



TEACHER CHARACTERISTICS AND STUDENTS' PERFORMANCE IN MATHEMATICS

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ABSTRACT: *While many researchers have investigated the causative factors of students' poor academic performance, the extent to which teachers' individual characteristics affect students' performance in mathematics, to the best knowledge of the researcher, has received little academic attention. This necessitated the study. The study adopted a convergent parallel mixed methods design involving three hundred and seventy-two (372) respondents who were sampled through Simple Random Sampling and purposive sampling techniques. Questionnaires and interview guides were used to collect primary data and this was complemented by an extensive literature review. The analysis of the collected data revealed that teachers' qualifications, teachers' choice of methodology, teachers' mastery of content, teachers' punctuality to class and teachers' relationship with students affect students' performance in mathematics in Sagnarigu Municipality. It was recommended among other things, that the stakeholders in education should ensure that only teachers who are qualified to teach mathematics are assigned to do so in all Senior High Schools within the Sagnarigu Municipality.*

KEYWORDS: *Performance, Mathematics, Teachers, Students*



INTRODUCTION

Many countries around the world attach great importance to education because it is vital to the transformation of humanity and its societies. Witte (2022) argues that education is the cornerstone of civilisation, where young people are trained to take on various responsibilities and work together to stabilise the society in which we live. While formal education has changed considerably in the West, it is still evolving in many parts of the global South, particularly in sub-Saharan Africa (Shikalepo & Hautemo, 2021). For many education stakeholders in Africa, retooling education to meet the needs of the industry remains a daunting task. Many education systems in Africa still promote rote learning without attempting to induce critical thinking and innovative ideas in students (Cieslik et al., 2021). Such systems accustom students to rote memorisation to the extent that they tend to avoid subjects like mathematics that require them to think independently.

Many scholars share in the argument of Adler and Alshwaikh (2019) that Mathematics is the foundation of modern scientific and technological development and an important means of communication that is persuasive, concise and clear (Adetunde, 2009; Akyeampong, 2017; Ali, 2021; Arthur, 2019; Arthur et al., 2014). Mensah (2017) further explains that Mathematics as a discipline is fundamental to science and technology and its functional role in science and technology is multifaceted, as such, no field of science, technology or business in the world can be separated from its application. Fletcher (2018) finds that the history of Mathematics has influenced cultures and continues to influence cultures to this time. Almost everyone uses some form of Mathematics in their daily lives. This suggests that learning Mathematics is not something to be taken for granted. Ali (2021) argues that the main purpose of teaching Mathematics is to develop students' ability to solve a range of complex mathematical problems through the application of Mathematics to real-life situations.

In Ghana, the Mathematics curriculum encourages the use of Mathematics in everyday life by identifying and applying appropriate strategies to solve mathematical problems (Mensah, 2017). Akyeampong (2017) finds that many Mathematics education programmes in Ghana emphasise the development of problem-solving skills and competencies that enable students to function both in and out of school. Thus, the Mathematics curriculum in Ghana requires students to learn how to relate their knowledge to practical situations, build critical thinking skills, make strategies, spawn ideas and imaginative solutions and decipher everyday scientific problems (Adetunde, 2009; Adler & Alshwaikh, 2019; Akyeampong, 2017).

However, Senior High School students in the Sagnarigu Municipality continue to deteriorate in their achievement in Mathematics as shown by the reports of their performance in WASSCE (SMED Report, 2013-2020). Casinillo et al. (2020) find that most students believed that good performance in Mathematics is mainly due to skill rather than effort. Prior to this study, Bosson-Amedenu (2018) also investigated the causes of poor student performance in Mathematics in Ghana and found that teacher effectiveness, home environment, school environment and staff strength were high predictors of student success in Mathematics, but the association between students' perceptions of Mathematics and student performance in Mathematics was low. In addition, Butakor and Dziwornu (2018) found that student and teacher involvement was statistically significant in forecasting the Mathematics achievement of Senior High School students in The Greater Accra Region. Fletcher (2018) also found a statistically significant association between students' background and their Mathematics achievement. Marbán and Mulenga (2019) further found that many students see poor



performance in Mathematics as a situation which they have little control over. Bosson-Amedenu (2018) also finds that students' attitudes towards Mathematics significantly determine their Mathematics achievement. Erath et al. (2021) discussed 'meta-belief system activity' based on a learning experiment and found that students' belief systems about Mathematics were strong predictors of learning outcomes.

Although these researchers have examined the impact of school physical resources, teacher qualifications and students' perception on students' achievement in Mathematics, they failed to examine the extent to which teacher characteristics such as professional experience, mastery of content, academic qualification, choice of methodology, teacher's punctuality in class and personal relationship with students affect students' performance in Mathematics. While few studies investigated the effects of teacher qualities on students' academic performance, (Bhagat et al., 2019; Khalilzadeh & Khodi, 2021; Kim et al., 2019), such studies were not specifically focused on performance in mathematics and, methodologically, they adopted a qualitative approach. This paper examined the extent to which teacher characteristics predict the mathematics achievement of Senior High School students in the Sagnarigu Municipality using a mixed methods approach. The study raises a number of questions: What is the effect of teachers' qualifications on the performance of students in mathematics in the Sagnarigu Municipality? What is the effect of teachers' choice of methodology on students' performance in mathematics in the Sagnarigu Municipality? How does the level of content mastery by mathematics teachers affect the performance of students in mathematics in the Sagnarigu Municipality? How does the teacher-student relationship affect students' performance in mathematics in the Sagnarigu Municipal? How does teachers' punctuality in class affect the academic performance of students in mathematics in the Sagnarigu Municipality? Answers to these questions will inform policy formulation in addressing teacher-related factors of poor students' performance in mathematics.

STATEMENT OF THE PROBLEM

Despite the idea that teachers are not the primary source of knowledge in the classroom, teachers' traits and actions are largely used to evaluate students' academic success. The teaching profession is going through a transformation. Therefore, experienced teachers who are willing to collaborate and share ideas are those who have been in the teaching profession for a long time. Conversely, newly trained teachers were less likely to adopt new ideas outside of what they had learned in college. Student's academic progress is seen to be correlated with teachers' actions, traits, and behaviour both within and outside the classroom. The poor performance of students in recent times is attributed to the traits and characteristics of teachers in the classroom. The study, therefore, seeks to examine teachers' characteristics as one of the contributing factors to students' poor academic performance in mathematics.

OBJECTIVES

The objective of the study was to:

- a. research the impact of instructors' qualifications on Sagnarigu Municipality students' mathematics performance.
- b. ascertain the impact of teachers' choice of methodology on Sagnarigu Municipality students' mathematics performance.



- c. determine the extent to which mathematics teachers' content knowledge affects their students' mathematics performance in the Sagnarigu Municipality.
- d. research how relationships between teachers and students in the Sagnarigu Municipality affect students' mathematics performance.
- e. research the impact of teachers' punctuality in class on students' mathematics performance in Sagnarigu Municipality.

LITERATURE/THEORETICAL UNDERPINNING

The Self-Determination Theory (SDT) indicates that social, cultural and biological conditions can either enhance or undermine human capacities for cognitive and psycho-social growth and development (Reeve, 2002). Deci and Ryan (2012) argue that SDT is particularly important in the academic setting because students perform differently just as humans flourish uniquely in other contexts. Vallerand et al. (2008) advance the argument further when they explain that the promising potentials of students are diminished in uncongenial social settings. SDT emphasises what humans really need from their social environment to be fully functional and competent. The SDT theory as applied to this study would mean that the potential of students in passing Mathematics could be enhanced by a congenial school environment which does not only have the needed facilities but is staffed with teachers who are academically and professionally competent and socially supportive. These will provide the academic, psychological and social needs of students and enhance their cognitive and psycho-social growth and development which would in turn improve educational outcomes

Ryan and Patrick (2009) insist that social and psychological needs are universally essential for optimal human functionality regardless of age, gender, cultural or social context. Reeve (2002) identifies the environment as being either autonomy-supportive or controlling competence-supportive or challenging, and integrative or ejective. Deci and Ryan (2012) associate themselves with Reeve's categorisation of the social environment and further explain that an autonomy-supportive environment provides choices and encouragement for individual self-actualisation, a competence-supportive environment provides structures and positive feedback for the actualisation of an individual's potential and a relatedness supportive environment is integrative, devoid of conflict and full of love, care and closeness from peers, subordinates and superiors.

Apart from the supportive relationship students may need from teachers, Peeters et al. (2018) insist that a teacher's qualification is also a very important determinant of students' performance in the classroom. Ambussaidi and Yang (2019) observed that among fifth-year teachers, more experienced teachers worked in classrooms with less emotional climate. Smith et al., (2016) also observed that experienced teachers had different ways of making students understand difficult topics in mathematics than inexperienced teachers. They further observed that teacher academic qualification was less significant in instructional quality than teacher experience. Klassen and Chiu (2010) also found that students whose teachers were friendly and related well with their students showed more interest in studying mathematics than those whose teachers were reported to be cold and less approachable.



Akinsolu (2010) found that novices were less effective in preparing lessons and had difficulty responding to students' questions and ideas. In a study of four experts and two novice teachers, Gage et al. (2017) find that experienced teachers were more likely to take their time and prepare their lesson plans while paying attention to more details while newly recruited teachers hurriedly prepare lesson notes and poorly executed their lesson plans in the classroom. Harris and Sass (2011) also find that teachers who are ready to work together and share ideas are those who have spent many years in the field of teaching and are ready to share and learn from their colleagues but those who just came from training were less likely to take new ideas other than those they learnt from college. They concluded that students who are taught by such teachers are less likely to perform well compared to those taught by teachers who are cooperative and ready to learn from their colleagues. This means that teacher experience affects instructional quality. Killion (2015) demonstrated that the length of years spent in school by teachers did not predict teachers' effectiveness in mathematics teaching but experience on the job was found to be significant in students' achievement in Mathematics. While these researchers established the link between teachers' levels of experience and students' performance in general, they did not investigate how teachers' levels of experience affect students uniquely in the subject of mathematics.

Newman (2019) also identified teachers' qualifications as one of the teacher-related factors that affect students' academic performance. A systematic analysis of twelve studies related to teacher qualification and student achievement in mathematics by Ambussaidi and Yang (2019) also demonstrated that teachers who had high academic qualifications had their students consistently scoring higher in standardised tests and examinations. They concluded that there is a strong association between teachers' academic qualifications and students' academic performance. Another study by Kim and Seo (2018) revealed mixed findings. They found a strong association between teaching quality and teachers' academic qualification among first-year teachers but found no such association in the second and third-year classes. They explained that such variation in the relationship between classroom quality and teacher experience was due to the tendency of first-year students to be more engaged in their academics than continuing students. Klassen and Chiu (2010) in their study also found that only between 4% and 6% of the variance in teaching quality was explained by teachers' academic certificates. One reason for these low estimates may be that few studies have closely aligned teacher mastery of content with teachers' years in school. Such alignment between Mathematics content courses and the effectiveness of lesson delivery may lead to stronger relationships between teacher academic qualification and students' achievement in Mathematics.

In a study by Marbán and Mulenga (2019) involving three hundred (300) high schools in Nigeria, teachers' professional qualification in Mathematics was statistically significant in explaining the quality of Mathematics lessons that were taught as there were adequate explanations where students ask questions and no teacher errors during lessons. In another study involving primary school teachers, Miller et al. (2017) found a close association between teachers' level of professional qualification and the level of comprehension of students during mathematics lessons. Ronfeldt et al. (2018) further observed that a teacher's professional qualification was significant in arousing students' interest in Mathematics. Schachman, Rochelle, Hertel, and Knudsen (2010), however, made contradictory findings when they observed that teachers' professional qualification was significant in predicting students' attitudes towards Mathematics but less so in predicting their actual rate of achievement in Mathematics. While the authors admitted that their study was based on self-reported data, they



also suggested that the effects of teacher professional qualification on students' performance in Mathematics may not be linear as found by many studies.

These findings generally suggest that teachers' professional qualifications are impactful on students' academic performance, although the mechanisms by which teacher qualification explains educational outcomes may be complex and require further research. These studies also did not pay particular attention to how teachers' qualification affects students in mathematics. They also failed to consider other characteristics of teachers such as content mastery and the quality of their relationship with their students as predictors of students' academic performance. These, therefore, made this study even more necessary and relevant

METHODOLOGY

A research philosophy depicts the ontological convictions of a researcher (Guha Thakurta & Chetty, 2015). There are varied views of researchers about the world. These have given rise to varied research philosophies such as realism, idealism, positivism, social constructivism, pragmatism and postmodernism (Birks, 2014). Realism is the belief that the world is outside there and can be subjected to scientific study. Idealism believes the world is made up of ideas and what we see as reality are reflections of ideas which have been translated into realities that we can study. So, for them, the study of physical realities does not provide complete insight into the nature of things. Positivism argues that the world is objective, measurable and quantifiable and that the reality of the world is independent of the knowledge of the individual (Cazeaux, 2017). Social Constructivism on the other hand argues that the reality of the world is subjective and dependent on the knower. Knowledge is constructed by individuals within a specific context based on their experiences. Pragmatism is the synthesis of both positivism and social constructivism (Saunders & Townsend, 2018). They believe that reality is both subjective and objective, constructed and measurable, dependent and independent of the knowledge of the individual. What matters is that knowledge should address the problems of society. Post-modernism on its part believes that nothing is certain; thus, reality moderates and complicates, so there is no certainty. Research can only measure reality only at the time the research was conducted but this cannot be generalised and fixated because reality keeps changing (Lee & Saunders, 2017; Saunders & Townsend, 2018; Saunders & Bradbury, 2006).

For this study, the pragmatist philosophy was adopted because the researcher believes that knowledge is measurable, objective, and independent of the knowledge of the individual, and it is also constructed by individuals during social interactions. At some points, knowledge is objective and measurable, and at other points, knowledge is better understood within a particular context. Whether students perform well in mathematics or not is objective, measurable and better understood within a particular social context. That the content mastery of the teacher affects students' performance in mathematics or not is objective, measurable and is better understood within a specific social context. The impact of students' and teachers' characteristics on students' performance in mathematics is equally objective and measurable but the concepts of performance may vary across societies depending on what value is placed on mathematics and education as a whole and this leans itself to the social constructivist analyses. To better measure the phenomenon of students' performance in mathematics, a pragmatist philosophy was deemed fit as a philosophical framework for this study. For this study, informed by the pragmatist research philosophy, the mixed methods approach was



adopted because the researcher intends to measure the characteristics of the teacher that affect students' performance in mathematics using both the quantitative and qualitative approaches.

The Study Area

Sagnarigu Municipality is located in the Northern Region of Ghana. It is bordered by Savelugu Municipal to the North, Tamale Metropolis to the south, Tolon district to the west and Kumbungu district to the East. The Municipality has a land area of approximately 114.29 square kilometres and is located between latitudes 9.4687° north and longitudes -0.8654° west and has an elevation of 189m (G.S.S, 2021). The Ghana Statistical Service (GSS, 2021) reports that the population of Sagnarigu Municipality is approximately 342000 and of this 50.6% are males and 49.4% are females. There are 23,447 households in the Municipality, with an average household size of 6 persons (G.S.S, 2021).

The Municipality was chosen because it has the highest number of Senior High Schools in the region. The Municipality is the cradle of education in the region as it has four government-aided high schools namely; Tamale Senior High School, Northern Business Senior High School, Islamic Senior High School and Kalpohin Senior High School, as well as a polytechnic and two colleges of education. The Municipality also has the Tamale School of Hygiene, the Community Health Nursing School and the Graduate School of the University for Development Studies. There are other private educational institutions in the Municipality. The Regional Education Office is also located in the district.

The dominant religions in the Municipality are the Abrahamic religions- Islam and Christianity- which have strict rules on relations between men and women, urging women to submit to their husbands at all costs (Glas & Spierings, 2019). The culture and the Islamic religion permit polygamous marriages, so 75% of married men in the municipality have more than one wife (G.S.S, 2021). Sagnarigu Municipal is dominated by the Dagomba ethnic group, which, like many other cultures in the north, has a patrilineal inheritance system whereby only men can inherit the property of their deceased parents (Chigbu, 2019).

Research Approach and Sampling Technique

The study was conducted using a mixed-method approach so that it could make use of any research tool or technique as needed and as it applied without being constrained by one particular methodology. This study made use of the convergent parallel mixed method design. This methodology was chosen because it allowed the researcher to gather both qualitative and quantitative data almost simultaneously, analyse them, and combine them when interpreting the findings. Cross-validating the data was made possible by this method. There were no notable discrepancies between the outcomes of the quantitative and qualitative data. The quantitative data were collected via a questionnaire. This offered the study more statistical power and enabled the researcher to collect data from a broader group of students and teachers. To collect the qualitative data, key informant interviews with management employees were done. This made it possible to get thorough data regarding the effects of teacher traits on students' mathematical performance.

The four public senior high schools in the Sagnarigu Municipality; Tamale Senior High School (TAMASCO), Northern School of Business (NOBISCO), Tamale Islamic Senior High School (TISEC), and Kalpohin Senior High School (KALISCO), were the focus of the study. Because they are important to school stakeholders and have pertinent knowledge about students' math



performance as well as the physical and social resources that are available within the schools for teaching and learning, the students and academic staff (teachers and management staff) were chosen as the target population. Their experiences would have given them in-depth knowledge of the instructors' qualities, such as the teachers' qualifications, punctuality in class, content mastery, teaching methodology, and the teacher-student relationship. Three thousand, four hundred and ninety-five (3,495) students and one hundred fifty (150) academic staff members attend TAMASCO. There are three thousand, three hundred and twenty-seven (3,327) students enrolled at NOBISCO, with one hundred and twenty-one (121) academic staff members. Two thousand, nine hundred and fifty-six (2,956) students attend TISEC, and there are one hundred and twenty (120) academic staff members. Two thousand, five hundred and ninety-three (2,593) students attend KALISCO, and there are one hundred and eighteen (118) academic staff members. The head teacher, assistant head teachers for academics, administration, and domestic duties, senior housemaster, and senior house mistress make up the six (6) management staff members for each of the four (4) schools. Table 1 displays the distribution of the target population.

Table 1: Distribution of target population

School Name	Student Population			Academic Staff Population		
	Male	Female	Total	Male	Female	Total
TAMASCO	2,428	1,067	3,495	105	45	150
NOBISCO	2,370	957	3,327	77	44	121
TISEC	1,831	1,125	2,956	74	46	120
KALISCO	1,531	1,062	2,593	70	48	118
TOTAL	8,160	4,211	12,371	326	183	509

Source: Field Data, 2021

Four thousand, two hundred and eleven (4,211) female students and eight thousand, one hundred and sixty (8,160) male students are represented in all four schools, according to Table 1. Twelve thousand, three hundred and seventy-one (12,371) students attend all four schools. Three hundred and twenty-six (326) male academic staff members make up the total in all four institutions, compared to one hundred and eighty-three (183) female academic staff members. The academic staff population, therefore, stands at five hundred and nine (509) for all four schools.

The target population for the study is made up of the twelve thousand, eight hundred and eighty (12,880) students and academic staff that were enrolled in the study as a whole. Three hundred and seventy-two (372) respondents were chosen for the study using Cochran's technique for determining sample size. The Nominal Rolls of each school were used to create a list of all students for the selection of the sample. All students were included in the final sample at a 90% representation rate because they made up more than ninety per cent (90%) of the target population. Therefore, three hundred and thirty (330) students were ultimately chosen at random from the created lists using Microsoft Excel.



All the mathematics teachers and academic management staff members who had backgrounds in mathematics in the various schools under consideration were purposively targeted for the study since they are directly involved in the day-to-day teaching and learning of mathematics in all four schools. TAMASCO, NOBISCO, TISEC and KALISCO have a mathematics teacher population of twenty-two (22), nineteen (19), eighteen (18) and sixteen (16) respectively. This gives a total of seventy-five (75) mathematics teachers in all four schools. Each school has six (6) academic management staff namely; the headmaster/mistress, an assistant headmaster in charge of academic affairs, an assistant headmaster in charge of administration, an assistant headmaster in charge of domestic affairs, the senior housemaster and the senior house mistress. This gives a total of twenty-four (24) academic management staff.

Thirty (30) mathematics teachers; nine (9) from TAMASCO, eight (8) from NOBISCO, seven (7) from TISEC and six (6) from KALISCO were selected. Twelve (12) key management staff members, who had backgrounds in mathematics were also selected to participate in the study. This gives a total sample size of three hundred and seventy-two (372) participants. Table 2 provides an overview of the sample used for the investigation.

Table 2: Distribution of sampled population

School Name	Student Population			Math Teacher Population			Management Staff		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
TAMASCO	65	28	93	7	2	9	2	1	3
NOBISCO	63	26	89	6	2	8	2	1	3
TISEC	49	30	79	5	2	7	2	1	3
KALISCO	41	28	69	4	2	6	2	1	3
TOTAL	218	112	330	22	8	30	8	4	12

Source: Field Data, 2021

DATA INSTRUMENTS

Questionnaire and Interviews were used to collect data for the study. The questionnaire was used to gather quantitative data from respondents where they were required to show their levels of agreement or disagreement with statements provided on a five-point Likert scale. There were two sets of questionnaires. There was a questionnaire for students and one for academic staff. Sections A of the questionnaire for both students and academic staff gathered data on the demographic characteristics of the respondents such as age, gender, years of stay in the school, and level. Items in this section were adapted from Sengul, Zhang, and Leroux (2019) and Plana et al., (2018). Sections B and C of the questionnaire for both students and academic staff respectively gathered data on teacher characteristics such as punctuality in class, content mastery, teaching methodology, teacher qualifications, student–teacher relationships and academic performance of students in mathematics including students’ math test results from the preceding two semesters, the researcher’s math test results, and overall school success in WASSCE over time. The contents for these sections were adapted from Schukajlow et al., (2018). Sections B and C of the questionnaire for students and academic staff responses were scored on a Five-Point Likert scale, with Strongly Disagree receiving a score of 1, Disagree receiving a score of 2, Can’t Say receiving a score of 3, Agree receiving a score of 4, and



Strongly Agree receiving a score of 5. According to Creswell (2014), a researcher can code and transform the data into numerical values for simple analysis using the Statistical Package for Social Sciences (SPSS version 20). The Cronbach Alpha reliability measure was used to check the reliability of the items from the scores of a pilot test. This gives an alpha level of 0.86 and 0.82 for the students and staff questionnaire respectively.

A semi-structured interview was self-constructed to gather data from the sampled key management staff members. Creswell (2014), defined an interview schedule as a process in which a respondent provides an answer to a question asked by a researcher to record. The interview data in this study was drawn from key management staff members, who had backgrounds in mathematics to complement the quantitative data. This implies that the interview schedule was used to collect qualitative data (Interviews) which assisted the researcher to explain results from the quantitative data (Questionnaire).

The interview schedule for key management staff had two sections, section A and Section B. Section A captured information on the variables of the study with respect to the research objectives. Section B elicited responses on demographic data of respondents such as gender, position in the school, number of years as a teacher, number of years in the current position, educational level, and professional and academic qualifications. Each of the interviews lasted between 30-60 minutes.

Validity and Reliability

The research tools were made available to other researchers for peer evaluation in order to ensure the study's dependability, credibility, and reliability. The final development of the instruments took the reviewers' comments into consideration. The eligibility of the questionnaire items for analysis was further determined by running a reliability statistic on them. According to Creswell (2014), questions in a survey are regarded as appropriate for analysis if the Cronbach Alpha value in a reliability statistic is not less than 0.5. This means that elements with a Cronbach Alpha value of less than 0.5 do not accurately measure a construct, hence those items would need to be eliminated in order to raise the Cronbach Alpha number. The results of the reliability statistics for this investigation are displayed in Table 3.

Table 3: Reliability Statistics

Construct	Number of Test Items	Number of Items Retained	Scale of Cronbach Alpha
Teachers' Qualification	10	7	0.94
Teachers' Methodology	10	6	0.89
Teachers' Mastery of Content	11	8	0.92
Teachers' Punctuality in Class	9	7	0.98
Teachers' Relationship with students	11	6	0.96

Source: Field Data, 2021

As shown in table 3, the test items whose removal would have raised the Cronbach Alpha scale for the latent constructs were eliminated. To determine the Cronbach Alpha scale, only tests that accurately evaluated the latent construct were used. Ten elements made up the construct "Teachers' Qualification," however only seven were employed in the analysis because the other



three had scales that impacted the Cronbach Alpha's score. Ten test items were included in the construct "Teachers' Methodology," but only six of them were used. Only eight of the eleven test items for "Teachers' Mastery of Content" were kept following the reliability investigation. Nine components made up the construct of "Teachers' Punctuality in Class," of which seven were kept following reliability calculations, and eleven test items made up the construct of "Teachers-Students Relationship," of which only six were kept. The Cronbach Alpha scale for each construct was more than 0.8, indicating that the test items accurately captured the objectives of each construct.

Data Collection Procedures

Students, Math teachers, and administrative staff from TAMASCO, NOBISCO, TISEC, and KALISCO provided the primary data for this study. The necessity of respecting the location of research sites and obtaining permission before visiting them cannot be overstated (Creswell, 2009). Prior to giving out the questionnaire, the researcher interacted with the respondents to build a connection with them, explain the goals of the study, and explain why getting their input was crucial to the success of the study. Before giving them the questionnaire, the researcher also requested their informed consent and provided them with assurances regarding the confidentiality of any information they would be sharing. The researcher carefully vetted and trained the research assistants who assisted in the data collection process, to ensure that high-quality data was obtained. The researcher chose and trained at least eight (8) research assistants who conducted the data collection in the four schools while the researcher engaged the management staff for the key informant interviews. The researcher and his assistants visited each school at designated times after the distribution of the questionnaire to collect those that were completed and to remind those respondents who had not yet done so of the importance of completing their questionnaire in order to ensure a maximum response rate. A week was devoted to training research assistants and visiting the schools to secure authorisation from the Headmaster/Mistress of the Schools for the conduct of the research. The complete data-gathering process took two weeks. Each school received two research assistants. For 10 days, research assistants were required to distribute and collect at least five questionnaires each day while the researcher conducted at least two (2) Key Informant Interviews each day. Before leaving the field, two days were devoted to finding and fixing any missing responses. The researcher issued letters of thanks to the schools and any other stakeholders who assisted in some manner with the data collection after the exercise.



RESULTS/FINDINGS

The quantitative data was analysed using descriptive statistics. SPSS was used to compile and input the respondents' replies. This was utilised to ascertain response frequencies and percentages in a table, as seen in table 4.

Table 4: Respondents Reported Effects of Teacher Characteristics on Students' Performance in Mathematics

Characteristic of Teachers	Students Responses	Teachers Responses	Total	Percentages
Teachers' Qualification	69	12	81	21.7
Teachers' Methodology	66	9	75	20.2
Teachers' Mastery of Content	70	7	77	20.7
Teachers' Punctuality in Class	61	3	64	17.2
Teachers' Relationship with students	64	11	75	20.2
Total	328	42	372	100

Source: Field Data, 2022

Selecting the teacher quality that has the greatest impact on student academic success was the task given to the respondents. According to table 4, sixty-nine (69) students and 12 mathematics teachers, or 21.7% of the total respondents, said that teachers' qualification was the factor that had the greatest impact on students' mathematics achievement. The most important quality of a teacher that influences students' arithmetic achievement, according to 70 students and 7 mathematics teachers, or 20.7% of all respondents, is "Teachers' Mastery of Content." 66 students and 9 mathematics teachers, or 20.2% of the total respondents, said that "Teachers' Methodology" was the most important teacher-related aspect that affected students' arithmetic performance. 20.2% of the total respondents—sixty-four (64) mathematics students and eleven (11) mathematics teachers—identified "Teachers' Relationship with Students" as the most important factor in predicting students' arithmetic achievement. Sixty-one (61) students and three (3) mathematics teachers, or 17.2% of the total respondents, said that teachers' punctuality in class was the teacher-related aspect that had the greatest impact on students' arithmetic achievement.

Thematic analysis was used to examine the qualitative information obtained from interviews about how teachers' traits affect children's mathematics achievement. The researcher repeatedly reviewed the transcripts of the data to become comfortable with the material. By underlining, colouring, and creating shorthand labels to explain the contents of text passages, the researcher coded the transcribed data. By using these codes, the researcher was able to quickly summarise the key ideas and recurring meanings in the data. Then, by mixing the codes, themes were created by finding patterns in the resulting codes. Reviewing and mapping these themes against the complete data set was done. A few of the themes were divided into subthemes, and others were blended to provide the themes with more depth and use. The concepts were then given names before being ultimately interpreted. Table 5 displays this information.



Table 5: Qualitative Analysis for Impact of Teacher Characteristics on Students' Performance in Mathematics

Codes	Basic Themes	Organising Theme
<ul style="list-style-type: none"> ● Competent ● Incompetent ● Qualified ● Highly qualified ● Confidence ● First degree ● Diploma ● Master's degree ● Training college ● University ● Distance ● Regular 	<ul style="list-style-type: none"> ● Students develop interest in mathematics when they considered the teacher highly qualified ● Students pay more attention when they feel the teacher is qualified to help them learn ● The competence level of mathematics teachers affects the interest level of students in the subject 	Teachers' qualification influences students' interest and subsequent performance in mathematics
<ul style="list-style-type: none"> ● Friendly ● Available ● Approachable ● Embarrassment ● Confidentiality ● Empathetic ● Good listener ● Less punishment 	<ul style="list-style-type: none"> ● Students will better confide in mathematics teachers about their learning problems when he is friendly to them ● Student love teachers who show concern for their needs ● Students will not participate in class of the teacher who continually embarrass them 	The way a teacher relates to students affect their interest in mathematics and as such affect their performance as well
<ul style="list-style-type: none"> ● Inexperience ● Cannot manage class ● Cannot control students ● Use of teaching and learning resources ● Demonstrations ● Students' engagement ● Students' participation ● Student-centred ● Interactive 	<ul style="list-style-type: none"> ● Students learn better when they are involved in the classroom ● Students understand better when the mathematics teacher dedicate time to explaining concepts and methods ● Students learn better when the mathematics teacher is able to control the class ● Students develop more interest in mathematics when the teacher uses appropriate teaching and learning materials 	The style of teaching affects students' interest in mathematics and predicts their performance in the subject.



<ul style="list-style-type: none"> ● Familiar with it ● Knows what he or she is doing ● Master of the subject ● Confidence levels ● Ability to break complex problems to smaller ones ● Extremely good 	<ul style="list-style-type: none"> ● Students understand better when teachers demonstrate a good mastery of content of the subject ● Students develop interest when the teacher appears to be good at the subject ● Students understand better when the teacher delivers with self-confidence and much efficacy 	When a teacher masters the content, he or she teaches better and this translates to better performance by students
<ul style="list-style-type: none"> ● Always on time ● Misses no class ● Does not tolerate absenteeism ● Informs the class of absence ● Organised ● Disciplined 	<ul style="list-style-type: none"> ● Students will be punctual if mathematics teachers are punctual ● Students love it when their teacher does not miss class ● Student will be more serious in learning mathematics if the teacher also demonstrates a certain level of seriousness 	Teachers' punctuality to class informs the students about his or her seriousness and this leads to more seriousness on the part of the students and better performance in mathematics exams

Source: Field Data, 2022

According to the findings of both qualitative and quantitative evaluations, teachers' credentials, manner of instruction, content knowledge, timeliness in class, and professional relationships with students all have an impact on students' mathematical performance. In more detail, these are covered in the section that follows.

DISCUSSIONS

Discussions for the various objectives were done after the analysis.

Teachers' Qualification and Students' Performance In Mathematics

The study found that teachers' qualification predicts students' performance in mathematics. This means that when students perceive their mathematics teachers as having the right qualification to teach them, they tend to be more attentive and develop a higher interest in the subject than when they perceive their teachers to be less qualified or unqualified to teach mathematics. One of the key informants corroborated this:

“The teacher plays a significant role in teaching and learning. The perceptions students have about a teacher will affect the manner in which they assimilate his or her message. If the students perceive that the teacher is not qualified, they will form a negative attitude towards him and whatever he teaches may not interest them because of the perception they have about his qualification. This will definitely affect the quality of teaching and learning and subsequently translate into poor performance from the students”



This finding also corroborates with the findings of Boateng et al. (2021) when they investigated the teacher-related factors that affect students' academic performance in Senior High Schools in Ashanti Region and found that teachers' qualification was closely associated with students' academic performance. This finding is also similar to the findings of Kim et al. (2018) who, in a quantitative analysis of the predictive factors of students' performance in mathematics, found a strong correlation between teachers' qualifications and students' performance in elective mathematics. The qualification for a mathematics teacher is, no doubt, very important in the teaching and learning process. The teacher needs both the academic and professional qualifications to comfortably and efficiently teach mathematics to the understanding of all students despite their individual differences in cognitive abilities. Teachers' academic and professional qualification, therefore, has a great impact on the quality of teaching and learning and the quality of teaching and learning determines the level of performance by students. To improve the performance of students in mathematics, therefore, schools must recruit mathematics teachers who have the requisite professional and academic qualifications to teach mathematics. Although Amoah (2020) in a qualitative study, found that teachers who had no professional qualification produced the same or even better outputs than those who were professional teachers in their study of teacher-related factors of students' performance in the Ahafo region. This, however, may not be generalised because they conducted their study in a primary school where the content is less complex as compared to the Senior High School levels.

Teachers' Choice of Methodology and Students' Performance in Mathematics

The study found that the choice of teaching methodology by teachers affects students' performance in mathematics. This means that the level to which the students are involved in the teaching and learning process determines their levels of interest in the subject. Teachers who choose methodologies that are teacher-centred may exclude students' participation in the classroom because they will be spoon-feeding them what they know. The students become passive in the learning process. This makes them lose interest in the subject and this may affect their performance in the subject subsequently. This was corroborated by one of the key informants as this

“Teaching requires a lot of creativity from the teacher. Teaching is more interesting to the learner when it is interactive and participatory. Teachers who do not involve learners in the teaching process will surely record low success”

This finding corroborates the finding of Ankomah (2021) when he employed a qualitative approach using a grounded theory with a systematic design to investigate the impact of teaching methodology and students' academic performance among Senior High School students in Bono East and found that teachers' teaching experience, teachers' qualification and teachers' pedagogical approach explained variations in students' academic performance in the district. Rwelamila (2019) also found that teaching methodology was closely associated with students' academic performance when they investigated the factors that were responsible for the poor performance of Senior High School students in Dare Salam. Teaching methods are very significant in teaching and learning. The complex nature of a classroom means that people have different cognitive abilities and varied backgrounds in mathematics. Teachers need to adopt methodologies that take cognisance of these differences. Newman (2019) points out that there is no single method of teaching that fits all situations. Teachers may, therefore, need to vary their pedagogy to suit their contexts and get every learner involved in the learning process.



Teachers' Mastery of Content And Students' Performance in Mathematics

The study revealed that the level at which a teacher demonstrates his or her mastery of the content in mathematics determines students' performance in the subject. This means that when a teacher teaches comfortably with confidence and efficacy, students become more enthused about mathematics than when teachers do not demonstrate adequate knowledge of mathematics. Teachers who have mastered the contents will prepare their lessons and follow the outline and give convincing deliveries in the classroom to the understanding of every student. When students see that the teacher has the capacity to help them to learn mathematics, they pick interest in it and this translates into higher performance in mathematics. When students, however, develop the perception that a mathematics teacher is not too familiar with the content, they will lose interest in the subject and this translates into poor performance. The response of some of the key informants corroborated this finding. One of the key informants explained this:

“The students see you as a master of your subject, so you as a teacher should be able to demonstrate to them that you are actually good at what you are teaching them. In cases where teachers fail to do this, the students lose interest in the subject and this leads to poor performance”

Hill and Chin (2018) also made similar findings when they investigated the causes of low academic performance among Junior High Students in the Greater Accra region. Teachers need to have adequate knowledge of the subject they teach so that they can transfer such knowledge to their students. A stern demonstration of this mastery would win students' interest, change their perceptions about mathematics and propel them to better performance.

Teacher-Student Relationship and Students' Performance in Mathematics

The study found that the teacher-student relationship affects students' performance in mathematics. This means that the way teachers relate with their students in the classroom and outside the classroom affects students' performance in their subjects. Learning occurs in a social environment. The social environment in a school consists of teachers, administrative staff and students. The teacher has a big social role to play in students' academic engagement. When students feel loved, cared for and valued by their teachers, they are more drawn to the teacher and would be more open to learning since the learning environment will be full of love, less tension and no anxiety. Teacher-student relationship has been found to have a great impact on student academic performance but it is particularly so on mathematics since many students perceive mathematics to be a difficult subject.

Teachers have a great influence on the performance of students. They constitute part of the social environment that students need to function at their best. As explained by the Self-Determination Theory, sometimes the prominent potentials of people are diminished in uncongenial social environments. When teachers make the learning environment uncongenial through their personal characteristics, students' performance in mathematics will surely dwindle but when teachers provide a congenial social environment through their personal characteristics of punctuality, friendliness, good appearances, mastery of content and professionalism, it will surely arouse students' interest in Mathematics and thus, increase their performance in the Subject (Zohair & Mahmoud, 2019). Yang and Li (2018) found that students have preconceived minds towards the teaching and learning of mathematics and so



once a teacher is unable to demonstrate his or her mastery of the content, they become even more entrenched in their mythology of mathematics being difficult. Teaching involves the transfer of knowledge.

Teachers' Punctuality and Students' Academic Performance

The study found that teachers' punctuality in class predicts the level of student performance in mathematics. Punctuality is a mark of discipline and a show of commitment and the level of seriousness a teacher attaches to teaching and learning activities. When a teacher demonstrates such levels of discipline and commitment, the students are compelled by the charisma of the teacher to also attach a certain level of seriousness to the learning of mathematics. This translates into better performance in mathematics by students. Many of the key informants shared this view as well. One of the key informants explained:

“To me commitment is infectious. When a teacher demonstrates high levels of commitment, the students are forced to work hard because they know the teacher will not tolerate any form of laziness since the teacher himself is committed. The level at which the teacher is available, when he comes to class, how he manages the class and the time he takes to complete a planned lesson will signal the level of commitment of the teacher to teaching mathematics. His or her commitment will influence students to show equal commitment. This may translate into higher performances”

This finding corroborates the finding of Ekperi (2018) when they investigated the impact of teacher-related characteristics on students' academic performance in Lagos State-Nigeria. They employed an explanatory sequential mixed method involving 400 students and teachers at different levels in Senior High Schools and found that teachers' characteristics such as professionalism, experience, choice of teaching methods and punctuality to class were closely associated with students' academic performance. Appiah and Agbelevor (2015), however, found no association between teachers' punctuality and students' academic performance when they adopted a quantitative approach with a survey design to investigate the effects of teacher preparedness and discipline on students' academic performance. The variance between their finding and that of this study resides in the fact that their study was conducted among university students who are more capable of independent learning compared to this study which was conducted among Senior High School students who need much on their teachers for guidance and facilitation.

Implication to Research and Practice

While many researchers have investigated the causative factors of students' poor academic performance, the extent to which teachers' individual characteristics affect students' performance in mathematics, to the best knowledge of the researcher, has received little academic attention. This necessitated the study. The study contributed to knowledge by investigating how teacher-specific traits such as teacher's qualification, teacher's methodology, teacher's mastery of content, teacher's punctuality in class and teacher's relationship with students affect students' passion and enthusiasm in learning mathematics.



CONCLUSION

This study established that students' performance in Mathematics is predicted by teachers' characteristics like qualification, choice of teaching methodology, content mastery, punctuality and quality of student-teacher relationship. This becomes manifest when students need their teachers to be friendly, to be able to explain concepts and the relationship between those concepts to the understanding of at least an average student in the classroom. Teachers' qualities remain particularly important for students who have very little background in mathematics. Such categories of students rely wholly on their teachers for guidance and possible direction. If teachers lack the academic qualification to teach mathematics, it means there will be low content to deliver and this could limit students' performance in mathematics. If teachers have the content but lack the techniques to transfer such content to the students, their impact on student performance may be low or none at all. Teachers need to also develop professional skills in relating to students and guiding them to success. The study concludes, therefore, that teacher characteristics predict students' performance in Mathematics.

Policy Recommendation

The study found that teachers' qualification has an influence on students' performance in mathematics. It is, therefore, recommended that the Human Resource Department of the Sagnarigu Education Directorate may post highly qualified mathematics teachers in Senior High Schools so as to improve the levels of students' performance in mathematics in the Municipal.

It was also found that teachers' methodological choice affects students' performance in mathematics. It was, therefore, recommended that the Regional Education Directorate should organise in-service training seminars and workshops for mathematics teachers so as to abreast them with trending teaching methods and techniques in mathematics.

It was further found that the level of mastery of content by teachers affects students' performance in mathematics. It is recommended that the Ghana Education Service may recruit and post only teachers who demonstrate adequate content mastery as reflected in their transcript and during the interviews so that they can comfortably teach mathematics in the senior high schools within the Municipal.

The study also found that the quality of the teacher-student relationship affects students' performance in mathematics. It is, therefore, recommended that the school management of the various Senior High Schools in Sagnarigu Municipal may encourage teachers to build professional relationships with their students so as to improve the quality of teaching and learning that will lead to higher performances in mathematics.

Recommendation for Future Research

While the study was quite comprehensive as it covered numerous teacher factors that predict students' performance in mathematics, there are other characteristics such as the age and experience of the teacher the study did not address and these could be considered for further studies by other researchers. The extent to which the individual characteristics of the students moderate the relationship between teacher characteristics and student performance in mathematics was not considered and this is an interesting area which could be studied. Again, this study was limited to students' performance in Mathematics, studies that consider the



general factors of students' academic performance in Northern Ghana would provide more data and help address issues of students' academic performances in all subjects.

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