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## RESEARCH ARTICLE

# ASSESSMENT OF GRADE10 STUDENTS' PERFORMANCE IN MATHEMATICS: THE CASE OF JIMMA ZONE

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**ABSTRACT**

The purpose of this study was to investigate the performance of grade10 students in mathematics tests and identify the major causing factors that influence students' achievement in mathematics. A correlation research design was employed. 10 secondary schools were sampled by purposive sampling technique. 21 sections (1378 students) of 10th grade students studying in the academic year 2014/15 and 40 mathematics teachers were sampled by Systematic sampling technique in the sampled schools. The study was carried out by employing close-ended questionnaires addressing issues attributing to mathematics achievement like gender stereotype, attitude, demographic factors, instructional factors, individual factors, students' mathematics semester average and grade letter of Ethiopian General Education Certificate Mathematics Examination (EGSECME). These variables were analyzed statistically with t-test and correlation analysis using version 20 SPSS-PC software package. The results of the study indicated that there is statistically significant differences between male and female students in mathematics achievement in EGSECME grade letter; and male students significantly performed better than female students. Moreover, the analysis of close-ended questions showed Demographic Factors, Instructional Factors, and Individual Factors are the causing factors that attribute to students' low mathematics achievement.



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## INTRODUCTION

Mathematics as a subject affects all aspects of human life at different degrees. The social, economic, political, geographical, scientific and technological aspects of man are centered on numbers. Disciplines where numbers are predominant and form integral part of mathematics include: statistics, accounts, arithmetic, engineering, etc. For example, the earliest civilization of mankind came through mathematical manipulations. The inter-relationship between mathematics, development and advancement of humans shows the importance of mathematics in life due to its numeral and symbolic nature, it is more related to the scientific and technological facets of man's world than to any other aspect as it occurs and re-occurs in the physical and natural sciences. The basic skills underlying all scientific and technological skills are the control of the tools of mathematics. Mathematics is seen as the language used to describe the problems arising in most branches of science and technology.

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It is a subject that is related to other school subjects in areas like number and numeration, variation, graphs, fractions, logarithms and indices, algebraic processes, solution of equation and also in area and volume. According to Schoefeld (1994), students would developed better mathematical thinking and perform better when the classroom creates an enabling environment in which students would have frequent opportunities to engage in more mathematical activities. Hynchley and Bell, (1993) recognized the effects of poor classroom factors on student's performance during mathematical activities and wrote this, "Underestimating the effect of concrete sensory experience is an important reason for the mathematics failure of many students at Senior High School". The obvious remedy for the students to perform better in mathematics is to make the contents real or decrease its abstractiveness and relate the concept to real life situation. Doyle, (1988) said it is important to structure classroom activities so that appropriate amounts of time are devoted for each mathematical activity where the student would developed the capacity to reason and solve mathematical problems in appropriate and powerful ways. However, the performance of students in mathematics has been a great concern to the society. Awokoya (1975), Fafunwa (1980), both agreed in

different researches that we live in a world where science and technology have become an integral part of the world culture, therefore, for any nation to be relevant; it must not overlook the importance of mathematics in its educational system. It is important for educators to adopt instructional design techniques to attain higher achievement rates in mathematics (Rasmussen and Marrongelle, 2006). Considering students' needs and comprehension of higher-order mathematical knowledge, instructional design provides a systematic process and a framework for analytically planning, developing, and adapting mathematics instruction (Saritas, 2004). "[Instructional design] is an effective way to alleviate many pressing problems in education. Instructional design is a linking science – a body of knowledge that prescribes instructional actions to optimize desired instructional outcomes such as achievement and effect" (Reigeluth, 1983, p.5). A growing body of research provides additional factors which could have an impact on students' achievement such as *gender, family structure, parents' educational level, socio-economic status, parent and student attitudes toward school*, and *parent involvement* (Campbell *et al*. 2000; Epstein, 1991; Fennema and Sherman, 1976, 1986; Fluty, 1997). Three factors or predictors in math achievement, are divided into sub factors: Demographic Factors (gender, socio-economic status, parent's educational level), Instructional Factors (teacher competency, instructional strategies and techniques, curriculum, school context and facilities), and Individual Factors (self-directed learning, arithmetic ability, motivation).

**Statement of the Problem**

In Ethiopia, greater emphasis is being placed on Industrial and Technological development. As a result, students are being encouraged to take up science related subjects. One subject that cut across all the sciences is mathematics because mathematical methods pervade literally every field of human endeavor and play a fundamental role in economic development of a country. Findings of National Learning Assessment carried out in 2010on EGSECE showed that students' performance in Mathematics was very low. According to this assessment, in Grade10 the analysis of variance showed a statistically significant difference in Mathematics score across regions .For instance, SNNP (36.1%) and Amhara (36.1%) scored highest. Gambella (25.4%) and Afar (28.2%) achieved lowest scores and the mean differences were statistically significant with the highest achieving ones, and Oromia scored (35.0%) (Zewdu, 2010). This is in agreement with the findings of (Umoinyang, 1999), and stated 'unfortunately performance of students in mathematics at the end of secondary education has not improved in the past decade.' Surprisingly, no region scored the minimum requirement(50%) set by MOE, in 2002 policy, to be attained in mathematics. Further, we analyzed G10 Mathematics EGSECE letter grades of three veteran secondary Schools of Jimma Zone, namely Dimtu, Jiren and Aggro, and a simple analysis showed that from the total of 5,623 students took G10 EGSECE in mathematics between the years 2008-2013, 1.52%, 6.60%, 49.09%, 24.52% and 11.99% of the students scored A, B, C, D and F, respectively. As it can be seen from this simple analysis students' G10 EGSECE result for the past six years (2008-2013) was very low in mathematics. And it might be natural to conclude that the EGSECE mathematics results of grade 10 students in the rest of secondary schools of Jimma zone could not be better than the results analyzed for the aforementioned three veteran secondary schools because these schools are rich in resources and experience.

**Significance of the Study**

A growing body of research findings indicates that demographic, individual; gender and instructional factors have an impact on the mathematical achievement of students. Identifying factors that affect mathematics achievement is particularly important to effectively educate new generations in a difficult subject. It also provides instructional designers better inputs for their design decisions. The purpose of the present study was to find answers to the following research questions:

- What are the factors that contribute to students' low performance in mathematics tests?
- What are the relationships between and among beliefs, attitudes and feelings towards mathematics, and achievement in mathematics?
- To what extent teaching materials used by teachers, teacher's classroom management, teachers' content knowledge and personality, teaching topics with real life enriched examples influence the students towards a favorable learning and learning outcome?
- To what extent do gender, family structure, parents' educational level, socio-economic status, parent and student attitudes toward school, and parent involvement have an impact on students' achievement in mathematics?

**Research Design and Population**

The design of this study was correlational mainly following quantitative approach supported by qualitative through questionnaires focused on those factors that result in students' poor achievement in Mathematics tests in the selected secondary schools of Jimma zone.

**Sampling Procedure and Sample Size**

The population of this study includes all existing governmental secondary schools in Jimma zone. To this end, ten secondary schools were selected as a sample schools for this study. These schools were selected purposively based on road accessibility, rich in their experience and resources. Teachers and students who participated in this study were also sampled appropriately. All mathematics teachers (on average 4-5 teachers per school) were expected. Systematic random sampling technique was used to choose all the 21 sections from the sampled schools.
Accordingly, 45teachers and 1378 students were expected from the selected ten secondary schools. From this sample size the survey respondents were 40 teachers and 1348 students who returned the questionnaires properly. Besides, some questionnaires were excluded from the analysis since they missed some of the key information. Owning to this, of 1348

students who returned the questionnaires, the responses of 1313 students was included in the analysis.

### Instruments of Data Collection and Administration

The instruments employed to gather appropriate data for this study includes questionnaire and documentation. Questionnaires were used as the major instrument to collect data from both teachers and students. The instrument was tested in the nearby secondary schools after three senior researchers critically commented upon it for further improvement, to improve the validity and reliability. The items in the questionnaire include background information, the range of achievement variables in terms of mathematics; having about 19 to 22 items with close ended questions.

### Data Analysis Techniques

The analysis was mainly based on descriptive combining some positive parameters like strongly agree, and agree on one hand and the negative parameters like strongly disagree and disagree on the other hand so that the aggregate could provide general picture of the respondents' views. Close ended items of the questionnaire were encoded using version 20 SPSS-PC software package and basic statistical methods were employed for analysis.

## DATA ANALYSIS AND DISCUSSION

### Respondents' Background Information

In this study, a total of 1353 respondents were involved, out of whom 1313 were students and the remaining 40 were teachers. Of 1313 student respondents, 1119 of them indicated their sex of which 44.5 % were males and the remaining 55.5% females. Among a total of 40 school teachers who indicated their sex, 94.3% were males and the remaining 5.7% females. The academic qualification of these mathematics teachers was at the level of first degree. Regarding their service years, it ranged from 1 to 38 years. And their average service year was 17.8 years.

### Data Analysis

As illustrated in Table 1, 88.2% of the respondents believed that motivating students to solve their own mathematical problems during mathematics class is teacher's vital task to help students understand mathematical problems ,whereas 63.7% rated that effective mathematics teachers should enjoy learning and 'doing' mathematics themselves, and 74.3% of the respondents agreed that the teacher should provide students with clear and concise solution methods for mathematical problems, which is contrary to most literatures. For instance, the teacher's main instructional task is to create a learning environment where students can engage in mathematical thinking activities and see mathematics as something requiring "exploration, conjecture, representation, generalization, verification, and reflection" (Carr, 1996, p.58).

Whereas,81.9% of the respondents rated solving mathematical problems as an essential part of the mathematics learning experience because it maximizes the benefit of student exploration and discovery (Martin A. Simon, 1986). Meanwhile, 73.8% of the respondents indicated that they start instruction by reviewing concepts with students, emphasizing comparisons to previously covered concepts, and 88.3% of the respondents agreed that they identify a new skill or concept at the beginning of instruction and provide a rationale for learning it. For instance, (Reigeluth, 1983, p.5) emphasized that considering students' needs and comprehension of higher-order mathematical knowledge, instructional design provides a systematic process and a framework for analytically planning, developing, and adapting mathematics instruction. The results in Table 2 indicated that students' attitude towards mathematics tends to be negative. For instance, more than 60% of the students did not realize the usefulness of mathematics and they do not feel free during mathematics classes. And 53% of the students agreed that success in mathematics is a matter of naturally gifted. To the contrary, 52.3% of the students rated that they can understand mathematics if due attention and time is given at studying it.

**Table 1. Teacher believe survey in teaching mathematics**

| Items | Scales of Agreement | | | |
|---|---|---|---|---|
| | Strongly disagree (%) | Disagree (%) | Agree (%) | Strongly agree (%) |
| 1. A vital task for the teacher is motivating students to solve their own mathematical problems | 2.9 | 8.8 | 50.0 | 38.2 |
| 2. Effective mathematics teachers enjoy learning and 'doing' mathematics themselves | 9.1 | 27.3 | 15.2 | 48.5 |
| | 5.4 | 12.7 | 54.9 | 27.0 |
| 3. Providing students with interesting problems to | | | | |
| | 0.0 | 16.7 | 38.9 | 44.4 |
| investigate in small groups is an effective way | | | | |
| | 5.7 | 20.0 | 42.9 | 31.4 |
| to teach mathematics | | | | |
| | 2.9 | 11.8 | 41.2 | 44.1 |
| 4. Students always benefit by discussing their solutions to mathematical problems with each other | | | | |
| | 0.0 | 6.3 | 71.9 | 21.9 |
| 5. It is the teacher's responsibility to provide | | | | |
| | 9.1 | 12.1 | 57.6 | 21.2 |
| students with clear and concise solution | | | | |
| | 3.1 | 3.1 | 50.0 | 43.8 |
| methods for mathematical problems | | | | |
| | 11.8 | 0.0 | 55.9 | 32.4 |
| 6.Mathematical material is best presented in an | | | | |
| | 5.1 | 7.7 | 66.7 | 20.5 |

Besides, about 60.9% of the students believed that a lot of things, about mathematics, have already been done by mathematicians. As a result, they preferred memorizing formulas and things to understand the concepts behind these formulas and when and how to use the available formulas. A single fact that all earlier studies on students' attitude and achievement in mathematics unanimously agreed on was a strong correlation between mathematics attitude and mathematical achievement, perceived usefulness of mathematics and mathematical achievement, and students' perceived confidence as a predictor of success in mathematics (Antonnen, 1969; Fennema and Sherman, 1978; Bouchey and Harter, 2005).

As illustrated in Table 3, above, 62.8% of the students believed that male students perform better than their female counter parts in mathematics tests. This fact is in agreement with the study conducted on gender differences in relation to mathematics achievement and self-confidence. (Grootenboer and Hammings, 2007), and they wrote…" those students who were rated more highly on mathematics performance by their teachers tended to be male." Whilst, 64.3% of the students agreed that parents' educational level has contribution to students' success or failure in mathematics. And 61.1% of the students rated that socio-economic factor is also among those factors that contributes to students' achievement in mathematics. For instance, Israel *et al*. (2001) concluded that parents' socio-economic status is correlated with a child's educational achievement. Another study by Jensen and Seltzer (2000) showed that factors such as individual study, parents' role, and social environment had a significant influence on "further education" decisions and achievements of young students'.

As depicted in Table 4, 76.4% of the respondents agreed that inappropriate mathematics curriculum results in poor students' mathematics achievement. And majority of the respondents (more than 70%) rated that instructional strategies and methods, teacher competency in mathematics education and school context and facilities highly influence students' performance in mathematics (Fennema and Sherman, 1986; Fluty, 1997). As it can be observed from Table 5 above, majority of the respondents (more than 65%) agreed that self-direct learning of the student, arithmetic ability of the student, and motivation are some of the factors that highly influence students' performance in mathematics. For instance, a study by Jensen and Seltzer (2000) showed that factors such as individual study, parents' role, and social environment had a significant influence on "further education" decisions and achievements of young students'. In another study, Meece, Wigfield and Eccles (1990) investigated cognitive motivational variables that influence high school students' decisions to enroll in advanced mathematics courses. Their findings revealed that mathematics ability perceptions affect students' valuing of mathematics and their expectations for achievement.

As shown in Figure 1, and Table 6, of 1319 students, 61(=8.5%) female students and 46(=7.7%) male students scored F grade, 208(=28.9%) female students, and 153(25.6%) male students scored D grade, 43.3% female, and 40.1% male students scored C grade, 13.3% female and 20.6% male students scored B grade, only 6% female and 6% male students scored A grade. Furthermore, it can be inferred that, male students performed better than their female counter parts. The study by Grootenboer and Hemmings (2007) found that those students who were rated more highly on mathematics performance by their teachers tended to be male.

**Table 2. Students'Attitude towards Mathematics, as reported by the students**

| Items | Scales of Agreement | | | |
|---|---|---|---|---|
| | Strongly agree (%) | Agree (%) | Disagree (%) | Strongly disagree (%) |
| 1. Mathematics is the most useful subject of all | 21.2 | 15.3 | 40.9 | 22.5 |
| 2.Mathematics makes me feel uneasy &confused | 16.2 | 20.6 | 34.1 | 29.1 |
| 3.Mathematics is enjoyable and stimulating t me | 19.7 | 25.8 | 27.7 | 26.7 |
| 4. There is nothing creative about mathematics; it's just memorizing formulas & things | 34.4 | 26.5 | 18.4 | 20.8 |
| 5. I try to learn mathematics because it helps develop my mind and helps me think more clearly in general | 31.5 | 46.6 | 16.2 | 5.8 |
| 6. Mathematics can be understood if time is devoted at studying it | 27.2 | 25.1 | 27.9 | 19.9 |
| 7. Mathematics class is always boring | 35.2 | 29.7 | 16.8 | 18.4 |
| 8.Unless you are gifted you can never understand mathematics | 27.4 | 25.6 | 25.2 | 21.9 |
| 9. Studying mathematics strengths my thinking ability and gives me pleasure | 25.0 | 14.2 | 26.3 | 34.5 |

**Table 3. Effects of Demographic Factors on Students' Mathematics Achievement, as reported by students**

| Items | Scales of Agreements | | | |
|---|---|---|---|---|
| | Strongly agree (%) | Agree (%) | Disagree (%) | Strongly disagree (%) |
| 1.Male students perform better than their female counter parts in mathematics | 27.0 | 35.8 | 28.1 | 16.1 |
| 2. Parents' educational level highly influences students' mathematics performance | 19.9 | 44.4 | 22.0 | 13.7 |
| 3. Socio-economic status is a determining factor that influences students' mathematics achievement | 23.9 | 37.2 | 23.6 | 15.4 |

**Table 4. Effects of Instructional Factors on Students' Mathematics Achievement, as reported by the students**

| Items | Scales of Agreement | | | |
|---|---|---|---|---|
| | Strongly agree (%) | Agree (%) | Disagree (%) | Strongly disagree (%) |
| 1.Mathematics curriculum may contribute to poor students' achievement in mathematics | 32.6 | 43.8 | 13.8 | 9.8 |
| 2. Instructional strategies and methods are keys in determining students' achievement in mathematics | 23.6 | 53.1 | 17.9 | 5.4 |
| 3.Teacher competency in mathematics education highly influences students' performance in mathematics | 30.5 | 47.8 | 15.1 | 6.5 |
| 4.School context and facilities have an impact on students' mathematics result | 24.6 | 45.3 | 21.3 | 8.9 |

**Table 5. Effects of Individual Factors on Students' Mathematics Achievement, as reported by the students**

| Items | Scales of Agreements | | | |
|---|---|---|---|---|
| | Strongly agree(% ) | Agree (%) | Disagree (%) | Strongly disagree (%) |
| 1.Self-direct learning of the student has a Strong relationship with student's mathematics result | 29.4 | 45.6 | 16.4 | 8.6 |
| 2.Arithmetic ability of the student influences his/her performance in mathematics | 25.5 | 41.5 | 22.7 | 10.3 |
| 3. Mathematics education requires highly Motivated students because it requires reasoning, making interpretations, & solving problems mathematical issues, & concepts | 32.1 | 40.5 | 18.5 | 9.9 |

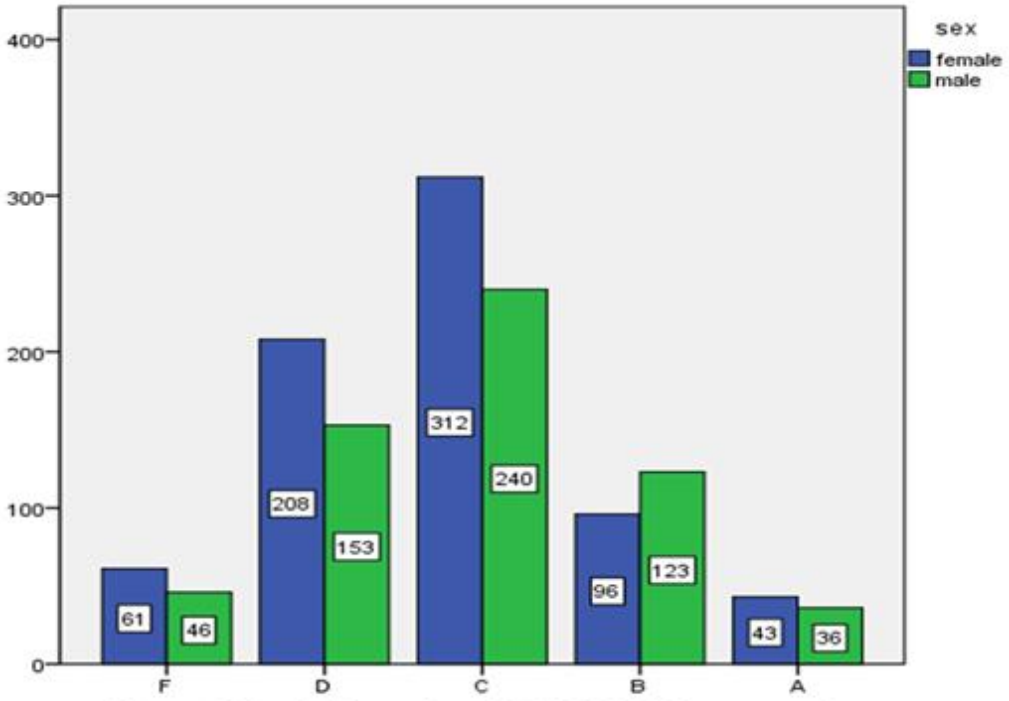


**Figure1.Grade10 students' EGSECME letter grade distribution by Sex**

**Table 6. Grade10 students' EGSECE mathematics letter grades distribution by Sex Cross tabulation**

| | | Grade | | | | | Total | Chi-square(p-value) |
|---|---|---|---|---|---|---|---|---|
| | | F | D | C | B | A | | |
| Sex | Female | 61 | 208 | 312 | 96 | 43 | 720 | |
| | | 8.50% | 28.90% | 43.30% | 13.30% | 6.00% | 100.00% | 12.64(.013) |
| | Male | 46 | 153 | 240 | 123 | 36 | 598 | |
| | | 7.70% | 25.60% | 40.10% | 20.60% | 6.00% | 100.00% | |
| | Total | 107 | 361 | 552 | 219 | 79 | 1318 | |
| | | 8.10% | 27.40% | 41.90% | 16.60% | 6.00% | 100.00% | |

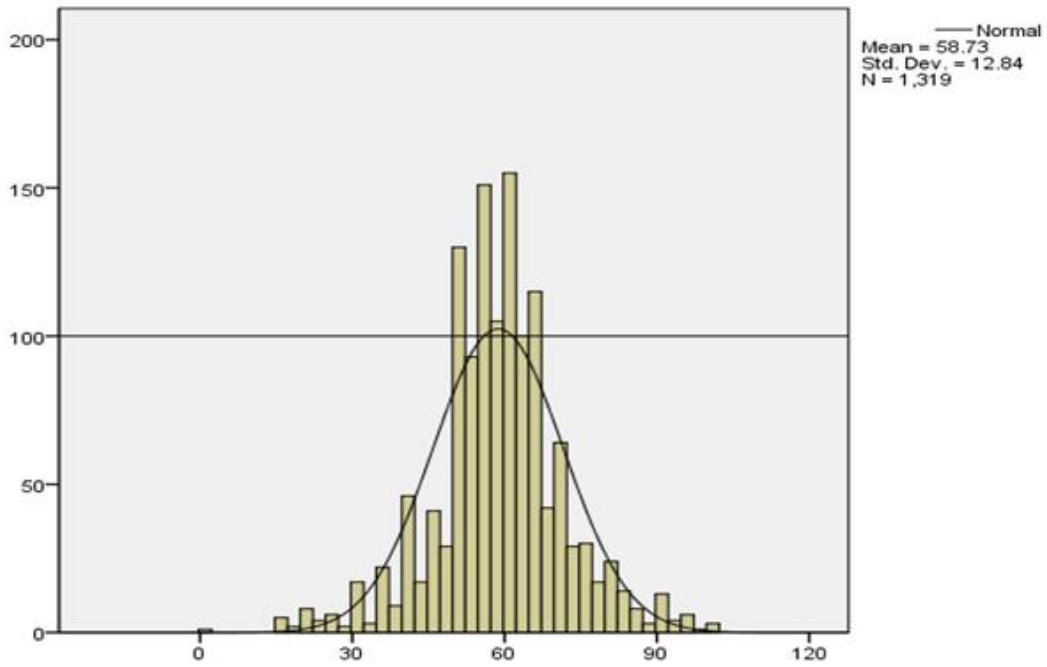


**Figure2. Normality check: Students' Mathematics semester average scores (continuous dataset**

**Table 7. Correlations among grade10 students sex, EGSECME grade & Mathematics semester average**

| | | Average | sex | Grade |
|---|---|---|---|---|
| Average | Pearson Correlation | 1 | -0.017 | .211** |
| | Sig. (2-tailed) | | 0.537 | 0.000 |
| sex | Pearson Correlation | -0.017 | 1 | .061* |
| | Sig. (2-tailed) | 0.537 | | 0.026 |
| Grade | Pearson Correlation | .211** | .061* | 1 |
| | Sig. (2-tailed) | 0.000 | 0.026 | |

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Being either classified as "above average" or "below average" in terms of mathematics performance was influenced significantly by gender. That is, males were more prone to be members of the above-average performance. Furthermore, the value of $p = 0.013<0.05$ indicated that there is an association (correlation) between grade10 students EGSECME letter grade and gender. As shown in Table7, a positive significant correlation was observed between students' mathematics semester average and grade 10 students' EGSECE Mathematics letter grade. ($r = 0.211$, $p= 0.000<0.010$), and between gender and students' mathematics grade 10 students' EGSECE Mathematics letter grade ($r = 0.061$, $p = 0.026<0.05$). However, there is no significant correlation between gender and students' mathematics semester average.

## DISCUSSION

As shown in Table 6, 35.5% of the students scored D and F, only 6% of the students scored 'A' in Grade10 students' EGSECE in Mathematics, and their mathematics semester average mean was 58.73(see Figure 2). This indicates that grade 10 students' performance in mathematics was low. However, failure to meet the standards of proficiency in mathematics is a complex matter to pin point the blame even to the learners.

There are many variables like teacher quality, financial resources of the school, quality of instruction, and many more are out of their control (McGuire, 2000) as referred by Joefeal S. Susan (2014).

### Students' Attitude and Mathematics Achievement

As indicated in Table 2, students' attitude towards mathematics was negative. Students who have high level of positive attitude in mathematics will have high level of success in mathematics (Tooke and Lindstorm, 1998). Inevitably, students' perceived confidence is a critical predictor of success in mathematics (Bouche and Harter, 2005).

### Demographic Factors and Mathematics Achievement

As the results of this study indicated, male students performed better than their female counter parts in mathematics, and parents' educational level & socio-economic status were also among the predictors of students' achievement in mathematics. Further, as shown in Table 7, a positive significant correlation was observed between students' mathematics semester average and grade10 students' EGSECME letter grade ($r = 0.211$, $p = 0.000<0.010$), and gender and students' mathematics grade10 EGSECME letter grade ($r = 0.061$, $p = 0.026<0.05$). However,

there is no significant correlation between gender and students' mathematics semester average.

**Instructional Factors and Mathematics Achievement**

As the results of this study indicated, majority of the students agreed that mathematics curriculum, instructional strategies and methods, and teacher competency in mathematics education were among the factors that influence students' performance in mathematics. This testifies the fact that teaching materials used by teachers, teacher's classroom management, teachers' content knowledge and personality, teaching topics with real life enriched examples influence students towards a favorable learning and learning outcome (Yilmaz, Altun and Olkun, 2010).

**Individual Factors and Mathematics Achievement**

The teacher's main instructional task is to create a learning environment where students can engage in mathematical thinking activities and mathematics as something requiring "exploration, conjecture, representation, generalization, verification, and reflection" (Carr, 1996, p.5). This indicates that self-direct learning (including students' patience, confidence, and willingness towards problem solving), arithmetic ability (ability of problem solving), and motivation were the key predictors of students' achievement in mathematics.

**Conclusion and Recommendations**

It is accepted that changing the quality of teaching and learning mathematics in positive direction is one of the major challenges and concerns of educators and instructional designers (Colakoglu and Akdemir, 2008). They ought to seek innovative and alternative ways to meet the evolving demands and needs of students in mathematics education. Identifying the factors that possibly affect the mathematics achievements of students could help instructional designers and instructors to select the best instructional strategies to design the most effective and efficient instruction. Effects of demographic factors including gender, parents' education level and socio-economic status on math achievement were investigated. Gender was found an important factor influencing the mathematics achievement of students; this is in agreement with other studies (Campbell, 1995; Gray, 1996; Kimball, 1989).

Parents' education level was found to be an effective factor in achievement of students in mathematics courses similar to the results of Coleman, (1966) and Campbell, Hombo and Mazzeo, (2000). Parents with higher level of education could be a role model for their children to accomplish high levels of achievement in math courses. Similar to the Eamon, (2005); Jeynes, (2002); Hochschild, (2003) and McNeal, (2001), socio-economic status in this study was reported as an important factor affecting the math achievement of students in math courses. Other significant factors in mathematics instruction and student achievement include curriculum, instructional strategies, methods, teacher (mathematics) competency, school context and facilities. The mathematics curriculum contains specific subject-matter and instructional design principles to enable students to develop logical and mathematical skills needed to understand fundamental mathematical concepts. Instructional strategies and methods are important for the achievement of students. The literature suggests that learning situations ought to be selected and implemented in a way that allows students to apply higher order operations (Wilson, 1996). Another important factor mathematics achievement is teacher competency (Ball, 1993). School safety and facilities (Reyonds *et al*., 1996), features of the school buildings, and crowdedness of school (Rivera-Batiz and Marti, 1995) were also reported to influence the achievement of students. Collectively, these results point out that attention should be given to school context and facilities to improve the mathematics achievement of students.

Understanding the student is important to identify factors they perceive to be effective for achievement in mathematics. Findings of this study revealed three factors that contribute to mathematics achievement: instructional strategies and methods, teacher competency in math education, and motivation or concentration. Further investigation of these three factors, through experimental studies, should enable instructional designers and math educators to continue to improve mathematics instruction. The findings also suggest that different instructional design strategies should be studied and applied in different contexts. Experiment with new instructional design models in a variety of different circumstances is vital to optimize mathematics instruction. One-size-fits-all instructional design strategies are not as efficient as those that are customized to meet specific learner needs. It is important to embody diagnostic and prescriptive tools to determine the best-fit design for each individual learner, and to make learning more meaningful based on known critical factors that affect mathematics achievement.

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