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An Examination of Mathematics Performance in Jamaica: Insight into the basis for low enrolment in Mathematics at the tertiary level

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Abstract

In Jamaica, there is a tendency to place the bulk of formal education for students in 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. The education of a child, especially at the primary level, should not be left to the teachers and/or administrators at schools as parents have more influence in the success of their children than teachers and this must be recognized by them to transform the dismally low performance at the primary level. The objective of this study is to evaluate factors that influence G-SAT performance in mathematics, and as such provide a bedrock for understanding deficiency in the subject area. The current study employs panel data using the 2017 GSAT results from Manchester and St Elizabethin Region 5 (i.e., Manchester, Clarendon and St. Elizabeth). The data were provided by the Ministry of Education of some 4,912 candidates who wrote the 2017 G-SAT examination in March. Results were obtained for candidates excluding their data including names on the five subjects they sat in April 2017-1) Language Arts (or English); 2) Communication Task; 3) Science;4) Mathematics, and 5) Social Studies. For this study a model will be built to evaluate 1) whether Language Arts, Communication Tasks, Science and Social Studies have a significant predictive influence on Mathematics performance, and 2) the extent of the predictability of each significant factor on Mathematics performance. The aim is to provide critical information on what affects Mathematics performance and thereby allow tertiary administrators to grasp the challenges of candidates in Mathematics to frame a solution to address the problem of dismally low performance in the discipline. The current research reveals that G-SAT Mathematics performance is influenced by performance in Social Studies, Language Arts, Science, Age and lastly Communication Tasks. 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 Communication Task (0.0%). It can be deduced from the findings that Language and Social Studies hold the keys to performance in mathematics, with the latter

being the main predictor. Students at the primary level must be properly taught and socialized to value scholastic achievements, especially in mathematics. Teachers and the policymakers at the Ministry of Education, Youth and Information as well as teacher education departments at higher education institutions must realize that a joint approach is required to solve the math problems being experienced by students. The data is indicating that at least in Region 5 in 2017, students are more likely to perform better in mathematics if they are performing in other subject areas.

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

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, 2003). 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 the 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 ones 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 primary-level students for Mathematics (see Table 1). This reality is echoed in the fact that at no point in the 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 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 emphasize 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 account 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 demand 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 and 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 in 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 to 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 problems 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 like (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 towards their job is reflected in their poor attendance to lessons, lateness to school, and unsavoury comments about students' performance that could damage their ego. In addition, poor methods 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 the teachers or students or both of them? Is it that students today are non-achievers because they have a 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' methods 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 the 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 Tobagoin 2001 by Kamala Persad-Bissessar who was the Minister of Education at the time

(Leslie, 2003). 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 for 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, theG-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 Tasks. Students are required to complete a total of eighty (80) multiple choice items from each subject area except 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 student's preparation for the G-SAT examinations. The researcher has also noted that parents who play a greater role in the student's day-to-day academic performance usually see their children being awarded a space in the school of their choice. 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. 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 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 parents must 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 regarding their academic performance and achievement in school, the children may exert a lot more effort 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 grade seven at Holy Trinity High School last September were reading at the grade-three level. In another test 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 where I teach.

Several colleagues who teach especially in 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 from 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 can 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 an indication from Samms-Vaughan's statements that parents' monetary support is also needed for their student's 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 who 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, and the crucial examination, and were awarded 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 by 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), studies should 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 Tasks, 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) the proportion of variance accounted for by the predictors, and 3) the relative contribution of each predictor.

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 which 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 the school, advances through collaborative social interaction and the social construction of knowledge (p. 40)

Situated learning theory suggests that learning takes place through the 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 represents how the student's role changes from being a beginner to an expert as they become more active and immersed in the social community where learning takes place.

Materials and Methods

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 research and there is stringency to the direction that must be followed. Whether research is quantitative (empirical/objective) or qualitative (subjective), the general schema is the same and the entire apparatus must be followed to execute effective research. Wanting to establish relationships, the researcher chose an empirical approach to the study of math achievement in education in 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 for 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 by a p-value less than or equal to five

percentage points (≤ 0.05) - two-tailed. 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) the 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 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 communities, multidisciplinary and teachers' colleges.

This research was conducted in Region 5 which 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 except 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 despite 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 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).

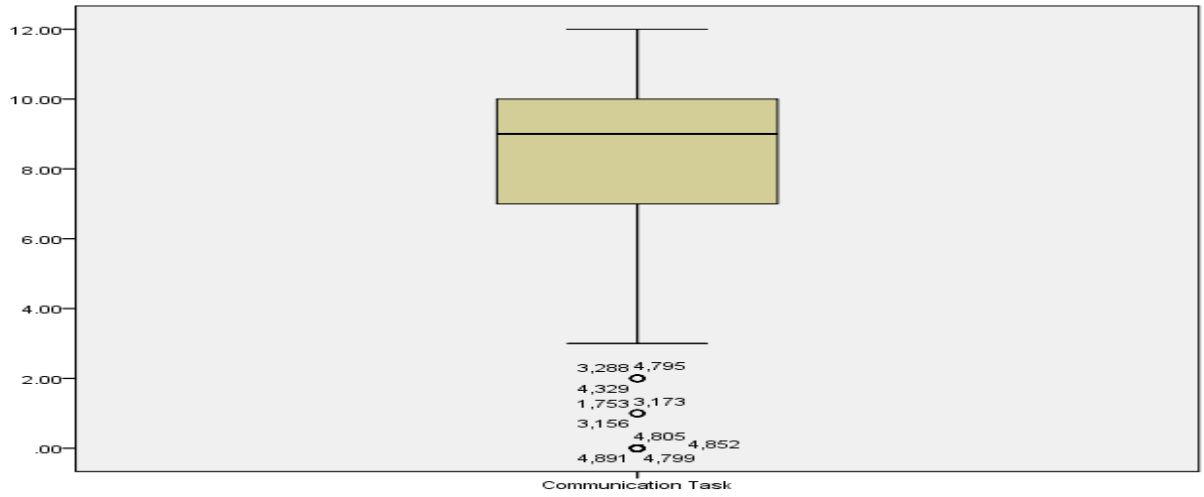

Table 2: Descriptive statistics for Language Arts, Communication Tasks, Science, and Social Studies and Mathematics for the 2017 G-SAT Examination

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 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. 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 the 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 the 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-Smirnov[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
a. Lilliefors Significance Correction						

Normality of all the variables in the OLS model (including Communication Task)

Figure 7 shows that there is normality for the 5 independent variables on the single dependent variable (i.e., G-SAT Mathematics scores). This denotes the assumption of normality of independent variables in an OLS regression model.

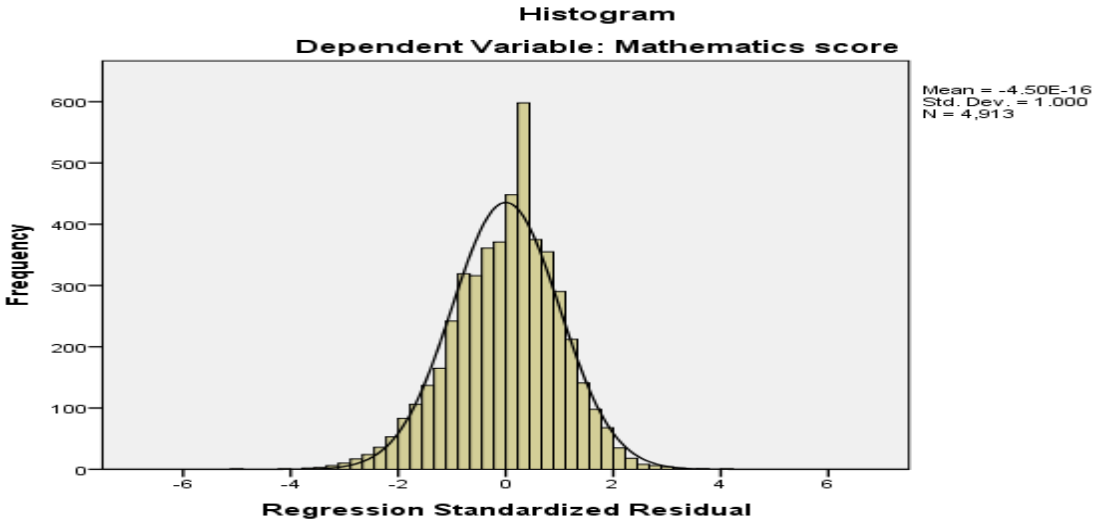

Figure 7: Frequency distribution and polygon of Mathematics score by the selected independent variable

Linearity assumption

Based on Figure 8, the distribution is almost perfectly fitted on the 45^0 lines, and this shows that the linearity assumption is upheld for this model using the 5 independent variables on the single dependent variable (i.e., Mathematics score).

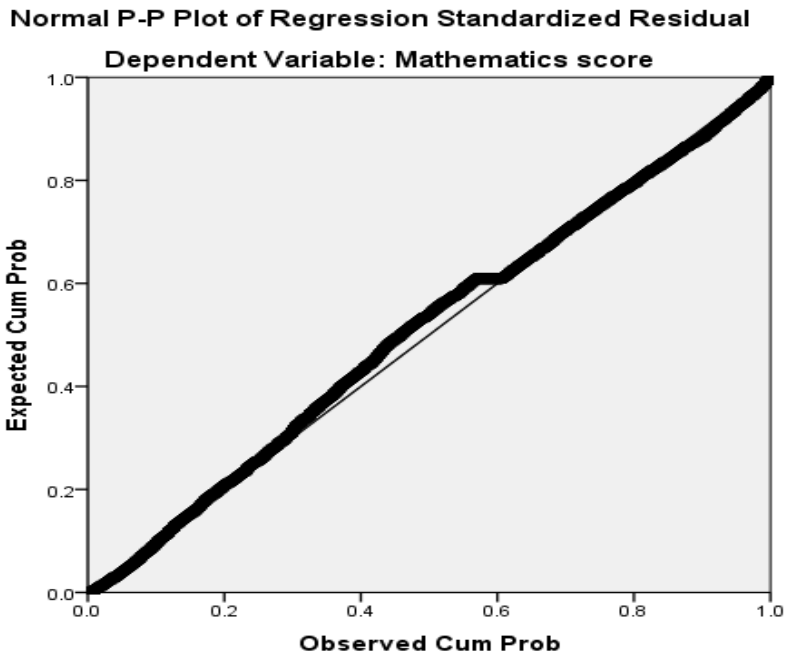

Figure 8: Normal P-P plot of regression

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. Strong (ie., $r_{xy} \geq 0.7$) statistical bivariate linear correlation existed for 1) Social Studies and Language Arts ($r_{xy} = 0.910$, $P < 0.05$), 2) Social Studies and Science ($r_{xy} = 0.918$, $P < 0.05$), 3) Communication Task and Language Arts ($r_{xy} = 0.838$, $P < 0.05$), 4) Social Studies and Communication Task ($r_{xy} = 0.797$, $P < 0.05$); but that these were not creating a problem of multicollinearity inspite of their high bivariate correlations.

Table 5: Correlations

		Mathematics score	Social Studies	Language Arts	Communication Task	Science	Age
Pearson Correlation	Mathematics score	1.000	.891	.889	.764	.885	-.161
	Social Studies	.891	1.000	.910	.782	.918	-.144
	Language Arts	.889	.910	1.000	.838	.920	-.132
	Communication Task	.764	.782	.838	1.000	.797	-.063
	Science	.885	.918	.920	.797	1.000	-.126
	Age	-.161	-.144	-.132	-.063	-.126	1.000
Sig. (1-tailed)	Mathematics score	.	.000	.000	.000	.000	.000
	Social Studies	.000	.	.000	.000	.000	.000
	Language Arts	.000	.000	.	.000	.000	.000
	Communication Task	.000	.000	.000	.	.000	.000

	Science	.000	.000	.000	.000	.	.000
	Age	.000	.000	.000	.000	.000	.
N	Mathematics score	4913	4913	4913	4913	4913	4913
	Social Studies	4913	4913	4913	4913	4913	4913
	Language Arts	4913	4913	4913	4913	4913	4913
	Communication Task	4913	4913	4913	4913	4913	4913
	Science	4913	4913	4913	4913	4913	4913
	Age	4913	4913	4913	4913	4913	4913

Assumption of normality, linearity and homoscedasticity

Figure 9 depicts the scatter plot of the predicted dependent variable (i.e., Mathematics score). Based on the scatter values, it can be concluded that all the assumptions of normality, linearity and homoscedasticity have been met for this study of factors that influence G-SAT Mathematics scores among candidates who sat the 2017 G-SAT examinations in Manchester and St. Elizabeth.

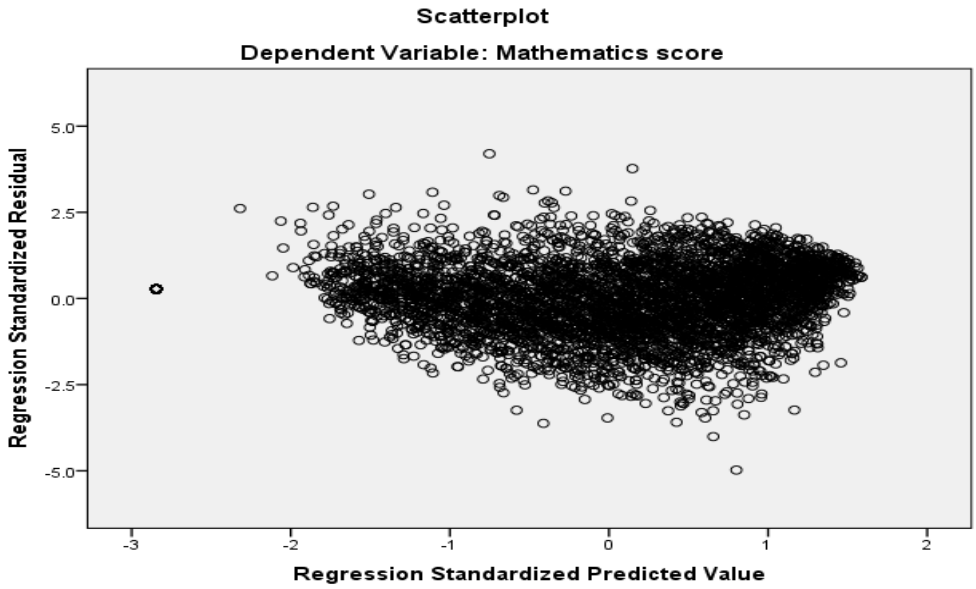

Figure 9: Predicted Mathematics score

Hypothesis

$$H_a: M_i = f(SS_i, S_i, C_i, L_i, A_i) \quad \text{.....[1]}$$

where M denotes the Mathematics score of each student i; Social Studies scores for each student i; Communication Task score for each student i; Language Arts score for each student i; and Age of respondent i.

The predictor model is a good linear fit for the data ($F[5,49012]=5069.956$, $P < 0.0001$)-see Table 7. The minimum ratio of valid cases for independent variables for multiple regressions is 5 to 1. With this study having 4,907 cases and 5 independent variables, this means that the ratio is 981.4 to 1, which satisfies the minimum requirement. Hence, the current linear model (Equation [1]), above, is a good one as the five independent variables are accounting for 83.8% of the variance in G-SAT scores in Mathematics

Table 6

Model Summary										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.915[a]	0.838	0.838	9.31992	0.838	5069.956	5	4907	.000	1.825
a. Predictors: (Constant), Age, Communication Task, Social Studies, Science, Language Arts										
b. Dependent Variable: Mathematics score										

Table 7

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2201907.206	5	440381.441	5069.956	<0.0001[b]
	Residual	426226.934	4907	86.861		
	Total	2628134.139	4912			
a. Dependent Variable: Mathematics score						
b. Predictors: (Constant), Age, Communication Task, Social Studies, Science, Language Arts						

Table 8: Coefficientsa

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
Constant	15.729	2.988		5.264	<0.0001	9.871	21.586					
Social Studies	0.332	0.015	0.35	21.853	<0.0001	0.302	0.362	0.891	0.298	0.126	0.129	7.764
Language Arts	0.331	0.019	0.314	17.78	<0.0001	0.295	0.368	0.889	0.246	0.102	0.106	9.463
Communication Task	0.251	0.104	0.026	2.4	0.016	0.046	0.455	0.764	0.034	0.014	0.29	3.445
Science	0.245	0.017	0.25	14.738	<0.0001	0.212	0.277	0.885	0.206	0.085	0.115	8.687
Age	-1.602	0.258	-0.036	-6.211	<0.0001	-2.107	-1.096	-0.161	-0.088	-0.036	0.97	1.03

a. Dependent Variable: Mathematics score

Table 8 presents predictor variables that will be used to test the hypothesis presented in the ANOVA. Collectively and individually, the variables are significant predictors of candidates' Mathematics scores on the 2017 G-SAT examinations. As such, the final model is expressed in Equation [2]:

$$M = a + b_1SS_i + b_2L_i + b_3C_i + b_4Si + b_5A_i \quad \text{.....[2.1]}$$

$$M = 15.73 + 0.332SS + 0.331L + 0.251C + 0.245S - 1.602A \quad \text{……[2.2]}$$

It can be deduced from [2.2] that all the subjects sat by candidates on the G-SAT examination positively contribute to better performance in Mathematics. However, younger students' performance in Mathematics is higher than that of older ones and this indicates that older ages should not be the yardstick for prescribing a student to sit G-SAT Mathematics. Table 8 cannot be used to assess the contribution of each predictor variable and so the stepwise method will be examined for this purpose.

Stepwise method

Using the stepwise regression approach, the SPSS program presented the contribution of each predictor variable in Table 9. The total explained variables for this model is 83.8%, with Social Studies contributing 79.3% of this followed by Language Arts (3.6%); Science (0.7%); Age (0.1%) and Communication Task (0.0%). It can be deduced from Table 9 that the Social Studies curriculum is contributing to a substantial part of the performance of primary-level students in Mathematics and that Communication Task's contribution is negligible. Although Communication Task's contribution is negligible to Mathematics performance on the 2017 G-SAT examination, it was still a part of the construction of the model, which is presented as Model 5 in Tables 9 and 10.

Table 11 shows that the most influential G-SAT subjects on G-SAT Mathematics performance are Social Studies followed by Language Arts, Science and lastly Communication Tasks. It should be noted here that the younger students perform higher than the older ones on the G-SAT Mathematics examination.

Table 9: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.891[a]	0.793	0.793	10.51582	0.793	18855.293	1	4911	.000	
2	0.911[b]	0.829	0.829	9.56463	0.036	1026.349	1	4910	.000	
3	0.915[c]	0.836	0.836	9.35778	0.007	220.475	1	4909	.000	
4	0.915[d]	0.838	0.837	9.32444	0.001	36.160	1	4908	.000	
5	0.915[e]	0.838	0.838	9.31992	<0.0001	5.759	1	4907	.016	1.825
a. Predictors: (Constant), Social Studies										
b. Predictors: (Constant), Social Studies, Language Arts										
c. Predictors: (Constant), Social Studies, Language Arts, Science										
d. Predictors: (Constant), Social Studies, Language Arts, Science, Age										
e. Predictors: (Constant), Social Studies, Language Arts, Science, Age, Communication Task										
f. Dependent Variable: Mathematics score										

Table 10: ANOVA

Model		Sum of Squares	df	Mean Square	F	P value
1	Regression	2085063.886	1	2085063.886	18855.293	<0.0001[b]
	Residual	543070.253	4911	110.582		
	Total	2628134.139	4912			
2	Regression	2178956.526	2	1089478.263	11909.183	<0.0001[c]
	Residual	449177.613	4910	91.482		
	Total	2628134.139	4912			
3	Regression	2198263.040	3	732754.347	8367.837	<0.0001[d]
	Residual	429871.100	4909	87.568		
	Total	2628134.139	4912			

4	Regression	2201406.944	4	550351.736	6329.867	<0.0001[e]
	Residual	426727.195	4908	86.945		
	Total	2628134.139	4912			
5	Regression	2201907.206	5	440381.441	5069.956	<0.0001[f]
	Residual	426226.934	4907	86.861		
	Total	2628134.139	4912			
a. Dependent Variable: Mathematics score						
b. Predictors: (Constant), Social Studies						
c. Predictors: (Constant), Social Studies, Language Arts						
d. Predictors: (Constant), Social Studies, Language Arts, Science						
e. Predictors: (Constant), Social Studies, Language Arts, Science, Age						
f. Predictors: (Constant), Social Studies, Language Arts, Science, Age, Communication Task						

Table 11: OLS Regression of Mathematics scores by selected Other G-SAT scores

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**	**95.0% Confidence Interval for B**		**Correlations**			**Collinearity Statistics**	
		B	**Std. Error**	**Beta**			**Lower Bound**	**Upper Bound**	**Zero-order**	**Partial**	**Part**	**Tolerance**	**VIF**
1	(Constant)	4.899	.412		11.885	<0.0001	4.091	5.708					
	Social Studies	.845	.006	.891	137.315	<0.0001	.833	.857	.891	.891	.891	1.000	1.000
2	(Constant)	-1.551	.426		-3.644	<0.0001	-2.385	-.717					
	Social Studies	.451	.014	.475	33.312	<0.0001	.424	.477	.891	.429	.197	.171	5.839
	Language Arts	.481	.015	.457	32.037	<0.0001	.451	.510	.889	.416	.189	.171	5.839
3	(Constant)	-2.154	.418		-5.148	<0.0001	-2.974	-1.334					
	Social Studies	.339	.015	.357	22.258	<0.0001	.309	.369	.891	.303	.128	.129	7.727
	Language Arts	.350	.017	.333	20.455	<0.0001	.317	.384	.889	.280	.118	.126	7.936

	Science	.246	.017	.251	14.848	<0.0001	.214	.279	.885	.207	.086	.116	8.608
4	(Constant)	15.645	2.989		5.234	<0.0001	9.785	21.505					
	Social Studies	.333	.015	.351	21.929	<0.0001	.304	.363	.891	.299	.126	.129	7.756
	Language Arts	.349	.017	.331	20.456	<0.0001	.316	.382	.889	.280	.118	.126	7.937
	Science	.248	.017	.254	15.020	<0.0001	.216	.281	.885	.210	.086	.116	8.611
	Age	-1.545	.257	-.035	-6.013	<0.0001	-2.048	-1.041	-.161	-.086	-.035	.979	1.022
5	Constant	15.729	2.988		5.264	<0.0001	9.871	21.586					
	Social Studies	.332	.015	.350	21.853	<0.0001	.302	.362	.891	.298	.126	.129	7.764
	Language Arts	.331	.019	.314	17.780	<0.0001	.295	.368	.889	.246	.102	.106	9.463
	Science	.245	.017	.250	14.738	<0.0001	.212	.277	.885	.206	.085	.115	8.687
	Age	-1.602	.258	-.036	-6.211	<0.0001	-2.107	-1.096	-.161	-.088	-.036	.970	1.030
	Communication Task	.251	.104	.026	2.400	0.016	.046	.455	.764	.034	.014	.290	3.445
a. Dependent Variable: Mathematics score													

Normality of all the variables in the OLS model (including Communication Task)

Figure 10 shows that the 5 independent variables are normal on the single dependent variable (i.e., G-SAT Mathematics scores). Hence, this means the assumption of normality of independent variables in an OLS regression model.

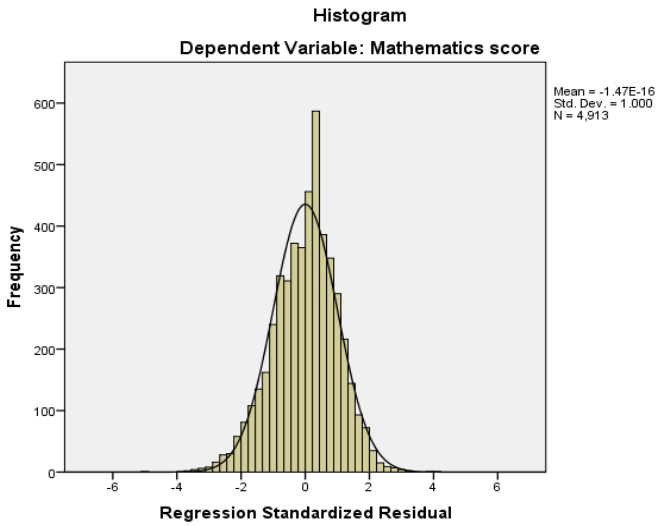

Figure 10: Frequency distribution and polygon of Mathematics score by the selected independent variable

Linearity assumption

Based on Figure 11, the distribution is almost perfectly fitted on the 45^0 lines, and this shows that the linearity assumption is upheld for this model using the 5 independent variables on the single dependent variable (i.e., Mathematics score).

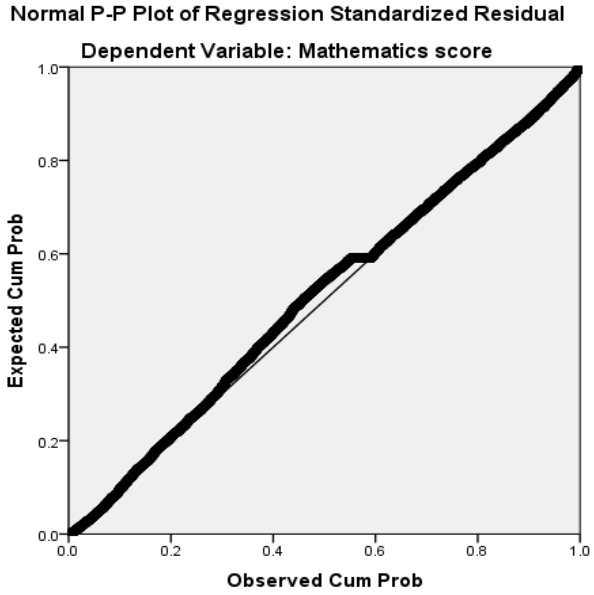

Figure 11: Normal P-P plot of regression

Assumption of normality, linearity and homoscedasticity

Figure 12 depicts the scatter plot of the predicted dependent variable (Mathematics score). Based on the scatter values, it can be concluded that all the assumptions of normality, linearity and homoscedasticity have been met for this study of factors that influence G-SAT Mathematics scores among candidates who sat the 2017 G-SAT examinations in Manchester and St. Elizabeth.

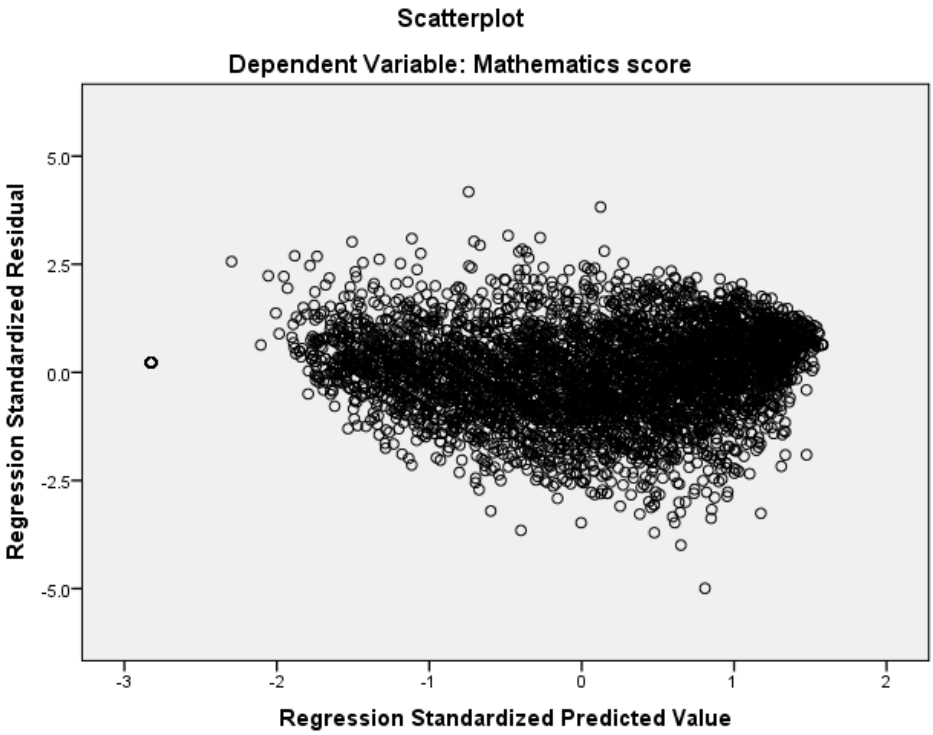

Figure 12: Predicted Mathematics score

Limitations of the Study

1. Results of the study may not be generalizable to other populations as the study was conducted in only one region.
2. The data examined was confined to only the most recent G-SAT results (2017).

Consequently, math achievement may likely vary in different years based on a multiplicity of factors impacting the teaching/learning process.

Discussion, conclusion and recommendations

In this era of globalization and technological revolution, education is considered a first step for every human activity. It creates the acquisition of knowledge and skills that enable individuals to increase their productivity and improve their quality of life. This increase in productivity also leads to new sources of earning and this in turn enhances the economic growth of a country (Saxton, 2000). Mathematics is taught globally to pupils because of its importance in critical thinking problem-solving and its role in daily living. Mathematics is universally accepted as a core subject occupying a central place in education. It is taught from the earliest grades and

provides a foundation for the learning of science and technology as well as for the interpretation of quantitative information in other subject areas (Buddo, 2002). According to Narine (2013), mathematics is the bedrock and indispensable tool for scientific, technological and economic advancement in any nation. It gives the nation the capacity to apply technology for the exploitation of the resources of nature. Such exploitation will depend greatly on mathematics for laying the foundation for political, governmental, military, civil, scientific, technological advancement, economic development, and socio-cultural and environmental peace. Schles (2009) went further than Narine (2013) in stating that mathematics is indispensable in such diverse fields as medicine, computer science, space exploration, skilled trades, business, government and also in our daily life. Mathematics goes beyond the aforementioned issue to time management, weather forecasting, spending and saving money, cooking, creating art, and moving from one place to another and so on (Schles, 2009).

Bourne (n.d) has observed that new ideas are reshaping the teaching of numeric skills.The style of calculations that parents learnt as children have fallen into disuse because the focus has been redirected away from numbers and toward logical relationships and mathematical languages. Instead of doing arithmetic in school, children are now likely to measure rooms, and desks, consider, classify, distinguish, differentiate and compare many aspects of what they have discovered for themselves (Bourne, n.d). Despite the important role that mathematics plays in society, Jamaicans have always underperformed in mathematics and this is expressed in the poor performance at the Caribbean Secondary Examination Council (CSEC) level, which goes back far back to G-SAT Mathematics.

The unsatisfactory performance of students in mathematics and the low levels of numeracy exhibited by students and graduates of the Jamaican educational system has been a cause of much concern for stakeholders in education and the private and public sectors (Ministry of Education, Jamaica, 2013, 4)

Based on research that emerged from various scholars as well as the Jamaican Ministry of Education concerning the low national achievement in mathematics at exiting high schools, there is an urgent need to examine whether G-SAT performance holds the key to the current Mathematics dilemma in Jamaica (Ministry of Education, Youth and Culture, 2011; 2013). Under-performance of Jamaican candidates in CSEC Mathematics must be placed in a wider context of foundation in the discipline and it is for this reason that students' foundation in Mathematics is important for analysis. Hence, G-SAT Mathematics scores are pivotal to understanding much of what obtain 4-to-5 years later, which culminates in the CSEC performance in Mathematics. Trying to find a solution that would provide every student with tools that they can use under the circumstances (i.e., under-performance in Mathematics) means an examination of both the passes in CSEC as well as G-SAT. Simply put, GSAT Mathematics summarizes the foundation of many students in the area of Mathematics and therefore accounts for the low performance at the secondary level.

This study has brought CSEC Mathematics into the discussion because G-SAT offers an examination of what obtains 4/5 years later. To comprehend the severity of the dilemma in Mathematics in Jamaica, an examination of passes in G-SAT Mathematics will be projected to

the CSEC Mathematics passes. In Jamaica, the majority of candidates who write the G-SAT examination do so in grade 6 at the primary level and 4 or 5 years later should write the CSEC Mathematics examination. Hence, using Table 12, in 2002, 51% of Jamaica candidates at the grade 6 level successfully pass the Mathematics examination, G-SAT, and 5 years later, the success rate in CSEC Mathematics was 35.3%. Using the previously stated approach, it is clear that there are some foundational flaws with the competencies of primary-level students in Mathematics that is crippling their likelihood of successfully writing the CSEC Mathematics examination.

Table 12: Passes in CSEC and G-SAT Mathematics, 2000-2016

Year	Passes in G-SAT Mathematics (%)	Passes in CSEC Mathematics (%)
2000		37.70
2001		32.00
2002	51.00	36.00
2003	48.00	36.00
2004	44.20	23.50
2005	57.80	39.40
2006	53.00	35.70
2007	46.00	35.30
2008	55.00	43.00
2009	53.00	40.90
2010	57.00	44.70
2011	62.00	39.90
2012	63.00	37.50
2013	61.00	42.20
2014	60.00	55.50
2015	56.00	57.00
2016	57.00	44.00

Source: Caribbean Examination Council (CXC) and Ministry of Education, various years

Mathematics is a pre-requisite for admission into higher institutions of learning in Jamaica such as sixth form, college or university. The poor performance of students in this urban area high school, like the population, makes it increasingly highly improbable that many of them will not go beyond the secondary level. Therefore, when Powell, Bourne and Waller (2007) found that education was the third leading national problem in Jamaica, the scenario is even worse in mathematics, particularly in schools that received students who obtained low scores on the Grade Six Achievement Test (G-SAT). The reality is that many students at the studied school enter grade seven with scores of less than 50% in mathematics, struggle with the subject at the secondary level and highly resent the subject and the fact that they have to do it in school.

Despite the importance of mathematics, some students today still have negative attitudes toward the subject. Such resentment commences at the elementary (or primary) level. The stressors placed on Jamaican students to write the G-SAT examination could account for the fear of mathematics because many complex concepts are forced upon the pupils with little time for

complete understanding and this can signal the departure from and dislike for the course. To reiterate the position of a former prime minister of Jamaica, Mr Seaga,the preparation for GSAT involves excessive homework which has to be attended to by parents or caregivers and in some instances, they either assist or leave the students to undertake the responsibility by themselves. In addition, a student's performance relates to the degree of assistance obtained. The problem can be viewed within the context of the relationship between parents and children, the extent to which they are assisted or not.

The lack of enthusiasm and interest in this subject is a cyclical process as many parents dislike the course, experience difficulty understanding it, fear the subject and cannot assist their children in understanding it. Some students argue that learning the four basic operations (addition, subtraction, multiplication, and division) is all they need, that the use of graphs and formulae has no relevance to their daily living, therefore there is no need to go into such depth in mathematics. However, others continue to do the subject despite the negative experience because they need a passing grade and others show interest and are doing exceptionally well. This is expressed in the percentage of those who successfully write the examination annually (see Table 12). This takes the discussion to the current issues of 1) of all the subjects in the G-SAT examination which ones have the most influence on Mathematics, and 2) whether is there a need to re-examine how Mathematics is taught from the primary to tertiary level.

In looking at the linear model, the findings indicate that the five independent variables are accounting for 83.8% of the variance in G-SAT scores in Mathematics. Additionally, the ANOVA results demonstrate that collectively and individually, the variables are significant predictors of candidates' Mathematics scores on the 2017 G-SAT examinations. Therefore, the null hypothesis is rejected. Hence, research question one which seeks to find out if age, science, social studies, language arts and communication tasks influence students' math achievement among region 5 G-SAT candidates in Jamaica, is answered in the affirmative.

Research question two is addressed by employing the stepwise regression approach. The question enquired about the contributions of age, science, social studies, language arts and communication tasks to students' math achievement among Region 5 GSAT candidates in Jamaica. The total explained variables is 83.8%, with Social Studies contributing 79.3% of this followed by Language Arts (3.6%); Science (0.7%); Age (0.1%) and Communication Tasks having a minute contribution.

The Social Studies curriculum is contributing to a substantial part of the performance of Region 5 primary-level students in Mathematics. The literature indicates that Social Studies often involve a functional application of social concepts that establish connections to different subject areas such as the sciences and arts. This application calls for a meaningful clarification of the interrelationships and an understanding of the human and social issues that emerge from the interaction of these differentiated subject areas. In a society that has increased levels of individualism, it may seem strange that all of us are influenced by basic attitudes and values by our families or friends. Students often conform to some of the norms of their peer groups in childhood and are sensitive to the judgments of others.

Situated learning theory (SLT) suggests that learning takes place through the relationship between people and connecting prior knowledge with authentic, informal and often unintended contextual learning. As social beings, we look to friends and family for moral support and psychological security. The achievement goals that we seek are generally meaningful and worthy of our effort only if they are highly regarded by the groups to which we belong. Okonkwo (1995) posits that peer group influences student academic achievements. Examination taking itself is a task, therefore students who attribute their successful performances to internal factors (ability and effort) would feel ashamed of potential failure and would put in more effort to ensure success. As such, the teaching of mathematics to primary-level students must be within the context of their previous knowledge as well as in a collaborative environment that will foster learning. For decades, those who are teaching mathematics including college professors have used the traditional approach, which is generally abstract and poses a problem for the students.

It is noteworthy that younger Region 5 students' performance in mathematics outperforms the older ones in 2017 and this indicates that being older should not be the predominant consideration for prescribing a student to sit G-SAT mathematics. The action of delaying school entry is a quest to give certain advantages to some students or retain students in certain grades to ensure students achieve at a higher level. This could be a futile effort to enhance student achievement. Empirical studies have indicated that when students are older than their classmates, their average academic performance declines and continue to decline the older they get. The research literature also suggests that older students are more likely to drop out of school. Coleman, Campbell, Hobson, McParland, Mood, Weinfield, York (1966) and White's (1982) studies showed that as students become older, the correlation between age and school achievement diminishes. Grissom (2004) in his study concluded that the negative relationship between age and achievement remains constant over time.

The issue of the underperformance of Jamaican students goes beyond the primary level, especially G-SAT. For decades, Jamaicans have vehemently complained about the state of the educational system. Various stakeholders including the major newspapers have sought to highlight the poor state of the educational system and still the matter continues unabated, with no clear ending in sight. The title of an article in the Jamaica Observer by Campbell (2014) aptly summarized the poor state of the Jamaican educational system —"Another report on the failing school's syndrome". The reality of the underperformance of Jamaican students has been equally echoed by empirical studies on the matter of student performance (Bourne, Baxter, Pryce, et al., 2015; Colquhoun and Bourne, 2012; Daley and Bourne, 2016; Francis, 2014; Williams and Bourne, 2016). The Jamaican newspapers examined the issue of the underperformance of students, especially in mathematics. More than 50 articles on the matter highlighting public opinion hold the same note in a cross-sectional study (Benjamin, 2011, 2012; Hibbert, 2016; Jamaica Gleaner, 2015; Poyser, 2015; Reid, 2011; Rose, 2013). The issue is that Jamaicans are viewing the status of the educational system as a national problem and that is the message across the newspapers.

The Jamaican newspapers have been turned to by people to express their dissatisfaction with the state of the educational system, and this is captured in some comments made by Balford Henry, a senior reporter at the Jamaica Observer:

In the report, Dwyer said that only 50 of the 129 schools inspected could be rated as effective, while 79 were seen as ineffective. According to the NEI, "effective schools" have strong leadership, a clear school mission, quality teaching and learning, a safe and orderly climate, transparent and effective monitoring of students' progress, high expectations and parental involvement.

The report pointed out that only a few schools were rated as "good", in terms of several other inputs and outputs: teaching in support of students' learning was only three per cent; two per cent were good in students' progress; five per cent in terms of human and material resources to support students' learning; and 14 per cent in terms safety, security, health and well-being (Henry, 2014)

The underperformance dilemma in Jamaica is captured in the findings of the NEI (National Education Inspectorate) cited by Henry, (2014) highlights:

In the 2004 report of the National Task Force on Educational Reform, one of the recommendations was that a National Quality Assurance Authority (NQAA) be established, to address the issue of performance and accountability in the educational system. In line with this recommendation, the Government of Jamaica has established an independent NEI to address the issues identified, and effect changes complementary to the transformation of the education sector (NEI, 2017)

The transformation in the education sector as outlined by NEI (2017) is fundamentally having to deal with literacy and numeracy. Although the NEI was formed to transform the education system in Jamaica, the underperformance of Jamaican candidates in mathematics as captured in Table 12 showed that over a decade and one half (2000-to-2016), the success rate in mathematics at the primary level (i.e. Grade Six Achievement Test, G-SAT) had never surpassed 63% and since 2012 the success rate has been trending downwards. It can be deduced from such statistics that there is the underperformance of young Jamaicans in mathematics and that the current study is pointing to the pedagogical practices involved in delivering the Social Studies curriculum that holds the key to changing how mathematics is taught and the successes thereafter. For more analysis of the data, in 2002, 49% of Jamaican candidates who wrote the G-SAT mathematics examination were unsuccessful and the rate further increased by 5.9%. It, therefore, came as no surprise that in 2004 the NEI was established to address the underperformance in mathematics at the CSEC level and mathematics coaches were introduced at the primary level.

At the epicentre of the national-educational problem therefore lies mathematics. The underperformance of Jamaican students at the primary level has continued into the secondary level, which explains why many major stakeholders including parents have sought answers to the question of ‘What can be done to change the failures in mathematics?’ (Reid, 2011; Thwaites, 2014). The Registrar of the Caribbean Examination Council, Dr Didacus Jules, indicated that there is the underperformance of boys in Grenada as well as the wider English-Speaking Caribbean region (Jules, 2010),

Low performance of not only Jamaican students but also those of other Caribbean countries in the core subject areas of mathematics and English. This is of both national and regional concern (Reid, 2011)

The problematic underperformance of Jamaican students in mathematics is also a gender-sensitive matter that must be taken into discussion of performance in mathematics. Dr Christopher Clarke, principal of Shortwood Teachers' College, opined that the underperformance of males in the Western Hemisphere extends beyond the last two decades and that reasons have been empirically established and as such explains the employment of different strategies by the Ministry of Education and other stakeholders (Clarke, 2015). Among the strategies employed by the Jamaican Ministry of Education to curb the underperformance of Jamaicans, especially boys, was one put forward by the Minister of Education, Ronald Thwaites, in the 2014-2015 sectoral debate in Jamaica. He postulated that:

In September of this year [2014] the Ministry of Education will deploy 146 Mathematics Coaches to primary and secondary schools. They will be charged with the specific purpose of raising teaching standards and student achievement in mathematics. In addition, teachers in targeted schools will be given access to an online training programme designed to strengthen their content knowledge. (Sector Debate by Ronald Thwaites, Minister of Education, in Ministry of Education, 2014, p. 17)

In efforts to combat the underperformance of Jamaican students at the primary-to-secondary levels, the Jamaican Ministry of Education approached it from a methodological aspect and so it instituted specialized teachers as ambassadors. The reality is that in two years post the initiative mathematics passes at CSEC declined by 22.8% (to 44.0% in 2016; see Table 12) and G-SAT fell by 5% (to 57% in 2016). Another initiative was spearheaded by the United States Embassy in Jamaica where:

Approximately 300 educators from primary and secondary schools across the island [Jamaica] participated in three one-day workshops analyzing the interplay of Math, Sports and Science in Education. Led by noted American statistician and researcher, Dr Rebecca Klemm, 'The Numbers Lady', participants received practical tips on how to improve student engagement and stimulate increased learning of the respective subject areas at both educational levels (Embassy of the United States of America, 2012)

Having identified that the underperformance of Jamaican students dates back four decades and that various measures have been instituted and/or employed to change this reality, the evidence still shows the continued declining performance of candidates in mathematics. This begs the question "What next can be done to alter the underperformance of students in mathematics?" A careful examination of mathematics research has supported the employment of game-based teaching as a medium to improve student performance, but little information exists on this method in Jamaica. On examination of the current findings, the Social Studies curriculum is all-inclusive, game-based, and research-based, and this subject offers the highest level of explanation of success, though limited, in G-SAT mathematics, and therefore holds some value as the way forward in the teaching of mathematics. Another important piece of evidence in this

mathematics audit is the role of Language Arts or English Language in the successes of GSAT mathematics. It can be deduced from the present empirical inquiry that low comprehension skills negatively impact the likelihood of learning mathematics among Jamaican students. Such findings mean that there is a need to begin an extensive comprehension programme in primary schools as a key component in unlocking the clear mathematical deficiency in Jamaican students writing mathematics examinations.

Conclusion

The issue of performance in mathematics in Jamaica persists in being a topical matter because of low achievement levels. According to the Ministry of Education, Youth and Information, in 2016, 57% of Jamaican candidates who wrote the Grade Six Achievement Examination failed the examination. This means that 43 out of every 100young Jamaican candidates (ages 11 and 12 years) have been unsuccessful in writing mathematics at the primary level, which has implications for the quality of students in mathematics at the high school level, matriculation in universities and/or colleges, and by extension, for national development. Therefore students at the primary level must be properly taught and socialized to value scholastic achievements, especially in mathematics. It is important that teachers and the policymakers at the Ministry of Education, Youth and Information realize that to solve the math problem, a joint approach is required that must be embedded into the curriculum of Social Studies and comprehension.

Students should not be overly pressured nor should they be held back from doing GSAT exams on account of being too young and not ready. Clearly as is demonstrable by the 2017 GSAT region 5 results, being “older” does not necessarily translate into being a better mathematician. This paper found that social studies build contexts that students can readily relate to and would not be seen as far removed from their lived experience, then Social Studies can be seen as a subject that students can apply to their everyday life. Could it be that Mathematics is too abstract or that it is taught abstractly and students are unable to apply its relevance to their day-to-day experience? If we can agree on that, then maybe we can agree too that the older students have an advantage of seeing the life application principles in social studies and by extension, they would be more inclined to see the application in mathematics if it were taught as an application subject. This argument by extension would also lead to the conclusion that “being older” would translate into being a better mathematician.

Recommendations

1. Colleges and universities must begin this change of retraining primary and secondary school teachers in how mathematics must be taught; that is, by way of coaching, discovery learning, cooperative, game-based approaches, and the practical solutions to issues in society;
2. Colleges and universities in the parish of Manchester should offer assistance to schools within the parish in the area of strategies for the teaching of mathematics, particularly at the primary level;
3. Tertiary institutions should re-examine how mathematics is taught, and as such provide an integrated curricula alternative to the current disjointed subjects curricula that are used from primary to secondary schools in Jamaica;

4. A comprehensive assessment or study should be carried out on how Social Studies is taught, its curriculum and how mathematics integrates some of the strategies;
5. Comprehension skills should be taught beyond the first year of college to all mathematics students as this will enhance their aptitude in the discipline;
6. Tertiary institutions should partner with the Ministry of Education in the continuous re-training of mathematics teachers in parishes of Manchester, Clarendon, and St. Elizabeth on an annual basis;
7. There is a need to introduce special incentives for people who are desirous of pursuing mathematics, particularly the teaching of mathematics in secondary schools - scholarships, grants, tuition reduction, and so forth;
8. There is also a need to integrate theory and practice in the teaching of mathematics
9. An understanding of the role and contribution of math to national development is needed. Mathematicians should be identified and their skills for advancing societal goals highlighted.
10. Greater equity is needed in the resources allocated to schools. Some schools are endowed with better resources and their students are better prepared with more qualified teachers to develop a more integrated curriculum. Other schools are left behind.
11. The Ministry of Education needs to set the tone as to the importance of mathematics and should therefore request that students are taught math everyday. They should encourage the brightest to be trained as math teachers and possibly give better incentives to attract and maintain talented teachers in this discipline. A national campaign should be launched and the private sector should be encouraged to support this venture. Given the gender concerns in math, more males as math teachers should also be incentivized.

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Annexe 1:

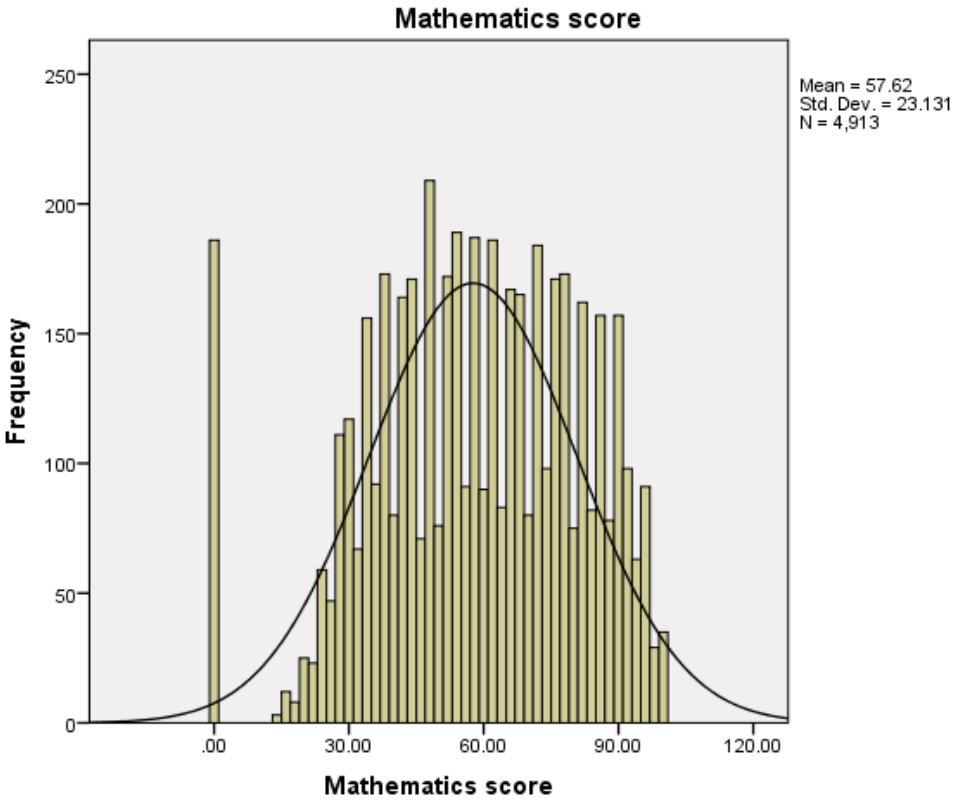

Figure 1: Distribution and frequency curve of Mathematics score

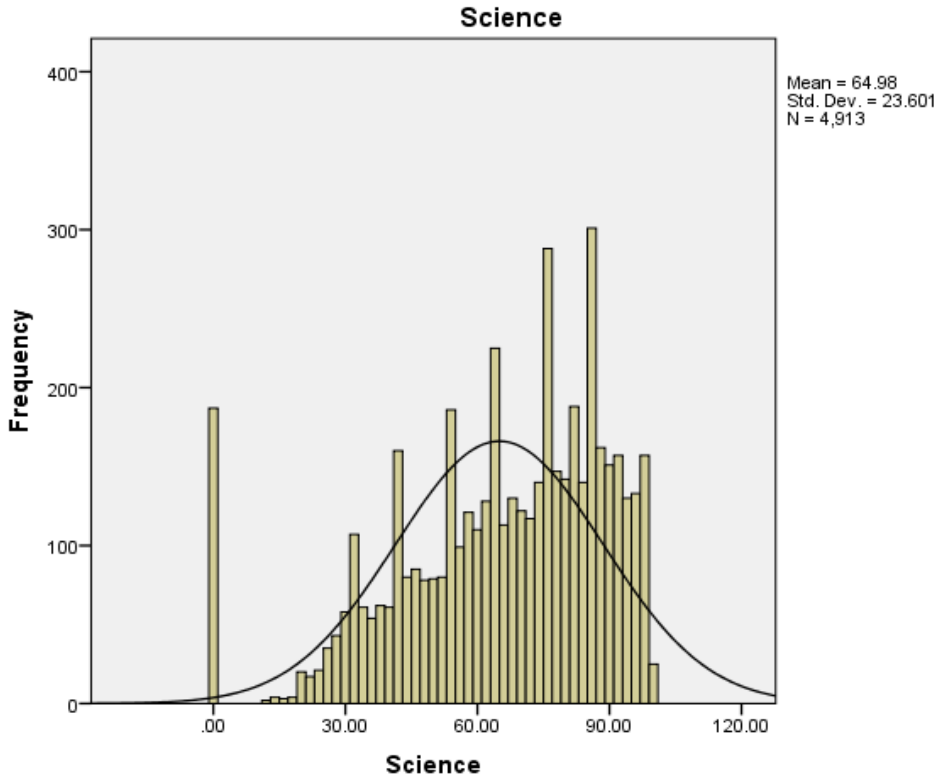

Figure 2: Distribution and frequency curve of Science score

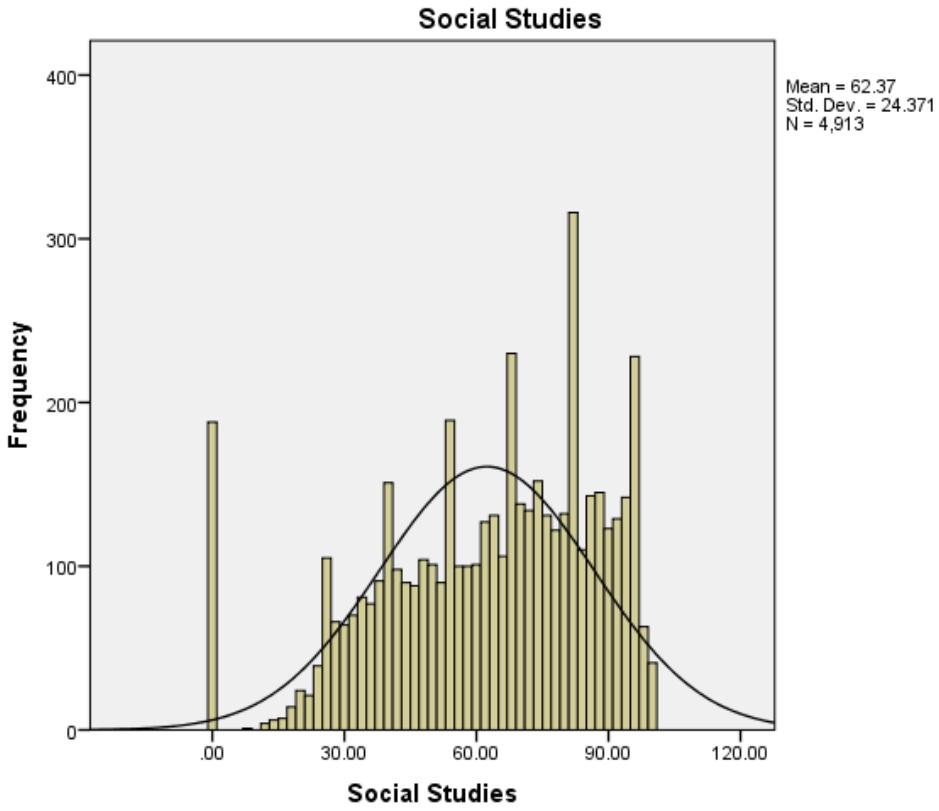

Figure 3: Figure 1: Distribution and frequency curve of Social Science score

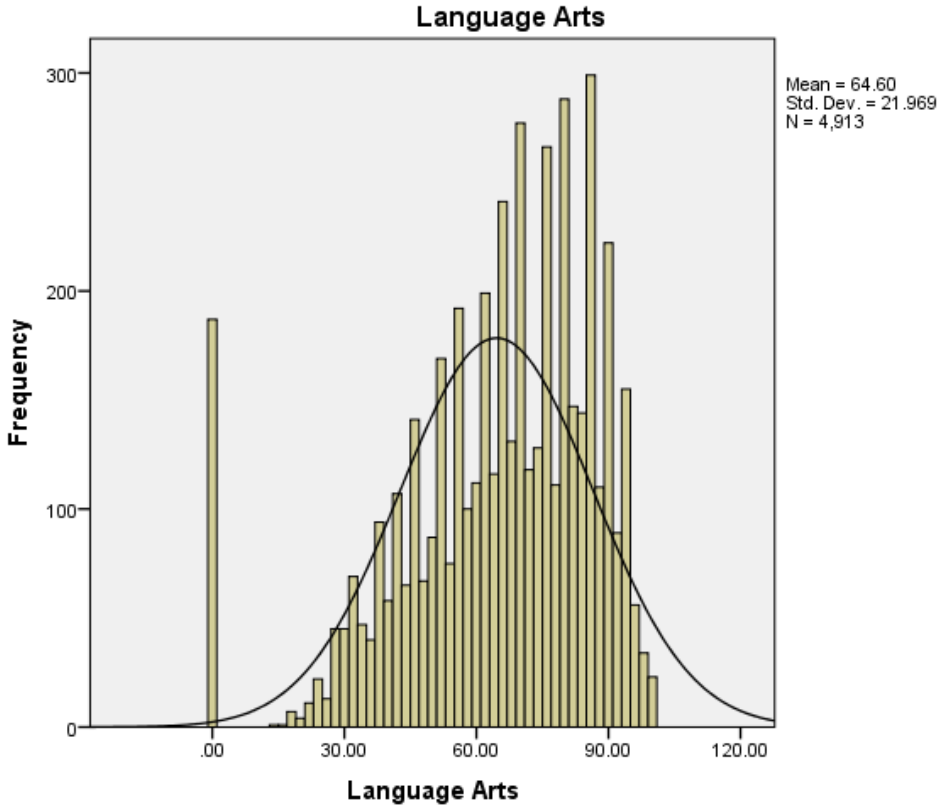

Figure 4: Distribution and frequency curve of Language Arts score

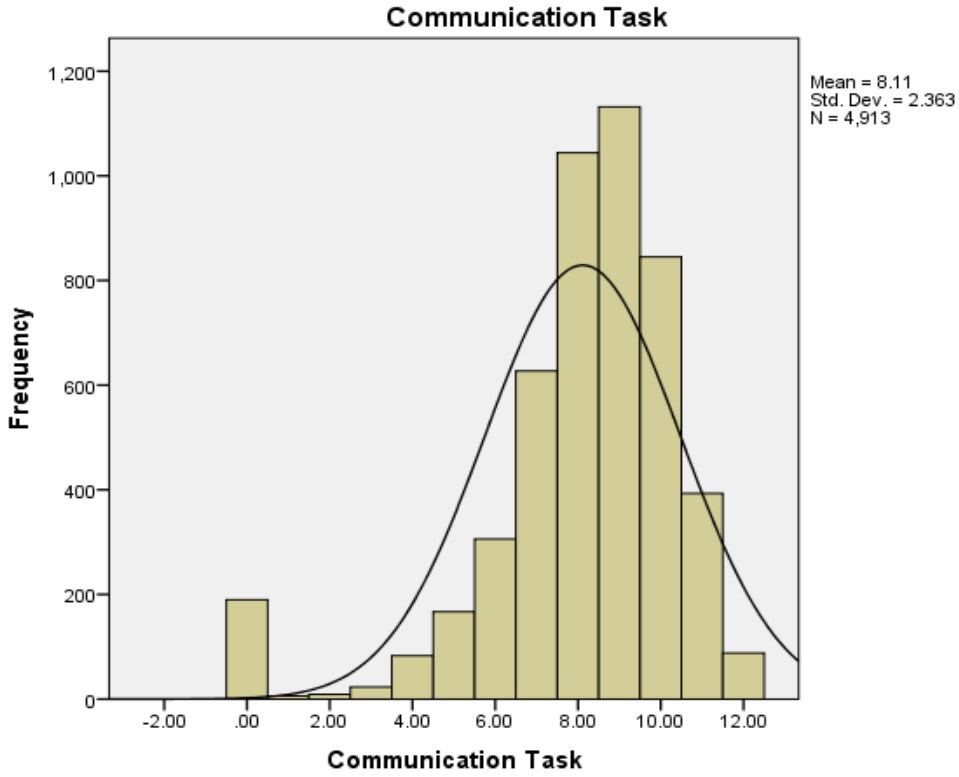

Figure 5: Distribution and frequency curve of Communication Task score

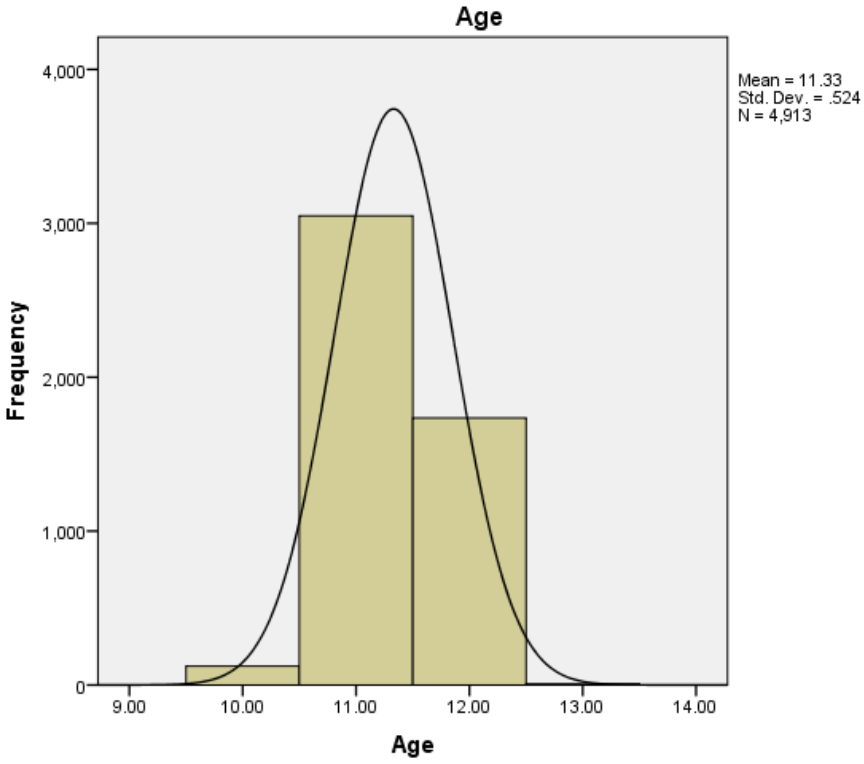

Figure 6: Distribution and frequency curve of Mathematics score