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Effect of Gender on Senior High School Students' Performance and Perception of Core Mathematics in the Cape Coast Metropolis of Ghana

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Abstract

This study investigated the gender differences in senior high school student's performance and perception of core mathematics in the Cape Coast Metropolis of Ghana. A mixed approach was used specifically the sequential explanation mixed method. A purposive, convenient, simple and stratified sampling method was employed in the study to select 393 senior high school students, consisting of 212 males and 181 females. Data was collected through the use of Mathematics Perception Questionnaires (MPQ), a mathematics test, and an interview protocol. Quantitative data (questionnaires and mathematics tests) was analysed using descriptive and inferential statistics, while qualitative data (interviews) was analysed on a thematic basis. The results of the study revealed that there was a significant gender difference in students' performance in mathematics in favour of females. Female students reported feeling more supported in mathematics by both parents and teachers than male students. Additionally, the results revealed that there was no significant difference between males and females in their perceptions of mathematics. Both males and females had a positive perception of mathematics because they saw the subject to be an integral part of daily life, also a way to succeed in many other areas The study recommends that stakeholders in the education sector should provide equal opportunities for both male and female students to learn and excel in core mathematics and also mathematics teachers in SHS should employ positive behaviours during teaching and learning to help students of both genders perform better.

Keywords gender differences; core mathematics performance; perception of mathematics

Introduction

Mathematics is an important subject due to its utility value and importance to the development of the world. It has been demonstrated that countries that invest in mathematics education have seen significant progress, for example; Japan China Singapore etc. A former Prime Minister of the United Kingdom had this on the importance of the study of mathematics to the world.

> *There's no secret to success in the modern world. If countries are going to win in the global race and children compete and get the best jobs, you need mathematicians and scientists – pure and simple. So today, we commit to delivering more maths and science teachers. This is all part of our long-term economic plan for Britain – making sure our children have the skills they need to thrive and get on. And by sticking to it, we will lift our children's horizons and pull our country up in the world." (Department or Business, Innovation and Skills, 2014)*

It is taught at all levels (Orton et. al. 2004) and is a compulsory requirement for admission into tertiary institutions in Ghana (National Accreditation Board, 2013).

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However, there is a consistently below-average performance of students in the subject (Gnagey & Lavertu, 2016), even within developed countries. Poor performance in mathematics is a major impediment to the educational attainment and advancement of students in Ghana. Failure in mathematics can lead to difficulties in accessing higher education, as well as employment opportunities. It is therefore important to identify the variables that affect students' performance in mathematics in Ghana so that they can have the necessary skills and support to excel in this subject.

According to research conducted by Tata et al (2014) in Nigeria, poor performance in mathematics appears to be related to various factors, such as students' negative attitude toward mathematics, fear of mathematics, inadequate qualified teachers, and a lack of appropriate teaching materials. Another research conducted by Michael (2015) revealed that teaching and learning mathematics was hindered by a range of issues, such as inadequate teaching conditions, managerial deficiencies in mathematics departments, lack of self-guided learning, and insufficient prior knowledge of mathematics among students.

The debate regarding the potential impacts of gender on students' academic performance is ongoing and has yet to be conclusively resolved (Buadi, 2000). While some studies have found evidence to support the notion of differences between boys and girls in mathematics achievement (Fennema and Leder 1990; Hedges and Newell 1999), other studies have not (Sprigler and Alsup 2003; Ding et al, 2007). According to the International Education Assessment (IEA), a global investigation found no significant disparities in educational accomplishment between male and female students in both eighth and fourth grades (Mullis et al., 2004). These conflicting results suggest that further research is needed to investigate the difference between genders in terms of academic performance in mathematics. Gender-related disparities in mathematics achievement and ability are a long-standing source of distress due to the lack of female representation in mathematics, physical sciences and engineering fields. In the UK, in 2008/9, only 38% of students studying mathematics in higher education were female, but only 18% of UK-based mathematics academics and 3% of full professors were female (Hobbs & Kooman 2006). Similarly, the Global Education Monitoring Team (2018) found that women in Ghana hold fewer than one-fourth of all Science, Technology, Engineering, and Mathematics (STEM) degrees.

Understanding and explaining the variability in student performance in mathematics requires taking into account perceptions (Mohamed & Waheed, 2011; Mato & De la Torre, 2010). Many students had an inaccurate view of Mathematics, deeming it a subject composed of many formulae, as well as a non-lively and unchanging subject (Ajai and Imoko 2015). Some learners believed it to be a subject for nerds and loners, and thus, only suitable for boys and men and not girls and women. These perceptions have been a major factor in the gender differences in Mathematics, Science and Engineering professions in Nigeria and Africa (Ajai & Imoko, 2015). Research has established that student learning outcomes are closely linked to their perceptions towards mathematics and that poor mathematics performance is often the result of a negative perception (Thompson, 1992). Ampadu's (2012) and Arthur et al (2017) studies found that teachers' actions and inactions, as well as students' negative perception of Mathematics, affect the learning experiences

and interest in the subject of Ghanaian students. Also, Wasike et al. (2013) and Kabeera (2018) both found that enhancing positive perception towards mathematics can lead to improved performance. Studies have shown that girls tend to have lower math self-efficacy than boys (Else-Quest et al., 2010; Meece & Eccles, 1990) and that this can be remedied by increasing girls' expectations of math performance (Sadker & Sadker, 1994). Studies have also found that girls tend to score slightly lower than boys on standardized mathematics tests at all grade levels, although the gap narrows as students progress through school (Bianchi & Spain, 2008; Else-Quest, Hyde, & Linn, 2010). However, this does not appear to be due to a difference in math ability between boys and girls, as studies have found that girls' attitudes toward math, as well as their self-confidence in the subject, are lower than boys' (Else-Quest et al., 2010; Meece & Eccles, 1990). In addition, researchers have found that girls perform better in mathematics when they are taught in a more gender-inclusive way, such as through collaborative learning activities, or when they are taught by female teachers (Else-Quest et al., 2010; Sadker & Sadker, 1994). Furthermore, girls tend to do better in mathematics when they are encouraged to pursue the subject and when they are allowed to explore it in more depth (Else-Quest et al., 2010). It is because of this that Michael (2015) argued that to see an improvement in mathematics performances in schools, both students and staff must shift to a more positive attitude.

To better address the issues raised, it is important to conduct a study to gain insight into students' performance and perception in mathematics in terms of gender.

Statement of the problem

Research conducted by Anamuah-Mensah and Mereku (2005) on the Trends in International Mathematics and Science Studies (TIMSS) report of 2003 found that Ghana performed poorly in Mathematics at grade 8. The mean score of 276 was well below the international average of 467, ranking Ghana 45th out of 46 countries. This low performance was further highlighted in the 2007 and 2011 TIMSS tests, with Ghana achieving a scale score of 130 and 430 respectively against the international average of 500 and 800 (Anamuah-Mensah, Mereku and Ghartey-Ampiah, 2008). Also, the performance of students in Core Mathematics in the West African School Certificate Examinations has been a cause of great concern for stakeholders in the education sector. The Education Sector report (Ministry of Education, 2018) revealed a fluctuating trend in students' performance in A1-C6 in mathematics from 2011 to 2017, increasing from 43.8% to 49.4% in 2012 and decreasing from 36.6% to 25% between 2013 and 2015 before increasing again to 32.8% in 2016 and 42.2% in 2017. The proportion of students with F9 in mathematics also increased gradually over the same period, from 18.8% to 45.2%.

In response, various interventions have been developed to improve student's performance in mathematics and bridge the gender gap. For example, the Ghana Education Service has established Science, Technology and Mathematics Educational (STEM) clinics to encourage and sustain the participation of girls in science, technology and mathematics in senior secondary schools (Awortwi, 1998). Despite these interventions, the performance of students in core mathematics has not been satisfactory.

Studies comparing gender differences in mathematics are mostly in favour of boys (Mubeen et al., 2013; Norton & Rennie, 1998) while others such as (Opolot-Okurot, 2005) reported in favour of girls. Gunderson et al. (2012) revealed that negative attitudes and anxieties towards Mathematics are more

pronounced in girls than boys. This could be because many girls tend to have low self-concepts of themselves and are more affected by the ramifications of gender stereotypes than their male counterparts. Smith (2004) observed in the United Kingdom (UK) that many female students across the globe have perceived Mathematics as a boring and difficult subject to study and hence, is meant for male and talented students. Nartey (2018) investigated gender differences in attitudes towards teaching and learning mathematics in senior high schools in Cape Coast Metropolis. Through a descriptive survey design, it was found that males had a more positive attitude towards mathematics than females, in terms of gender interest, confidence, fear and success. However, when it came to gender competence, the findings showed no significant differences

Given the persistent poor performance of students in Core Mathematics, there is a need for further research to ascertain whether there are gender differences in perception and performance in this subject. The lack of a comprehensive understanding of the gender differences in performance and perception of mathematics has been identified as a knowledge gap. To address this gap, a mixed-method approach combining quantitative and qualitative methods could be employed. This approach could provide an in-depth understanding of the issue and provide a more comprehensive understanding of the gender differences in performance and perception of mathematics.

Purpose of the study

The purpose of this study was to examine the performance of senior high school students in mathematics and their perceptions of the subject, based on gender. This could help inform strategies to improve academic performance in mathematics among students.

Objectives of the Study, Research Questions and hypotheses

Specifically, the objectives of the study were: (1) to examine senior high school students' performance in mathematics by gender; and (2) to explore senior high school students' perceptions towards mathematics by gender. To answer these research questions, the following hypotheses were formulated: (1) There is a significant difference in students' performance in core mathematics across gender; (2). There is a significant difference in students' perceptions of core mathematics across gender.

Theoretical Framework

Kaiser and Rogers (1995) and Jungwirth (2003) developed a theoretical framework for gender equity that is based on deficit, difference, and identity theories. Deficit theory states that gender disparities in educational outcomes are caused by deficiencies or weaknesses in girls' experiences, knowledge, and skills, while difference theory claims that differences in learning behaviours and outcomes, as well as the identities formed by learners in classrooms, are explained by analysing the relationships and the power within these relationships in mathematics classrooms. Identity theory is focused on an adolescent's attempts to develop and regulate the self, which is influenced by personal identity-plus stereotype patterns (Perry & Pauletti, 2011). Bishop and Forgasz (2007) define equity as an outcome of education, with access to learning as a condition for achieving equity. They also associate equity with equality and the three aspects of gender identified by Fennema (1995): equal outcomes, equal opportunities, and equal treatment. They present a second meaning in which equity is viewed as a criterion for evaluating many aspects of education, including outcomes,

access, attitudes, and teaching quality. Lowrie and Diezmann (2005) focus on the knowledge gap among girls, while Horne (2004) investigates the influence of teachers and teaching practices on the likelihood of girls being "rule-followers" and boys being "risk-takers". Cox, Leder and Forgasz (2004) find that females receive higher mean scores than males in the vast majority of comparisons made in senior secondary mathematics in Victoria. Postmodern researchers criticize difference theory for portraying learners as homogeneous and instead focus on the multiple and shifting identities that are shaped by their experiences. Anthony and Walshaw (2007) argue that equity is "relational" and situated and it necessitates a variety of pedagogical strategies that consider the various needs of students in the mathematics classroom. Liberal feminists criticize the assumption of deficit theory that there must be something wrong with girls, while radical feminists embrace gender differences and call for curriculum and teaching methods to be changed. Gilbert & Calvert (2003) state that women who are drawn to science are drawn to subjects that are typically associated with men and masculinity. Finally, critics have cast doubt on the concept of shifting identity and its implications for choice and they have argued that gendered social norms deny girls agency. Watt (2004) and Shannon (2004) have attempted to persuade girls of the importance of studying mathematics at a high level and to examine the valid decisions that girls make concerning mathematics, respectively. Thus, this theoretical framework has implications for the understanding of gender equity in education and the development of strategies to promote it.

Literature review

Gender and mathematics performance

Gender has been a key variable in numerous studies on science and mathematics achievement. Data from the World Bank (2019) shows that in Ghana, there is still an unequal distribution of access to education between males and females, as evidenced by the gender parity index from 2011-2018. This is likely due to the traditional belief that boys are more competent in mathematics than girls, which leads to more boys enrolling in mathematics-related subjects (Boateng & Gaulee, 2019). The literature surrounding gender and academic performance in mathematics is varied; studies conducted in countries of the North have shown that boys generally perform better than girls (Hedges & Nowell, 1995; Randhawa, 1994). However, an alternate body of research has revealed that the gender gap in mathematics performance is diminishing (Frost, Hyde & Fennema, 1994; Hyde, Fennema & Lamon, 1990; Perie, Moran & Lutkus, 2005). However, an interesting body of international literature suggests that female students perform better than male students (Arnot, David & Weiner 1999; Brown & Kanyongo, 2010). A large-scale study in the U.S.A. by (Hydea & Mertzb (2009) revealed that girls have reached parity with boys in mathematics performance, including a high school where a gap existed in earlier decades In the United States of America, a large-scale study carried out by Hyde and Mertz (2009) discovered that girls have reached parity with boys in mathematics performance. Other factors may include the marginalization of girls in the mathematics classroom and the perception of teachers that girls' performances in mathematics are dependent on rote learning, hard work and perseverance (Jungwirth, 1991; Walden & Walkerdine, 1985).

The concept of perception

Perception plays a key role in academic performance and is particularly important in mathematics. According to Rindfleisch (2007), perception can be defined as how a person views their ability in a given subject. Students' perceptions are shaped by how they attribute success and failure. Generally, students who have a high perceived ability in a subject will attribute their success to their ability and attribute their failures to external factors. In contrast, students with low perceived ability in a particular subject will more likely attribute their success to luck, and their failure to lack ability. Gibson and Spelke (1983) identified five stages of perceptual development. As individuals progress through these stages, their perception of the subject becomes more selective, purposeful and efficient. Research has shown that a strong perception of ability has a positive impact on academic performance, as students who have a high perceived ability in a subject are more likely to persist and engage with the material (Pintrich & Schrauben, 1992). Therefore, it is important to consider the role of perception (nature of the study of mathematics) in academic performance, particularly in mathematics, to ensure successful learning outcomes.

Empirical evidence

A 2007 study by Asare-Nkoom, which used purposive sampling and questionnaires to analyse the attitudes of 581 pupils, found that both boys and girls had positive attitudes towards mathematics across all eight dimensions. Girls saw mathematics as less of a male-dominated domain than boys. However, many changes could have occurred in the past decade, so this research aims to update the findings of Asare-Nkoom (2007) by assessing more recent studies.

Bhowmik and Banerjee (2016) conducted a study examining the relationship between attitude towards mathematics and the achievement of High School students in Jangal Mahal, West Bengal (India). The sample consisted of 394 secondary (class ten) students from six different high schools. The Mathematics Attitude Scale and Mathematics achievement test developed and standardized by the authors were used. Results showed significant gender differences in attitude towards mathematics, though not so much in achievement in mathematics. Additionally, there was a positive correlation between attitude towards mathematics and achievement in mathematics. The current study used a sample of 393 students as well as mathematics achievement tests which are similar to that of Bhowmik and Banerjee (2016)

Agdie et al. (2019) conducted a study to assess the attitudes of students towards Mathematics and to identify factors that influence student performance in Mathematics. Data were collected from students and their teachers through a self-administered questionnaire. The sample of 347 students included 313 from two government schools and 34 from a private school. Results showed that students in private schools had higher scores than those in government schools. Male students scored better than female students.

Kiptum et al. (2013) investigated the effects of gender on primary school students' mathematics performance in Keiyo South District, Kenya. Using a descriptive survey design, the study examined the attitudes of primary school learners towards mathematics. The sample population consisted of 300 learners, 150 male and 150 female, and all Mathematics teachers from the sampled schools. Stratified random sampling was used to categorize schools, and

simple random sampling was used to select both students and teachers. Questionnaires and interviews were used to collect data. The results showed that boys had more positive attitudes towards mathematics than girls. The study used stratified sampling and qualitative research design to enrich the results similar to the current study.

Osei (2013) examined gender differences in academic performance in mathematics at the Senior High School (SHS) level in the Tamale Metropolis of Northern Ghana. A survey research design was used and 500 students and 50 mathematics teachers were randomly selected. The data collected was analysed using measures of central tendency such as frequency count, percentage spread, mean, mode and median. The results showed that the general performance of students in mathematics at the SHS level was low and that male students performed significantly better than female students. This study highlights the need for further research on gender differences in academic performance in mathematics.

A study, conducted by Yussif (2016), aimed to explore gender differences in mathematics achievement among students at Bimbilla College of Education. A descriptive cross-sectional design was employed, and 30 college students were sampled via stratified and simple random sampling techniques. Data was collected through a questionnaire (Cronbach's alpha = 0.73) and mathematics test items and analysed quantitatively with descriptive and inferential statistics. Results of the study revealed a significant gender difference in student mathematics achievement, with male students outperforming their female counterparts ($p \leq .05$).

Also, Hanawa (2017) conducted a study on the impact of gender and socio-psychological factors on the academic performance of mathematics of senior secondary school students in the Jalingo Education Zone, Taraba State, Nigeria. The sample of the study included 453 SSII mathematics students, 240 boys and 213 girls, from 12 schools within the Education Zone. A Gender and Socio-psychological Factor Questionnaire (GESFAQ) and a Mathematics Achievement Test (MAT) were used to collect data. Results showed that gender does not significantly influence mathematics achievement. However, there was a statistically significant influence of peer group, test anxiety, attitude towards mathematics, and motivation on students' achievement in mathematics.

Tetteh et al. (2018) conducted a descriptive survey to explore the gender differences in mathematics performance among pre-service teachers in the Brong-Ahafo region of Ghana. A sample of 100 pre-service teachers, comprised of 50 males and 50 females, was selected from the second-year form at the public College of Education. The actual examination scores of the pre-service teachers were collected and analysed using the t-test in SPSS. Results revealed a significant difference in performance between males and females, with females having a higher score. These results suggest that gender plays an important role in mathematics performance among pre-service teachers in the Brong-Ahafo region. This study provides evidence to suggest that further research should be conducted to explore the potential contributing factors to the gender gap.

Anokye-Poku and Ampadu (2020) conducted a study to explore the gender differences in attitudes towards mathematics and mathematics achievement among Ghanaian Junior High School students. A descriptive survey design was utilized with a sample of 360 students. Two instruments, a semi-structured questionnaire and student test scores, were administered to assess the students' attitudes and achievements. The

results indicated that overall, both male and female students held positive attitudes towards mathematics and no significant difference in attitudes between genders was found. However, there was a significant difference in achievement, with male students performing better in mathematics than female students.

Methods

Research design

A sequential explanatory mixed methods research design was used in this study. This research approach is useful in explaining and interpreting quantitative findings. It involves collecting and analysing quantitative data first, followed by qualitative data (Creswell 2013). This design was chosen because it allows for a more comprehensive understanding of the student's perception towards mathematics and their performance. The quantitative data provides a basis for the analysis, while the qualitative data helps to explain and add depth to the results. The results of this research will provide a better understanding of the relationship between students' performance and their perceptions towards mathematics.

Research population

The target population of this study was all senior high school students in the Cape Coast Metropolitan area. This included students from 10 senior high schools, 3 boys' schools, 2 girls' schools and 5 co-educational schools, with a total of 23,209 students enrolled.

Sample size and sampling technique

This study utilized Yamane's (1967) formula to determine a sample size of 393 from the population of 23,209 students from senior high schools in the Cape Coast Metropolis. This sample was then proportionally distributed among the student populations of the schools. This study employed a combination of convenience, stratified, and simple random sampling techniques to select five schools and students. Convenience sampling was used to select schools due to their easy accessibility and proximity, while stratified sampling was used to ensure a fair distribution of students in terms of their programme of study and gender. Simple random sampling was employed to select the students, providing each participant with an equal opportunity for selection. By using these three sampling techniques, the study was able to obtain a representative sample of the population of interest.

Research instrument, validity and reliability issues

This study examined the perceptions of senior high school students towards the learning of mathematics as well as their academic performance. A questionnaire, a mathematics test, and an interview protocol were used to collect data from 393 senior high school students. The questionnaire consisted of two parts, with the first part investigating students' background information and the second part on their perceptions towards the learning of mathematics. The questionnaire was divided into two sections. Section A solicited information on the socio-demographic characteristics of the respondents, while Section B sought information on the factors influencing the performance of core mathematics. The questionnaire was structured using a five-point Likert scale. The mathematics test was used to measure students' academic performance in mathematics, while the interview protocol was used to obtain an in-depth understanding of the quantitative data.

Reliability was tested via a pilot study and Cronbach's alpha, which yielded a value of

0.801, indicating high reliability. Face and content validity were used to assess validity, while the trustworthiness of the qualitative data was ensured through member checking, dependability, transferability, and confirmability were all complied with.

Data collection and analysis procedure.

In this study, we sought to examine the effects of gender on students' performance and perception of mathematics. To achieve this, a permission letter was sent to the Headmasters of the chosen school, who granted permission for the research to be conducted. The Headmasters and Headmistresses then referred the researcher to various Heads of Mathematics and the ICT Department. The various Heads of Departments organized meetings with their members where the researcher was allowed to brief them on the purpose of the research and the kind of assistance needed. In weeks' time, the researcher went back and with the help of various teachers, the students were informed about the study and were briefed on the purpose of the study, what is required of them, and the need for their cooperation for the fieldwork after which the questionnaires were administered. A Likert five-point scale was deployed within the questionnaire with a scale between 1 and 5 where 5= Strongly Agree, 4=Agree, 3=Neutral, 2= Disagree, while 1=Strongly Disagree The questionnaire was closed ended and they were 11 in number. The Mathematics and Perception Questionnaire (MPQ) and were administered personally in addition to some teachers to help improve the collection and response rate of the questionnaire. They were collected as soon as it was completed by the respondents. This enabled the researcher to obtain 100% response rate. After the questionnaires were collected, the mathematics test also administered for 1 hour 30 minutes. The mathematics test questions were set by the researcher based on the approved Ghana Education Service syllabus.

In the qualitative phase, the researcher established a good relationship with the participants. This relationship influenced the research process and the quality of data gathered. Various kinds of communication and interaction such as confidentiality with the participants before the interview session offered a sense of security and freedom to the participants to express themselves well. The researcher personally conducted the interview to help in explaining the data obtained in the quantitative stage. After every interview, the researcher expressed appreciation to the interviewee for their cooperation and participation. Some of them expressed interest in the findings of the study. An average time of one and half hours was spent in each school during the interview sessions. The duration of the interview was five days with a day being spent in a school.

Table 1 Performance of students in core mathematics by gender

Gender	Fail N (%)	Pass N (%)	Total N (%)	Mean	Standard Deviation
Male	77(36)	135(64)	212 (54)	53.6	13.0
Female	44(24)	137(76)	181(46)	57.0	12.1
Total	121 (30)	272(69)	393	55.1	12.7

[1]Fail: Obtained less than 50% score; [2]Pass: Obtained 50% or higher score

Descriptive statistics and inferential statistics (independent t-test) were used to determine the differences explored. The assumptions for each type of analysis were met. Qualitative

data analysis involved using thematic analysis, which is a structured approach to managing and summarizing data. This form of analysis was used to produce a clear and organized final report in line with the research objectives.

Results

Performance of Students in Core Mathematics by Gender

Table 1 shows the results of a mathematics test conducted on the performance of students in core mathematics. The result indicates that the overall pass rate was 69%, with male students having a pass rate of 64% and female students having a pass rate of 76% (Table 1).

The mean score for male students was 53.55 and 57.00 for female students, with a total mean score of 55.14. The standard deviation for male students was 13.00, 12.06 for female students, and 12.67 for the total group. These results suggest that for the total group. These results suggest that female students generally perform better than male students in core mathematics.

This study also sought to evaluate the influence of gender on the students' perception towards mathematics, looking at students' ratings on eleven different statements (see Table 2).

Table 2 Students ratings of statements about their perceptions of mathematics by gender

Statement	Gender		Disagree N (%)	Neutral N (%)	Agree N (%)	M	SD
1. The concepts in Maths are too complex for me to understand	M	212	104(49)	36(17)	72(34)	2.81	1.30
	F	181	88(48)	25(14)	68(38)	2.76	1.44
2. Mathematics has relevance in my life	M	212	6(3)	14(6)	192(91)	4.46	0.76
	F	181	7(4)	10(5)	164(91)	4.44	0.81
3. The time of the day in which Maths is taught affects student performance in Maths	M	212	59(28)	35(16)	118(56)	3.43	1.26
	F	181	47(26)	23(13)	111(61)	3.56	1.32
4. There are so many formulas in Maths that affect student performance in Maths.	M	212	53(25)	46(22))	113(53)	3.36	1.23
	F	181	43(24)	26(14)	112(62)	3.52	1.25
5. The language used in mathematics is difficult to understand	M	212	126(59)	35(17)	51(24)	2.52	1.21
	F	181	92(51)	41(23)	48(26)	2.66	1.22
6. Students feel they are not involved in the teaching and learning process	M	212	110(52)	49(23)	53(25)	2.65	1.12
	F	181	82(45)	45(25)	54(30)	2.78	1.26
7. The student's perception that only bright students can perform well in Maths	M	212	103(49)	34(16)	75(35)	2.83	1.32
	F	181	84(46)	25(14)	72(40)	2.82	1.45
8. Students have the perception that mathematics is for boys	M	212	127(60)	35(16)	50(24)	2.43	1.31
	F	181	129(71)	13(7)	39(22)	2.14	1.38
9. Mathematics is abstract and boring	M	212	82(39)	34(16)	96(45)	3.10	1.39
	F	181	66(37)	20(11)	95(52)	3.15	1.48
10. Students have the perception that it is the teacher who can make mathematics learning easier.	M	212	45(21)	29(14)	138(65)	3.69	1.25
	F	181	41(23)	19(10)	121(67)	3.70	1.33
11. Maths involves a lot of computation which is so tiring and prevents good performance unlike other subjects	M	212	92(43)	47(22)	73(34)	2.90	1.24
	F	181	64(35)	42(23)	75(41)	3.11	1.27
Overall Perception	M	212				3.14	0.55
	F	181				3.12	0.55
Cluster						3.15	0.55

Source: Field Data 2021

Results indicated that, overall, both male and female students had neither high nor low perception of mathematics as a difficult subject that is of relevance in their lives, as they had a mean rating of 3.14 and 3.12 respectively. In the first statement, about half of the male and female respondents disagree the concepts in mathematics were too complex to understand (i.e., 49% of male students and 48% of female students) implying they do not see the subject as difficult; however, about 4% more females than males agree or perceive the subject as

difficult (i.e., 34% of male students and 38% of female students). The same proportion, that is, 91% of both male and female students agreed that mathematics has relevance in their lives. On all the statements, there was little difference the males and females raking of the items. That is, the statements that were ranked among the top four by the males were also the top four of the females; also, the statements that were ranked among the bottom four by the females were also the statements that were ranked among the top four by the males were also the top four of the females four of the males.

As the study sought to ascertain whether or not significant differences exist between male and female students' performance in, and perception of, mathematics, the results in Tables 1 and 2 were subjected to further analysis using the independent t-test to test the null hypothesis that "there is no statistically significant difference in students' performance in core mathematics across gender". A Levene's test for equality of variances was carried out and the results (F = 2.034, p = 0.155) indicate that the data meets the parametric assumptions for the test. Table 3 shows the result of the independent t-test on the comparison of performance in core mathematics by male and female students.

From Table 3, the independent-samples t-test performance results show that the difference observed between the mean of the male teachers ($M = 53.6,\ SD = 13.0$) and the mean of the female teachers ($M = 57, SD = 12.1$) was found to be statistically significant [t (391) = -2.708, $p < 0.01$].

The mean difference between genders was -3.47196 (standard error of the difference = 1.27518). These results provide evidence that there is a significant difference in performance between male and female students in core mathematics.

Also, from Table 3, the independent-samples t-test perception results show that the difference observed between the mean of the male students ($M = 3.14,\ SD = 0.55$) and the mean of the female students ($M = 3.12,\ SD = 0.55$) was not found to be statistically significant [t (391) = -.515, $p > 0.05$]. The results showed that there was no significant difference in perception between female and male students or between genders.

Table 3 Results of the independent sample t-test of the students' performance in, and perception of, mathematics by gender (N=393)

Category	Mean	Std. Div.	t	df	Sig. (2-tailed)	Mean Diff	Std. Error Diff
Performance							
Male	53.6	13.0	-2.708	391	0.007	-3.47196	1.28208
Female	57.0	12.1					
Perception							
Male	3.14	0.55	-.515	391	.607	-.02882	0.5592
Female	3.12	0.55					

Reasons for females performing better in mathematics than males

This study used interviews to explore the reasons for the gender difference in mathematics performance among the students. The interviews were focused

finding out why females were performing better than their male counterparts. The results revealed that girls performed better in core mathematics due to such factors as better study habits, perception of mathematics as being more relevant in their lives, received more motivation to take the subject more seriously from both school and home, and were treated by teachers in mathematics lessons with more patience than the males. Additionally, girls might be more motivated due to the possibility of losing a scholarship. These factors indicate that more effort should be made to support boys and create an environment in which all students can excel in mathematics.

For example, a student said,

> *Girls pay more attention in class than boys and sometimes the boys do not copy notes and solve problems given to them by teachers but tend to copy from the girls. This makes teachers show more love and patience to girls than boys".*

Another student said

> *Please, girls, are performing better than boys because most of the girls are on a scholarship programme and a failure in maths will call for the forfeiture of the scholarship. This makes the girls go the extra mile in their studies.*

Also, a third student reported

> *Sir, parents are ready to provide all materials needed for studies for a girl, but for boys sometimes, they doubt them and therefore most of them do not get all materials needed for studies. Sir, please, those of us in mixed schools, more girls attend extra classes than boys giving an advantage to the girl.*

When students were asked to explain why they have a positive perception of mathematics, most respondents explained that mathematics is essential to their daily lives, as it is used in activities such as buying and selling and is necessary for pursuing future job opportunities. It was also noted to be important for studying other subjects as captured below

Student G said

> *Mathematics is important because most fields that are high paying require mathematics as a base.*

Student I said

> *Mathematics is important to me because the course that, I want to offer is Physical Science in the University, I have to do well in mathematics.*

On a perception that mathematics should not be taught in the afternoon, students believed that the time of day does not significantly impact their ability to learn mathematics, as long as the teacher is engaging and the teaching method is activity-based. Furthermore, students noted that they are often able to understand the subject even when attending extra classes after school. Some responses are captured as follows:

Student A said

> *Sir, please, it depends on the teacher, some teachers teach early in the morning and still, students sleep.*

Another student *said*

> *For me, if the class is lively and I am involved or we solve more examples, I would enjoy the lesson any time in the day. We go for extra classes and they teach us for us to understand.*

Another student said

> *Sir, I think that, if the lesson is activity-based like how teachers teach*

> *construction, it would not matter the time, students would understand, also Mathematics is about calculations and you cannot sleep when you are studying it whether in the morning, afternoon and evening.*

On a perception that mathematics is not for women or girls, students interviewed believed that achieving success in mathematics is based on practice and determination, not gender. This suggests that with the right encouragement, any student can excel in mathematics, regardless of gender or intelligence level.

Student A said

> *Sir, gone were the days that we thought mathematics was for boys, today, even we the girls are performing better than the boys. During speech day, it is mostly the girls who sweep all the awards in mathematics-related subjects.*

Another student said

> *Women are working in all areas of life, medicine, engineering, and banking, so what the boy can do the girl can do better.*

Another third student said

> *Sir, we have both male and female teachers teaching us, so it cannot be true that mathematics is for boys.* Similar views were expressed by the other

Student A

> *Mathematics to me was not created for special people. Sir, it's about practice.*

On whether mathematics is for only brilliant students, students interviewed suggested that mathematics is not just for the academically gifted, but can be achieved by anyone with dedication and hard work. They reported that regular attendance, homework completion, and practice were necessary to do well and that motivation from parents, teachers, and friends could also be helpful.

Student C said

> *If we all attend classes regularly, do our homework, and practice what we are taught, we would be good in mathematics.*

Students F,

> *Sir, please, once we get support and motivation from our parents, teachers, and friends, we would all do well.*

Student G said,

> *please, with determination, commitment and hard work, it does not matter, we can all do mathematics and perform well in it.*

Discussion

This study investigated the influence of gender on mathematics performance and perception between male and female students to assess the validity of the gender equity theory. Contrary to the gender equity theory, the results of this study showed that female students performed better than male students in mathematics and there were no significant differences in perception. This suggests that socialization and gender stereotypes may not be the primary factors causing the lower performance of females in mathematics.

This study found that senior high school students in Cape Coast Metropolis generally performed well in Core Mathematics (M= 55.14 SD=12.67). Furthermore, female students performed better than male students (M=57.00, SD= 12.07) in Core Mathematics, which is consistent with other literature that

suggests that female students generally have higher scores in mathematics than male students (Arnot, David & Weiner, 1999; Brown & Kanyongo, 2010), Hanawa (2017) as well as large-scale study in the U.S.A. by Hydea and Mertzb (2009). However, this finding is not supported by all studies, as some studies have found that males have better scores in mathematics than their female counterparts (Agdie et al., 2019; Yussif, 2016; Anokye-Poku & Ampadu, 2020; Osei 2013, Tetteh et al. 2018)). Overall, these findings suggest that the performance of students in Cape Coast Metropolis on Core Mathematics is generally good, with female students performing better than males. Girls are outperforming boys in mathematics due to a variety of factors, such as better study habits, greater motivation, and more patient teachers. To improve boys' performance in mathematics, efforts should be made to create an environment that supports all students.

This study also sought to examine male and female students' perceptions of mathematics. Overall, these findings indicate that both male and female students hold positive perceptions towards mathematics. This corroborates with Asare-Nkoom's (2007) study on Sex-Differences in Attitudes towards Mathematics of Junior Secondary School Pupils in the Central Region of Ghana, which also found that both boys and girls had positive attitudes towards mathematics. However, this contradicts a study by Bhowmik and Banerjee (2016), Kiptum et al. (2013) and Anokye-Poku and Ampadu (2020) who observed that there were no gender differences in students' perceptions of mathematics.

The study found that the reasons for students' positive perception of mathematics are that students saw mathematics as an important part of everyday life and can be made more accessible to students with engaging activities, the right guidance, and gender neutrality. The time of day and language used in mathematics may be a source of difficulty, but with the right motivation and determination, success in the subject is achievable.

Conclusion

This study examined gender differences in students' performance and perception towards mathematics. The study found that overall, female students had a higher performance in mathematics than male students depicting that gender differences exist in students' performance in mathematics. No gender differences were observed in the students' perception of mathematics showing that gender does not influence how students perceive mathematics. Female students reported higher levels of support from both parents and teachers in mathematics than male students. These results suggest that gender-based differences in mathematics performance and perception may be the result of social and cultural influences. This highlights the importance of creating a learning environment that is supportive of both genders and that encourages positive attitudes towards mathematics for all students.

Recommendation

Based on these findings, the study recommends that the following strategies should be adopted to build positive perceptions of mathematics among students: encouraging students to understand concepts rather than memorize them, assigning experienced teachers to teach in classes with a non-elective mathematics background, employing positive behaviours during teaching and learning, engaging children in mathematical activities from an early age, and organizing workshops to erase negative perceptions and misconceptions. In conclusion, it is important to create an environment that is conducive to the learning

of mathematics and to ensure that students have positive attitudes towards the subject.

Further research is needed to explore other possible causes and to identify strategies that can be used to improve mathematics performance and perception among female students.

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