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Mathematics Performance in Jamaica

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ABSTRACT: Introduction: In Jamaica, there is a tendency to place the bulk of formal education for students on schools. Parents, particularly at the primary level, owe most of their children's success to the involvement of the schools. The issue of solely blaming teachers is a scapegoat for the lethargic role that many parents have played (or not) in their children's academic life. Aim: The objective of this study is to evaluate factors that influence Grade Six Achievement Test (G-SAT) performance in mathematics, and the performance of students in mathematics at the ending of primary level schooling. Methods: The data were taken from the Ministry of Education dataset of some 4,912 candidates who wrote the 2017 G-SAT examination from Manchester and St Elizabeth in Region 5 (Manchester, Clarendon and St. Elizabeth) excluding the personal information of the students. The level of significance that is used to determine statistical significance is less than 5% (0.05) at the 2-tailed level of significance. Findings: The current research reveals that G-SAT Mathematics performance is influenced by performance in Social Studies, Language Arts, Science, Age and lastly Communication Task. The five predictors account for 83.9% of the variance in mathematics performance. Of the five subjects, previously listed, Social Studies contributed the most to the performance in mathematics (79.3%) followed by Language Arts (3.6%), Science (0.7%), Age (0.1%) and lastly by Communication Task (0.0%). Conclusion: Therefore, it is imperative that students at the primary level are properly taught and socialized to value scholastic achievements especially in mathematics.

KEYWORDS: English performance, Grade Six Achievement (G-SAT) results, Mathematics performance,

I. INTRODUCTION

The Grade Six Achievement Test or GSAT is the main assessment tool used by the Ministry of Education in Jamaica to evaluate the performance of students at the primary or preparatory level who will transition into the secondary educational system. It is the final examination administered primarily to Grade Six children, who would have completed the primary curriculum. It is Jamaica's national high school entrance examination, which is similar to one of a different name in Trinidad and Tobago (Leslie, 2008). In 1999 G-SAT replaced the UK's Common Entrance Examination. According to a former Minister of Education," There is a crisis of teaching and learning in Jamaica and this crisis has affected mathematics. Significant changes must take place in teaching mathematics." Therefore, greater effort is needed on the part of teacher to help in engineering changes which will provide students with a greater understanding of mathematical concepts. Teachers have been teaching to prepare students for exams and this should change. The methods used in teaching the subject may not be the best one to use or may not be the most effective at this present time If the old ways have not worked, then new methods must be found to address the inefficiencies. Over the last decade and one-half (2000-2016), the average performance in G-SAT Mathematics has been a success rate of 54.9%±5.7% (CI: 51.8% – 58.1%), suggesting that approximately 55 out of every 100 candidates who wrote the examination have been successful. The reverse of that is that 45 students out of every 100 failed the examination. In fact, for the period under consideration, the highest rate of success occurred in 2012 (i.e., 63%) indicating a fundamental weakness in preparing of primary level students for Mathematics (see Table 1). This reality is echoed in the fact that at no point in period did Jamaica experience a success rate in G-SAT Mathematics that exceeded 70%, suggesting a challenge in preparing both students and teachers in Mathematics at the primary level, and this must be urgently addressed in order to arrest the problem in the society.

Table 1:
Performance of Jamaican Students on Grade Six Achievement Test (G-SAT), 2002-2016

Year	%
2002	51.0
2003	48.0
2004	44.2
2005	57.8
2006	53.0
2007	46.0
2008	55.0
2009	53.0
2010	57.0
2011	62.0
2012	63.0
2013	61.0
2014	60.0
2015	56.0
2016	57.0

Source: Ministry of Education, Youth and Information, various years

Mathematics continues to be an important component in the formation of the educated person, and as such mathematics education should reflect the goals of education in a dynamic society. We must therefore address more than the acquisition of skills and mastery of ideas. We must also address more than the accumulation of facts and principles. Mathematics education in the age of information must place emphasis on the higher skills of discussion, interpreting and evaluation (Ministry of Education, ud, 4). Within the context of the Ministry of Education's perspective, it is increasingly important to address the sub-performance of students in mathematics in Jamaica. It is the very nature and the importance of mathematics to life that drive various stakeholders to pursue programmes to remedy the situation. The already established position that mathematics encompasses most areas of peoples' lives, and having splintered primary and secondary school curricula in Jamaica accounts for why students are not seeing the integration of the various subjects, and accounts for the low performance in Mathematics yet high performances in Principles of Accounts, Social Studies, and Principles of Business et cetera.

There is a natural fear among students who write mathematics examinations in Jamaica, which leads to their reluctance to sit the course and pursue careers in mathematics or those professions that demands mathematical skills and competence. The responsibility is placed on teachers to find creative ways of teaching mathematics.
It is important to note that once people have a good attitude toward learning mathematics, they will be more likely to indulge in the course, seek to understand the concepts and this will develop their confidence in their ability to perform mathematical operations (Furner & Berman, 2003). In the past male students did better in mathematics than female students. Currently male students outperform female students in solving mathematical problems, (The Statistical Institute of Jamaica 2009). There is more apprehension admitting to problems of numeracy than literacy because there is the perception that not all individuals are "cut out" to do mathematics. Therefore, individuals who are unable to read generally feel ashamed to say so, but this does not obtain for mathematics. People will openly confess that they cannot do mathematics. There has been a fear of the subject as stated by Lester, F. K. Jr. (1983); therefore, teachers and students alike avoid the subject, or show little or no interest in learning mathematics. A teacher will teach the stronger areas of mathematics but avoid teaching areas in which they have challenges. Correspondingly, students will also be weak in these areas of mathematics and will not necessarily want to learn those areas.

This has been an ongoing trend among teachers and students, which could account for the inability of some parents to do mathematics as well. In these situations, therefore, parents would be unable to assist their children with their homework in mathematics. Education at the primary school level is supposed to be the base and the foundation for higher knowledge in secondary and tertiary institutions. It is an investment as well as a vehicle for the achievement of a more rapid economic, social, political, technological, scientific and cultural development in the country. The National Policy on Education (2004) stipulated that secondary education is an instrument for national development that fosters the worth and development of the individual for further

education and development, general development of the society and equality of educational opportunities to all Jamaican children, irrespective of any real or marginal disabilities The role of primary education is to lay the foundation for further education and if a good foundation is laid at this level, there are likely to be no problem at subsequent levels. However, different people at different times have passed the blame of poor performance in primary schools on `to students because of their low retention ability, parental factors, association with wrong peers, low achievement, low achievement motivation and the likes (Aremu & Sokan, 2003; Aremu & Oluwole 2001; Aremu, 2000). Morakinyo (2003) believe that the falling level of academic achievement is attributable to teachers' non-use of verbal reinforcement strategy. Others found out that the attitude of some teachers to their job is reflected in their poor attendance to lessons, lateness to school, unsavory comments about students' performance that could damage their ego. In addition, poor method of teaching would affect pupils' academic performance. Given the issues identified above, the question therefore is what is the cause of this lowering of standard and poor academic performance of G-SAT students? Is the fault entirely that of teachers or students or both of them? Is it that students today are non-achievers because they have low intelligent quotient and a good neutral mechanism to be able to act purposefully, think rationally and deal effectively with academic tasks? Or is it because teachers are no longer as committed as before? Could the problem lie in teachers' method of teaching and interaction with students? Can it be argued that the poor performance of students is caused by parents' neglect, separation and poverty? The objective of this study is to evaluate factors that influence G-SAT performance in mathematics, and as such provide bedrock for understanding deficiency in the subject area. The current study employs panel data using the 2017 G-SAT results for Region 5 (i.e., Manchester, Clarendon and St. Elizabeth).

Background: As in Jamaica, the Common Entrance Examination (CEE) was abolished in Trinidad and Tobago in 2001 by Kamala Persad-Bissessar who was the Minister of Education at the time (Leslie, 2008). This gave rise to the Secondary Entrance Assessment (SEA), which replaced the CEE. The SEA is an entrance examination for placement in the secondary educational system. Children at the primary level are assessed by the SEA, like G-SAT, for readiness into a secondary school. Embedded in this system (SEA) is the reality that older children can be kept back in primary school, and this could have a negative interpretation. In Jamaica, the G-SAT examination is slated yearly in the first quarter of the year. It is scheduled for two days in March, and the results are used for placing students in secondary schools. Students are tested in five (5) subject areas, namely English (including comprehension), Social Studies, Science, Mathematics and Communication Task. Students are required to complete a total of eighty (80) multiple choice items from each subject area with the exception of Communication Task and Science, which have 60 items. To gain a place at a traditional high school in Jamaica, students have to score very high marks in all the subject areas that they are tested on in the G-SAT examination. As a teacher at the secondary level, the researcher has observed that parents in their aspirations for their children to attend one of these traditional high schools, tend to become involved in the students' preparation for the G-SAT examinations. The researcher has also noted that parents who play a greater role in the students' day to day academic performance usually see their children being awarded a space in the school of their choice.

In order to meet entrance requirements (score), for one of the traditional high schools in Jamaica, parents oftentimes put their children through rigorous stressful exercises which is equally the case with the teachers. Edward Seaga, former Prime Minister of Jamaica and Educator stated that The consequence of the excessive homework burden falls on the parent/caregiver who either responds by giving full assistance to the student, or fails to respond, leaving the student to take on the responsibility alone. Obviously, the degree of assistance received will markedly improve the success of the student. Although this is a desirable relationship between parents and children, the first part of the problem starts here (Seaga, 2011) Like Seaga (2011), the researcher recognized and realized that students need the full support of their parents in order to achieve their maximum potential from schooling, particularly at the primary or preparatory level. Parental involvement in a child's early education is consistently found to be positively associated with a child's academic performance (Hara & Burke, 1998; Hill & Craft, 2003; Marcon, 1999; Stevenson & Baker, 1987). As such, parental involvement provides the base for primary level students to effectively navigate the stressors of the G-SAT examination. It is believed that when parents pay keen attention to their children's academic performance, students are motivated and this directly influences greater performances in the different subject areas. Researchers have found empirically that parent-child interactions, specifically stimulating and responsive parenting practices, are important influences on a child's academic development (Christian, Morrison, & Bryant, 1998; Committee on Early Childhood Pedagogy, 2000).

As a teacher and parent, I concur with the findings of the aforementioned academic researchers that it is imperative for parents to expose their children to various experiences; for example, taking them on trips and other educational activities as these become stimuli and information for better academic performance. I have seen the importance of paying keen attention to the idea that when parents are involved students may achieve higher grades and test scores, better school attendance, better attitudes and behaviour and increased motivation as well as better self-esteem. When students are aware of their parents' high expectations and aspirations in regard to their academic performance and achievement in schools, the children may exert a lot more effort in order to achieve success in school. This is supported by the literature on the topic. Graham (2012) wrote an article in the Gleaner in which he postulated that Holy Trinity High School in Kingston had an uphill task to bring the below-par students who enter its gates to the level where they should be when they leave. Teachers at the secondary level have to be teaching lower-level primary school work because some of the students entering grade seven are "not smarter than a seven-year-old". The Principal added that about a quarter of the children who entered grades seven at Holy Trinity High School last September were reading at the grade-three level. In another testing of half of the 350 students, 32 were found to be reading below the grade-two level.

Furthermore, on examining an intake of 350 students it was revealed that about 180 had an average G-SAT (Grade Six Achievement Test) mark of 40 per cent and lower. Similar results or worse are also evident in the school that I teach. Several colleagues who teach especially non-traditional High schools noted that their students are admitted with sub-scores on the G-SAT examination compared to those who are placed in traditional high schools. Graham (2012) and the Principal of Holy Trinity High School contended that the task of the teachers at that school, like many other non-traditional high schools, is made more difficult by the lack of parental involvement in the life of children in the upgraded high schools. The Principal of Holy Trinity High School, in examining the lack of parental support, lamented that "We sent out letters to all of the parents for the below-par students we tested and do you know how many turned up? One!" She opined that "What we find is that those students who do well often have good parental support." Reid (2011) in examining factors affecting the performance of students opined that limited parental support and involvement impact student performance. Seaga also commented that The G-SAT is not a once-a-year problem. It is an insidious problem for the great majority of parents and caregivers, almost daily. This agitation occurs particularly with those responsible for nine and 10-year-old students approaching the dreaded G-SAT exam that is taken at age 11. The heavy burden of homework in preparation for G-SAT is occupying from two or three hours. This is a prime grievance (Seaga, 2011) It can be deduced by Seaga's (2011) postulations that parents are a part of the success (or failure) of students on the G-SAT examination, and if this is not understood parents could adequately fail to prepare the children for this examination. Samms-Vaughan (2004), on the other hand, stated that children whose parents are able to pay for extra tutoring to prepare them for G-SAT are better prepared for the examination, as it allows them to perform at a higher level than their poorer counterparts. The result is that they are placed in traditional high schools which are considered better than the upgraded high schools. Even though Samms-Vaugh did not speak to the active engagement of parents in the pre-preparation process, the act of sending the child to extra-lessons is another aspect of parental involvement, which accounts for the greater academic performances of students in the G-SAT experience. There is indication from Samms-Vaughan's statements that parents' monetary support is also needed for their students' educational development. Williams (2006) reported some related views of top G-SAT Awardees`.

According to Bishop (2006), Grade coordinator at Barracks Road Primary in St James, "The drive the students need from some parents is not there". He continued to say that "Some parents don't buy books for their children and don't assist them with homework, so the children are at a disadvantage. Although as a teacher you try to bring them along, you are not making any headway". Adams (2006), Senior teacher at George Headley Primary in St Andrew support the position of Bishop that "The children in my class who succeed are the ones whose parents are behind them. They are always seeking meetings to ask what they can do to assist their children, because they know the areas where their children are weak," Bishop (2006) further added that students do poorly usually lack parental support. Students who did poorly on the G-SAT examination, according to Bishop indicated low parental involvement in the pre-preparation process of the G-SAT. "They [parents] claim they don't have the time, they don't attend meetings, and so the children are left behind," Bishop said. Students from Williams and Adams' classes were among six primary school students who performed excellently in mathematics in this year's Grade Six Achievement Test (G-SAT) (Bishop, 2006).

Five of them earned perfect scores in mathematics, the crucial examination, and were awarded with scholarships valued at $40,000 each by Kraft Foods. This is an indication that positive results can be obtained when parents go the extra mile and become involved in their children's education.

A cross-sectional national survey conducted Powell, Bourne and Waller (2007) revealed that education was the third leading national problem experienced in Jamaica, with crime and unemployment being first and second respectively With the growing dilemma in the Jamaican educational system and dismally low performance of students in Mathematics, especially at the G-SAT level and leading into Caribbean Secondary Examination Certificate Level (CSEC), it is fitting that studies continue to evaluate the performance of students in Mathematics, particularly at the primary level, as this is the medium through which everything blossoms and knowledge is fermented for later academic development. For decades, Jamaica has been conducting and writing the G-SAT examination and yet the data has never been used to evaluate whether age, Language Arts, Social Studies, Communication Task, and Sciences are related to primary level students' Mathematics achievement. The research will 1) assess the degree of relationship between the predictors (Age, Language Arts, Social Studies, Communication Task, and Sciences) and the criterion variable (G-SAT Mathematics score), 2) proportion of variance accounted for by the predictors, and 3) the relative contribution of each predictor.

II. THEORETICAL FRAMEWORK

The theory, Situated Learning, developed by Lave and Wenger (1991) reasoned that learning is a matter of creating meaning from real activities of daily living. This theory is an expansion of the work of Dewey, Gibson, Vygotsky and Schoenfeld in which they postulated that students are more inclined to learn by actively participating in the learning experience. The situated learning theory (SLT) was further developed by Brown, Collins and Duguid in which they emphasized the idea of the cognitive apprenticeship model. This "cognitive apprenticeship" supports learning in a domain by enabling students to acquire, develop and use cognitive tools in authentic domain activity (Brown, Collins, and Duguid, 1989; Lave, 1988; Lave and Wegner, 1990; OTEC, 2007; Pappas, 2015).

Brown and colleagues stated that: …cognitive apprenticeship attempts to promote learning within the nexus of activity, tool, and culture that we have described. Learning, both outside and inside school, advances through collaborative social interaction and the social construction of knowledge (p. 40) Situated learning theory suggests that learning takes place through relationship between people and connecting prior knowledge with authentic, informal and often unintended contextual learning (Brown, et al., 1989; Lave, 1988; Lave and Wegner, 1990). This indicated that learning is more effective when a student is actively engaged in mathematics rather than attempting to receive knowledge passively-cognitive apprenticeship model. The theory of situated learning involves students in cooperative activities where they are challenged to use their critical thinking and kinesthetic abilities (OTEC, 2007; Brown et al, 1989).This construct represent how the students role changes from being beginner to expert as they become more active and immersed in the social community where learning takes place.

Design and Methodology: Crotty (2005) notes that the schema of the research process is simply not a unidirectional model. He points out that the research process begins with an epistemology followed by a theoretical perspective, methodology and method. Embedded in this schema is the process of carrying out a research and there is stringency to the direction that must be followed. Whether a research is quantitative (empirical/objective) or qualitative (subjective), the general schema is the same and the entire apparatus must be followed in order to execute an effective research. Wanting to establish relationships, the researcher chose an empirical approach to the study of math achievement in education Region 5 of Jamaica. This empirical perspective warrants the use of a large volume of data, precise measurement of variables and advanced statistical techniques. As a result, this study used 2017 G-SAT secondary data collected and published by the Ministry of Education, Youth and Information in Jamaica. It utilized the G-SAT passes for education Region 5 which comprises schools in the parishes of Manchester and St. Elizabeth. The Ministry is responsible for collecting, collating, analyzing, calculating, and forecasting information in order that government can be able to formulate policies and implement programmes to address educational issues within the society.

Statistical Analyses: For this data set, the data were stored, retrieved and analyzed using the Statistical Packages for the Social Sciences (SPSS) for Windows version 24.0 (SPSS Inc.; Chicago, IL, USA). Descriptive statistics were performed on the data as well as percentages and frequency distributions. Statistical significance was determined a p-value less than or equal to five percentage points (≤ 0.05) – two-tailed. In order to ensure that all the assumptions of Ordinary Least Square (OLS) were maintained in this study, the researcher examined 1) autocorrelation, 2) linearity and 3) collinearity (Lewis-Beck, 1980; Mamingi, 2005). The general standards employed in this work, which raised concern about multicollinearity, are 1) Durbin-Watson test and 2)

correlation coefficients. Where Durbin-Watson is between 1.5 and 2.5, there is no problem with multicollinearity (Mamingi, 2005).

Population and Sample: The Ministry of Education Youth and Information executes the Government's mandate of ensuring a system which secures quality education and training for all persons in Jamaica in order to optimize individual and national development. As such, the Ministry of Education, Youth and Information is the driving force for change, growth and development in education, providing the legislative framework, policies, strategies, plans, and resources to enable institutions, agencies and other bodies to achieve their agreed mandates. The Ministry is one of Jamaica's largest public entities and comprises presently 11 agencies, six Regional Offices, and a central office with approximately 40 units which fall under five divisions. These unite to provide the framework for the efficient functioning of over 1,000 public educational institutions that serve over 100,000 students and over 20,000 teachers. The Ministry of Education is also responsible for two public universities and several community, multidisciplinary and teachers' colleges. This research was conducted in Region 5 that comprises the parishes of Manchester and St. Elizabeth. According to the latest G-SAT candidate figures obtained from the Planning and Development Division of the Ministry, Region 5 had a total of 4,913 students of the over 39,000 who sat the 2017 G-SAT. Region 5 was selected because of the researcher's work with the Ministry of Education, Youth and Information in the region. Additionally, the researcher also wanted a more manageable data set to satisfy the timelines for the research period.

Findings : The average performances of G-SAT candidates who sat the 2017 examination from Region 5 (Manchester and St. Elizabeth) in the following subjects are 1) Mathematics (57.6%±23.1%, 95%CI: 57.0-58.0%); Science (65.0%±23.6%, 95%CI: 64.3-65.6%); Social Studies (62.4%±24.4%, 95%CI: 61.7-63.0%); Language Arts (64.6%±22.0%, 95%CI: 64.0-65.2%), and Communication Tasks (8.1±2.4, 95%CI: 8.0-8.2%). The skewness values for the subjects were -0.371, -0.829, -.0623, -0.977, and -1.576 respectively. This means that with the exception of Communication Task with a value exceeding -1.0, the errors are present in all the distribution; but these errors are tolerable-because the data is relatively normally distributed in spite of the presence of errors. Comparatively, Mathematics is the weakest subject for those who sat the 2017 G-SAT examination. This indicates that the mean is not good to use to represent the average for Communication Task, and as such the median is a better value for the average (8, range = 12) because of the fact that candidates obtained 0 on the examination and therefore this acts as an extreme outlier; thereby distorting the arithmetic mean

for being the average. The 0s are extreme outliers and reduce the mean from 9 to 8.1 (see Figure, below)

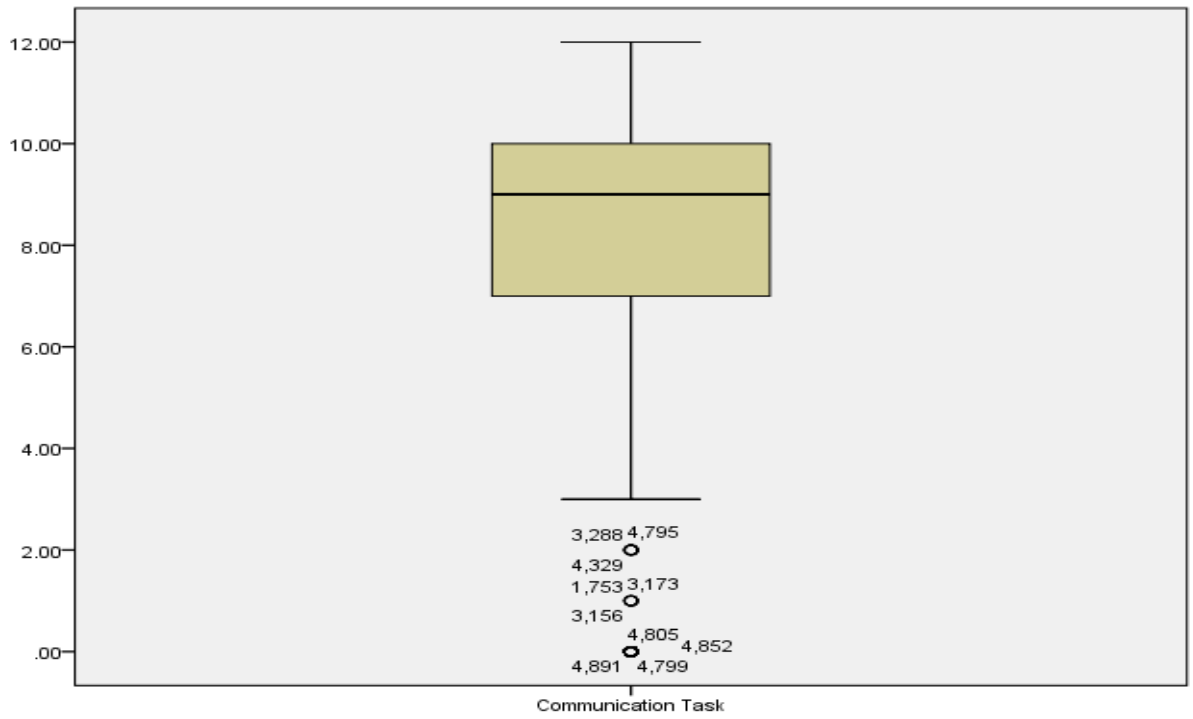

Table 2:
Descriptive statistics for Language Arts, Communication Tasks, Science, Social Studies
And Mathematics for the 2017 G-SAT Examination

Details	Mean±SD, 95%CI
Mathematics	57.6%±23.1%; 57.0%-58.0%
Science	65.0%±23.6%; 64.3%-65.6%
Social Studies	62.4%±24.4%; 61.7%-63.0%
Language Arts	64.6%±22.0%; 64.0%-65.2%
Communication Tasks	8.1±2.4; 8.0-8.2

The average age of the candidates who sat the 2017 G-SAT examination from Region 5 (Manchester and St. Elizabeth) was 11.3years±0.523, with a skewness of 0.217. The minimal skewness indicates that there are errors in the data; but they are not extreme enough to distort the mean from representing the average. In fact, a negative kurtosis indicates that the distribution is tending towards the centre and so this is a relatively normal distribution.

Table 3:
Descriptive statistics of age of sampled candidates

			Statistic	Std. Error
Age	Mean		11.3312	0.00747
	95% Confidence Interval for Mean	Lower Bound	11.3165	
		Upper Bound	11.3458	
	5% Trimmed Mean		11.3384	
	Median		11.0000	
	Variance		0.274	
	Std. Deviation		.52351	
	Minimum		10.00	
	Maximum		13.00	
	Range		3.00	
	Interquartile Range		1.00	
	Skewness		.217	0.035
	Kurtosis		-.773	0.070

Testing the assumption for ordinary least square (OLS) regression : Normality Table 4 presents normality test on all the variables that are examined in this study. Based on probability values, which are all less than 5%, this means that normality does exist for each value, and that is so using both Kolmogorov-Smirnov and Shapiro-Wilk tests of normality (see Annex 1, with the distribution curves).

Table 4:

Tests of Normality

	Kolmogorov-Smimov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Mathematics score	0.056	4913	<0.0001	0.973	4913	<0.0001
Science	0.096	4913	<0.0001	0.936	4913	<0.0001
Social Studies	0.086	4913	<0.0001	0.951	4913	<0.0001
Language Arts	0.090	4913	<0.0001	0.930	4913	<0.0001
Communication Task	0.194	4913	<0.0001	0.853	4913	<0.0001
Age	0.382	4913	<0. 0001	0.690	4913	<0.0001

Figure 7: Frequency distribution and polygon of Mathematics score by selected independent variable Linearity assumption : Based on Figure 8, the distribution is almost perfectly fitted on the 450 line, and this shows that the linearity assumption is upheld for this model using the 5 independent variable on the single dependent variable (i.e., Mathematics score)

Assumption no multicollinearity: The Durbin-Watson test shows a value of 1.825 (Table 6) and this suggests that there is no multicollinearity among the independent variables. Table 5 presents information on bivariate correlations (i.e. Pearson's Product Moment Correlations) of all the variables employed in this study. Clearly, strong (ie., $rxy \geq 0.7$) statistical bivariate linear correlation existed for 1) Social Studies and Language Arts ($rxy = 0.910$, $P < 0.05$), 2) Social Studies and Science ($rxy = 0.918$, $P < 0.05$), 3) Communication Task and Language Arts ($rxy = 0.838$, $P < 0.05$), 4) Social Studies and Communication Task ($rxy = 0.797$, $P < 0.05$); but that these were not creating a problem of multicollinearity inspite of their high bivariate correlations.