} 5 - 2\log_{10} 3 + \log_{10} 2 + \log_{10} 3^2$

$\log_{10} 5 - 2\log_{10} 3 + \log_{10} 2 + 2\log_{10} 3$

$\log_{10} 5 + \log_{10} 2 + 2\log_{10} 3 - 2\log_{10} 3$

$\log_{10} 5 + \log_{10} 2$

$\log 5 \times 2 = \log 10 = 1$

(b) $T_n = a + (n-1)d$

$T_{54} = 7 + (54-1)d = 166$

$7 + 53d = 166$

$53d = 166 – 7$

$53d = 159$

$d = \frac{159}{53}$, $d = 3$, the common difference of the A.P is 3

5. (a) Gradient = $\frac{1}{4}$, x = 2, y = 6

$\gamma - \gamma_1 = m(x – x_1)$

$\gamma – (-6) = \frac{1}{4}(x-2)$

$\gamma + 6 = \frac{1}{4}(x-2)$

$4(\gamma + 6) = (x-2)$

$4\gamma + 24 = x - 2$

$4\gamma + 24 + 2 = x$

$4\gamma + 26 = x$

$x - 4\gamma - 26 = 0$

(b) length of an arc

$\frac{\theta}{360} \times 2\pi r$

$\frac{90}{360} \times 2 \times \frac{22}{7} \times 14$

= 22cm

APPENDIX III
UNIVERSITY OF IBADAN, IBADAN
FACULTY OF EDUCATION
DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION
Teacher Pedagogical Knowledge Observation Scale (TPKOS)

SECTION A

Location: Ibadan zone 1☐ Ibadan zone 2 ☐ Ibadan zone 3 ☐ Ibadan zone 4☐
School code: ………………… …………………………………..

SECTION B

Instruction: To be rated according to degree of occurrence:
1= Poor, 2= Fair, 3= Good, 4= Very Good, 5= Excellent

S/N	**Pedagogical knowledge: Mathematics teacher:**	1	2	3	**4**	**5**
1	Communicates clearly what students did correctly.					
2	Focuses on specifics, not just right and wrong in mathematics class					
3	Draws students' attention to an idea in order to mark its importance					
4	Breaks the task down when students are struggling in mathematics class					
5	Reminds students of a rule to use in mathematics class.					
6	Allows time for students to process and doesn't immediately give the answer.					
7	Allows students time to engage in tasks during mathematics class					
8	Moves on when most students have mastered task in mathematics class.					
9	Reviews ideas previously learned					
10	Turns responsibility back to students for thinking through and figuring out ideas.					

APPENDIX IV

UNIVERSITY OF IBADAN, IBADAN

FACULTY OF EDUCATION

DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION

Teacher Quality of Instruction Observation Scale (TQIOS)

Section C:

Location: Ibadan zone 1☐ Ibadan zone 2 ☐ Ibadan zone 3 ☐ Ibadan zone 4☐

Teacher Qualification: NCE☐ HND☐ B.Ed./B.Sc.☐ M.Ed./M.Sc☐ Ph.D.☐

Teaching Experience: 1-5 years ☐ 6-10 years ☐ 11 years and Above ☐

School code: …………………………………………..

Topic: ………………………………..

Time Started: ……………………… Time Stopped: ……………………………

Date of observation: ……………………… Term: 1st☐ 2nd☐ 3rd ☐

Section D: Teachers' Quality of Instruction Observation Scale (TQIOS)
(To be rated according to degree of occurrence)

S/N	Behaviour	Rating				
A	**Lesson Development**	1	2	3	4	5
1	Lesson is based on the lesson note					
2	Extent of use of lecture method					
3	Uses a variety of teaching methods different from lecture					
4	Gives specific feedback					
5	Provides alternative activities to support individual differences					
6	Encourages students to express their ideas					
7	Treats every student with respect					
8	Evaluates lesson adequately					
9	Provides summary of lesson					
10	Uses entire class time to effectively teach					
11	Grade's assignments in good time					
B	**Set induction**					
12	Lesson starts on time					
13	Starts lesson from known to unknown					
14	Communicate the focus of the lesson					
15	Stimulates learners' interest					
C	**Presentation of Content**					
16	Demonstration of knowledge of content					
17	Relates subject content to real-life situation					
18	Exhibits a keen interest in the subject matter					
D	**Communication of content**					
19	Speaks fluent English					
20	Speaks in a way that the students understand					
21	Communicates subject content in precise and clear terms					
22	Presents content step by step manner					
23	Signals important points in the lesson					
E	**Questioning Techniques**					
25	Frequency of use of questions					
26	Frequency of use of recall questions					
27	Frequency of use of Higher level questions					
28	Quantity of evaluation questions are adequate					
F	**Class Management**					
29	Praise's student's performance					
30	Provides cues to stimulate correct response					
31	Monitor's student's participation					
32	Criticises students' utterances that make students feel bad					
33	Allow wait-time to encourage low-performance students to answer questions					

34	Encourages student's participation					

Signature: ……………………… Date: ………………………

APPENDIX V
Classroom Climate Inventory (CCI)

Dear Students,

This is not an examination or academic test. Hence feel relaxed in answering these questions. Your answers will be kept confidential. Therefore, be HONEST and FREE in giving your answers. You are kindly requested to participate by giving your best opinion and would be used for research purpose only. ***Please respond to all the items.***

Thank you.

SECTION A: Demographic information

1. School code: ……..
2. Gender: Male ( ) Female ( )

SECTIN B: Mathematics Classroom Climate Inventory (MCCI)

Please choose the option that is most appropriate with a tick.

In order to better understand what you think and feel about your mathematics teacher, please respond to each of the following statements with a tick (√) on a scale of 4= Strongly Agree, 3= Agree, 2= Disagree and 1= Strongly disagree.

S/N	ITEM	RESPONCES			
		4	3	2	1
Personalisation: My mathematics teacher:					
1	Considers students' feelings.				
2	Talks individually with students.				
3	Is unfriendly and uncaring toward students.				
4	Helps each student who is having trouble with the work.				
5	Moves around the classroom to talk with students.				
Involvement:					
1	My mathematics teacher talks rather than listens.				
2	Students express their opinions in mathematics class.				
3	My mathematics teacher dominates class discussions.				
4	Students in mathematics class pay attention to what others are saying.				
5	Students present their mathematics work to the class.				
Student Cohesiveness					
1	My mathematics class is made up of individuals who don't know each other well.				
2	I do not have interest to know other students in mathematics class				
3	I love other students in mathematics class.				
4	I don't have chance to know other students in mathematics class.				
5	I know all students in mathematics class				
Satisfaction					
1	Mathematics class is interesting.				
2	I am not satisfied with what is done in math class.				
3	I enjoy going to math class.				
4	Mathematics class is a waste of time.				
5	Mathematics classes are boring.				
Task Orientation					
1	I know exactly what has to be done in mathematics class.				
2	My mathematics class starts on time.				
3	My group in mathematics class gets distracted instead of sticking to the point.				
4	Mathematics class always disorganized.				
5	Mathematics assignments are clear and I know what to do.				
Innovation					
1	New ideas are occasionally tried out in mathematics class				
2	New and different ways of teaching are once in a while used in mathematics class.				

3	My mathematics teacher used new activities for students in mathematics class.				
4	Students do the same type of activities every class.				
5	My mathematics teacher often thinks of unusual class activities.				
Individualisation					
1	All students in mathematics class are expected to do the same example, in the same way and same time.				
2	Teaching methods allow me to proceed at my own pace.				
3	There is opportunity for me to pursue my particular interest in mathematics class.				
4	My mathematics teacher decides what will be done in our mathematics class.				
5	My mathematics teacher allowed me to choose activities and how I will work it out.				

APENDIX VI

Students' Interest in Mathematics Questionnaire (SIMQ)

SECTION C:

Instructions: Every statement has two options; you are to decide carefully whether: Strongly agree = 4, agree =3, disagree =2 and strongly disagree =1.

S/N	ITEMS	4	3	2	1
1	Mathematics is interesting				
2	I like mathematics				
3	Mathematics is fun				
4	Mathematics is boring				
5	I want to learn more about mathematics				
6	I hate mathematics				
7	Learning about mathematics is important				
8	Learning about mathematics is helpful				
9	Learning about mathematics is a waste of time				
10	Mathematics is hard for me				
11	I feel excited when a new mathematics topic is announced				
12	I answer lots of questions in my mathematics class				
13	I get distracted easily during mathematics class				

APPENDIX VII
Mathematics Achievement Test

Instruction: Answer all questions **Time:** 25 mins.

Each question has four letters A – D choose the right option and write the letter down.

1. Simplify 2 ½ + $1^1/_3$ of $1\ ^5/_6 - {^1/_3}$

A. 5 ¾ B. $4\ ^1/_2$ C. $3\ ^3/_2$ D. 2 ¾

2. If 3 times a certain number is subtracted from twice the square of the number, the result is 5. What are the possible values of the number?

A. -5,-1 B. -1,2 ½ C. -1,-2 ½ D. 5,-1

3. If $27^x = 9^y$, find the value of x /y

A. $^1/_3$ B. $^2/_3$ C. 3 D. $1\ ^1/_2$

4. If log 2 = 0.301, what is log 64?

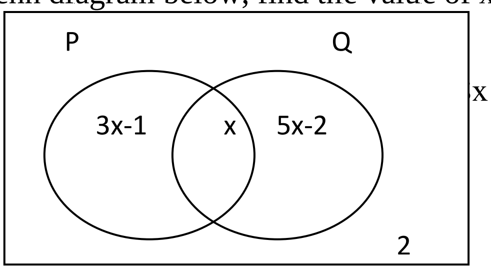
A. 1.506 B. 1.606 C. 1.706 D. 1.806

5. The data below shows the scores of a set of students in a mathematics test. If x is the mode and y is the median find (x, y)

Marks	4	5	6	7	8
Frequency	9	9	8	6	2

A. (6,5) B. (5,6) C. (8,9) D. (5,5)

6. From the Venn diagram below, find the value of x



A. 1 B. 2 C. 3 D. 4

7. The probability that Dokun, Yinka, and Wasiu fail a test are ¼, $^1/_5$, and $^1/_6$, respectively. Find the probability that all the boys pass the test

A. $^1/_3$ B. $^1/_6$ C. ½ D. $^7/_{30}$

8. Find the 7^{th} term of the geometric progression 4,12,36 . . .

A. 2916 B. 1458 C. 729 D. 365

9. If $\log_9 x = 1.5$, find x

A. 36 B. 13.5 C. 24.5 D. 27

10. Simplify $125^{-2/3}$ X 15

A. $^1/_{25}$ B. $^3/_5$ C. $^1/_5$ D. $^3/_{25}$

11. Factorize $(25y^2 - 4)$

A. $(2y - 5)(5y + 2)$ B. $(5y - 2)(5y + 2)$ C. $(5y - 2)(5y - 2)$ D. $(5y - 2)(2 + 5y)$

12. Construct a quadratic equation whose roots are $-\frac{1}{2}$ and $2\frac{1}{2}$

A. $4x^2 + 8x - 5 = 0$ B. $4x^2 - 8x - 5 = 0$ C. $4x^2 - 8x + 5 = 0$ D. $4x^2 - 8x = 0$

13. If $4^m = \frac{1}{64}$, find the value of $2m^2$

A. 16 B. 32 C. – 18 D. 18

14. Evaluate $\log_{10} 45 + \log_{10} 9^{-1} - \log_{10} 2^{-1}$ without using table.

A. 1 B. 2 C. 10 D. 5

15. If $\log_2 16 = 4x - 1$, what is the value of x?

A. $\frac{4}{5}$ B. $\frac{5}{4}$ C. $\frac{4}{3}$ D. $\frac{3}{4}$

16. Calculate the variance of the following set of numbers below: 5, 11, 13, 14, 17

A. 8.0 B. 16.0 C. 10.3 D. 7.3

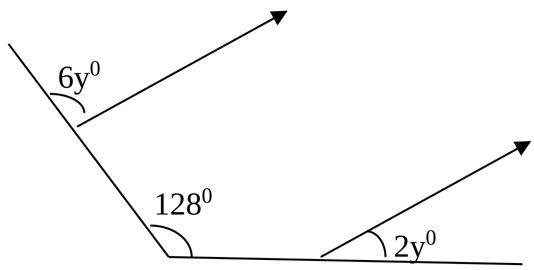
17. If P = {Prime factors of 210} and Q = {Prime numbers less than 10}, find $P \cap Q$

A. {2,3,5} B. {2,3,5,7} C. {1,2,3} D. {1,3,5,7}

18. A basket contains 50 eggs, 15 of them are bad. If an egg is taken out, find the probability that it is good.

A. $\frac{17}{20}$ B. $\frac{1}{10}$ C. $\frac{7}{10}$ D. $\frac{10}{7}$

19. Find y in the figure below:



A. 16^0 B. 32^0 C. 96^0 D. 21^0

20. The bearing of a point A from a point B is 042^0. Calculate the bearing of B from A

A. 138^0 B. 222^0 C. 228^0 D. 48

APPENDIX VIII
Mathematics Achievement Test (MAT)
Answer sheet

Name of School: …………………………………………………………….

Instructions: Kindly tick the correct option from letters A - D.

s/n	A	B	C	D
1				
2				
3				
4				
5				

s/n	A	B	C	D
6				
7				
8				
9				
10				

s/n	A	B	C	D
11				
12				
13				
14				
15				

s/n	A	B	C	D
16				
17				
18				
19				
20				

APPENDIX XI
Key to Mathematics Achievement Test (MAT)

1. B	11. B
2. B	12. B
3. B	13. D
4. D	14. A
5. B	15. B
6. A	16. B
7. C	17. B
8. A	18. C
9. D	19. A
10. A	20. B