DOI: https://doi.org/10.56738/issn29603986.geo2023.4.35
ISSN 2960-3986
GEO Academic Journal Vol. 4 No. 1 – 2023 series


**Internal and External Factors Influencing Math Performance:**

**Predictive Model for a Development Plan**

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DOI: https://doi.org/10.56738/issn29603986.geo2023.4.35

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**Abstract**

Creating a mathematically literate citizenry by improving Math performance has been every educator's concern. Thus, the researcher aimed to determine the predictors of Math performance based on internal and external influences. It employed descriptive-correlational method having Grade 11-Academic track learners as respondents. It utilized survey questionnaire and employed document analyses. It was found out that the level of Math performance did not meet expectation. The level of internal factors in terms of academic control, student responsibility, comprehension skills, and attitude towards Math was high; but low on self-efficacy belief. The level of external factors in terms of NCAE was low on General Scholastic Aptitude, Technical-Vocational Aptitude, and Academic Track; while District-Initiated Test did not meet expectations. In terms of school-based factors, the level of school environment and learning resources/facilities in Math was high. In terms of socio-economic factors, combined monthly family income was very low, highest educational attainment of parents is elementary level. Significant correlation existed between Mathematical performance (MP) and academic control (AC), student responsibility (SR), attitude towards Math (ATM), general scholastic aptitude (GSA), technical-vocational aptitude (TVA), academic track (AT), Math 10 district-initiated achievement test (DIAT) and

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ISSN 2960-3986
GEO Academic Journal Vol. 4 No. 1 – 2023 series
GEO Global Educators Professional Enhancement International Inc.

learning resources/facilities (LR) in Math only. The predictive model was Math Performance = 5.71 + 7.89AC + 5.13SR + 0.14GSA + 0.25DIAT. Therefore, Math Performance is influenced by the learners' value on being responsible of their learning and by their cognitive ability. It is recommended that the development plan for Grade 11 Math be implemented.

*Keywords*: Mathematics, math performance, internal and external factors, predictive model, descriptive-correlational method,

## Introduction

The topmost priority of education is the quality of students' performance in academic standards (Junio & Liwag, 2016). Ideally, learners' academic performance is the outcome of teaching and learning process in terms of knowledge and skills in students acquired in schools (Maganga, 2016). While some students have high academic performance, others do not have. When a gap between the actual academic performance and the students' expected performance occurs, it becomes a diverging or unsatisfactory performance. Educators and researchers have been exploring factors that contribute to effectively address performance of learners. Learners are likely to perform better if they are aware and if they understand the factors that influence academic performance. Such factors could be internal or external.

An individual's motivated behavior is substantially driven by various intrinsic needs (Onay & Benligiray, 2018). This suggests that a learner exerts effort to attain academic success because it is driven by relative needs within him. These internal drives may include academic control, student responsibility, comprehension skills, attitude towards Math and self-efficacy belief. These factors perceive attractiveness of future outcomes that can likely be attained with the belief that exerting effort will actually lead to high performance. On the other hand, academic performance can also be influenced by external factors which may

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ISSN 2960-3986
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include test results in National Career Assessment Examination (NCAE) in the subtests of General Scholastic Aptitude (GSA), Technical-Vocational Aptitude (TVA) and Academic Track (AT), and District-Initiated Test in Math 10. It May also consider school-based factors such as school environment and learning resources/facilities in Mat, and socio-economic factors such as combined monthly family income and highest educational attainment of mother and father. Learners cannot intervene in these matters and cannot fully control them according to their own interests (Onay & Benligiray, 2018). The external factors could also explain the reasons for specific performance in students.

However, looking at the current situation, performance of learners in Mathematics has been very low. This can be proven by the following results: low international benchmarks in the Third International Mathematics and Science Survey (TIMSS) 2011 report, and poor rating in the 2011-2012 National Achievement Test (NAT) result with an overall mean of 46.37 (Tudy, 2014). With such results mentioned showing the low performance of the students in Mathematics, there is a need to continue investigating factors influencing student performance in Math.

Obviously, previous studies emphasized a lot of different variables concerning academic performance. What makes this research different is the distinct combination of internal and external factors of student performance specifically in Math, with Grade 11-Academic track learners of La Libertad districts as respondents. Guided with the variables discussed by different researchers, the proponent of this study chose her combination of variables that are recognizable in the locale of the study. The researcher, therefore, would like to investigate further the impact of those aforementioned internal and external factors when combined together, and the degree of direct and indirect effects each of them could contribute to the prediction of student performance in Mathematics. This is the premise upon which the

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ISSN 2960-3986
GEO Academic Journal Vol. 4 No. 1 – 2023 series

researcher would like to assess: the predictors of performance in Math among the Grade 11-Academic track students in the two districts of La Libertad based on the internal and external factors.

## Literature Review

The basic education curriculum including that of Math was prepared by experts in the field of curriculum making and subject specialization. However, questions are raised on why Filipino learners are still lagging behind their counterparts in the neighboring countries of South-East Asia in the international test called Third International Mathematics and Science Surveys (TIMSS) in Mathematics and Science (Bilbao, et al., 2008). It is therefore an urge for every school to significantly raise the level of performance of the learners against the national standards. It must start with an investigation of factors that can influence such performance. Such factors could be internal or external. As cited by Ginea, et al. (2008), students identified as “external” were at greater risks for academic failure. On the other hand, those who experience more success are identified as “internal”.

Researchers in math education have come up with many factors which demonstrate some significant relationship with math achievement. Findings of earlier works about the impact of these factors on math performance are both conflicting and parallel. The internal factors that may influence Math Performance in this study include academic control, student responsibility, comprehension skills, self-efficacy beliefs ,and attitude towards Math.

The study of Fishman (2012) revealed that students with high academic control would most likely assume ownership over their academic outcomes. In terms of perceived academic control, it ultimately impacted the academic achievement of high school students across all 4 ethnic groups (You, et al., 2011). Also, the findings of Respondek et al. (2017) found out that perceived academic control positively and significantly predicted student’ achievement over

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an entire freshman academic year. This is in consistent with the key finding of the study of Al-Agili et al. (2013) revealing that academic control has predicted math performance over and above other variables. These findings support that of Perry et al. (2011) that students with high-academic-control believed they preferred better performance and obtained higher final grades. Perceived control has a direct effect on subsequent academic achievement as well as an indirect effect, which is mediated by high school student's academic engagement behaviors for all 4 ethnic groups; which ultimately impacted the academic achievement of high school students across all 4 ethnic groups. So, teachers should see to it that high academic control must be sustained among students as they can influence better performance.

In terms of student responsibility, result was indicated in the study of Fishman (2012) that the students' sense of responsibility for academic outcomes played only partially mediating the relationship between their perceptions of control and reported use of regulated behavior. This personal responsibility should be continually sustained because they affect the extent to which learners achieve desirable outcomes academically. In terms of comprehension skills, the study of Laurito et al. (2016) conducted to the students in Biliran province revealed that the comprehension test scores of the student-respondents were very low in problem solving. As affirmed by Duru and Koklu (2011), students had difficulty in comprehending mathematical texts and word problems

In the study of Kim et al. (2018) showed that the results of Bayesian Meta-Analysis (BMA) indicated that computer-based scaffolding significantly impacted cognitive outcomes in problem-based learning in STEM education. The result of the BMA contributes to an enhanced understanding of the effect of computer-based scaffolding within problem-based learning.

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A lot of findings concerning self-efficacy beliefs serve as strong foundation of this study. One is that of Musso et al. (2012) revealing that domain-specific self-efficacy beliefs influence effort investment. This means that the self-efficacy belief of a learner can directly affect his ability to learn. Conversely, students achieve success, because they have developed strong efficacy beliefs (Murray, 2013 & Tosto et al., 2016). Moreover, the study of Murray (2013) on factors that influence math achievement in the University of Guyana - Berbice campus revealed that self-efficacy was positively correlated to math performance but the degree of association is negligible. He further revealed that self-efficacy was not found to be statistically significant predictors of Math performance even if the relationship is positive.

Similar to self-efficacy beliefs, the variable on Attitude Towards Math offers a lot of findings and results that can be used to support this study. The results of the study of Mbugua et al. (2012), Aunzo and Lanticse (2015), Tudy (2014) and Mata et al. (2012); indicated that respondents have positive attitude towards Mathematics. Students who have shown positive attitude towards the subject tend to perform well (Alpacion et al., 2014). Hence, performance in math can be improved by developing a positive attitude towards the subject. Another one that lends credence to information regarding respondents' attitudes was provided by Ismail et al. (2015), that most students felt strongly motivated to learn Mathematics and believed that the mathematics they learn in school was useful to them. Furthermore, Tudy (2014) and Alpacion et al. (2014) also discovered that only attitude towards math manifested significant influence to academic performance. On the contrary, the revelation of Suan (2014) showed that the main reason why others discontinue studying Mathematics because of their perception as boring, hard and useless. In terms of attitude towards Math (ATM), the study of Nicolaidu and Philippou (2012) indicated a significant relation relationship between attitudes and achievement. Also, in the study of Mata et al. (2012), attitude towards math was the

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ISSN 2960-3986
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criterion variable, not the predictor. The hierarchical analysis using structural equation modeling showed that motivation-related variables are the main predictors of ATM.

Considering all the internal factors of mathematics performance discussed above, the main challenge lies on the teachers who should be aware of the internal attributes which influence learners in Math because they are influential and significant in determining success in math endeavors. Moving on, the external factors considered include the level of performance in National Career Assessment Examination (NCAE) covering the subtests in General Scholastic Aptitude (GSA), Technical-Vocational Aptitude (TVA), and Academic Track (AT); and District-Initiated Achievement Test (DIAT) in Math 10. It also includes the school-based factors such as school environment and learning resources/facilities in Math; and socio-economic factors such as combined monthly family income, highest educational attainment of mothers and highest educational attainment of fathers.

All enrolled Grade 9 learners in public and private high schools operating with permit take NCAE because it is mandatory and recommendatory (Llego, 2017). Like many standardized tests, the NCAE not only measures students' general scholastic knowledge but also vocational aptitude, occupational preferences and entrepreneurial skills (Ross, 2016). Many researchers reported that standardized test scores and high school grades are effective predictors of success in college mathematics. While many of them exposed such, some others reported contrary findings. One example is the findings that grades in high school were almost useless as predictors of grades in introductory mathematics courses and that Scholastic Aptitude Test (SAT) scores did not predict overall scholastic achievement in community college in Arizona (Benford & Newsome, 2008). In the study of Pagudpud et al. (2018), it was revealed that the "determined" cluster obtained the lowest percentage; these are those who scored best on the clerical ability and non-verbal ability tests, but they scored low in

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ISSN 2960-3986
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mathematical ability and logical reasoning ability tests. It was also revealed that most of the students belong to cluster zero, or those only high in clerical aspects but less in Mathematical ability and logical reasoning. Likewise, proficient cluster who are lowest in clerical ability, lowest in HUMSS ability and lowest in STEM ability do not comprise the majority of the respondents. The low result in Mathematical ability can be related to the result of the study of Duru and Koklu (2011) that students had difficulties in comprehending the mathematical texts and understanding word problems.

In the 2013 NCAE, the second to the highest percentile rank was posted in Mathematics (88.4), where the students' quantitative abilities and computational skills were assessed, particularly on working with numbers, perceiving relationship between two quantities and solving arithmetic problems (NETRC, 2014). Furthermore, the results of the study of Muhid et al. (2018) indicated that all of the SAT subsets, those are verbal, numerical, analytical and spatial, are significant predictors of academic achievement of Islamic school students in Indonesia.

Unlike in NCAE, the Grade 11 learners positioned third to the highest in Mathematics (83.0) (Muhid et al., 2018). Specifically in General Mathematics, they learned how to solve problems involving rational, exponential and logarithmic functions; to solve business-related problems; and to apply logic to real-life situations; while in Pre-Calculus, they learned how to apply concepts and solve problems involving conic sections, systems of nonlinear equations, series and mathematical induction, circular and trigonometric functions, trigonometric identities, and polar coordinate system (K to 12 Mathematics Curriculum Guide, 2016).

Looking particularly into the National Achievement Test (NAT) results, the Department of Education (DepEd) singled out low reading competence as a primary factor of public school students in Mathematics (Camello, 2011). This agrees with the low

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international benchmarks in the Third International Mathematics and Science Survey (TIMSS) 2011 report and the poor rating in the 2011-2012 National Achievement Test (NAT) result with an overall mean of 46.37 (Tudy, 2014). Significant positive correlations of the students' performance were consistently observed in the three academic areas (English, Math and Science and in the three grade levels (Ferrer and Cruz, 2017).

In terms of tests, positively skewed learner performances around the low median showed that learners did not perform well in the science and mathematics test in general. Mean scores for the whole test as well as for the mathematics and science subsections were well below 50% (Maree et al., 2006). It is the area of basic cognitive abilities, or the basic processing capacity of the cognitive system in these students that best provides the information necessary to correctly identify this group (Musso et al., 2012).

. In terms of school environment, Tosto et al. (2016) revealed that classroom environment did not show any direct association with math achievement; hence, environment does not significantly predict math performance. This contradicts with the study of Suan (2014) revealing that the effect of students' learning environment on learning outcomes depends on the students' perception that identifies such environment. This would relate to the capacity of the teacher to enhance classroom management because students cannot learn in chaotic and poorly-managed environment.

Another external factor considered in this study is learning materials/facilities in Math. Wekesa (2013) concluded that besides textbook, common instructional resources like charts, real objects, models and nets of solids were rarely used during Mathematics lessons. It means that instructional materials are provided, but teachers did not utilize them to promote learning. Dickerson et al. (2013) also disclosed that most of learning materials claimed to be available for use, were inadequate. This problem of inadequacy of learning materials and

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ISSN 2960-3986
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visual aids in teaching has been frequently encountered by teachers, but could be addressed through resourcefulness and innovations. The study of Nyaoga (2014) has similar results because it revealed that there exists a weak negative relationship between school facilities and student performance; but different because it is statistically insignificant. This contradicts with the results that availability of teaching/learning resources enhances the effectiveness of schools as these are necessary things that can bring about good academic performance in students (as cited by Yara and Otienno, 2010).

One of the socio-economic factors considered in this study is the family income. Pinoy Money Talk in Philippine Business News (updated February 12, 2018), reported that a family of five (5) with a total income of less than 10,000 pesos is considered poor according to an estimate of National Statistics Coordination Board (NSCB) of the Philippines. As per NSCB, high income refers to an average monthly income of 200,000 pesos; middle income, average of 36,934 pesos; and low income, average of 9,061 pesos. This may not be detailed and definitive enough to fully understand income, but can provide a good foundation for reference. In the study of Hijazi and Naqvi (2016), it was shown income had as significant negative relationship with student's achievement. This explains that students belonging to a prosperous family do not consider studies as a priority. This is asserted by study of Nyoni, et al. (2017) revealing that higher socio-economic status was the best indicator of the students' quality of academic achievement The research of Akhtar (2012) showed converse results.

As to highest educational attainment of parents, according to Mbugua et al. (2012), the ability of the learners to translate math achievement to high educational aspirations naturally occurs at home for learners from families with high level of education, where examples of opportunities and strong background in Math can provide, are immediate. Umameh (2014) further reported that aside from teachers, attitude towards math was also

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influenced by other variables like parents' occupation and education, gender, and socio-economic status. In particular, the study of Hijazi and Naqvi (2016) concluded that mother's education has significant positive relationship with student achievement and that general factors like mother's education is an independent variable affecting student's achievement.

## Methodology

This study utilized the descriptive-correlational method. It is descriptive since it is concerned with determining the perception level and performance level of the internal and external attributes that would predict the performance in Math of Grade 11 learners enrolled in the Academic track. Likewise, it is correlational because it sought to test the relationship between and among the internal and external factors that could predict learners' performance.

This study considered all 236 Grade 11 learners enrolled in the Academic track of the Senior High School (SHS) program of the three (3) secondary schools in the two (2) districts of a large-sized division in Central Philippines school year 2017-2018. Purposive sampling was employed in the determination of the respondents. According to Crossman (2020), Purposive sampling is a non-probability sampling that is chosen depending on demographic characteristics and the objectives of the study. Table 1 shows the distribution of respondents.

**Table 1**

*Distribution of Respondents*

| Name of School | Type of School | Total Enrolment | Percentage of Enrolment |
|---|---|---|---|
| La Libertad Technical-Vocational School | Public | 154 | 65.25 |
| PacuanNational High School | Public | 67 | 28.39 |
| Saint Francis School – La Libertad | Private | 15 | 6.36 |
| **TOTAL** | | **236** | **100.00** |

The researcher used only one (1) set of survey questionnaire to collect data on learners' perceptions of all internal factors (academic control, student responsibility,

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ISSN 2960-3986
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comprehension skills, self-efficacy beliefs and attitude towards Math); and two of the external factors (school environment and learning resources/facilities in Math). The instrument was divided into three (3) parts; the first part was the collected data on socio-economic data like family income and educational background of parents; the second part contained items on perception levels of internal factors, and the third part was on perception level on external factors.

The questionnaires on perceived academic control and student responsibility were adapted from those used by Fishman (2012) on his study. The eight-item instrument was used to measure the student's perception of control. The students' level of responsibility was measured using a six-item scale developed by Laurmann and Karabenick and being used by Fishman (2012) as an exploratory measure in his study. The respondents were asked to report their sense of personal responsibility. Students' level of self-efficacy belief was measured by a ten-item instrument adapted from Nicolaido and Philippou (2012). Attitudes towards mathematics was measured by a 21-item instrument containing statements that reflect feelings towards Mathematics ranging from extremely positive to negative adapted from Mathematics Attitudes Survey. Questions on school environment and comprehension skills were both adapted from Students as Allies (SAA) survey. The perceptions on learning resources/facilities contained items adapted from surveys carried out in the study of Atieno (2014).

The scale utilized was designed for learners to indicate the level to which they agreed with the given statements using four-point Likert scale ranging from one (1) which is strongly disagree to four (4) which is strongly agree.

Document analyses were used to capture academic performance in Math. This was important for information provided through such documents is verifiable and permanent in

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nature. The senior high school math performance data collected, comprised of the percentage scores in the periodic tests in General Math and Statistics and Probability.

After preparing the research instrument, the researcher proceeded to ask permission and approval of the District Supervisors of the research venue to allow her to administer the survey questionnaires to all Grade 11 learners as respondents of her study. After the administration of the survey questionnaires, retrieval was done immediately. The response rate to the survey questionnaire was 100 percent. The researcher also collected data on test results from the Math teachers, and NCAE ratings from the Guidance in-charge of the schools. All collected data were tabulated using the Microsoft Excel Worksheet and were treated using appropriate statistical formulas with the aid of the SPSS to facilitate analysis and interpretation.

## Results and Discussions

### *Learners' Level of Performance in Math 11*

The scholastic performance of learners is generally represented with numerical ratings as bases in determining their levels of achievement. The students' level of performance in Math 11 refers to average percentage scores in General Mathematics, and Statistics and Probability.

**Table 2**

*Percentage Scores in Grade 11 Math*

| Average Percentage Scores | Description | Frequency | Percentage |
|---|---|---|---|
| 90-100 | Outstanding | 6 | 2.54 |
| 85-89 | Very Satisfactory | 11 | 4.66 |
| 80-84 | Satisfactory | 14 | 5.93 |
| 75-79 | Fairly Satisfactory | 37 | 15.68 |
| Below 75 | Did Not Meet Expectation | 168 | 71.19 |
| Total | | 236 | 100.00 |
| Mean: **62.50** | | | |
| Descriptive Rating: **Did not Meet Expectation** | | | |

Based on the ranges of grades used in the K to 12 Basic Education Curriculum grading system, the result of Table 2 showed that 6 learners or 2.54 percent belonged to

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90 - 100 level or Outstanding; between 85-89 level, 11 or 4.66 percent were in the Very Satisfactory level; between the level 80-84, 14 students or 5.93percent were Satisfactory; between the level 75-79, 37or 15.68percent, and 168 or 71.19 percent failed to meet the expectations

It is also revealed that the mean performance of the learners in Grade 11 Mathematics was 62.50 which failed to meet the expectations. This implies that there is a need to improve their performance in the said periodic tests. It can be noted further from the table that a number of learners had percentage scores below 75. It connotes that students have to exert more efforts in developing the fundamental knowledge and skills and core understanding in Math, as they did not converge in the median range. The data further reveal that students had difficulty in Grade 11 Math accounting the fact that only very few of them got percentage scores equivalent to Satisfactory or even higher. Just like in the result of the study of Laurito, et al. (2016) at Naval School of Fisheries in Biliran province, none of the respondents got the highest grade of 91 to 94 in Geometry, and the average grade in Math by the respondents fall under 75-78. The study of Andaya (2014) of the students of Philippine Normal University-Isabela campus, also revealed that tests in Mathematics reveal low performance of students of the said school.

***Level of Internal Factors Influencing Learners' Performance***

The internal factors of learners' performance in Mathematics include academic control, student responsibility, comprehension skills, self-efficacy belief, and attitude towards Mathematics. The items are rated on a four-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree).

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ISSN 2960-3986
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**Table 3**

*Level on Academic Control*

| Items | *sd* | Mean | Interpretation |
|---|---|---|---|
| 1. I have a great deal of control over my academic performance in Math. | 0.57 | 2.74 | High |
| 2. The more effort I put into my Math subjects, the better I do in them. | 0.63 | 2.96 | High |
| 3. No matter what I do, I can't seem to do well in my Math subjects. | 0.64 | 2.55 | High |
| 4. I see myself as largely responsible for my performance throughout my senior high school career | 0.65 | 2.99 | High |
| 5. How well I do in my Math courses is often the "luck draw" | 0.68 | 2.43 | Low |
| 6. There is a little I can do about my performance in Math | 0.63 | 2.83 | High |
| 7. When I do poorly in Math, it's usually because I haven't given my best effort. | 0.63 | 2.95 | High |
| 8. My grades in Math are basically determined by things beyond my control and there is little I can do to change that. | 0.60 | 2.99 | High |
| 9. My academic performance and experience has given me a deeper understanding of my life than could be achieved without this experience. | 0.67 | 3.07 | High |
| 10. Regardless of what my grades in Math are, I try to appreciate how my high school experience can make me a stronger person overall. | 0.62 | 3.28 | Very High |
| 11. No matter how well I do on a test or in a course, I try to "see beyond" my grades to how my experience at high school helps me to learn about myself. | 0.67 | 3.16 | High |
| 12. Whenever I have a bad experience at high school, I try to see how I can "turn it around" and benefit from it. | 0.71 | 3.14 | High |
| **Overall Results** | **0.64** | **2.79** | **High** |

Source: Fishman, 2012

Table 3 indicates the level of the academic control in Math. As shown in the table, an overall mean of 2.79 interpreted as high was obtained by the respondents (M=2.79, SD=0.64). This indicates that the respondents have high academic control over their Math courses believing they can identify causes and overcome failure and perform better to obtain

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higher grades. The study of Fishman (2012) is affirmed by this, that students with high academic control would most likely assume ownership over their academic outcomes.

Item No. 10 got the highest mean of 3.28 or very high level. Most of the learners strongly agreed to the statement, "regardless of what my grades in Math are, I try to appreciate how my high school experience can make me a stronger person overall". This implies that the amount of failure a student commits would not hinder his desire to succeed and aim for the better. On the contrary, item no. 5 got the lowest mean of 2.43, interpreted as low level. This states that "How well I do in my Math courses is often the luck draw". It can be inferred that students' view on his accomplishment in Math is not due to effort for achieving high performance but just based on good chances. This is contrary to findings of Perry et al. (2011) that students with high-academic-control believed they preferred better performance and obtained higher final grades. So, teachers should see to it that high academic control must be sustained among students as they can influence better performance.

**Table 4**

*Level on Student Responsibility*

| Items | *sd* | Mean | Interpretation |
|---|---|---|---|
| 1. I am interested in the Math lessons taught by my math Teacher | 0.68 | 2.97 | High |
| 2. I make excellent progress throughout the semesters in my Math classes | 0.63 | 2.61 | High |
| 3. I like the Math topics taught by my instructors. | 0.61 | 2.79 | High |
| 4. I learned the required material in the Math class. | 0.50 | 2.98 | High |
| 5. I value learning Math taught by my Math teacher. | 0.59 | 3.03 | High |
| 6. I do well in my Math class. | 0.63 | 2.80 | High |
| **Overall Results** | **0.61** | **2.87** | **High** |

Source: Fishman, 2012

Table 4 presents the level of student responsibility. It can be seen from the table that all respondents agreed to each of the six (6) statements; hence, the level of student responsibility gained an overall high level result (M=2.87, SD= 0.61). It implies that

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learners who feel they can manipulate their internal commitment to school work are more inclined to feel responsible for the completion of their academic outcomes.

Though all items obtained high level, it can be noted that item no. 5 got the highest mean of 3.03; it is on valuing Math taught by the Math teacher. On the other hand, item no. 2 got the lowest mean of 2.61. This is on making excellent progress throughout the semesters in Math classes. This infers that learners are less responsible in achieving exceptional advancement in Math. A parallel result was indicated in the study of Fishman (2012) that the students' sense of responsibility for academic outcomes played only partially mediating the relationship between their perceptions of control and reported use of regulated behavior. This personal responsibility should be continually sustained because they affect the extent to which learners achieve desirable outcomes academically.

**Table 5**

*Level on Comprehension Skills*

| Items | *sd* | Mean | Interpretation |
|---|---|---|---|
| 1. I can explain the reasoning behind an idea. | 0.63 | 2.67 | High |
| 2. I can represent and analyze relationships using tables, charts, and graphs. | 0.60 | 2.64 | High |
| 3. I can work on problems for which there is no immediately obvious method of solution. | 0.57 | 2.38 | Low |
| 4. I can use computers to solve problems and exercises. | 0.69 | 2.32 | Low |
| 5. I can write equations to represent relationships. | 0.63 | 2.42 | High |
| 6. I can practice computational skills. | 0.60 | 2.85 | High |
| 7. It is easy for me to remember formulas and procedures. | 0.69 | 2.42 | High |
| 8. I can think in sequential and procedural manner. | 0.64 | 2.53 | High |
| 9. I understand mathematical concepts, principles and strategies. | 0.63 | 2.66 | High |
| 10. I understand how mathematics is used in the real world. | 0.75 | 2.88 | High |
| **Overall Results** | **0.64** | **2.58** | **High** |

Source: SAA Survey

Table 5 reveals the level of comprehension skills of Grade 11 learners. As projected in Table 5, the level of comprehension skills was high (M=2.58, SD=0.64). This implies that the learners agree that their level of understanding on mathematical concepts is satisfactory.

DOI: https://doi.org/10.56738/issn29603986.geo2023.4.35
ISSN 2960-3986
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GEO Global Educators Professional Enhancement International Inc.

This perceived level of comprehension skills must be enhanced in all Mathematics classes; this is a task that every Math teacher must do.

The table also reveals that the highest mean was in item no. 10 with a mean score of 2.88 or high level. This is on understanding how mathematics is used in the real world. However, the lowest mean was obtained by item no. 4 with a mean score of 2.42 or low level. This is on the skill of using computers in solving problems and exercises. The use of computer could be a help in looking for solutions on problems and exercises in Mathematics; however, the respondents have less access to computer units or have less competence of navigating the computer applications for solving Math problems. The result conforms to the study of Kim et al. (2018) that the results of Bayesian Meta-Analysis (BMA) indicated that computer-based scaffolding significantly impacted cognitive outcomes in problem-based learning in STEM education. The result of the BMA contributes to an enhanced understanding of the effect of computer-based scaffolding within problem-based learning.

Relative to the result of this study is that of Laurito et al. (2016) conducted to the students in Biliran province which showed that the comprehension test scores of the student-respondents were very low in problem solving. Also affirmed by Duru and Koklu (2011), they revealed that students had difficulty in comprehending mathematical text and word problems

DOI: https://doi.org/10.56738/issn29603986.geo2023.4.35
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**Table 6**

*Level on Self-Efficacy Belief*

| Items | *sd* | Mean | Interpretation |
|---|---|---|---|
| 1. I am one of the best students in Mathematics. | 0.72 | 2.06 | Low |
| 2. I believe that I have a lot of weaknesses in Mathematics. | 0.71 | 2.99 | High |
| 3. Compared to other students, I am a weak student in Mathematics | 0.70 | 2.53 | High |
| 4. Mathematics is not one of my strengths. | 0.73 | 2.75 | High |
| 5. I usually can help my classmates, when they ask me for help in problem-solving. | 0.74 | 2.61 | High |
| 6. I can usually solve any Mathematical problem. | 0.69 | 2.40 | Low |
| 7. I do not feel sure about myself in problem solving. | 0.57 | 2.73 | High |
| 8. When I start solving a mathematical problem, I usually feel that I would not manage to give a solution | 0.65 | 2.69 | High |
| 9. I can solve two-step problem. | 0.63 | 2.61 | High |
| 10. I have difficulties in solving one-step problem. | 0.68 | 2.50 | High |
| **Overall Results** | **0.68** | **2.59** | **High** |

Source: Nicolaido & Philippou, 2002

Table 6 displays the level of self-efficacy beliefs (SEB) of Grade 11 students. By combining together all the responses, an overall SEB index had a mean of 2.59 or high level (ME=2.59, SD=0.68). The highest mean was obtained by item no. 2 with a mean score of 2.99 interpreted as high level. This is on believing on having a lot of weaknesses in Mathematics.

On the other hand, item no. 1 got the lowest mean of 2.06 or low level, which states " I am one of the best students in Math". The result obviously shows that the learners were not confident in their abilities with regards to their performance in Math subject. Hence, teachers should pay attention to these learners who might be prone to disappointment in case frequent failures are experienced. This is reinforced by the finding of Musso et al. (2012) that domain-specific self-efficacy beliefs influence effort investment. This means that the self-efficacy belief of a learner can directly affect his ability to learn. Conversely, students achieve

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success, because they have developed strong efficacy beliefs (Murray, 2013&Tosto, et al., 2016).

**Table 7**

*Level on Attitude towards Math*

| Items | *sd* | Mean | Interpretation |
|---|---|---|---|
| 1. Mathematics is enjoyable and stimulating to me. | 0.72 | 2.71 | High |
| 2. In mathematics you can be creative and discover things by yourself. | 0.59 | 3.12 | High |
| 3. Students who have understood the mathematics they have studied will be able to solve any assigned problem in five minutes or less. | 0.69 | 2.81 | High |
| 4. I try to learn mathematics because it helps develop my mind and helps me think more clearly in general. | 0.64 | 3.22 | High |
| 5. Using the web (or a computer) is a good way for me to learn mathematics. | 0.73 | 2.52 | High |
| 6. Everything important about mathematics is already known by mathematicians. | 0.74 | 2.89 | High |
| 7. Mathematics is needed in order to keep the world running. | 0.67 | 2.83 | High |
| 8. Mathematics is important for my chosen profession. | 0.78 | 2.93 | High |
| 9. Mathematics is needed in designing practically everything. | 0.69 | 2.86 | High |
| 10. Communicating with other students helps me have a better attitude towards mathematics. | 0.66 | 2.88 | High |
| 11. I am interested and willing to acquire further knowledge of mathematics. | 0.73 | 3.04 | High |
| 12. The skills I learn in this class will help me in other classes for my major. | 0.64 | 2.97 | High |
| 13. I learn mathematics well from lectures. | 0.65 | 2.71 | High |
| 14. Mathematics is not important in everyday life. | 0.71 | 1.72 | Very Low |
| 15. I have never liked mathematics, and it is my most dreaded subject. | 0.76 | 2.34 | Low |
| 16. There is nothing creative about mathematics; it's just memorizing formulas and things. | 0.76 | 2.33 | Low |
| 17. Mathematics makes me feel uneasy and confused. | 0.63 | 2.67 | High |
| 18. Mathematics is a solitary activity, done by individuals in isolation. | 0.63 | 2.62 | High |
| 19. Mathematics is less important to people than art or literature. | 0.75 | 2.33 | Low |
| 20. Real mathematics problems can be solved by common sense instead of the mathematical rules you learn in school. | 0.69 | 2.81 | High |
| 21. Ordinary students cannot expect to understand mathematics, they expect simply to memorize it and apply what they have learned mechanically and without understanding. | 0.67 | 2.54 | High |

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| | | | |
|---|---|---|---|
| **Overall Results** | **0.69** | **2.77** | **High** |

Source: Mathematics Education Survey

Table 7 presents the level on Attitude Towards Math (ATM) of the Grade 11 learners. The overall mean was found to be 2.77 with a verbal interpretation of high level (M=2.77, SD=0.69). This signifies that the learners gave a unifying perception of their attitude towards Math which is positive. This is in consistent with the results of the study of Mbugua et al. (2012), Aunzo and Lanticse (2015), Tudy (2014) and Mata et al. (2012); indicating that respondents have positive attitude towards Mathematics. Students who have shown positive attitude towards the subject tend to perform well (Alpacion et al., 2014). Hence, performance in math can be improved by developing a positive attitude towards the subject.

From the table, it can be gleaned that the highest mean of 3.22 or high level was obtained by item no. 4 that states, “I try to learn Mathematics because it helps develop my mind and helps me think more clearly in general”. On the other hand, respondents strongly disagreed with item 14 obtaining a mean score of 1.72 or very low level; indicating that they regarded the importance of Math in everyday life. This result also lends credence to information regarding respondents’ attitudes provided by Ismail et al. (2015) that most students felt strongly motivated to learn Mathematics and believed that the mathematics they learn in school was useful to them. On the other hand, this is in contrary to the revelation of Suan (2014) that the main reason why others discontinue studying Mathematics because of their perception as boring, hard and useless.

***Level of External Factors Influencing Math Performance***

The external factors affecting learners’ performance in Mathematics include results in the National Career Assessment Examination (NCAE), district-initiated achievement test (DIAT) in Math 10, perception levels on school environment and learning resources/facilities

DOI: https://doi.org/10.56738/issn29603986.geo2023.4.35
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in math, combined monthly family income, highest educational background of mothers and highest educational background of fathers.

**Table 8**

*National College Assessment Examination (NCAE) Rating in General Scholastic Aptitude (GSA)*

| Percentile Rank | Descriptive Rating | Frequency | Percentage |
|---|---|---|---|
| 98 – 99 | Very High (VH) | 3 | 1.27 |
| 86 - 97 | Above Average (AA) | 5 | 2.12 |
| 51 – 85 | Average (A) | 53 | 22.46 |
| 15 - 50 | Low Average (LA) | 156 | 66.10 |
| 3 - 14 | Below Average (BA) | 18 | 7.63 |
| 1 - 2 | Poor (P) | 1 | 0.42 |
| Total | | 236 | 100.00 |
| Average Percentile Rank | **40.69** | | |
| Descriptive Rating | **Low Average (LA)** | | |

Table 8 shows the NCAE Rating in General Scholastic Aptitude (GSA) which covers the subtests on Scientific Ability (SA), Reading Comprehension (RC), Verbal Ability (VA), Mathematical Ability (MA), and Logical reasoning (LRA). The data on the GSA results are expressed in percentile ranks. The average percentile rank obtained is 40.69 generally described as Low Average. This explains further that the examinees scored higher than 15-50 percent only of the others.

Table 8 also shows that only 0.42 percent or 1 out of 236 got a percentile rank of 1-2. Likewise, it shows that 156 or 66.10 percent got a percentile rank of low average within the range of 15-50. It implies that the respondents are deficient in areas covered in Math, English and Science subjects. It further connotes that they have less probability to excel in academic programs that work mostly on scientific methodologies, possess less potential to pursue in courses involving public speaking and even writing, have low sense of mathematical ability and skills, and are less likely to succeed in courses which require high analytical/thinking skills. This contradicts with the result of the study of Pagudpud et al. (2018) revealing that the

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"determined" cluster obtained the lowest percentage; these are those who scored best on the clerical ability and non-verbal ability tests, but they scored low in mathematical ability and logical reasoning ability tests. The lowest scores in Math can be attributed to what Duru and Koklu (2011) concluded, that students had difficulties in comprehending the mathematical texts and understanding word problems.

**Table 9**

*NCAE Rating in Technical-Vocational Aptitude (TVA)*

| Percentile Rank | Descriptive Rating | Frequency | Percentage |
|---|---|---|---|
| 98 – 99 | Very High (VH) | 1 | 0.42 |
| 86 - 97 | Above Average (AA) | 27 | 11.44 |
| 51 – 85 | Average (A) | 79 | 33.47 |
| 15 - 50 | Low Average (LA) | 114 | 48.31 |
| 3 - 14 | Below Average (BA) | 15 | 6.36 |
| Total | | 236 | 100.00 |
| **Average Percentile Rank** | **49.90** | | |
| **Descriptive Rating** | **Low Average (LA)** | | |

Table 9 shows the result in Technical-Vocational Aptitude (TVA) in NCAE which covers Clerical Ability (CA), Non-Verbal Ability (NVA), and Visual manipulation of Skills (VMS). The overall mean percentage of 49.90 which is low average implies that the respondents possess low potential in areas requiring good manual skills, involving diagrammatic and similar visual information works, and necessitating visual manipulative skills. It can be noted that these skills are to be mastered as these prepare one in the world of work, making senior high school graduates globally competitive in the workforce.

It can be noted from Table 9 that within the range of 15-50, 114 out of 236 or 48.37 percent obtained Low Average rating, while that of 98-99, 1 out of 236 or 0.42 percent obtained Very High Rating. Similarly, the result of Pagudpud et al. (2018) revealed that most of the students belong to cluster zero, or those only high in clerical aspects but less in Mathematical ability and logical reasoning.

DOI: https://doi.org/10.56738/issn29603986.geo2023.4.35
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**Table 10**

*NCAE Rating in Academic Track (AT)*

| Percentile Rank | Descriptive Rating | Frequency | Percentage |
|---|---|---|---|
| 99+ | Excellent (E) | 1 | 0.42 |
| 99 – 99 | Very High (VH) | 2 | 0.85 |
| 86 - 97 | Above Average (AA) | 20 | 8.47 |
| 51 – 85 | Average(A) | 67 | 28.39 |
| 15 - 50 | Low Average (LA) | 123 | 52.12 |
| 3 - 14 | Below Average (BA) | 23 | 9.75 |
| Total | | 236 | 100.00 |
| **Average Percentile Rank** | | **44.04** | |
| **Descriptive Rating** | | **Low Average** | |

Table 10 presents the result in the Academic Track (AT) in NCAE which measures the innate ability or potential of a student to succeed in the following areas: Humanities and Social Sciences (HUMSS), Science, Technology, Engineering and Mathematics (STEM), and Accountancy, Business and Management (ABM).

As shown in the table, only one (1) or 0.42 percent obtained 99+ percentile rank with a descriptive rating of Excellent. Most of the learners converged in the range of 15 to 50 percentile rank which is Low Average. There were 123 or 52.12 percent who belonged to this range and with a mean percentile rank of 44.04. It obviously reveals that these learners are at risk in possessing abilities and basic concepts required for one to pursue specialization in the areas of Humanities and Social Sciences (HUMSS), Science, Technology, Engineering and Mathematics (STEM) and Accountancy, Business and Management (ABM). However in the study of Pagudpud et al. (2018), this proficient cluster who are the lowest in clerical ability, lowest in HUMSS ability and lowest in STEM ability do not comprise the majority of the respondents.

In the 2013 NCAE the second to the highest percentile rank was posted in Mathematics (88.4), where the students' quantitative abilities and computational skills were assessed, particularly on working with numbers, perceiving relationship between two quantities and

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ISSN 2960-3986
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solving arithmetic problems (NETRC, 2014). Furthermore, the results of the study of Muhid et al., (2018) indicated that all of the SAT subsets, those are verbal, numerical, analytical and spatial, are significant predictors of academic achievement of Islamic school students in Indonesia.

**Table 11**

*District-Initiated Achievement Test (DIAT) Results in Math 10*

| **Percentage Scores** | **Description** | **Frequency** | **Percentage** |
|---|---|---|---|
| 90-100 | Outstanding | 8 | 3.39 |
| 85-89 | Very Satisfactory | 6 | 2.54 |
| 80-84 | Satisfactory | 7 | 2.97 |
| 75-79 | Fairly Satisfactory | 19 | 8.05 |
| Below 75 | Did Not Meet Expectation | 196 | 83.05 |
| Total | | 236 | 100.00 |
| **Average Percentage Score** | **51.06** | | |
| **Descriptive Rating** | **Did not Meet Expectations** | | |

Table 11 shows the level of District-Initiated Achievement Test (DIAT) in Math 10. With an average mean percentage score of 51.06 which is below 75**,** one can generalize that the performance of the students in the said achievement test was very low.

As also shown in the table, only 8 or 3.39 percent were within 90-100 percentage scores or Outstanding, while 196 or 83.05 percent did not meet the expectation**.** The Department of Education (DepEd) sets criterion-reference in determining students' performance which is 75.00 percent proficiency level. These results in DIAT further connote that students are deficient in their Math 10 formative and summative tests parallel to Math 10 competencies as they manifested difficulty in the achievement test, as evident from the low scores they obtained. This supports the findings of Maree et al. (2006) that the mean scores for the whole test as well as for the mathematics and science subsections were well below 50%.

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This low performance in Math test is parallel to the low international benchmarks in the Third International Mathematics and Science Survey (TIMSS) 2011 report and the poor rating in the 2011-2012 National Achievement Test (NAT) result with an overall mean of 46.37 (Tudy, 2014). Looking particularly into the National Achievement Test (NAT) results, (DepEd) singled out low reading competence as a primary factor of public school students in Mathematics (Camello, 2011).

On the contrary, the Grade 11 learners positioned third to the highest in Mathematics (83.0) (Muhid et al., 2018). Specifically in General Mathematics, they learned how to solve problems involving rational, exponential and logarithmic functions; to solve business-related problems; and to apply logic to real-life situations; while in Pre-Calculus, they learned how to apply concepts and solve problems involving conic sections, systems of nonlinear equations, series and mathematical induction, circular and trigonometric functions, trigonometric identities, and polar coordinate system (K to 12 Mathematics Curriculum Guide, 2016).

**Table 12**

*Level on School Environment*

| **Items** | ***Sd*** | **Mean** | **Interpretation** |
|---|---|---|---|
| 1. Students show respect for their math teachers. | 0.57 | 3.48 | Very High |
| 2. The school is clean (comfort rooms, class rooms, hallways). | 0.66 | 2.85 | High |
| 3. There are a lot of after-school Math activities that are interesting to me. | 0.64 | 2.67 | High |
| 4. Securities are able to solve problems of trespassers, violence, and conflicts. | 0.75 | 2.67 | High |
| 5. Students arrive in class promptly. | 0.64 | 2.68 | High |
| 6. You know where to go in case of fires and other calamities. | 0.71 | 3.11 | High |
| 7. You feel confident among your math peers. | 0.68 | 2.79 | High |
| 8. Disruptions in class are not drawing your attention from your math teachers. | 0.68 | 2.53 | High |
| **Overall Results** | **0.67** | **2.85** | **High** |

DOI: https://doi.org/10.56738/issn29603986.geo2023.4.35
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Table 12 displays the level of School Environment (SEN). This includes everything within the school from leadership to classroom practices to learners' feeling of connectedness. The overall mean (M=2.85, SD=0.67) shows the typical perception level which is high. It implies that learners look positively to everything within the school from leadership to classroom practices to students' feeling of connectedness specifically in mathematics classes

Item No. 8 with a mean score of 2.53 or high level had the lowest mean. This item states "Disruptions in class are not drawing your attention from your math teachers" This item, having been stated negatively implies that learners are less easily disturbed by any form of distractions while engaging in Math lessons. As also revealed in the same Table, item No. 1 on learners showing respect for their math teachers got the highest mean of 3.48 with a verbal interpretation of Very High. This agrees with the study of Suan (2014) that the effect of students' learning environment on learning outcomes depends on the students' perception that identifies such environment. This would relate to the capacity of the teacher to enhance classroom management because students cannot learn in chaotic and poorly-managed environment. This contradicts to what Tosto et al. (2016) revealed that classroom environment did not show any direct association with math achievement.

DOI: https://doi.org/10.56738/issn29603986.geo2023.4.35
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**Table 13**

***Level on Learning Resources/Facilities in Math***

| Items | *sd* | Mean | Interpretation |
|---|---|---|---|
| 1. The number of Math reference books in the school through the library is adequate. | 0.74 | 2.69 | High |
| 2. Teaching resources such as math models, charts, colored chalk and geometrical sets are adequate. | 0.66 | 2.75 | High |
| 3. Use of resource persons in Math is frequent. | 0.66 | 2.72 | High |
| 4. Use of field trip/excursions is frequent. | 0.78 | 2.32 | Low |
| 5. Use of computers in teaching and learning Math is common. | 0.74 | 2.50 | High |
| 6. Students have adequate number of calculators. | 0.61 | 2.76 | High |
| 7. Students receive and use adequate textbook/learning materials. | 0.80 | 2.54 | High |
| 8. Other learning intervention materials aside from textbooks like SIMs, worksheets and the like are available | 0.73 | 2.40 | Low |
| **Overall Results** | **0.72** | **2.59** | **High** |

Table 13 presents the data on the level of Learning Resources/Facilities in Math (LR). The overall result (M=2.59, SD=0.72) shows that that the level of physical and material resources required to enable students to achieve academic excellence is high. It implies that respondents agree that instructional materials do not only merely convey information, but are instrumental for engaging students in thinking. However, the study of Wekesa (2013) revealed contrast finding. His study concluded that besides textbook, common instructional resources like charts, real objects, models and nets of solids were rarely used during Mathematics lessons. It means that instructional materials are provided, but teachers did not utilize them to promote learning. In particular, item no. 6 got the highest mean of 2.76 interpreted as high level on students having adequate number of calculators.

As can be gleaned from the same table, item No. 4 got the lowest mean of 2.32 with a verbal interpretation of high level on the frequent use of field trip/excursions as a learning resource. Field trips are not usually resorted to due to bigger expenses to be entailed and the greater risk the teachers may face. This result lends credence to that of Dickerson et al.

DOI: https://doi.org/10.56738/issn29603986.geo2023.4.35
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(2013) that most of learning materials claimed to be available for use, were inadequate. This problem of inadequacy of learning materials and visual aids in teaching has been frequently encountered by teachers, but could be addressed through resourcefulness and innovations.

**Table 14**

*Combined Monthly Family Income*

| Range of Monthly Income (in pesos) | Level | Frequency | Percentage |
|---|---|---|---|
| 250,000 and over | Very High | 4 | 1.69 |
| 100,000- 249,999 | High | 3 | 1.27 |
| 60,000- 99,999 | Average | 2 | 0.85 |
| 40,000-59,999 | Low | 8 | 3.39 |
| Under 40,000 | Very Low | 219 | 92.80 |
| Total | | 236 | 100.00 |

Table 14 shows the data on the combined monthly family income. The ranges of family income were based on the 2009 Philippine Classification of Individual Consumption According to Purpose (PCOICOP) on the final report of 2012 Family Income and Expenditure Survey (FEIS) of the National Statistics Office in Manila. The table reveals that most of the respondents belonged to a family whose family income is under 40,000, with a frequency of 219 out of 236 or 92.80 percent which is very low level, and only three (3) or 1.27 percent with 100,000 to 249,999.

Pinoy Money Talk in Philippine Business News (2018), reported that a family of five (5) with a total income of less than 10,000 pesos is considered poor according to an estimate of National Statistics Coordination Board (NSCB) of the Philippines. Also, as per estimate of the National Statistics Coordination Board (NSCB) of the Philippines as detailed by FEIS, the result implies that most of the respondents are coming from middle-income to low-income families. Middle income refers to an average monthly income of 36,934 pesos, and low income refers to an average monthly income of 9,061 pesos (Philippine Business New, 2018)

DOI: https://doi.org/10.56738/issn29603986.geo2023.4.35
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**Table 15**

*Highest Educational Attainment of Mothers*

| Highest Educational Attainment | Frequency | Percentage |
|---|---|---|
| College Graduate | 13 | 5.51 |
| College Level | 16 | 6.78 |
| High School Graduate | 42 | 17.80 |
| High School Level | 45 | 19.07 |
| Elementary Graduate | 57 | 24.15 |
| Elementary Level | **63** | **26.69** |
| Total | 236 | 100.00 |

Table 15 presents the level of educational attainment of the respondents' mothers. It can be noted from the table that most of the mothers of the respondents attained elementary level only with a frequency of 63 or 26.69 percent.

**Table 16**

*Highest Educational Attainment of Fathers*

| Highest Educational Attainment | Frequency | Percentage |
|---|---|---|
| College Graduate | 15 | 6.36 |
| College Level | 13 | 5.51 |
| High School Graduate | 28 | 11.86 |
| High School Level | 34 | 14.41 |
| Elementary Graduate | 60 | 25.42 |
| Elementary Level | **85** | **36.02** |
| Has not gone to school | 1 | 0.42 |
| Total | 236 | 100.00 |

Table 16 presents the educational background of the fathers of the respondents. The table shows that there was one (1) or 0.42 percent of the respondents who have not gone to school. The highest educational attainment obtained by most of the fathers was elementary level only; with a frequency of 85 or 36.02 percent.

Comparing Table 15 and Table 16, it can be noted that most parents have attended elementary education but have not graduated. This further connotes that most parents may not

DOI: https://doi.org/10.56738/issn29603986.geo2023.4.35
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be good role models for their children in academic matters since they do not attain education beyond secondary education. According to Mbugua et al. (2012), the ability of the learners to translate math achievement to high educational aspirations naturally occurs at home for learners from families with high level of education, where examples of opportunities and strong background in math can provide, are immediate. Similarly, Umameh (2014) further reported that aside from teachers, attitude towards math was also influenced by other variables like parents' occupation and education.

**Table 17**

*Internal and External Factors of Math Performance*

| Factors | Result | Interpretation |
|---|---|---|
| **Internal** | | |
| 1. Academic Control | 2.79 | High |
| 2. Student Responsibility | 2.87 | High |
| 3. Comprehension Skills | 2.58 | High |
| 4. Self-efficacy Belief | 2.35 | Low |
| 5. Attitude Towards Math | 2.77 | High |
| Average Level | 2.62 | High |
| **External** | | |
| 6. General Scholastic Aptitude | 40.69 | Low Average |
| 7. Technical-Vocational Aptitude | 49.90 | Low Average |
| 8. Academic Track | 44.04 | Low Average |
| Average Percentile Rank | 44.88 | Low Average |
| 9. District-Initiated Achievement Test in Math 10 | 51.06 | Did Not Meet Expectation |
| 10. School Environment | 2.85 | High |
| 11. Learning Resources/Facilities in Math | 2.59 | High |
| Average level | 2.72 | High |
| 12. Combined Monthly Family Income | Under 40,000 pesos | Very low |
| 13. Highest Educational Attainment of Mother | Elementary level | |
| 14. Highest Educational Attainment of Father | Elementary level | |

As a summary for both internal and external factors influencing Math Performance, it is shown in Table 17 that internal factors such as academic control, student responsibility, comprehension skills, and attitude towards math obtained high descriptive rating; only self-

DOI: https://doi.org/10.56738/issn29603986.geo2023.4.35
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efficacy belief had low descriptive rating. On external factors, general scholastic aptitude, technical-vocational aptitude and academic track of the National Career Assessment Examination (NCAE) obtained low average percentile ranks. District-initiated achievement test in Math 10 had an overall percentage score of 51.06 which was below 75.00 proficiency level. Levels on school environment and learning resources/facilities in Math were high. Combined monthly family income was very low, and the highest educational attainment of both mothers and fathers was elementary level only. In the absence of push by school policies towards math performance, the only source of guidance, encouragement, and support for their learners will be in their teachers and school facilitators.

**Table 18**

*Correlates of Learners' Math Performance*

| **Independent Variables** | **Pearson *r* and Level of Significance** | **Math Performance** |
|---|---|---|
| Academic Control (AC) | Pearson Correlation | **0.34**** |
| | p-value | **0.00** |
| Student Responsibility (SR) | Pearson Correlation | **0.23**** |
| | p-value | **0.00** |
| Comprehension Skills (CS) | Pearson Correlation | 0.08 |
| | p-value | 0.23 |
| Self-Efficacy Belief (SEB) | Pearson Correlation | 0.10 |
| | p-value | 0.12 |
| Attitude Towards Math (ATM) | Pearson Correlation | **0.37**** |
| | p-value | **0.00** |
| NCAE-General Scholastic Aptitude (GSA) | Pearson Correlation | **0.50**** |
| | p-value | **0.00** |
| NCAE-Technical-Vocational Aptitude (TVA) | Pearson Correlation | **0.44**** |
| | p-value | **0.00** |
| NCAE- Academic Track (AT) | Pearson Correlation | **0.48**** |
| | p-value | **0.00** |
| District-Initiated Achievement Test (DIAT) in Math 10 | Pearson Correlation | **0.58**** |
| | p-value | **0.00** |
| School Environment (SEN) | Pearson Correlation | 0.02 |
| | p-value | 0.73 |
| Learning Resources/Facilities in Math (LR) | Pearson Correlation | **-0.15*** |
| | p-value | **0.02** |
| Combined Monthly Family Income (FI) | Pearson Correlation | -0.11 |

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| | | |
|---|---|---|
| | p-value | 0.10 |
| Highest Educational Attainment of Mother (EAM) | Pearson Correlation | -0.07 |
| | p-value | 0.31 |
| Highest Educational Attainment of Father (EAF) | Pearson Correlation | 0.02 |
| | p-value | 0.76 |

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

Table 18 shows the significant relationship between Math performance and the identified internal and external factors. As shown in the table, there was a degree of association between mathematics performance and the following independent variables, namely: Academic Control (AC) with low Pearson correlation of 0.34 and significance value of 0.00, Student Responsibility (SR) with low Pearson correlation of 0.23 and significance value of 0.00, Attitude Towards Mathematics (ATM) with negligible Pearson correlation of 0.37 and significance value of 0.00, General Scholastic Aptitude (GSA) rating with moderate Pearson correlation of 0.50 and significance level of 0.00, Technical-Vocational Aptitude (TVA) rating of 0.44 and significance value of 0.00, Academic Track (AT) rating with moderate Pearson correlation of 0.48 and significance value of 0.00, and District-Initiated Achievement Test (DIAT) in Math 10 with moderate Pearson correlation of 0.58 and significance value of 0.00 Significant correlation existed between mathematics performance and the aforementioned variables, the highest of which is that with district-initiated test in Math 10. It indicates that students with high scores in the Math 10 achievement test achieve high mathematics performance in Grade 11. The statistical findings revealed that the learners got the highest grade in science both in NCAE and Grade 10, while English in Grade 11.

The study of Fishman (2012) established a strong and significant relation between perceived academic control and student responsibility; simply put, student responsibility is an important component in motivating students to achieve better performance. In terms of

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perceived academic control, it ultimately impacted the academic achievement of high school students across all 4 ethnic groups (You, et al., 2011). In terms of attitude towards Math (ATM), the study of Nicolaidu and Philippou (2012) indicated a significant relation relationship between attitudes and achievement. Significant positive correlations of the students' performance were consistently observed in the three academic areas and in the three grade levels (Ferrer & Cruz, 2017).

On the other hand, no correlation existed between mathematics performance and the following variables: comprehension skills (CS) with self-efficacy belief (SEB), school environment (SEN), combined monthly family income (FI), highest educational attainment of mothers (EAM), and highest educational attainment of fathers (EAF); all with negligible Pearson r values of 0.08, 0.10, 0.02, -0.11, -0.07, 0.02; respectively. Their p-values of 0.23, 0.12, 0.73, 0.10, 0.31, and 0.76 respectively; shows insignificant level.

In terms of SEB, the study of Murray (2013) on factors that influence math achievement in the University of Guyana - Berbice campus revealed that self-efficacy is positively correlated to math performance but the degree of association is negligible. This is further confirmed by Tosto, et al. (2016) that self-efficacy has been found to be strongly associated with mathematics performance.

In addition to, the result could not prove that the relationship between mathematics performance and family income is positive because its coefficient value of -0.06 and p-value of 0.10 shows an inverse relation, contrary to the assumption that affluence gives more facilities to learn. This result also agrees with the that of Hijazi and Naqvi (2016) that income showed significant negative relationship with student's achievement. This explains that students belonging to a prosperous family do not consider studies as a priority. The research of Akhtar (2012) showed converse results.

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The same situation above is also true to mothers' educational attainment having coefficient value of -0.07 and a p-value of 0.31. The highest educational attainment of the mothers is inversely related to math performance implying that as the educational level of mothers increases, math performance decreases. In other words, the educational level of mothers does not influence on learners' performance in math. This disagrees with the study of Hijazi and Naqvi (2016) concluding that mother's education has significant positive relationship with student achievement.

One interesting result is with learning resources/facilities in math having low negative negligible Pearson correlation of -0.15 but is significant at 0.02. This implies that math performance of the students is inversely related to learning resources/facilities in Math. This implies further that the presence of learning materials/facilities in Math cannot increase academic performance. The study of Nyaoga (2014) has similar results because it revealed that there exists a weak negative relationship between school facilities and student performance; but different because it is statistically insignificant. This contradicts with the results that availability of teaching/learning resources enhances the effectiveness of schools as these are necessary things that can bring about good academic performance in students (as cited by Yara and Otienno, 2010). This assertion is supported by the evidence that self-efficacy exerts a greater influence on math achievement than mental ability (as cited by Lebens, et al., 2010).

***Predictive Model***

The predictive model is a statistical model to predict math performance. Multiple regression analysis was utilized to prove that the internal and external factors identified predict performance of students in math. The result includes Model Summary, Analysis of

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Variance (ANOVA) and Coefficients. The data presented in Tables 19 to 21 indicated the different statistical properties of the model.

**Table 19**

*Model Summary*

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | 0.675[a] | 0.466 | 0.42 | 10.67 |

a. Predictors: (Constant), SEN, FI, GSA, EAM, SEB, SR, AC, EAF, DIAT, LR, CS, TVA, ATM, AT

Table 19 presents the Summary of the Model. Results from the model summary showed that the value of R-square is 0.466 suggesting that 46.60 percent of the variance is due to the linear and combined influence of all the independent variables affecting students' performance in Math. The variables combined can explain 46.60 percent of the performance of the students in Mathematics; the rest of the 53.40 percent can be explained by other factors not mentioned in the model. The standard error of 10.78 explained the measure of the size of the errors in regression. The result was moderate; so, it proves that the student performance in Math is the product of the combined internal and external factors.

**Table 20**

*ANOVA*

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 21971.31 | 14 | 1569.38 | | |
| | Residual | 25182.93 | 221 | 113.95 | 13.77 | 0.00 |
| | Total | 47154.24 | 235 | | | |

a. Dependent Variable: AVE_PT
b. Predictors: (Constant), SEN, FI, GSA, EAM, SEB, SR, AC, EAF, DIAT, LR, CS, TVA, ATM, AT

Table 20 presents the result of the Analysis of Variance (ANOVA) or F-statistic which was carried out to find the overall strength of the model. The results of the multiple

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regression analysis as shown in Table 20 indicated a linear correlation between dependent and independent variables having F-value of 13.77 which represents the effect of the internal and external variables of a single factor on student performance. The *p*-value of 0.00 shows that the model is significant.

**Table 21**

*Coefficients*

| Model | | Unstandardized Coefficients B | Std. Error | Standardized Coefficients Beta | t | Sig. |
|---|---|---|---|---|---|---|
| 1 | (Constant) | 5.71 | 11.13 | | 0.51 | 0.61 |
| | Academic Control (AC) | 7.89 | 3.47 | 0.14 | 2.28 | **0.02** |
| | Student Responsibility (SR) | 5.13 | 2.20 | 0.15 | 2.33 | **0.02** |
| | Comprehension Skills (CS) | -3.01 | 2.76 | -0.08 | -1.09 | 0.28 |
| | Self-Efficacy Beliefs (SEB) | 0.60 | 2.54 | 0.01 | 0.24 | 0.81 |
| | Attitude Towards Math (ATM) | 4.40 | 3.78 | 0.08 | 1.16 | 0.25 |
| | NCAE – General Scholastic Aptitude (GSA) | 0.14 | 0.05 | 0.20 | 2.63 | **0.01** |
| | NCAE – Technical-Vocational School (TVA) | 0.03 | 0.04 | 0.06 | 0.92 | 0.36 |
| | NCAE – Academic Track (AT) | 0.01 | 0.05 | 0.02 | 0.19 | 0.85 |
| | District Initiated Test (DIAT) in Math | 0.25 | 0.04 | 0.36 | 5.69 | **0.00** |
| | School Environment (SEN) | -1.77 | 2.07 | -0.06 | -0.85 | 0.39 |
| | Learning Resources/Facilities in Math(LR) | -0.64 | 1.11 | -0.03 | -0.58 | 0.56 |
| | Combined Monthly Family Income (FI) | -0.78 | 0.54 | -0.08 | -1.44 | 0.15 |
| | Highest Educational Attainment of Mother (EAM) | 0.47 | 0.54 | 0.05 | 0.87 | 0.39 |
| | Highest Educational Achievement of Father (EAF) | 0.04 | 2.76 | 0.00 | 0.01 | 0.99 |

a. Dependent Variable: AVE_PT

Table 21 presents the coefficients of the model. By Beta coefficients, the model showed that the following variables caused negative variation in math performance of the students: comprehension skill, school environment, learning resources/facilities in math, and combined monthly family income. From among the factors causing negative variation in

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math performance, only learning resources and facilities in Math was significant. This implies that the provision of learning resources/facilities in math do not cause increase in Math learning.

On the other hand, the following variables caused positive variation in math performance: academic control, student responsibility, self-efficacy belief, attitude towards math, general scholastic aptitude, technical-vocational aptitude, academic track, district-initiated test in Math 10 and highest educational attainment of mothers and fathers. Of the variables above having a positive relationship with math performance, only academic control, student responsibility, general scholastic aptitude and district-initiated achievement test in Math 10 were found to be statistically significant.

The important predictors on math performance were the district-initiated achievement test in Math 10 and the general scholastic aptitude which are external factors. Though having negative beta coefficient, learning resources/facilities in Math is also a significant predictor on math performance. Internal factors also positively predict student performance in Math; that is, academic control and student responsibility.

There are many findings that are similar to the findings of this study. The findings of Respondek et al. (2017) revealed that perceived academic control positively and significantly predicted student' achievement over an entire freshman academic year The results of this study indicate that all of the SAT subsets, those are verbal, numerical, analytical and spatial, are significant predictors of academic achievement of Islamic school students in Indonesia (Muhid et al., 2018). The main determinants of performance appear to be basic cognitive processing variables (Musso et al., 2012). Also, the study of Murray (2013) revealed that self-efficacy was not found to be statistically significant predictors of Math performance even if the relationship is negative.

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However, there are also studies whose findings contradict to the findings of this study. Tudy (2014) and Alpacion et al. (2014) discovered that only attitude towards math manifested significant influence to academic performance. Also, the study of Nyoni et al. (2017) revealed that higher socio-economic status was the best indicator of the students' quality of academic achievement. Likwise, Hijazi and Naqvi (2016) discussed the general factors like mother's education as an independent variable affecting student's achievement. Lastly, Tosto et al. (2016) revealed that environment does not significantly predict math performance.

Generally, only the academic control (AC), student responsibility (SR), general scholastic aptitude (GSA) and district-initiated achievement test (DIAT) in Math 10 were significant and could be used to predict student performance in Math. Hence, the regression equation becomes:

$$\boldsymbol{MATH\ PERFORMANCE = 5.71 + 7.89\,AC + 5.13\,SR + 0.14\,GSA + 0.25\,DIAT}$$

The equation shows that academic control was the strongest predictor over variables with an unstandardized beta coefficient of 7.89 and significant at 0.02. This is in consistent with the key finding of the study of Al-Agili, et al. (2013) revealing that academic control has predicted math performance over and above other variables.

To show the utility of the regression equation formed, the researcher shows the following application using actual data of one of the respondents, where AC =2.92, SR = 2.67, GSA = 26, DIAT =45. The solution is: 5.71 + 7.89 (**2.92**) + 5.13 (2.67) + 0.14 (26) + 0.25 (45), which will result to a mathematics performance of **57.34**.

If the AC is increased by 1 to make it **3.92**, the solution would be 5.71 + 7.89 (**3.92**) + 5.13 (2.67) + 0.14 (26) + 0.25 (45) = **65.23**. It indicates that for every point improvement as measured by academic control, there is a corresponding increase in math performance by

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7.89 when all other variables are held constant. Furthermore, if the SR is raised to **3.67** from 2.67, then 5.31 + 7.89 (2.92) + 5.13 **(3.67)** + 0.14 (26) + 0.25 (45) = **62.47.** Similarly, there is a corresponding increase of 5.13 points in the mathematics performance for every point increase in the SR considering all variables were held constant.

If the student's percentile rank in GSA becomes **27** from 26, then 5.71 + 7.89 (2.92) + 5.13 (2.67) + 0.14 **(27**) + 0.25 (45) = **57.48.** Each time GSA increases by one (1) point, the math performance also rises by 0.14. Moreover, if the score of the student in increased by one (1) point, from 45 to **46**, 5.71 + 7.89 (2.92) + 5.13 (2.67) + 0.14 (26) + 0.25 **(46)** = **57.59.** Hence math performance rises by 0.25 for every increase of DIAT by one (1) point.

***Path Model***

Multiple regression was extended to path analysis to test the fit of correlation matrix against two or more causal models being compared. Path analysis is useful in decomposing the source of correlation between math performance and the identified independent variables. It is a method of testing the validity of theory about causal relationships between three or more variables that have been studied using correlational research design (Cadorna, 2015). It was conducted to determine which of the factors have direct/indirect effects on math performance.

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***Figure 1***

**Structural Model**

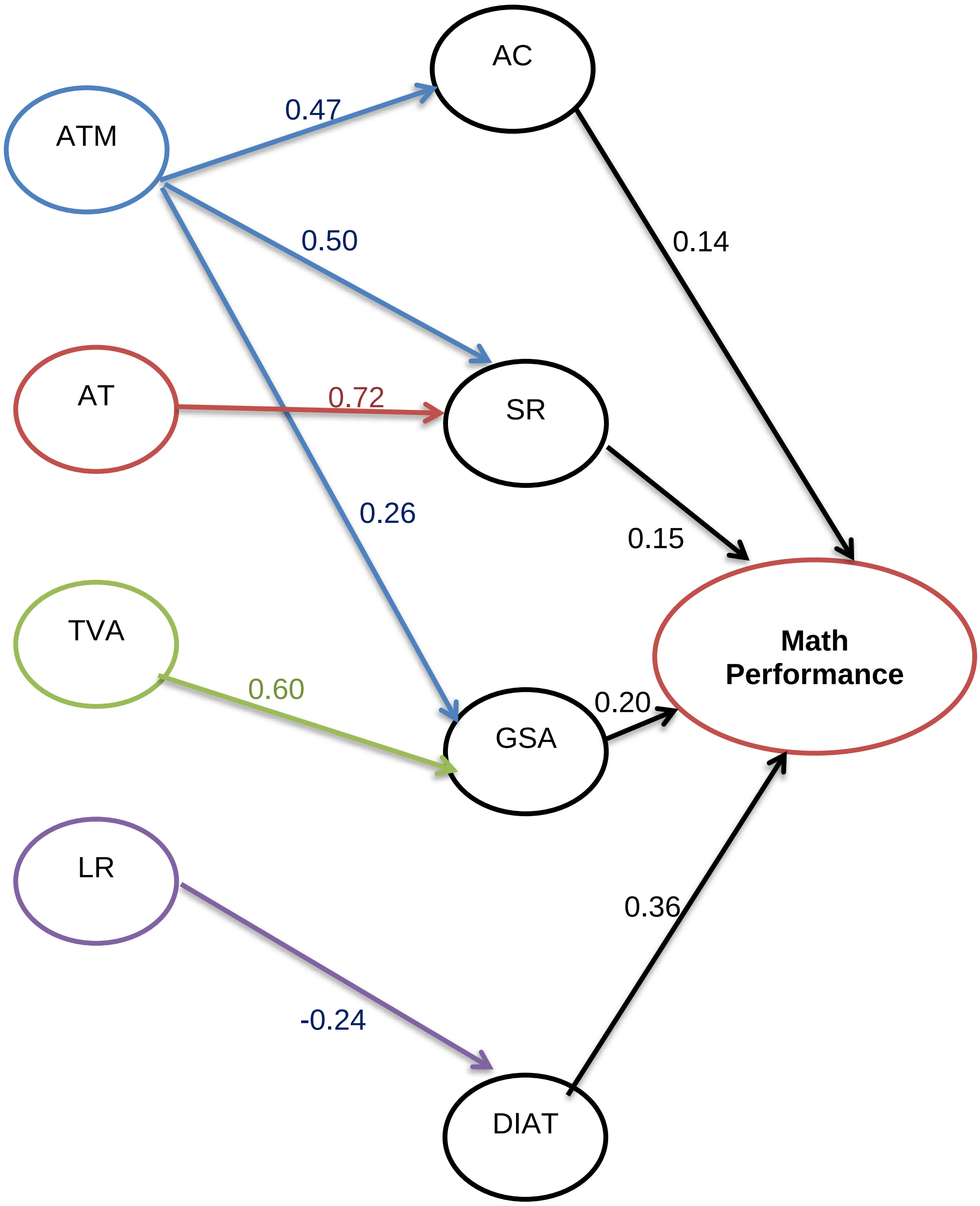

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Figure 4 shows the final and reduced model after removing the paths that did not statistically contribute to the model. The path model was created to see how much effect of each of the independent variables is direct and how much is an indirect effect math performance.

**Table 22**

*Direct, Indirect and Total Effects on Math Performance*

| Independent Variables/Factors | Direct Effect | Indirect Effect Mediator | Effect | | Total Effect |
|---|---|---|---|---|---|
| Academic Control (AC) | 0.14 | ATM | 0.07 | 0.07 | 0.21 |
| Student Responsibility (SR) | 0.15 | ATM | 0.08 | 0.08 | 0.23 |
| General Scholastic Aptitude (GSA) | 0.20 | AT | 0.14 | 0.36 | 0.56 |
| | | TVA | 0.12 | | |
| District-Initiated Achievement (DIAT) | 0.36 | ATM | 0.09 | 0.00 | 0.36 |
| in Math 10 | | LR | -0.09 | | |
| **Total** | 0.85 | | | 0.51 | 1.36 |

Table 22 provides evidence concerning the direct effects, indirect effects and total effects of the aforementioned independent variables on math performance. As shown in the Table, the independent variables that have direct effects on math performance were academic control, student responsibility, general scholastic aptitude and district-initiated achievement test in Math 10. The direct effects were 0.14, 0.15, 0.20 and 0.36 respectively. The factors that have an indirect effect on math performance were the attitude towards math (ATM), academic track (AT), technical-vocational aptitude (TVA), and learning resources/facilities in math (LR). The magnitudes of the indirect effects were 0.07, 0.08, 0.36, and 0.00.

For academic control, student responsibility and district-initiated test in Math 10, the direct effects were greater than the indirect effects. It shows that they predict more strongly in a direct way than they do in an indirect way. This is similar to the findings of You et al. (2011) that perceived control has a direct effect on subsequent academic achievement as well as an indirect effect, which is mediated by high school student's academic engagement.

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Moreover, intervening variables like attitude towards Math (ATM), and learning resources/facilities in Math (LR) contribute only a little involvement in causing mathematics performance. These mediators did not strongly affect nor intervene the influence of academic control, student responsibility and District-initiated achievement test (DIAT) in Math 10 on math performance.

The fact that the relationship between academic control and student responsibility to math performance was mediated by the attitude towards Math (ATM) and learning resources/facilities in Math does not imply that they do not matter. Improving their levels of perception may influence math achievement through the aforementioned mediators. In the study of Mata et al. (2012), attitude towards math was the criterion variable, not the predictor. The hierarchical analysis using structural equation modeling showed that motivation-related variables are the main predictors of ATM. Results also highlighted the main effects of grade and math achievement of ATM.

On the other hand, district-initiated test in Math 10 had the highest significant direct effect of 0.36 and an indirect effect of 0.00. This implies that previous achievement in math is a necessary condition and is a sufficient condition for learners to take more challenging math activities to improve performance.

For general scholastic aptitude (GSA), the indirect effect was greater than the direct effect. It means that GSA predicts more strongly in an indirect way through academic track (AT) and technical-vocational aptitude (TVA) than in a direct way. It further implies that the learners' performance in GSA that caused math performance depends greatly on their AT and TVA scores. Hence, AT and TVA play a crucial role in enhancing Math learning

In general, the total effect was positive. It implies that math performance increases for every increase in each of the academic control, student responsibility, and district-initiated

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test in Math 10 and general scholastic aptitude. This overall observation confirmed the regression equation formulated

The overall implication of the regression equation model as confirmed by the path model, is that for students to display excellent academic performance in Grade 11 Math, by possessing prior knowledge of district-initiated test in Math 10 and general scholastic aptitude in the National Career Assessment Examination (NCAE); and having high academic control and student responsibility over Math.

**Conclusion**

The students' achievement in the average percentage scores in Grade 11 Math was below 75 proficiency level having an overall mean of 62.40 which did not meet the expectation. The levels of internal factors affecting student performance was high in the areas of academic control, student responsibility, comprehension skills, and attitudes towards math, but low in self-efficacy beliefs. The level of external factors affecting Math performance is high in the areas of school environment, learning resources/facilities in Math had.

For the ratings in National Career Assessment Examination (NCAE), the average percentile rank was low in General Scholastic Aptitude (GSA), Technical-Vocational Aptitude, and Academic Track (AT). The level of District-Initiated Test (DIAT) in Math 10 did not meet expectation.

Frequency of 219 out of 236 or 92.80 percent belonged to a family whose monthly income was under 40,000 pesos. For the educational background of the parents, both that of mothers and fathers were similar: 63 or 26.69 percent of the respondents' mothers had attended elementary education but has not graduated;85 or 36.02 percent that of respondents' fathers.

Significant correlation existed between Mathematical performance and the following variables: AC, 0.00 level of significance; SR, 0.00; ATM, 0.00; GSA 0.00; TVA, 0.00; AT,

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0.00; and DIAT, 0.00. Conversely, significant correlation did not exist between mathematics performance and CS, 0.23 level of significance; SEB, 0.30; SE, 0.73;FI, 0.10, and EAM, 0.31and EAF, 0.76.

The factors that have direct effects on academic on math performance were academic control, student responsibility, general scholastic aptitude, and district-initiated test in Math 10; while those who have indirect effects are technical-vocational aptitude, academic track and learning resources/facilities in Math

Math performance of the learners can be predicted using their performance in the district-initiated achievement test, general scholastic aptitude, students' responsibility, and academic control. It can be concluded that math performance is influenced by the cognitive ability of the learners and their value on being responsible for their learning. Weiner's theory posits that any behavior can be attributed to one's effort. It is hereby recommended that the predictive model for performance in Mathematics be utilized as basis for implementing a development plan for Grade 11 Math.

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## Acknowledgement

The researcher wishes to acknowledge those who greatly contributed to the accomplishment of this dissertation:

Almighty God and Loving Father, who made this great accomplishment possible;

University President, Dr. Rosein A. Ancheta Jr., CTU-Moalboal Campus Director, Dr. Romeo G. Pableo, and graduate school director, Dr. Severina P. Velos, for their steadfast concerns to the graduate school students;

Researcher's adviser, Dr. Marivel B. Go, for the unfailing support and immeasurable help extended;

Researcher's professors of CTU-Moalboal campus and the Panel of Examiners namely: Dr. Rebecca DC. Manalastas, Dr. Victor D. Vilaganas, Dr. Zosima A. Pañares, Dr. Adoracion A. Lawas, Dr. Elvira B. Joyohoy, and Dr. Reynaldo T. Gabales, for sharing their expertise and knowledge;

Special thanks to the District Supervisor of La Libertad District I Mr Peter R. Lajato and Acting District Supervisor of La Libertad District II, Mr. Randy D. Dunque for granting permission in the conduct of this study;

Grade 11 Math Teachers of the Districts of La Libertad for the assistance during the collection of respondents' data;

Grade 11-Academic Strand students of the senior high schools of La Libertad Districts for their sincerity in answering the survey items used in this study;

Co-workers and close friends for the inspiration and moral support extended;

DOI: https://doi.org/10.56738/issn29603986.geo2023.4.35
ISSN 2960-3986
GEO Academic Journal Vol. 4 No. 1 – 2023 series

To all who have contributed in the completion of this study, her sincere expression of gratitude and appreciation!

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