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Impact of Parent Interest in Mathematics and Students Mathematics Interest on Student Mathematics Achievement

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Abstract

A student's academic and cognitive development is greatly influenced by their mathematics education, and the importance of parental participation in promoting this interest cannot be estimated. The study aims to evaluate the impact of parental interest in mathematics and student's mathematics interest on students' mathematics achievement. The study employed quantitative research method with the used of structured questionnaire for collecting data. The sample of the study comprised of 200 first-year students from four selected senior high school in Ghana-Kumasi. The study findings revealed that, parent interest and student interest in mathematics had a statistically significant direct positive impact on students' mathematics achievement. Moreover, there relationship between parental interest and students' interest in mathematics had a positive effect and was statistically significant.

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INTRODUCTION

The connection associated with mathematics interest of students and that of their parents, as well as how these elements interact to affect a learner's progress in the subject, is a crucial issue in the field of education. A student's ability in mathematics not only plays a crucial role in their academic path but also has a long-term effect on their job chances (Kencana et al., 2020). Therefore, it is critical for educators, parents, and legislators to understand how parental participation and student motivation in mathematics interact.

Parental interest in mathematics refers to the level of zeal, prodding, and assistance parents give their kids while they study and understand mathematical ideas (Teodorović et al., 2022). Helping with homework, participating in mathematical conversations, or exposing kids to extracurricular math activities are just a few ways this interest could show out. However, a student's interest in mathematics is related to their individual curiosity, involvement, and desire in mastering the subject. Students are more likely to put in the effort necessary to thrive in mathematics when they have a true interest in the topic (Bütüner & Baki, 2020).

Parents' interest in mathematics has a variety of effects on their children (Froiland & Davison, 2016). A home learning environment that promotes mathematics as pleasurable and beneficial can be fostered by parents who

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demonstrate a real interest in the subject. As a result, a child may be more inclined to investigate mathematical ideas and work out difficulties. Additionally, parents that actively participate in arithmetic activities with their kids offer more chances for learning and skill improvement.

On the other hand, a student's aptitude in math is greatly affected by their personal enthusiasm in the subject (Kwarteng et al., 2018). Learners do better when they find mathematics interesting and relevant to their daily life because they are more willing to devote time and effort to it (Leyva et al., 2022). A student's self-efficacy may rise as a result of a strong interest in mathematics, boosting their self-assurance and motivating them to tackle more difficult math-related tasks (Ugwuanyi et al., 2020).

Parental interest in mathematics and student interest in the subject are two elements that frequently go hand in hand. Students can be inspired to be curious and interested in mathematics by their parents' love for the topic (Tambunan, 2018). In contrast, a student's excitement for math might, in turn, persuade parents to support their child's mathematical journey by increasing parental involvement (Ndijuye, 2023).

Examining the complex dynamics of these interactions and how they affect a student's math ability is crucial in this situation. The study aims to determine the impact of parental interest and student's interest in mathematics on student mathematics achievement. Figure 1 present conceptualisation model used for the study.

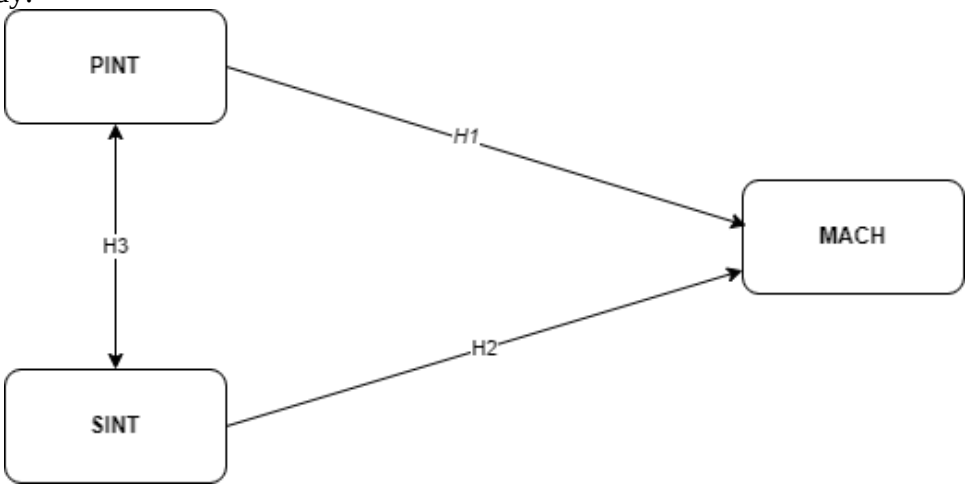

Figure 1: The conceptualised model

From the Figure (1), parental interest in mathematic (PINT) and students' interest in mathematics (SINT) serves as two independent variables while students mathematics achievement (MACH) serves as dependent variable. The Figure 1 aims to determine the impact of parental interest in mathematics (PINT) and student's interest in mathematics (SINT) on student's mathematics achievement (MACH) and the relationship between parental interest in mathematics (PINT) and student's interest in mathematics (SINT).

Literature review

Parent Interest in Mathematics on Students Mathematics Achievement.

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A problem of major importance in the field of education is the impact of parental interest in mathematics on a student's mathematical achievement. Parents are extremely important in influencing how their children feel and behave about math and other topics. Parental excitement and genuine mathematics interest can have a significant impact on their child's academic success and mathematical growth (Teodorović et al., 2022). Students are more likely to develop a good attitude toward mathematics when their parents do (Arthur et al., 2015). This attitude can help people feel less anxious about arithmetic and be more ready to interact with mathematical ideas. Students may study math more diligently and spend more time on it if their parents are also interested in the subject. Children frequently try to copy their parents, so if they witness their parents placing a high value on mathematics, they are more likely to make an effort to master the subject themselves (Froiland & Davison, 2016). Parents who have a mathematical interest are more likely to help their children with their schoolwork. They can greatly aid a student's comprehension and mastery of arithmetic subjects by providing explanations, advice, and a supportive learning environment at home. Talking about arithmetic with their children can help them develop their problem-solving and critical-thinking abilities. When parents actively participate in their children's discussions and inquiries about arithmetic, it can improve the child's comprehension and enthusiasm for the subject. Parents who are aware of the practical uses of mathematics can show their kids how important it is (Vaiopoulou et al., 2021). This can make math more fascinating and meaningful for pupils by demonstrating how math principles are employed in real-world situations. Parental engagement in mathematics can have a beneficial and long-lasting influence on a student's academic career (Chun & Dickson, 2011). If they have a solid foundation and an interest in mathematics from a young age, it may influence their academic and career choices.

H1: Parental mathematics interest has a direct positive influence on learner's achievement in mathematics.

Students' Mathematics Interest on their Achievement.

Higher levels of motivation are frequently accompanied by interest in mathematics (Arthur et al., 2022). Students are more likely to participate in their studies, finish their assignments, and persevere through difficult issues if they regard math to be engaging and pleasant (Abreh et al., 2018). Mathematically inclined learners are more likely to take active role in their education. They are more inclined to seek out more information to further their understanding, participate in class discussions, and ask questions. A student's ability to focus on mathematical tasks can be improved by interest in mathematics (Arthur et al., 2017). They are more inclined to devote the time and effort necessary for problem-solving and skill development, and they are less prone to get sidetracked. Mathematics-inclined students are more likely to voluntarily practice and investigate mathematical ideas outside of the classroom. This additional practice may result in better proficiency and skills. A student's self-efficacy-their confidence in their capacity to succeed at mathematical tasks can be increased by their passion in mathematics (Prast et al., 2018). Students that have stronger self-efficacy are more willing to take on difficult problems and persevere through

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challenges. Students may become more interested in mathematical issues as a result. They might look for advanced resources, research related topics, or gain a deeper comprehension of mathematical ideas.

Positive feelings like curiosity, excitement, and enjoyment are linked to an interest in mathematics (Karatas-Aydin & Isiksal-Bostan, 2022). The learning process may become more enjoyable and less stressful as a result of these feelings, improving performance. Improved problem-solving skills are frequently correlated with math interest (Ismail et al., 2023). Students who are passionate about arithmetic are more likely to approach challenging issues with imagination and perseverance (Arthur, 2022). In the end, kids who are highly motivated by mathematics typically perform higher on tests and examinations in the area. Their passion and commitment to the subject may result in better grades and scores on standardized tests.

H2: Students interest in math has a direct positive impact on their achievement in mathematics.

Relationship between Parent Interest and Students Interest in Mathematics.

Parents frequently act as examples for their children. When parents demonstrate a real interest in mathematics by talking about math-related subjects, completing math problems, or demonstrating love for the subject, it may encourage children to do the same. The attitudes and behaviors that students perceive in their parents have a higher chance of being imitated by them (Vaiopoulou et al., 2021). Parents who have a mathematical interest are more likely to support and encourage their children's mathematical endeavors (Lazarides & Ittel, 2012). Helping with homework, participating in conversations about arithmetic, and offering access to educational materials are some examples of this support. A good attitude and increased interest in mathematics can be fostered in students through such interaction. Positive learning environments can be created at home with the help of parents who are interested in mathematics. (Winter et al., 2021). Children are more likely to regard mathematics in the same manner when it is valued and enjoyed in the home, which might increase their own interest in the subject (Arbain & Shukor, 2015). Math-related interactions with their children are common among parents who show an interest in the subject. These conversations can pique a child's curiosity and inspire them to further investigate mathematical ideas, which will heighten their interest in the subject. Parents who have a passion for mathematics may introduce their children to math-related activities outside of the classroom, such as games, puzzles, and field trips. Student's interest in arithmetic can be further cultivated through these experiences, which can make it more interesting and fun (Yeh et al., 2019). Math-loving parents are more likely to encourage their children to ask questions and look for solutions (Arthur et al., 2015). This encourages curiosity and inquisitiveness, two qualities necessary for fostering an interest in mathematics. Math-interested parents may have higher standards for their students' performance in the subject (Anwar et al., 2019). Students may be inspired to have an active interest in mathematics and work toward academic success as a result of these expectations.

H3: There is a significant positive relationship between Parent Interest and Students' Interest in Mathematics.

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RESEARCH METHOD

The study used a survey design with a questionnaire as a data collection instrument to collect responses from the three senior high schools selected. The data collected will be analyzed using descriptive and inferential statistics. The researcher used three weeks for collecting data. The sample size of the study comprises of 200 first year students from selected four public senior high schools in the Ashanti Region of Ghana. These students undertake mathematics as a core subject. The researcher used stratified sampling and simple random sampling. Stratified sampling techniques was use to categorize the students into the various courses offered in the school and employed simple random sampling techniques that is, Yes or No method to select respondents from each starter for the study.

Three main variables, parents' interest in mathematics, students mathematics interest and students achievement in mathematics was used for the study. Five-point Likert scale was deployed for the measurement items which requires the respondents to choose from 1 been strongly agree to 5 been strongly disagree. The study uses four control variables (gender, age, religion, and course). The parent's interest in mathematics scale and student's interest in mathematics scale comprise five (5) items. This scale was adopted from the work of Arthur, (2019). Students' achievement in mathematics, on the other hand, was made up of seven (7). This scale was also adapted from Arthur et al. (2017) research. SPSS version 23 was used to analysed the data collected from the participants of this study. The analysis was in terms of frequency, percentages, mean, standard deviation and finally inferential statistics (SEM).

RESULTS AND DISCUSSION

Table 1 provides demographic data for a sample of 200 participants, categorized by sex and age group. Boys represent 55.5% of the sample (n = 111), while girls account for 45.5% (n = 89). With respect of the study, 31% of the participants are below 14 years (n = 62), 50.5% are in the 14–16 age group (n = 101), and 18.5% are above 16 years (n = 37). The majority of the sample is composed of boys and individuals aged 14–16 years, indicating a slight male predominance and a concentration of participants in the mid-teen age group.

Table 1: Participants characteristics

Demography	Category	Frequency	Percentage
Sex	Boys	111	55.5
	Girls	89	45.5
Age Group	Below 14	62	31
	14 – 16	101	50.5
	Above 16	37	18.5
Total		200	100

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Exploratory Factor Analysis (EFA)

Exploratory Factor Analysis was run in SPSS (Ver. 23) software to determine the number of indicators loaded at particular components (unobserved variable). Indicators whose loading are less than minimum threshold of 0.5 or without loading will either be removed or deleted for the appropriate indicators whose loading is above the maximum threshold of 0.5 and loaded at its rightful construct (Bamfo et al., 2018).

Table 2: Exploratory Factory Analysis (EFA)

Rotated Component Matrix			
Measurement Items	Component		
	1	2	3
PINT2		.849	
PINT3		.881	
PINT4		.868	
PINT5		.846	
SINT2			.814
SINT3			.842
SINT4			.807
SINT5			.804
MACH1	.733		
MACH2	.720		
MACH3	.847		
MACH4	.849		
MACH5	.850		
MACH6	.847		
MACH7	.828		

KMO and Bartlett's Test		
Total variance explained		80.33%
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.923
Bartlett's Test of Sphericity	Approx. Chi-Square	2915.321
	df	105
	Sig.	0.000
Determinant		2.79E-07

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
[a]Rotation converged in 5 iterations.

From Table 2, the factors PINT2, PINT3, PINT4, and PINT5, which are connected to parental interest in mathematics, have a significant impact on component 1. These items appear to be very closely related with Component 1 based on the high factor loadings. The variables SINT2, SINT3, SINT4, and SINT5, which reflect student interest in mathematics, are the key drivers of component 2. The significant factor loadings show that these items and Component

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2 have a strong connection. The variables MACH1, MACH2, MACH3, MACH4, MACH5, MACH6, and MACH7, which are associated with student mathematical achievement, define Component 3. On Component 3, these items have significant factor loadings.

The data is quite favorable for factor analysis, as shown by the KMO value of .923. It is suggested that the variables are appropriate for this analysis by a KMO value that is near to 1. The Bartlett's Test's p-value is .000, which is lower than the usual alpha level of .05. This reveals that factor analysis can move forward since the correlations between the variables are sufficiently different from an identity matrix. After applying a Varimax rotation with Kaiser Normalization, the rotation converged after 5 rounds. This rotation technique is frequently used to streamline the factor structure, optimize the variance explained by each component, and maintain the orthogonality (i.e., lack of correlation) of the components to improve interpretability.

Confirmatory Factor Analysis (CFA)

Confirmatory Factor Analysis (CFA) examines the fit of the model with the used of the retained indicator(s) from EFA results.

Table 3: Confirmatory Factor Analysis (CFA)

Model Fitness: CMIN = 133.667; DF = 83; CMIN/DF = 1.610; TLI = .978; CFI = .983; GFI = .921; RMR = .044; RMSEA = .055; PClose = .292	Std. Loading
PINT: CA = .941; CR = .941; AVE = .789	
PINT 2: My parent supports me when learning mathematics.	.859
PINT3: I learn mathematics with my parents.	.880
PINT4: My parents and I played mathematics games after learning mathematics.	.927
PINT5: My parent assists me with my mathematics assignment at home.	.906
SINT: CA = .927; CR = .929; AVE = .767	
SINT2: I like reading mathematics to other subjects.	.871
SINT3: Attending math lessons is execrating.	.912
SINT4: I easily give up when working on mathematics.	.885
SINT5: Teachers do not involve students in the teaching-learning of math.	.759
MACH: CA = .946; CR = .944; AVE = .707	
MACH1: My achievement in mathematics is far better than in any other subject.	.769
MACH2: My achievement in mathematics is excellent.	.759
MACH3: I can get better grades in mathematics tasks.	.864
MACH4: I'm naturally good at mathematics.	.890
MACH5: I am less worried about my achievement in math than any other subject.	.912
MACH6: I am highly confidence about mathematics concepts.	.880
MACH7: Learning complex concepts in mathematics worries me less.	.800

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The analysis of the CFA was done with the used of Amos (ver. 23) software. Moreover, we assess the structural equation model's (SEM) suitability and offer data on the standardized loadings for the observed variables corresponding to parental (PINT), student (SINT), and student achievement (MACH) mathematics interest. Average variance extracted (AVE) and composite reliability (CR) was examined to evaluate the construct validity of these variables.

From Table 3, the CMIN/DF ratio that is near to 1 denotes a good model fit, while the result of 1.610 in this case denotes a respectable fit. There is a good fit when the TLI, CFI, and GFI values are all near to 1. These metrics assess how well the model fits in comparison to a reference model. The difference between the observed and expected covariance matrices is measured by RMR. A decent match is indicated by a value of.044. The model appears to provide a reasonable fit to the data, according to the RMSEA value of.055. A good model fit is often characterized by RMSEA values below.08. The likelihood of a close fit is measured by PClose. Given that it is higher than the usual cutoff of .05. A value of .292 indicates that the model fit is reasonable. The values for CR and AVE show that the latent constructs are highly internally consistent (CR) and effectively capture the variance of the corresponding observable variables (AVE). The constructs show strong validity and reliability in convergent situations. Finally, the SEM model shows a good fit of the data, and the standardized loadings, CR, and AVE values show that the latent constructs are reliable and construct valid. This shows that the model accurately captures the links between parental, student, and parental interest in mathematics as well as student achievement in mathematics. Figure 2 presents the confirmatory factor analysis diagram.

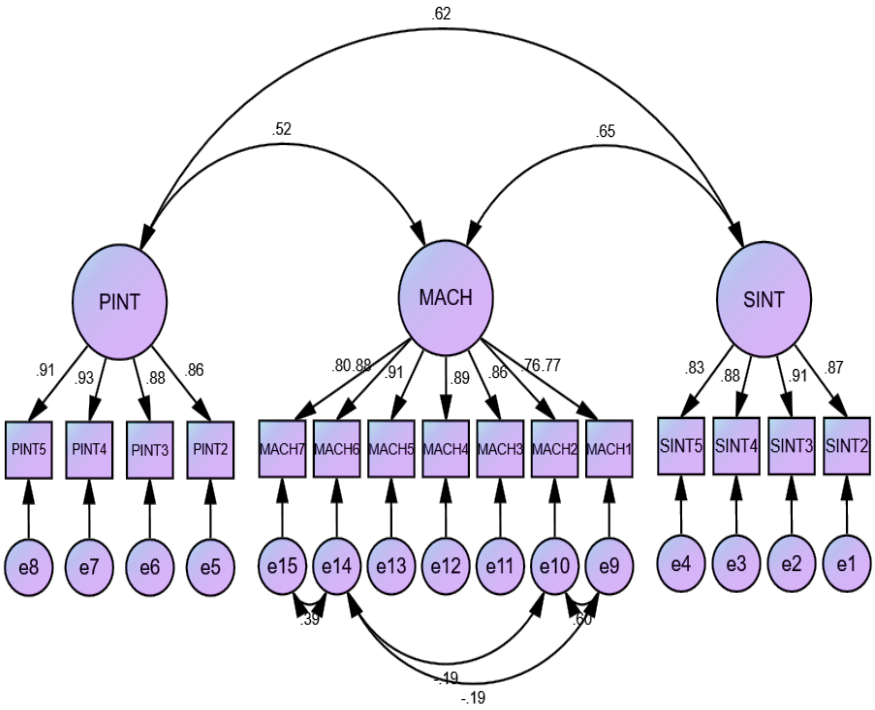

Figure 2: Confirmatory Factor Analysis (CFA)

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Discriminant Validity

In this study, we provide the findings from a structural equation model (SEM) analysis that took into account three variables: student success in mathematics (MACH), parental interest in mathematics (PINT), and student interest in mathematics (SINT). The analysis offers details on the CR, AVE, and the connections between these variables, including their path coefficients as shown (see Table 4).

Table 4: Discriminant Validity

Variables	CR	AVE	PINT	SINT	MACH
PINT	.941	.789	.894		
SINT	.929	.767	.620*	.876	
MACH	.944	.707	.645*	.516*	.841

Boldface is square root of AVE and * is correlation Sig. at 0.05

A discriminant validity is achieved when the least square-root of AVE is more that the highest value of the intercorrelated variables. From Table (4), the highest value for the intercorrelated variables was .645 (PINT and MACH) whiles the least value for the square-root for AVE is .841 (MACH). Since the least value for the square-root of the AVE exceeded the highest value for the intercorrelated variable, then discriminant validity has been achieved.

The route effects of parental and student interest in mathematics on student mathematics accomplishment (MACH) are examined in this study using the findings of a structural equation model (SEM) analysis. SEM was used to examine the connections between these variables and determine how they interact. For each path in the model, the analysis offers standardized estimates (Std. Estimate), critical ratios (C.R), standard errors (S.E), and p-values. Form Table 5, the standardized estimate of the relationship between gender and student mathematics achievement (MACH) is -0.011. This suggests that, despite being extremely modest and not statistically significant, there is a weak negative association between gender and mathematical achievement. Gender may not be a significant predictor of mathematical achievement, according to the critical ratio (C.R) for this path, which is -0.202 and the p-value is .840. In addition, the standardized estimate for the relationship between age and student mathematics achievement (MACH) is -0.014. This suggests a shaky inverse association between age and math ability, but like the gender impact, the relationship is very modest and not statistically significant. Age is not a reliable indicator of math proficiency, according to the critical ratio (C.R) for this path, which is -0.250, and the p-value is.803. Moreover, a considerable positive standardized estimate of 0.211 exists for the relationship between the course (probably referring to the kind of course or curriculum) and student mathematics accomplishment (MACH). This implies a strong positive correlation between mathematics achievement and the course type. The type of course substantially predicts mathematics achievement, as shown by the critical ratio (C.R) for this path of 3.611 and the p-value of .000. Finally, a standardized estimate of .033 corresponds to the relationship between religion and student mathematical achievement (MACH). This suggests a somewhat favorable correlation between

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religious belief and mathematical ability, although the effect is marginal and not statistically significant. Religion does not significantly predict mathematical achievement, according to the C.R for this path, which is .576, and the p-value is .565.

Table 5: Summary Path

Path Effects	Std. Estimate	S.E	C.R	p-value
Gender→MACH	-.011	.092	-.202	.840
Age→MACH	-.014	.053	-.250	.803
Course→MACH	.211	.039	3.611	.000
Religion→MACH	.033	.050	.576	.565
PINT→MACH	.189	.072	2.410	.016
SINT→MACH	.529	.077	6.156	.000
PINT↔SINT	.620	.069	6.611	.000

Result in Table 5 show that, the standardized estimate of the relationship between student mathematics achievement (MACH) and parental interest in mathematics (PINT) is .189. This suggests that parental interest in mathematics and student achievement in mathematics is positively correlated. At the p .05 level (p-value =.016), the critical ratio (C.R) for this path is 2.410, which is statistically significant. Therefore, it can be said that parental mathematics interest has a very favorable influence on their children's accomplishment in math. Therefore H1 *"Parent interest in mathematics has a direct positive effect on student's mathematics achievement"* is accepted for this study.

Moreover, a significant standardized estimate of .529 exists for the relationship between student interest in mathematics (SINT) and learner mathematics achievement (MACH). This shows that a learner's own mathematics interest and their ability in math have a substantial and favorable relationship. Strong statistical significance is indicated by the critical ratio (C.R) for this path, which is 6.156 (p-value =.000). Thus, it can be said that a student's passion in mathematics had a considerable and beneficial influence on their achievement in the subject. Therefore *H2 "Students Mathematics Interest has a direct positive effect on Mathematics Achievement"* is accepted for this study.

Finally, the standardized estimate of the bidirectional relationship between parental and student mathematics interest is .620. This reveals a significant and favorable association between parental and student interest in mathematics, demonstrating the interdependence of these two variables. The critical ratio (C.R) for this path is 6.611, and it has a very high statistical significance (p-value =.000). This suggests that parental and student mathematics interest is significantly related and reinforces each other. Therefore H3 "*There is a significant positive Relationship between Parent Interest and Students Interest in Mathematics"* is accepted for this research.

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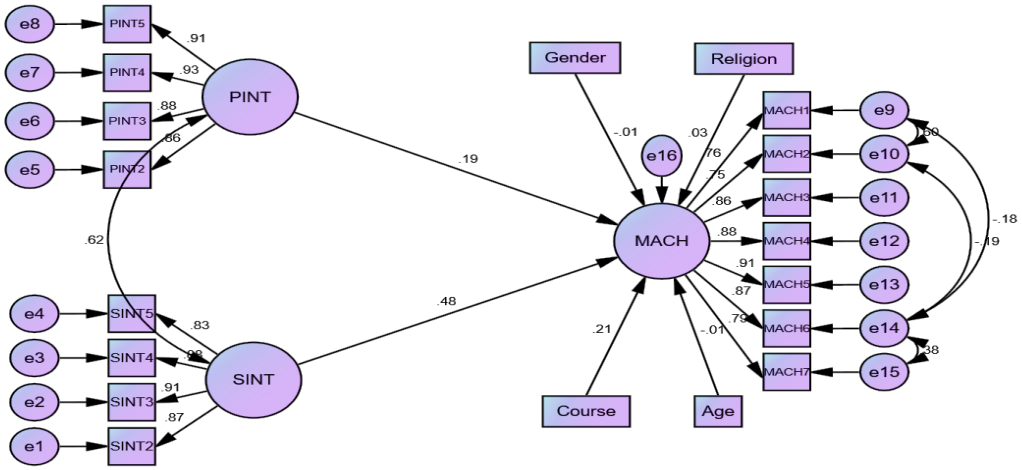

Among the three selected student, the effect of parental mathematics interest on learner's mathematics achievement was statistically significant. The study further explains that, there was 18.9% positive effect on learner's achievement in mathematics when parents show interest in learning mathematics. The current study confirmed with other studies (Arthur et al., 2022; Callaman & Itaas, 2020). They concluded that, the interest parents developed in mathematics learning had a significant effect in learner's mathematics interest. Parent pedagogical content knowledge in mathematics had a significant influence on learners mathematics performance (Appiah et al., 2023; Teodorović et al., 2022).

Moreover, learners' mathematics interest had a statistically positive influence on their achievement. The study result support the study of Doño and Mangila (2021) and Prast et al., (2018). In their study found that, learner's mathematics interest significantly predicts their mathematics achievement. According to Heinze et al. (2005), interest in mathematics is a reliable predictor of mathematics achievement. A study was conducted by Froiland and Davison (2016) to determine the impact of math interest of 11th grade students on their mathematics achievement. The finding of their study revealed that, mathematics achievement of 11th grade learners was influenced by their mathematics interest.

Finally, the analysis result shows that there is a positive strong correlation between parent interest in mathematics and learner's mathematics interest. The study result is in line with a study of (Barut & Wijaya, 2020). Their study concluded that, the relationship between parent mathematics interest and learner's interest in mathematics was positive and statistically significant. Farooq et al. (2011) in their study found that, when parent shows interest in mathematics when teaching their children has a significant influence on their children interest in mathematics. Student's mathematics interest is an essential factor that determines student's active participation and achievement in mathematics (Arthur et al., 2017; Yeh et al., 2019).

CONCLUSION

The students concluded that, parent mathematics interest had a significant direct positive impact on learners' mathematics achievement. Moreover, learner's mathematics interest had a significant positive influence on their mathematics

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achievement. Finally, the study result showed that, there was a statistically positive and significant association between parent mathematics interest and students' interest in mathematics. Based on the results of the study, the researcher recommends the following.

Encourage Parental Involvement: Parents should be encouraged to show interest in mathematics and actively participate in their children's learning process. This could be through helping with homework, discussing mathematical concepts, or even learning alongside them.

Foster Interest in Mathematics Among Learners: Educational institutions should aim to make mathematics more engaging and interesting for students. This could be achieved through practical applications, interactive learning methods, and real-world problem-solving activities.

Create a Positive Learning Environment: A positive and supportive learning environment can help foster interest in mathematics. Teachers and parents should avoid negative comments about the subject and instead highlight the importance and relevance of mathematics in everyday life. Teacher acceptance and use of technology (see, Bandoh et al., 2024; Lotey et al., 2023) in pre-tertiary mathematics education could help create a conducive learning environment.

Continuous Assessment and Feedback: Regular assessment of the students' mathematical skills can help in identifying areas of improvement. Constructive feedback can boost their confidence and interest in the

As the sample size was small, generalisation prospects can be discarded. Future studies can examine larger sample size. For more insight into mathematics performance, further studies can investigate factors such as techniques and materials used by facilitators in teaching mathematics concepts, especially geometric topics. Additional work should involve qualitative.

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