

Evaluation of students' performance in elective mathematics: The effect of high school students' perceived difficulty of the subject

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ABSTRACT

Perception has been attributed as a major cause of students' weakness in mathematics. Hence, this study evaluates its effect on student's performance in the area of mathematics as an elective subject in some selected Senior High School (SHS) in Ghana. Mixed method research design that employed questionnaire with closed-ended and open-ended items were used in the collection of the data. Stratified sampling technique was used in selecting 300 students as sample for the study. Descriptive statistics and Multiple regression were used to analyse the quantitative data. Again, thematic analysis was used for the qualitative data. The findings showed that, SHS students perceived elective mathematics as a difficult subject. Nonetheless, they perceived the teacher-learner activities employed by their teachers in elective mathematics classroom as motivating. Further, they perceived as constructive, the teaching methods used by their elective mathematics teachers. In addition, the study revealed that students' performance in elective mathematics was not significantly influenced by their perceived difficulty of elective mathematics, teacher motivation and teaching methods although the students expressed favourable dispositions towards these attributes. Thus, the need for Heads of High Schools, to do background check of students' prior performance, interest and motivation in mathematics as a prerequisite condition for students to pursue elective mathematics is implied in this study. This could stem the tide in the students' abysmal performance in elective mathematics. Implications for policy, practice and further research are discussed.

ARTICLE HISTORY

Received 2024-05-01

Accepted 2024-08-26

KEYWORDS

Perceived difficulty

Perceived teacher motivation

Perceived teaching methods

Elective mathematics

INTRODUCTION

The practical effect of mathematics is felt in all areas of academic endeavours (Asomah et al., 2023a). This is as a result of the problem solving and outcome prediction capacities of mathematics across all academic disciplines of study (Odogwu, 2015). Despite the important role mathematics play in peoples' life and in the development of many economies technologically, it remains one of the subjects and job areas least pursued by students (Asomah et al., 2024). It is therefore, frightening that, mathematics generally, and elective mathematics in particular, which is regarded as one of the key subjects for success in all spheres of

life is not properly accorded the necessary attention it deserves. This lack of prioritization of the teaching and learning of mathematics in Sub-Saharan Africa of which Ghana, a middle-income country which is not in exempt is disquieting (Asomah et al., 2023b). Thus, resulting in students' poor performance in this important discipline especially at the secondary school level (Enu et al., 2015). Interestingly, compared to other subjects, students' performance in mathematics has been abysmal. For the purposes of the conduct of this study, performance is defined as the process by which a student must produce or perform in order to display their knowledge and abilities (Odden et al., 2007). To this end, a test conducted in this study sought to compel students to cognitively leverage their abilities and knowledge to display the correct answer to the mathematics questions posed. The low performance in mathematics has been largely ascribed to how students perceive the subject (Asomah et al., 2018). Several studies affirm perceptions as a constituent in offering an explanation and comprehension of the unpredictability in students' performance in mathematics (Mohamed & Waheed, 2011). Hence, the prioritization of perceptions as an attributable cause of students' poor performance in mathematics as an elective subject especially at the SHS level in the current study. Thus, students' poor performance in mathematics is attributed to their perception of the subject at school. The implications of such views towards the teaching and learning of mathematics have long been a source of apprehension to learners and instructors (Asomah et al., 2023b; Royster, Harris, & Schoeps, 1999). Hence, understanding these factors as an attributable function of one's success in mathematics particularly in an elective subject is crucial for reducing the perceived difficulty students associate with this subject (Asomah et al. 2023a). Nevertheless, literature indicates that, providing support, personalized learning resources, and strategies to enhance self-efficacy can positively influence students' perceptions towards elective mathematics and performance (Pretorius et al. 2016). Further, it could be argued that, Students' perceived difficulty of elective mathematics is subjective and can be influenced by various factors, including prior mathematical background, self-efficacy beliefs, and personal interest in the subject matter (Barasa, 2016). However, in spite of these attributes, students find elective mathematics challenging, while others perceive it as overly difficult and intimidating as evidenced in their performance (West Africa Examination Council [WAEC], 2023). The relationship between the perceived difficulty of a subject and the performance thereof is complex. While some students may be motivated to overcome challenges, others might disengage or develop avoidance behaviours (Afolabi, et al., 2020). In this way, the teaching methods employed in an elective mathematics plays a significant role in shaping students' perceptions (Pretorius et al. 2016). Further, innovative and student-centered approaches that emphasize real-world applications, collaborative learning, and practical problem-solving skills contribute to a positive learning experience. Most importantly, the attribute of motivation is a key factor in an academic achievement. Hence, the anchoring of the current study on these attributes. This is because, perceiving elective mathematics as too difficult diminishes students' intrinsic motivation (Chapelle et al., 2017; Asomah et al. 2022). Moreover, studies indicate that gender and cultural elements may impact individuals' perceptions of mathematical difficulty (Kim, 2022). Further, Koay et al., (2023) asserted in his study that poor performance in mathematics is attributable to teachers' inability to complete the content of the mathematics syllabus, students lack of confidence and interest in their ability to do mathematics. Aside these assertions, the consequent effect of perceptions on student achievement have been worrying in contemporary literature. There have been several studies conducted on the perceptions of students in Ghana and elsewhere in mathematics (e.g., Kumi et al., 2021; Hatsu et al., 2023; Groen et al., 2015), but there are fewer studies that include students' perspectives on mathematics as an elective subject at the SHS level even though the students' perceptions play a critical role in improving their performance (Cofie, 2020; Hagan et al., 2020). The poor performance of Ghanaian students in elective mathematics reflected in how abysmally they performed in the WAEC examinations (WAEC, 2023). Thus, an evaluation of the perceived difficulty in elective mathematics and its effects on performance in senior high schools cannot be an under-statement. To this end, recognizing the intersection of these factors with students' perception

towards a subject is crucial for fostering inclusive learning settings and mitigating potential performance gaps. It is in this regard that, a study purposed to evaluate students' performance based on the effect of their perceived difficulty of the subject cannot be over-emphasized.

The study context

One of the subjects in school curricular that is considered to be of utmost importance on a global scale is mathematics (Suleiman & Hammed, 2019). This is because a nation's socioeconomic progress is greatly influenced by its foundation in science, technology, engineering and mathematics education (Asomah et al., 2024). In consideration of the importance devoted to mathematics, its teaching and learning is compulsory at the basic and secondary education levels in Ghana (NaCCA, 2020). There are two kinds of mathematics programmes taught in the Ghanaian SHS; core mathematics (a common core mathematics curriculum compulsory for all SHS students) and an elective mathematics (an optional course for Art, Visual, Business but compulsory for science related programmes) (NaCCA, 2020; Xin et al., 2020). Thus, in particular, the teaching and learning of elective mathematics is regarded as optional for students in the SHS. However, it is compulsory for students pursuing science students, and an option for the Art and Business students (Ministry of Education [MOE], 2010). While elective mathematics subject offers students the opportunity to explore advanced mathematical concepts, the perceived difficulty associated with this subject poses a significant challenge (Barasa, 2016). In this way, an exploration of factors that contribute to the perceived difficulty of the subject will afford educators an opportunity to tailor their teaching strategies to be more effective and engaging in the learning environments to overcome this challenge (Akinleke, 2017). The perceived difficulty in elective mathematics varies among students based on individual factors such as mathematical background, self-efficacy beliefs, and personal interest (Asomah et al. 2022; Barasa, 2016). Therefore, comprehending these mirages of factors that contribute to perceptions is crucial for implementing effective interventions purposed to enhance the students' learning outcomes in mathematics. An intervention that reduces negative perceptibility and informed with the characterises that position students to understand the subject matter with ease cannot be understated (Asomah et al. 2018). This is because, the impact of perceiving elective mathematics as difficult may increase mathematics anxiety and decrease confidence among students (Griira & Jaeck 2019). Further, the impact of perceived difficulty on students' intrinsic motivation and long-term career aspirations in mathematics-related fields remains an understudied area (Kele A. 2018; Taylan 2018). As such, recognizing the importance of motivation and understanding how it interconnects with the perceived difficulty of elective mathematics is essential for fostering sustained interest and success of students in the learning environment. It is worthy to note that, Kumar, et al. (2020) contended that, lack of interest in mathematics and the perceived difficulty of mathematics by students remain some of the major factors affecting mathematics education in both developed and developing countries of which Ghana is inclusive. Mathematics still remains one of the most perceived difficult subjects in the classroom (Akhter & Akhter, 2018; Gafoor & Kurukkan, 2015). Currently in the Savelugu Municipality in the northern part of Ghana, it is not sufficiently clear the proportion of students who perceive elective mathematics as difficult and the degree to which the perceived difficulty of this subjects positively or negatively impacts SHS students in milieu of the student's underperformance in elective mathematics (Savelugu Municipality Education Office, 2024; WAEC, 2023). To this end, this study sought to evaluate the perceived learning difficulties of Senior High School students and it effect on their performance in in the area of elective mathematics.

Theoretical underpinning of the study

This study draws its theoretical basis from three theories; the expectancy value theory, the attribution theory and the social cognitive theory. The expectancy value theory is a theory of motivation that describes the relationship between a student's expectancy for success at a task or the achievement of a goal in relation

to the value of task completion or goal attainment (Lubrick et al. 2019). It was originally developed to explain gender differences in mathematics engagement and achievement in school children (Adesoji & Idika 2015). Subsequently, it has been used to explain how expectancies and values directly and indirectly influence achievement choices, performance, effort, and persistence across a wide range of academic and physical domains and age groups (Sawah & Kusaka 2023; Ünveren & Karakus 2020). In this study, the expectancy value theory encompasses a broad range of attitudes, including efficacy, affective reactions, values, expectancies of success and perceptions in relation to elective mathematics (Shawa 2020). The theory argues that expectancies for success and subjective task values are reciprocally related to each other and directly related to achievement-related choices and performance. In addition, Attribution theory as employed in this study, deals with the question of how individuals make judgments and seek to explain how they consider the causes of their behaviours and those of others (Weiner, 2004). The theory is concerned with how individuals interpret events and how this relates to their thinking and behaviour. Proponents of this theory assume that people try to determine why people do what they do, that is, attribute causes to an observed behaviour. This theory was critical since it afforded participants of the study the opportunity to attribute and explain their perception in relation to elective mathematics. Since, according to Baştürk (2016), attributions have the potential to affect beliefs, emotions and behaviour. Finally, the last theory used was the social cognitive theory postulated by Bandura (1991). This theory maintains that human behaviour is the product of interactions between personal, cognitive, behavioural, and environmental factors (Asma & Dallel 2020). According to this theory, people's interaction with the environment, behaviour of others, and one's own cognition etc. act as principal factors in influencing the development of their personality and behaviour (Asma & Dallel 2020). The theory focuses on recognizing the social origins of human thoughts and behaviours. Hence, its use in the current study to evaluate the students' disposition towards elective mathematics as a course of study at the SHS level in Ghana.

Conceptual framework

According to Bethlehem (2009), the conceptual framework of a study clarifies the assumptions made by the researchers about the studied phenomenon. As a result, in evaluating the perceived learning difficulties of SHS students and its effect on their performance in elective mathematics, the constructs of Perceived difficulty, Perceived teacher motivation, Perceived teaching methods and mathematics performance have been defined. Consequently, the relationships among these are depicted and outlined in the conceptual framework of the study.

Figure 1 provides the conceptual framework of the study.

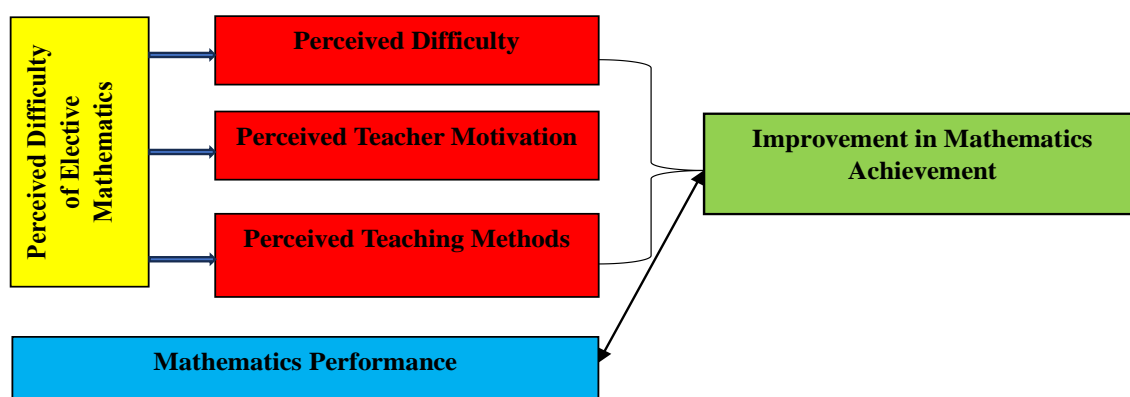


Figure 1. Conceptual Framework (Authors Own Construct, 2024)

In this study, the key constructs include Perceived difficulty, Perceived teacher motivation, Perceived teaching methods (Asare-Inkoom, Gyamerah, & Najimudeen 2008). Thus, independent variables are the

Perceived difficulty, Perceived teacher motivation, Perceived teaching methods and mathematics performance. The dependent variable is the improvement in mathematics achievement. The perceived difficulty of elective mathematics as a conception formed and exhibited by students is influenced by a number of factors of which Perceived difficulty, Perceived teacher motivation, Perceived teaching methods are considered in this study. The experiences students have with regard to elective mathematics relate to the way the subject was taught (pedagogy), motivated and one's performance (Asomah et al. 2018). These attributes in the learning environment positively and negatively influence students' improvement in an elective mathematics achievement (Asomah et al. 2023b).

Research questions

The study focusses on answering the following research questions:

1. What are the perceived difficulties SHS students associate with the study of elective mathematics?
2. What is the performance of SHS students in Elective Mathematics in the Savelugu Municipality?

Hypotheses

H₀: There is no significant correlation between the perceived difficulty of elective mathematics and students' performance in the subject in Savelugu Municipality.

RESEARCH DESIGN

Mixed method research design was employed in this study. Thus, an investigation to evaluate the perceived learning difficulties of Senior High School students and its effect on their performance in the area of elective mathematics was carried out with a controlled variance (Creswell, 2003). This design incorporates both quantitative and qualitative data collection and analysis techniques. The method affords comprehensive understanding of the evaluation of the current phenomenon under investigation (Creswell, 2017). Thus, mixed method research design as was used in this study provided comprehensive understanding of the perceived learning difficulties and the consequent effect on performance. To this end, the authors explored this phenomenon from various perspectives and obtained a richer and deeper insight (Migiro & Magangi, 2011).

Sample and Participants

The Savelugu municipality is located in the northwestern part of Ghana and has Savelugu as its capital town. The municipality has elective mathematics students' population of 1,221 (Savelugu municipal Education Office, 2023). A stratified sampling technique was used in drawing the sample for the conduct of the study. The Computerised School Selection and Placement System [CSSPS] (2023) guided the placement of SHS into groups of two (strata). This is because the groupings of SHS by the CSSPS are homogeneous in each group and characterised by quality and quantity of infrastructure (school buildings, ICT labs, libraries etc.), learning facilities, staffing (quality and quantity of students) and academic performance. In determining the sample size, Slovin's formulas were used at 5% sampling error (Stephanie, 2003). Thus, $n = \frac{N}{1+Ne^2}$ using a confidence interval of 95%. $N=1,221$ $e= 0.05$, $n = \frac{1,221}{1+1,221(0.05)^2} \approx 300$. To this end, a sample of 300 elective mathematics students was selected. In relation to the open-ended items, sample of opinions selected in each stratum were anchored on the students' duration at school as well as the scope and content of the topics covered in elective mathematics. The attainment of data saturation point (a stage where additional information was superfluous) informed the number of students selected for this phase of the study (Fugard & Potts, 2015). Thus, six (6) participants were selected randomly on an equal basis. Consequently, respondents herein referenced as Student 21, Student 22, Student 23, Student 24, Student 25, Student 26 were used. This positioned the respondents to be classified and identified regarding specific statements made. Participation

in the study was at the behest of the students. In addition, anonymity and confidentiality of the respondents were ensured. The demographic distribution of the students in the study is shown in Table 1.

Table 1. Demographic information

| | Mean \pm Standard Deviation | |
|---------------|-------------------------------|----------------|
| Age | 18.40 \pm 1.668 | |
| | Frequency | Percent |
| Gender | | |
| Male | 204 | 68.0 |
| Female | 96 | 32.0 |

Instrument

The study adapted questionnaire with closed-ended and open-ended items (Abotowuro, & Amoakoh, 2019) and Mathematics Achievement Test (MAT) (WAEC, 2023) were developed grounded on the gaps and evolving themes identified in literature. Specifically, a survey consisting of 3-parts was used. Firstly, respondents completed their demographic information (e.g. sex, age, section of academic etc.). The closed ended-items which accounted for the second part of the questionnaire involved evaluation of the effect of high school students' perceived difficulty of elective mathematics. Thus, statements on the three domains namely, Perceived difficulty, Perceived teacher motivation, Perceived teaching methods. A 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5) were employed. Both questionnaires were in the English language as this is the medium of instruction used in senior high schools in Ghana. The respondents were admonished to specify the extent to which they agree or disagree to the items. To this end, a score of one (1) and five (5) was explained as very strong negative and positive observations respectively. Subsequently, an average score of 2.5 on the Likert scale was designated negative when it's below the average and positive when above it. The last part, afforded the respondents an opportunity to comment on the domains through the open-ended items. The second instrument, mathematics achievement test (MAT) was a multiple-choice question comprising (MCQ) 50 items. The items covered areas of Algebra, Coordinate Geometry, and Trigonometry which are second year courses and were confirmed (evidence from the mathematics lesson notes from the teachers) to have been taught by the participating schools (NaCCA, 2023). Hence, the use third year students in the study. Further, the MAT was reviewed by seasoned teachers at the SHS after its construction using a standardized criteria set by West Africa Examination Council, a body in charge of examinations at the level of SHS in the West African Region.

Piloting of the instrument

SHS students with similar characteristics to those in Savelugu Municipality were selected to participate in the pilot testing of the instrument. According to Perneger et al. (2015), a sample size of 30 is considered reliable as lesser sample sizes may lack the statistical influence to classify predominant themes in a study. Consequently, a sample size of 45 students participated in the pilot stage of the study. The results of the pilot test indicated a reliability coefficient ranged 0.65- 0.71. The inputs received were incorporated. Thus, the final Cronbach's alpha reliability estimates for the instruments employed in the study were calculated. In particular, Perceived difficulty (6 items, $\alpha = .85$), Perceived teacher motivation (8 items, $\alpha = .90$), and Perceived teaching methods (5 items, $\alpha = .87$). According to Kothari (2004) and Zohrabi (2013), coefficients above 0.7 are classified as satisfactory, while coefficients exceeding 0.8 are regarded as very good. In ascertaining the content, facial and criterion validity of the MAT, experts in the field of mathematics education at the Teacher Education Department, University of Ghana revised and contributed to the test items' relevance and consistency in terms of the scope and content and the curricular practices in the SHS mathematics syllabus.

Data collection and analysis

The administration of the questionnaires with closed and open-ended items and MAT took place in the respective schools of the respondents of the study. This was to report on the three domains in relation to the evaluation of students' performance in elective mathematics and their perceived difficulty of the subject (Cohen et al., 2017). The third researcher submitted official letters of permission to heads of the SHS who in turn granted access to the assistant academic heads, heads of mathematics departments and the elective mathematics students in the selected schools. In consultation with the heads of the mathematics departments, elective mathematics teachers randomly selected third year students from different programmes offered by the schools to participate in the study. The instruments were administered in the respective participating schools. This was to enable the authors report on how things look like without disrupting the environment of the schools involved in the study (Cresswell, 2020). In particular, the questionnaires with closed and open-ended items were first given to the students to respond to after which the MAT followed. The respondents were given 2-hours to complete the two sets of instruments administered. The completed instruments were retrieved immediately after the stipulated time period. Thereby, ensuring 100% return rate during the data collection exercises stage of this study. The MAT was scored out of hundred and used to assess students' performance in elective mathematics. The scores for the test were graded using the West Africa Examination Council Grading System for Examinations (West Africa Examination Council [WAEC], 2023). Further, the relationships between perceived difficulty of elective mathematics (Perceived difficulty, Perceived teacher motivation, Perceived teaching methods) and students' performance in elective mathematics was conducted using Multiple Regression analyses. Regression analyses was also performed to identify predictors of academic performance. To this end, a preliminary examination was conducted for the data, this was done to determine the standard assumptions of multiple regression. The standardised residuals were found in the region presupposing the insignificance of the recorded outliers in the study. Thus, the data was found to be ranged between -3.3 to 3.3 implying that it was suitable for the conduct of this study (Pallant, 2016). In addition, descriptive statistics was employed to analyse survey responses and academic performance data. The use of thematic analysis was employed to identify recurring patterns, themes, and nuances in participants' experiences as observed on the open-ended items (Miles & Huberman, 1994). Triangulation was achieved through the complementarity of qualitative and quantitative data for a comprehensive understanding of the findings in the study. Thus, the data obtained from qualitative and quantitative sources were analysed independently to ascertain the point of convergence and divergence in the data. Consequently, the evidence from the two sources were integrated to provide consistency in the data analysis with the view to responding to the research questions as set in the study. To present the findings, results were visualized using tables.

RESULTS

The influence of the perceived difficulty of elective mathematics on High School Students' Performance was measured quantitatively by administering a 5-point Likert scale questionnaire and qualitatively with use of the open-ended items administered to 300 students at some selected SHS during the conduct of the study. The results are presented in three sections: The perceived difficulties SHS students associated with the study of elective mathematics, the performance of students in elective mathematics and the testing of the research hypothesis.

The perceived difficulties SHS students associate with the study of elective mathematics

This research question was used to explore students' perceived difficulties in elective mathematics. Three domains namely, Perceived difficulty, Perceived teacher motivation and Perceived teaching methods were employed to address students' perceived difficulties in elective mathematics. Consequently, each of the three

domains that underpinned the perceived difficulties in elective mathematics are presented in Tables 2,3 and 4.

Perceived difficulty

The data shows that students agreed to most of the statements assessing perceived difficulty as a domain in measuring students' perceived difficulty. For instance, students agreed that: "There are certain elective mathematical topics that, no matter how hard I try, I can never fully understand" (M=3.56, SD=1.25). In particular, answering questions in elective mathematics were also found to be difficult for the students (M= 3.19, SD=1.24). In addition, they revealed that, even "Memorizing formulas and definitions in Elective Mathematics is very difficult" (M= 3.27, SD= 1.29). These views were supported by responses to the open-ended items by first Student 25, thus, "*Matrices and Calculus are very difficult to solve*" and second by Student 26 who also noted that "*Surds, rational function. They are very difficult to understand*". The results of perceived difficulty are presented in Table 2.

Table 2. Perceived difficulty

| Statements | M | SD | Remarks |
|--|-------------|--------------|----------------|
| There are certain elective mathematical topics that, no matter how hard I try, I can never fully understand | 3.56 | 1.25 | Agreed |
| The basic topics presented in Elective Mathematics are difficult for me to understand | 2.72 | 1.24 | Disagreed |
| The question in elective mathematics is Difficult for me to solve. | 3.19 | 1.24 | Agreed |
| Memorizing formulas and definitions in Elective Mathematics is very difficult | 3.27 | 1.29 | Agreed |
| My views on Elective Mathematics often makes me worried about my performance | 3.07 | 1.30 | Agreed |
| My views on the difficulty of Elective Mathematics have had a noticeable impact on my performance in the subject | 3.31 | 1.22 | Agreed |
| Overall | 3.18 | 0.514 | Agreed |

M-Mean, SD-Standard Deviation

Further, students alluded to effect that, their views on elective mathematics often makes them worried about their performance (M= 3.07, SD= 1.30) and as a result, such views have had a noticeable impact on their performance in the subject (M= 3.31, SD= 1.22). However, it can be observed that students disagreed with the statement "The basic topics presented in Elective Mathematics are difficult for me to understand" (M= 2.72, SD= 1.24). This could suggest that while students may find specific topics or aspects of elective mathematics challenging, they do not necessarily find the foundational concepts difficult to comprehend. The overall mean (M= 3.18, SD= .514) indicates that students, agree with the statement regarding the perceived difficulty of elective mathematics. These results indicate that students generally perceive elective mathematics as challenging, particularly in specific areas such as understanding certain topics, solving questions, and memorization.

Perceived teacher motivation

The results as presented in Table 9 show a high perceived teacher motivation (M= 3.42, SD= .43) among students. The following statements contributed to the high perception: "I have confidence in my ability to learn elective mathematics well because of my elective mathematics teacher(s)." (M= 3.56, SD= 1.23), "My elective mathematics teacher is personally interested in my studies in mathematics" (M= 3.57, SD= 1.19), "My elective mathematics teacher values my feedback on his/her teaching methods" (M= 3.21, SD= 1.18), The results of perceived teacher motivation are presented in Table 3.

Table 3. Perceived teacher motivation

| Statements | M | SD | Remarks |
|--|-------------|-------------|----------------|
| I have confidence in my ability to learn elective mathematics well because of my elective mathematics teacher(s). | 3.56 | 1.23 | Agreed |
| My elective mathematics teacher is personally interested in my studies in mathematics | 3.57 | 1.19 | Agreed |
| My elective mathematics teacher values my feedback on his/her teaching methods | 3.21 | 1.18 | Agreed |
| My elective mathematics teacher is always ready to explain the topics in mathematics when students request further clarification during elective mathematics lessons | 3.95 | 1.03 | Agreed |
| My elective mathematics teacher maintains a friendly student-teacher relationship with me even after his/her lesson has ended | 2.85 | 1.47 | Agreed |
| My elective mathematics teacher talks happily about elective mathematics as a subject, which encourages us to study mathematics. | 3.68 | 1.05 | Agreed |
| My elective mathematics teacher encourages me to bring out the best in me in elective mathematics. | 3.55 | 1.24 | Agreed |
| My elective mathematics teacher involves me in making decisions concerning elective mathematics in class. | 3.02 | 1.18 | Agreed |
| Perceived teacher motivation | 3.42 | 0.43 | Agreed |

M-Mean, SD-Standard Deviation

Moreover, it is worthy to note that, according to the students, their elective mathematics teacher is always ready to explain the topics in mathematics when students request further clarification during lessons (M= 3.95, SD= 1.03), talks happily about the subject (M= 3.68, SD= 1.05), encourages them to bring out their best (M= 3.55, SD= 1.24). Further, the students noted that, their elective mathematics teacher involves them in decisions making processes (M= 3.02, SD= 1.18), maintains a friendly student-teacher relationship with them even after his/her lesson has ended (M= 2.85, SD= 1.47). This means that whereas the overall perceived teacher motivation is relatively positive and suggestive of the fact that, on average, students feel supported and motivated by their elective mathematics teachers as evidenced on the response from Student 24 who said *"He is supporting us to learn more and after class he will advise us to learn"*. Nonetheless, there is a perceived decrease in the maintenance of a friendly student-teacher relationship after lessons as argued by Student 22 *"He doesn't support us in any way apart from normal class lessons"*

In view of the data, the findings depict that, respondents showed a high perceived teacher motivation in elective mathematics. This is evident from the mean scores of the statements that contributed to this perception, which range from 3.21 to 3.95. Thus, students generally hold positive perceptions of their elective mathematics teachers, viewing them as motivated, interested, approachable, and encouraging.

Perceived teaching methods

The results show that, there is a positive perception of teaching methods (M= 3.41, SD= .56) employed by the teachers. The following statements contributed to the positive perception: "I enjoy elective mathematics because my teacher makes sure we understand a topic very well before moving to the next topic" (M=3.15, SD=1.27), "I enjoy the learning of elective mathematics very when the teacher uses diagrams, graphs, and real-life activities to teach me in class" (M= 3.63, SD= 1.22), The results of perceived teaching methods are presented in Table 4.

Table 4. Perceived teaching methods

| Statements | M | SD | Remarks |
|--|-------------|------------|---------------|
| I enjoy elective mathematics because my teacher makes sure we understand a topic very well before moving to the next topic | 3.15 | 1.27 | Agreed |
| I enjoy the learning of elective mathematics very when the teacher uses diagrams, graphs, and real-life activities to teach me in class | 3.63 | 1.22 | Agreed |
| I enjoy the learning of elective mathematics very well when the teacher allows us to work in groups in class | 3.48 | 1.34 | Agreed |
| I enjoy the learning of elective mathematics very well when the teacher allows us to work on individual basis on homework, class exercise and project work during the teaching of mathematics. | 3.03 | 1.36 | Agreed |
| I enjoy the learning of elective mathematics very well when the teacher allows us to consult each other, reason together in order come out with solutions to the questions in class | 3.80 | 1.10 | Agreed |
| Overall | 3.41 | .56 | Agreed |

M-Mean, SD-Standard Deviation

In addition, student averred that, they enjoy the learning of elective mathematics very well when the teacher allows us to work in groups in class (M= 3.48, SD= 1.342), allows us to work on individual basis on homework, class exercise and project work during the teaching of mathematics (M=3.03, SD= 1.367) and consult each other, reason together in order come out with solutions to the questions in class (M= 3.80, SD=1.108). These views were corroborated the following statements:

Student 21 *"He uses different methods in teaching elective mathematics also after every lesson he gives us work or homework just to see your understanding, he also gets our attention before working examples"*

Student 23 *"He gives us trial questions and takes time to go through it and sometimes allows us in turns to come to the board to solve questions"*

Overall, students generally have positive perceptions of the teaching methods used in teaching elective mathematics. In particular, students appreciate the teachers use of visual aids, collaborative group work, individual assignments, and peer consultation in elective mathematics learning environment.

The performance of students in Elective Mathematics

This research question was used to assess students' performance in an elective mathematics test using the MAT. The scores for the test were graded using the WAEC Grading System for Examinations. The outcomes are recorded in Table 5.

Table 5. Performance in Elective Mathematics Test

| Performance | | | Frequency | Percent |
|-------------|-------|-----------|-----------|---------|
| Marks | Grade | Remarks | | |
| 80-100 | A1 | Excellent | 3 | 1.0 |
| 70-79 | B2 | Very good | 4 | 1.3 |
| 65-69 | B3 | Good | 1 | .3 |
| 60-64 | C4 | Credit | 5 | 1.7 |
| 55-59 | C5 | Credit | 7 | 2.3 |
| 50-54 | C6 | Credit | 15 | 5.0 |
| 45-49 | D7 | Pass | 31 | 10.3 |
| 40-44 | E8 | Pass | 61 | 20.3 |
| 0-30 | F9 | Fail | 173 | 57.7 |

The results of the MAT reveal a diverse spectrum of student performance. A notable 1.0% of students achieved an excellent level of proficiency, securing grades in the A1 range. Demonstrating a very commendable performance, 1.3% of students earned grades in the B2 range, indicating a very good understanding of the subject. In the good category, 0.3% of students received a B3 grade, reflecting a satisfactory level of achievement. Moving to the Credit grades (C4, C5, C6), a combined 9.0% of students attained this level, showcasing a decent grasp of the subject matter. Among the passing grades, 10.3% of students received a D7, while a larger portion, 20.3%, secured an E8. Although these grades represent a successful passage of the test, they suggest varying degrees of proficiency. Unfortunately, the majority of students, comprising 57.7%, fell into the failure category with an F9 grade. This highlights a significant challenge in the understanding and application of Elective Mathematics among a substantial portion of the student body. In general, the distribution of student performance indicates that a significant percentage of students fell into the failure category, while the pass and higher-grade categories make up a smaller proportion.

Research hypothesis one

H_0 : There is no significant correlation between the perceived difficulty of Elective Mathematics (Perceived difficulty, Perceived teacher motivation and Perceived teaching methods) and students' performance in the subject in the Savelugu Municipality.

This hypothesis was tested to ascertain whether the perceived difficulty of Elective Mathematics will influence students' performance in Elective Mathematics

Table 6. Predictive relationship between the perceived difficulty of Elective Mathematics and students' performance

| | B | S. E | β | t | Sig. |
|------------------------------|----------|-------------|---------------------------|----------|-------------|
| Perceived difficulty | .231 | 1.498 | .009 | .155 | .877 |
| Perceived teacher motivation | -.100 | 1.788 | -.003 | -.056 | .956 |
| Perceived teaching methods | 1.128 | 1.379 | .048 | .818 | .414 |

A multiple linear regression was performed to ascertain the predictive relationship between perceived difficulty of Elective Mathematics and students' performance in elective Mathematics. The regression model was not statistically significant, $F(3,296) = .230$, $p = .876$. The model explained .2% of the variance in students' performance in Elective Mathematics. The results revealed that students' performance in elective Mathematics was not significantly influenced by Perceived difficulty ($\beta = .009$, $p = .877$), Perceived teacher motivation ($\beta = -.003$, $p = .956$) and Perceived teaching methods ($\beta = .048$, $p = .414$). This suggests that the perceived difficulty of elective Mathematics (Perceived difficulty, Perceived teacher motivation and Perceived teaching methods) among students, does not influence their performance in elective mathematics. Based on this finding, we fail to reject the null hypothesis. Similarly, the study did not find a significant correlation between Perceived teacher motivation and students' performance. However, it is possible that other factors, such as teacher qualifications, teaching experience, and teaching strategies, may have a greater impact on performance than teacher motivation alone. Finally, the study did not find a significant correlation between Perceived teaching methods and students' performance.

DISCUSSION

The study sought to evaluate students' performance in elective mathematics: the effect of high school students' perceived difficulty of the subject. The discussions in connection with this study was presented from three perspectives as reported in the results section as; SHS students' perceived difficulty of elective mathematics, the performance of SHS students in elective mathematics and testing of the corresponding

hypothesis. In particular, SHS students' perceived difficulty of elective mathematics was answered using three domains namely, Perceived difficulty, Perceived teacher motivation and Perceived teaching methods. Consequently, each of these domains that underpinned SHS students' perceived difficulty of elective mathematics are discussed.

Perceived difficulty

The findings of the study under this domain shows that, students generally perceived elective mathematics as a difficult although some averred contrary opinions on subject at the SHS. In particular, in solving mathematics questions, committing to memory certain formulas and rules and the learning of some topics in the elective mathematics curriculum. This finding aligns with the observations of Asomah et al., (2023a; Ignacio et al., 2006) whose finding stipulates that, students perceive mathematics as boring, difficult, and impractical. Further, the finding that, perceiving elective mathematics as too difficult can diminish students' intrinsic motivation (Asomah et al. 2018; Chapelle et al., 2017) is implied in the current study.

Perceived teacher motivation

Under this domain, the study revealed that, students have positive perceptions of the teaching methods used in teaching elective mathematics. In particular, students appreciate the teachers use of visual aids, collaborative group work, individual assignments, and peer consultation in elective mathematics learning environment. This finding resonates with the observations of a teaching philosophy that was placed emphasis on real-world applications, collaborative learning, and practical problem-solving can contribute to a positive learning experience (Pandey and Banik 2011; Pretorius et al. 2016). This finding is further affirmed by Chapelle et al., (2017) who contended that, motivation is a key factor in academic achievement.

Perceived teaching methods.

The study held that, contrary to the popular belief that mathematics teachers employ conventional method of teaching without regard for the student as the focus of attention. The findings of the current study depict that, students generally had positive perceptions of the teaching methods used in teaching elective mathematics. In particular, students appreciate the teachers use of visual aids, collaborative group work, individual assignments, and peer consultation in elective mathematics learning environment. This result of the current study is synonymous to the findings of (Asomah et al. 2023a; Pretorius et al. 2016) who argued in their studies that, students perceived the pedagogical approaches employed in teaching elective mathematics as innovative and student-centred.

In relation to all the constructs as observed in the current study, the findings are consistent with the extensive studies of Cofie, (2020) who investigated the perceptions senior high students in Ghana have about mathematics and the impact of these perceptions on their mathematics achievements. Specifically, the study identified students' perceptions of mathematics in senior high schools, examined the factors that influence these perceptions, and determined the relationship that exists between the perception constructs identified and students' performance in mathematics. Cofie's study found a positive perception of student's self-confidence, interest in mathematics, teacher motivation and competencies as well as difficulty in mathematics as was found in the current study. However, the existence of myths, and beliefs, as well as the usefulness of the subject could not be ascertained as it was beyond the scope of the study.

Students Performance

In general, the distribution of student performance indicates that a significant percentage of students fell into the failure category, while the pass and higher-grade categories make up a smaller proportion. The student's poor performance registered in this study aligns with the findings of Koay et al., (2023) who asserted in their study that poor performance in mathematics is attributable to teachers' inability to complete the content of the mathematics syllabus, students lack of confidence and interest in their ability to do mathematics. Further, the results obtained in this study agree with the findings of Enu et al., (2015) whose

work outlined similar poor mathematics performance among students in some selected colleges of education in Ghana. Thus, it could be asserted that irrespective of the grade, the performance associated with mathematics is problematic.

The results of the multiple linear regression analysis indicate that there is no significant relationship between the perceived difficulty of Elective Mathematics and students' performance in the subject. This finding is at variance with the positive correlation established between perceived difficulty and academic performance in a study by Bulgan (2018). This study contends that students who perceived mathematics as more difficult had higher levels of intrinsic motivation and better performance in the subject. Additionally, the results suggest that perceived teacher motivation and teaching methods do not significantly influence students' performance in elective mathematics, which is inconsistent with some research that highlighted the importance of teacher motivation and effective teaching strategies in mathematics education (Asomah et al. 2023; Butakor, 2016). However, it is important to note that the sample size in this study was relatively small ($n=300$), which may limit the statistical power of the generalisation. Furthermore, the study only focused on perceived difficulty, teacher motivation, and teaching methods as predictors of performance. However, other factors such as prior mathematics knowledge, study habits, and motivation may also play a role. Therefore, further research with larger sample sizes and more comprehensive measures of these variables is needed to confirm these findings.

Hypothesis Testing

In relation to the hypothesis tested, the results of the study do not support the hypothesis H_1 , which suggests that there is a significant correlation between the perceived difficulty of elective mathematics (Perceived difficulty, Perceived teacher motivation, and Perceived teaching methods) and students' performance in the subject in the Savelugu Municipality. This finding aligns with that of Hatsu et al., (2023). Hatsu and his colleagues studied the Impact of students' perception on Achievement of mathematics in the Ga East Municipality in Ghana. Their findings show that the students have a positive perception of learning mathematics. Further, they observed that, students' performance was not significantly impacted by their perception of mathematics as was observed in the current study. Nonetheless, the work of Bosson-Amedenu (2017) which generally agrees with this hypothesis, may not apply to this specific context. The study found that there is no significant correlation between the perceived difficulty of elective mathematics and students' performance. This finding, further contradicts with studies which suggest that students who perceive mathematics as difficult are likely to perform poorly in the subject (Collishaw et al. 2023). However, it is possible that other factors, such as prior knowledge, teaching methods, and student motivation, may have a greater impact on performance than perceived difficulty alone. Moreover, the study did not find a significant correlation between Perceived teacher motivation and students' performance. Further, Hagan et al., (2020) studied Students' Perception towards Mathematics and Its Effects on Academic Performance. The research sought to find out the perception of students towards Mathematics and how it affects their academic attainment in a Ghanaian context. Although, a sample size of 297 students less than the current study were selected through stratified sampling of which 180 were males and 117 were females. The results of the study showed that, students have positive perception towards mathematics. Even though students had positive perception towards mathematics it was also found that they perceive mathematics as a difficult subject. This resonates with the findings of the current study. Moreover, the study further established a negatively weak relationship between perception and students Mathematics performance contrary to the studies of Asomah et al., (2022) who contended that, students' perception towards mathematics was favourable as a result of which a positively weak correlation between the students' perception and attitude towards mathematics was confirmed.

Finally, the study did not find a significant correlation between Perceived teaching methods and students' performance. This result is inconsistent with a study by Clyatt, (2017) which suggests that effective teaching methods can have a positive impact on student performance.

CONCLUSIONS AND IMPLICATIONS

In conclusion, students exhibit positive disposition towards Perceived teacher motivation and Perceived teaching methods but expressed their Perceived difficulty towards mathematics as an elective subject. Further, the results of the multiple linear regression analysis indicate that there is no significant relationship between the perceived difficulty of Elective Mathematics and students' performance in the subject. In particular, the study found that there is no significant correlation between the perceived difficulty of elective mathematics and students' performance, the study did not find a significant correlation between Perceived teacher motivation and students' performance and the study did not find a significant correlation between Perceived teaching methods and students' performance. Thus, an exposition, through research on other factors such as teacher qualifications, teaching experience, and differentiated teaching strategies are implied in this study. To this end, the need for Heads of High Schools, to do background check of students' prior performance, interest and motivation in mathematics as a prerequisite condition for students to pursue elective mathematics is implied in this study.

Limitations and further research

The study was restricted to only students from public SHSs in the Savelugu Municipality. Hence, the deficit in the generalization of the findings of this research over all SHS. The model explained .2% of the variance in students' performance in elective mathematics. Hence, the need for further studies to account for the .8% of the variance in students' performance in elective mathematics. Overall, these results suggest that while perceived difficulty, teacher motivation, and teaching methods are important factors in mathematics education, their impact on student performance may be more complex than previously thought. Further, qualitative research is therefore needed to better understand the relationship between these factors and student performance in specific contexts.

Conflicts of Interest

The authors declare no conflicts of interest.

Funding

The authors received no direct funding for this research.

Data availability statement

As a result of the anonymity and confidentiality of the participants in this study, the supporting data are exclusively available@ rkasomah@ug.edu.gh

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