Factors Associated with Mathematics Results at G.C.E. (O/L) Examination

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Abstract

The General Certificate of Education (Ordinary Level) (G.C.E O/L) examination is the first most important public certificate examination in Sri Lanka. Most of the candidates 'fail' the G.C.E (O/L) examination due to their failure in Mathematics, leaving them without any viable option for their future. Identification of factors related to the results of Mathematics is essential to rectify this problem. This paper presents some findings of a study carried out in 2008 to explore the factors related to the results of Mathematics of the G.C.E (O/L) examination. The necessary data were collected from a survey conducted in the Piliyandala Educational Zone. The components of the syllabus that are most weighted in the marking scheme and the components preferred by the students were identified. The external factors that are associated with Mathematics marks were also identified through analysis of variance and regression analysis. Findings are useful to those who design curricula as well as to the teachers and parents.

Key words: G.C.E (O/L), Mathematics, ANOVA, Regression analysis

Introduction

General Certificate of Education (Ordinary Level) examination (G.C.E O/L) is an important examination conducted by the Department of Examinations of Sri Lanka. This examination is the first certificate examination indicating the school learning achievement of students completing eleven years of schooling. Passing this examination is a minimal requirement for further education or formal employment in the public and private sectors. Therefore, the G.C.E (O/L) examination is a vital hurdle for all Sri Lankan students.

A large number of students (456,898 in 2007, according to reports of the Department of Examinations) sits for the G.C.E (O/L) examination every year. A student sits for 10 subjects examinations and must pass Mathematics and the first language (Sinhala or Tamil) in order to 'pass' the G.C.E (O/L) examination. Unfortunately, more than 50% of the candidates fail to satisfy this requirement. As a result, they become destitute without any chance to further education or a formal employment. Therefore, it is imperative to take appropriate steps to overcome this problem as early as possible.

Table 1 shows the percentages of candidates who failed in Mathematics at the G.C.E (O/L) examination in the recent past. Most of the candidates 'fail' the G.C.E (O/L) examination due to their failure in Mathematics.

Table 1: Percentages of failures of Mathematics at G.C.E
(O/L) examination from 2002 to 2009

Year	2002	2003	2004	2005	2006	2007	2008	2009
Number of students sat for Mathematics paper	341638	366607	362072	370290	369307	276126	256858	271611
Number of failures	204880	211972	197402	211473	211687	142067	127813	133117
Failure Percentage (%)	59.97	57.82	54.52	57.11	57.32	51.45	49.76	49.01

(Source: Results reports of Department of Examinations from 2002 to 2009)

The failure rate, which was alarming and significantly higher than 50% from 2002 to 2007, has dropped to a figure which is marginally below 50%, after 2007. However, since the cutoff mark for a 'pass' is not available from the Department of Examinations, it is not possible to determine whether this is a real improvement or an artificial effect. Nevertheless, the failure rate in Mathematics is still unacceptably high. Since this leads to grave social implications by leaving a large percentage of youth without any viable future plan, remedial measures must be taken as early as possible. Identification of factors related to the results of Mathematics is essential for this purpose. It was the main objective of this study. This study consisted of three main components:

1. Study of the Mathematics syllabus and marks allocation for the different components of the syllabus in the past papers to identify 'important components'.

2. Study of the marks obtained by a sample of students in school examinations to identify the 'preferred components' and the 'difficult components'

3. Study of factors related to the marks for Mathematics at school examinations.

Sample Selection and Data Collection

The data for the first component of the study were obtained by examining the teacher's instruction manual, marking schemes of 10 past G.C.E. (O/L) question papers and one third-term test paper of a school in the Western Province.

In order to obtain the necessary data for the second and the third components of the study, 12 schools were randomly selected from the Piliyandala Educational Zone. This educational zone was selected as the study population for convenience.

There are 3 educational divisions in the Piliyandala Educational zone, namely, Dehiwala, Kesbewa and Moratuwa. There are 101 schools in the Piliyandala Educational Zone. The schools are divided into 4 categories.

1 AB Schools	-	Schools with Advanced Level Science stream classes
1 C Schools	-	Schools with Advanced Level Arts and/or Commerce stream (s) but no Science stream classes
Type 02 Schools	-	Schools with classes only up to grade 11
Type 03 Schools	-	Schools with classes only up to grade 5

Type 03 schools are out of the scope of this study because these schools do not have classes up to G.C.E (O/L). Tamil medium schools were not considered due to practical difficulties in communication. Therefore, the study population consisted of 80 schools only. Table 3 shows the classification of these 80 schools according to the educational division and type.

Table 2: Classification of schools in Piliyandala zone according to
the educational division and type

Type\Educational Division	Dehiwala	Moratuwa	Kesbawa
1 AB Schools	10	06	02
1 C Schools	05	02	07
Type 02 Schools	17	16	15
Total	**32**	**24**	**24**

Twelve (12) schools were selected for the sample according to the proportional allocation of schools in the Piliyandala Educational Division.

Table 3: Classification of schools in the sample according to
educational division and type

Type\Educational Division	Dehiwala	Moratuwa	Kesbawa	Total
1 AB Schools	01	01	01	03
1 C Schools	01	01	01	03
Type 02 Schools	02	02	02	06
Total	**04**	**04**	**04**	**12**

In order to analyze the performance of students in Mathematics, their marks were required. Since the marks of the GCE O/L examinations were not available from the Department of Examinations, marks of the third- term test paper were obtained from the selected schools of the Western Province. This paper was common for all the schools in the Western Province.

In order to identify the student's preference and to analyze the performance, total marks for Paper I and question-wise marks for Paper II of the Western Province third term test paper (2007) were obtained. Since these students had already left the school, we could not collect data from them to identify the factors related to the marks. Therefore, we obtained the total marks (Paper I + Paper II) of the Western Province second term test (2008) and other data (using a questionnaire) from those who were expected to sit for the O/L examination in December 2008.

Results

This section presents the analyses carried out for the three components of this study and their results.

Components of the Syllabus

According to the teacher's instructional manual, there are six main components, namely,

1. **Arithmetic:** Real Numbers, Indices & Logarithms, Percentages, Insurance, Tax, Arithmetic and Geometric series, etc.

2. **Algebra:** Algebraic expressions, Algebraic fractions, Linear equations, Quadratic equations, Graphs, Inequalities, etc.

3. **Geometry:** Area of the parallelograms and triangles, Pythagoras' theorem, Triangles, Tangent, Geometric constructions, Cyclic quadrilateral, etc.

4. **Measurement:** Surface area of solid, Volume of solid, Trigonometry, etc.

5. **Sets & Probability :** Sets, Probability

6. **Statistics:** Data representation, Quartiles, etc.

Table 4 shows how the marks were allocated for the above components in 10 past GCE O/L examinations, and one Western Province examination. Table 5 presents some descriptive statistics of these data.

Table 4: Marks allocation (Papers I and II combined)

Paper	Arithmetic (%)	Algebra (%)	Geometry (%)	Measurement (%)	Sets & Prob. (%)	Statistics (%)
Western Province Examination -2007	20.7	20.2	23.5	14.2	11.2	10.2
G.C. E.(O/L) - 2007	22.6	19.7	23.5	17.6	9.3	7.3
G.C. E.(O/L) - 2006	18.7	19.7	27.5	15.7	9.2	9.2
G.C. E.(O/L) - 2005	19.6	15.3	28.1	17.6	9.2	10.2
G.C. E.(O/L) - 2004	23.2	18.2	23.5	18.5	9.3	7.3
G.C. E.(O/L) - 2003	20.2	20.2	21.5	20.1	9.3	8.7
G.C. E.(O/L) - 2002	26.1	20.1	23.0	19.6	2.9	8.3
G.C. E.(O/L) - 2001	23.1	22.6	22.6	19.1	6.8	5.8
G.C. E.(O/L) - 2000	28.5	18.7	24.5	14.7	5.8	7.8
G.C. E.(O/L) - 1999	29.5	19.7	22.5	15.7	5.8	6.8
G.C. E.(O/L) - 1998	28.5	19.7	24.5	12.7	5.8	8.8

According to these statistics, the most weighted component is Geometry and the least weighted component is Sets and Probability. The weight of Arithmetic is almost the same as that of Geometry.   Algebra and Measurement have also been given fairly high weights. The weight for Statistics is almost the same as that for Sets and Probability.

Table 5: Descriptive statistics of the marks allocation

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Variable          N  N*   Mean   StDev Minimum     Q1  Median     Q3 Maximum
Arithmetic (%)   11  0   23.70   3.88   18.70  20.20  23.10  28.50   29.50
Algebra (%)      11  0  19.464  1.763  15.300 18.700 19.700 20.200  22.600
Geometry (%)     11  0  24.064  2.043  21.500 22.600 23.500 24.500  28.100
Measurement (%)  11  0  16.864  2.420  12.700 14.700 17.600 19.100  20.100
Sets & Prob. (%) 11  0   7.691  2.431   2.900  5.800  9.200  9.300  11.200
Statistics (%)   11  0   8.218  1.383   5.800  7.300  8.300  9.200  10.200
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Table 05 shows the summary statistics of marks allocation. According to the weight of marks allocation Geometry, Arithmetic, Algebra, and Measurement can be recognized as the most important components of the syllabus.

According to the above summary statistics, the order of 'importance' of the components is ranked considering their median values.

Geometry $>$ Arithmetic > Algebra > Measurement > Statistics $>$ Sets & Probability

Time Allocation for the Components of the Syllabus

According to the teacher's instruction manual, the time allocated for the above six components of the syllabus are shown in Table 6.

Table 6: Time allocation for different sections

	Grade 10	Grade 11	
Area	**Number of periods**	**Number of periods**	**Total**
Arithmetic	42	47	89 (23.6%)
Algebra	39	44	83 (22%)
Geometry	44	44	88 (23.3%)
Measurement	30	24	54 (14.3%)
Sets & Probability	14	14	28 (7.4%)
Statistics	18	17	35 (9.3%)
Total	**187**	**190**	**377**

According to this table, time has been allocated in the following order.

Geometry $\approx$ Arithmetic > Algebra > Measurement > Statistics $>$ Sets & Probability

The order of 'importance' given by these statistics and the order of time allocation are the same. Furthermore, the time allocation for each component is approximately proportional to the mean marks allocated for each component.

Students' Preference and Performance

There are two question papers for Mathematics. Paper I consist of 30 questions and is worth of 60 marks. Paper II consists of 10 questions and a student should answer the first question (compulsory question) and 7 other questions out of 9 questions to obtain 140 marks. This makes the total marks for the two papers 200.

Mathematics marks of the Western Province third term test paper (2007) were available of three hundred and forty (340) students. Figure 1 shows the dot-plot of the marks for question paper 1. Table 7 and Table 8 show the descriptive statistics and the frequency distribution of the marks.

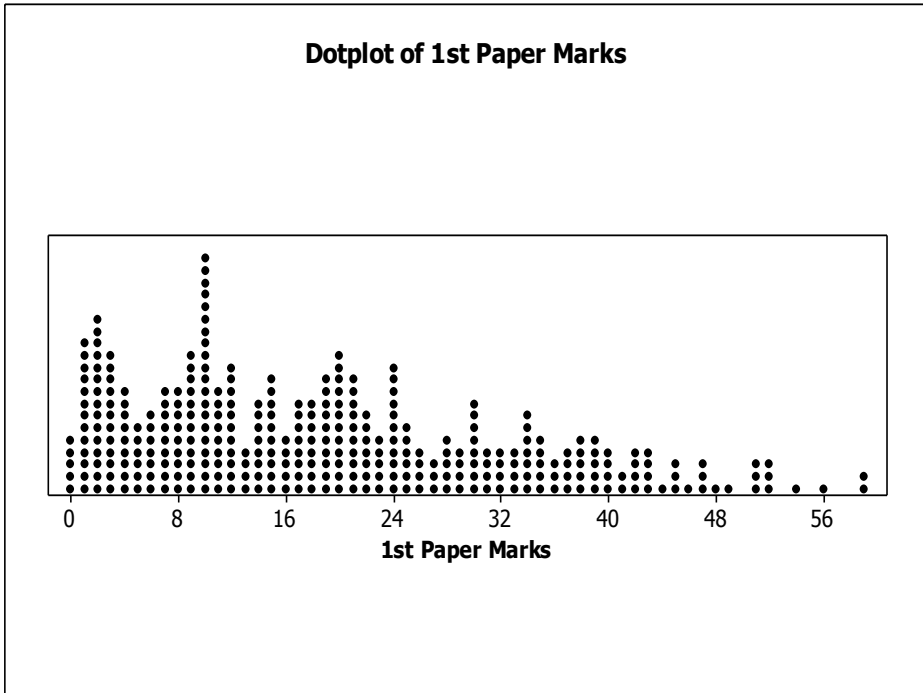**Fig 1: Distribution of marks for Paper - I**

Table 7: Descriptive statistics of Paper -I

1st Paper Marks (out of 60)							
Variable	N	Mean	StDev	Minimum	Q1	Median	Q3	Max
1st Paper	340	19.291	13.863	0.0	8.250	17.000	29.0	59.0

The distribution of marks for Paper I is highly skewed to the right. Fifty percent of students scored less than 17 out of 60 while 75% of students could not score half of the total marks for Paper I.

Table 8: Frequency distribution of the marks for Paper – I

Marks	No. Students	%	Cum Pct
00	5	1.47	1.47
1--2	28	8.24	9.71
3--4	21	6.18	15.89
5--6	13	3.82	19.71
7--8	18	5.29	25.00
9--10	32	9.41	34.41
11--20	85	25	59.41
21--30	63	18.53	77.94
31--40	45	13.24	91.18
41--50	20	5.88	97.06
51--60	10	2.94	100
Total	**340**	**100.00**	

According to the statistics given in Table 08, 25% of the students scored below 9 (15%) for Paper I. Nearly 35% of the students were not able to score more than 10 (17%), even though ten very simple questions in basic arithmetic operations (addition, subtraction, multiplication and division) were included in this paper. This implies that nearly 35% of the students are incapable of taking even the basic arithmetic operations. Only 22% of the students were able to obtain more than half of the total marks.

Since only the total marks were available for Paper I, it was not possible to analyze the performance in different components of the syllabus. However, this information was available for Paper II. Table 9 shows the number of students who had attempted each question in Paper II. (Note that Question 1 is a compulsory question).

Table 9: Selection of questions

Que.NO	Section	Counts	%
Q1		340	100
Q2	Arithmetic & Algebra	146	43
Q3	Geometry	260	76
Q4	Algebra	266	78
Q5	Arithmetic	203	60
Q6	Statistics	289	85
Q7	Measurement	98	29
Q8	Measurement	145	43
Q9	Geometry	42	12
Q10	Sets & Probability	230	68

The most popular question was Q6 (Statistics). Eighty five percent (85%) of the students had attempted this question. Question 4 (Algebra - Graph) and Question 3 (Geometric constriction) were the next in popularity respectively. Sixty eight percent (68%) of the total population had selected Question 10 which was from Sets and Probability. Question 7, which was based on the volume of a cylinder, was not a popular choice. Only 29 % of the students had attempted this question. Question 9, which was from Geometry, was the least attempted question. Only 12% of the candidates had attempted this question. According to these statistics, order of popularity of the components of the syllabus is as follows.

Statistics > Algebra (Graph)> Geometry Construction > Sets & Probability > Arithmetic > Arithmetic and Algebra > Measurement > Measurement > Geometry.

It is clear that the most highly weighted components in the syllabus (Geometry, Arithmetic, Algebra, and Measurement) are less preferred by the students.

Table 10 shows the descriptive statistics of the marks obtained by the students for six components of the syllabus. Note that the marks have been added over each component and converted into percentages for ease of comparison. For example, Question 3 and Question 9 are from Geometry.

 If a student had obtained 5 marks for Question 3 and 4 marks for Question 9, then his/her marks for the Geometry component would be calculated as [(5+4)/(total marks for Question3 and Question 9)]*100.

Table 10: Descriptive statistics of mathematics marks

Variable	N	Mean	Stdev.	Min	Q1	Median	Q3	Max
Arithmetic	340	31.62	24.19	0	10.7	25	46.43	100
Algebra	340	33.62	28.08	0	7.14	28.57	53.57	100
Geometry	340	27.49	22.91	0	7.14	23.41	50	95.24
Geometry (Except Geometry construction)	340	17.78	17.63	0	0	14.29	32.14	92.85
Measurement	340	14.43	22.67	0	0	0	17.86	100
Statistics	340	39.83	31.13	0	9.52	33.33	66.67	100
Sets & Probability	340	29.48	25.93	0	9.52	23.81	42.86	100

The mean mark for each component is larger than the median mark, indicating that the distribution of marks for each component is positively skewed. Therefore, we chose the median as the measure of average for the purpose of comparison. Unfortunately, the average (median) mark for each component is very low. Even for the most popular component, Statistics, the average mark is 33.33%. The average marks for the four most highly weighted components (Geometry, Arithmetic, Algebra, and Measurement) are below 30%. It is very striking that the median marks for the Measurement component is 0 and the seventy-fifth percentile is 18%. This implies that the most difficult component for the students is Measurement.

According to the above statistics, the order of performance, from the best to the worst, is as follows:

Statistics > Algebra > Arithmetic> Sets and Probability > Geometry> Measurement.

Factors related to Mathematics marks

In order to identify the factors related to the exam results for Mathematics, data were collected from the students who expected to sit for the O/L examination in December 2008. Data on the following variables were collected using four hundred and forty six (446) completed questionnaires. In order to identify the factors possibly related with Mathematics marks, analysis of variance (ANOVA) was carried out taking mathematics marks as the response variable and 20 categorical variables as factors. The following table shows the description of variables.

Table 11: Description of variables

No:	Variable Name	Description	Level labels and levels
1	Division	Educational Division	1-Dehiwala, 2-Kesbawa, 3-Moratuwa
2	SchType	School Type	1-Type 02 2-Type 1C 3-Type 1 AB
3	Gender	Gender of the student	1- Female 2-Male
4	Interest	Interest in mathematics	0-No 1-Yes
5	SchExersies	Answering the exercises in school text book	1-Low (less than 40%) 2-Moderate (between 40% and 70%) 3-High (more than 70%)
6	Attendance	School Attendance	1-Low (less than 50%) 2-Moderate (between 50% and 80%) 3-High (more than 80%)
7	ExtraTime	Time (hours) spent per week for extracurricular activities (Hours)	1-0-0.5 hours 2-hours 3- More than 4 hours
8	Tutiontime	Time spent per week for mathematics tuition (Hours)	1-0-1 hours 2-1.1-2 3-2.1-4 4-More than 04 hours
9	Time	Time spent for travel from home to school and vice versa (minutes)	1-5-15 2-15.1:30 3-More than 30 hours
10	TuitionExercies	Working on tuition tutorials	1-Low (less than 40%) 2-Moderate (between 40% and 70%) 3-High (more than 70%)
11	MotherEmp	Whether the mother is employed	0-No 1-Yes
12	MEdu	Highest education level of the mother	1- Less or up to G.C.E (O/L) 2- Passed G.C.E (O/L) 3-Passed G.C.E (A/L) 4 - Degree/Diploma

13	FatherEdu	Highest education level of the father	1- Less or up to G.C.E (O/L) 2- Passed G.C.E (O/L) 3-Passed G.C.E (A/L) 4 - Degree/Diploma
14	Help	Whether received help from older siblings to solve mathematical problems	1-Low/No 2-Moderate 3-High
15	ParentInvolve	Parental Involvement (Getting help from parents to solve mathematics problems and their attention to the studies of students)	1-Low/No 2-Moderate 3-High
16	Income	Monthly family Income level	1- Less than Rs 10,000/- 2- between Rs 10,000/- and Rs 25,000/- 3- In between Rs 25,000/- and Rs 40,000/- 4 - Greater than Rs 40,000/-)
17	Timetable	Whether studying according to the time table at home	0-No 1-Yes
18	Workingtime	Time spent per week for studying mathematics at home (Hours)	1-Low (0:3) 2-Moderate (3.1:7) 3-High (more than 07 hours)
19	TVtime	Time spent per day on watching television	1– 0: 1 2– 1.1:2 3-2.1:3 4-More than three hours
20	HobbyTime1	Time spent per day on hobbies (Hours)	1– 0: 0.5 2– 0.51:1 3-1.1:2 4-More than two hours

A model with the 20 main effects and all two way interactions were fitted. Higher order interaction effects were not taken into consideration due to the difficulties in practical interpretation. The usual model assumptions were tested and found to be valid. All the factors and two-way interactions that were significant at 0.2 level were selected for further investigation. The following table shows the significant main effects and the two-way interactions.

Table 12: ANOVA

Dependent Variable: Mathematics

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	189028.160[a]	57	3316.284	24.182	.000
Intercept	125023.684	1	125023.684	911.650	.000
Interest	815.877	1	815.877	5.949	.015
SchExersies	7418.944	2	3709.472	27.049	.000
TuitionExercies	4396.444	2	2198.222	16.029	.000
FatherEdu	992.722	3	330.907	2.413	.066
Help	1436.486	2	718.243	5.237	.006
Income	1654.242	3	551.414	4.021	.008
SchType * Interest	10562.371	4	2640.593	19.255	.000
Gender * MotherEmp	1309.214	1	1309.214	9.547	.002
Gender * Timetable	725.215	2	362.607	2.644	.072
TuitionTime* Workingtime	2625.653	9	291.739	2.127	.026
TuitionExercies * MotherEmp	1155.646	2	577.823	4.213	.015
TuitionExercies * Workingtime1	1468.301	4	367.075	2.677	.032
MotherEmp * FatherEdu	686.664	3	228.888	1.669	.173
MotherEmp * Income	1296.475	3	432.158	3.151	.025
FatherEdu * Workingtime	1922.734	6	320.456	2.337	.031
Help * ParentalInvolve	4024.940	6	670.823	4.892	.000
Error	53210.297	388	137.140		
Total	1150616.000	446			
Corrected Total	242238.457	445			

a. R Squared = .780 (Adjusted R Squared = .748)

The level of school exercise is done by students, interest in mathematics, level of tuition exercise, level of father's education, level of help from older sisters or brothers and the level of monthly income are the six main effects, and ten two-factor interaction effects are significant at 0.2 levels of significance.

In order to estimate the effects of the factors, a multiple linear regression model was fitted by taking Mathematics marks as the response variable and the variables selected from ANOVA as the explanatory variables. Model assumptions were tested and found to be valid. The following table shows the estimates of the regression parameters and the corresponding p-values. Here, the variable labels with numbers at the end indicate dummy variables. For example, SchExersies2 indicates the dummy variable which takes value 1 for cases with SchExersies = 2 and value 0 for other cases. Similarly, SchExersies3 indicates the dummy variable which takes value 1 for cases with SchExersies=3 and value 0 for other cases. This can be similarly applied to all other dummy variables. Note that Interest is a dummy variable by definition.

Predictor	Coef	SE Coef	T	P
Constant	**15.172**	**2.050**	**7.40**	**0.000***
SchExersies2	**11.697**	**1.732**	**6.75**	**0.000***
SchExersies3	**18.440**	**2.146**	**8.59**	**0.000***
Interest	1.425	2.251	0.63	0.527
TuitionExercies2	0.738	3.016	0.24	0.807
TuitionExercies3	0.448	4.182	0.11	0.915
FatherEdu2	-3.548	2.766	-1.28	0.200
FatherEdu3	-2.301	3.879	-0.59	0.553
FatherEdu4	**23.464**	**7.800**	**3.01**	**0.003***
Help2	-1.166	2.254	-0.52	0.605
Help3	**-10.593**	**3.528**	**-3.00**	**0.003***
Income2	3.055	1.761	1.73	0.084
Income3	4.067	2.410	1.69	0.092
Income4	**10.953**	**2.858**	**3.83**	**0.000***
SchType2*Interest	-3.290	2.371	-1.39	0.166
SchType3*Interest	**12.327**	**2.166**	**5.69**	**0.000***
Gender*MotherEmp	**10.876**	**2.672**	**4.07**	**0.000***
Gender*Timetable	-1.972	1.722	-1.14	0.253
Workingtime2*Tutiontime2	0.523	4.707	0.11	0.912
Workingtime2*Tutiontime3	-3.066	4.819	-0.64	0.525
Workingtime2*Tutiontime4	-2.537	5.121	-0.50	0.621
Workingtime3*Tutiontime2	-8.572	6.132	-1.40	0.163
Workingtime3*				

Tutiontime3 Workingtime3*	-11.245	6.303	-1.78	0.075
Tutiontime4 TuitionExercies2*	-8.486	6.616	-1.28	0.200
MotherEmp	2.244	3.523	0.64	0.525
TuitionExercies3* MotherEmp	**12.719**	**4.377**	**2.91**	**0.004***
TuitionExercies2* Workingtime2	1.684	4.912	0.34	0.732
TuitionExercies2* Workingtime3	**16.133**	**6.523**	**2.47**	**0.014***
TuitionExercies3* Workingtime2	11.129	5.734	1.94	0.053
TuitionExercies3* Workingtime3	**22.893**	**7.121**	**3.21**	**0.001***
FatherEdu2* MotherEmp	2.653	3.570	0.74	0.458
FatherEdu3* MotherEmp	-3.040	4.820	-0.63	0.529
FatherEdu4* MotherEmp	3.596	6.905	0.52	0.603
FatherEdu2* Workingtime 2	6.553	3.795	1.73	0.085
FatherEdu2* Workingtime 3	**9.583**	**3.799**	**2.52**	**0.012***
FatherEdu3* Workingtime 2	9.297	5.006	1.86	0.064
FatherEdu3* Workingtime 3	**13.508**	**4.592**	**2.94**	**0.003***
FatherEdu4* Workingtime 2	**-24.342**	**9.226**	**-2.64**	**0.009***
FatherEdu4* Workingtime 3	-11.909	8.594	-1.39	0.167
ParentInvolve2* Help2	3.472	3.109	1.12	0.265
ParentInvolve2* Help3	**8.580**	**4.077**	**2.10**	**0.036***
ParentInvolve3* Help2	1.755	3.467	0.51	0.613
ParentInvolve3* Help3	**9.589**	**4.007**	**2.39**	**0.017***

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S = 12.1429   R-Sq = 75.7%   R-Sq(adj) = 72.9%
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*Indicates factors that are significant at 0.05 level

All the above factors are of the same scale (Categorical Variables). Out of the main effects which are significant at 0.05 level of significance, the most important factor is school exercises which affect the result for mathematics. When all other variables are constant students who do more than 70% of the school exercises scored more marks than students who do same school exercises at the lowest level. Interaction effect of school type and interest in mathematics is the next influential factor that affects the performance in mathematics.

Discussion

- Presently, all the students are promoted to the higher class at the end of each year without any proper investigation. This may be one of a reason for the higher failure rates in mathematics. This practice makes students lazy. They do not make any effort to improve their knowledge as they know that they are promoted to the next grade even though they get zero marks for every subject. They do not understand their weaknesses in the subjects before the G.C.E (O/L) examination. Due to this system, students lose their valuable time they could use to improve their other abilities. Therefore, students who have sufficient knowledge should only be upgraded. If there is a proper investigation method to promote students, they will have an idea about their weaknesses before the G.C.E. (O/L) Examination.

- Most students do not have a basic knowledge in Geometry. As a result of this, the majority of students perform poorly in the questions on Geometry. This adversely affects on their marks since geometry is the section which has the highest marks allocation. Logical thinking ability and logical writing ability can be improved better through Geometry than through the other components. Unfortunately most of the students do not improve in this skill since they skip the questions from that component.

Conclusions

- According to the marks allocation, Geometry, Arithmetic, Algebra and Measurement respectively have been given top priority by allocating the four highest weights in the marking scheme. However, in Paper II, the above highly weighted components have been selected less frequently by the students. This implies that students are less confident in those important components. The most frequently selected component as well as the component with the highest average mark is Statistics. This implies that students are more confident and perform best in Statistics. However, the impact of this is minimal, since the weight for Statistics is very low.

- The marks for each component as well as the total marks are positively skewed. Therefore, the median and inter-quartile range is more suitable than the commonly used mean and standard deviation as measures of average and dispersion respectively.

- The median marks for each component is less than 33.33%. This implies that at least fifty percent of the students are very weak in all the components, being unable to score at least 1/3 of the total marks allocated for each component.

- The most difficult component (least average and least third quartile) for the students is Measurement. However, more than 50% of the students have selected questions from this component in Paper II, probably because they are unaware of their weakness in that component. The effect of this on the total marks is significant since Measurement is one of the important components accounting for 16% of the total marks.

- The following variables were found to have significant associations with Mathematics marks: school exercises, interest in mathematics, tuition exercises, level of father's education, and help from older sisters or brothers, level of monthly income, parental involvement and time spent on studies.

- The most influential factor is school exercises. This is a very important factor which affects the result of mathematics. The students who do school exercises at the maximum level can increase the marks for mathematics up to 18% on average in comparison with the students who do school exercises at a low level,

when all the other variables are constant. It is also found that students who do school exercises moderately can gain, on average, 11 marks more for mathematics than the students who do tuition exercises at a low level, when all the other variable are constant.

- The students who are interested in Mathematics and study at 1 AB schools gain on average 12 marks more than the other students. The interest of students in other schools may not lead to higher marks because of deficiencies in facilities like lack of qualified teachers, lack of proper guidance, etc.

- Male students with working mothers seem to score 10.8 marks more than the others, on average. However, we do not have a practical interpretation of this result.

- Those who do moderate to a high amount of tuition exercises and spend more than seven hours a week for studies score significantly higher than others.

- The students who get help from their older sisters or brothers for their mathematics problems at the maximum level with high parental involvement score more marks than other students.

- Those students from high income families score more than the others on average. This may be due to the possibility of entering into better schools (eg. 1 AB schools), ability to take more tuition etc.

Limitations

- Data of schools from every province could not be collected due to practical problems and time limitations.

- Only the school candidates were considered due to the difficulty to access private candidates.

- Five Tamil medium schools in the Piliyandala Zone were not considered for this study due to practical difficulties in communication.

- Third term test marks in the school were used instead of actual marks for mathematics at the G.C.E (O/L) examination because the Department of Examinations, refused to provide the test scores.

Suggestions and Recommendations

- Median and inter-quartile range should be taken as measures of average and dispersion of the marks of G.C.E. (O/L). The mean is a misleading measure of average for this purpose and therefore the standard deviation is not an appropriate measure of dispersion around the average.

- Teachers should try to identify the strong and weak areas of the students and advice them on selecting questions in Paper II. This may result in an increase in the marks for Paper II.

- Course designers should try to allocate more time for the four most important components of the syllabus, especially to improve the skills in the Measurement component.

- It was observed that most of the students preferred to select questions related to day to day incidents. Including more questions related to real life would make the question paper more attractive to the students.

- Students should be given proper knowledge and training in the key mathematical operations (Addition, Subtraction, Multiplication and Division). This should be started from primary levels. There should be a proper investigation method to check the students' knowledge in main arithmetical operations, before the end of primary education.

- Amount of school exercises directly affect the results of Mathematics. Students can improve their performance significantly by increasing the amount of school exercises.

- Teachers should adopt attractive teaching methods to motivate the students and create competition among them whenever possible to improve the marks for Mathematics.

- Students should spend at least seven hours per week for Mathematics at home and should complete tuition exercises at the highest level to gain better Mathematics results.

- Parents should create a suitable environment for their children to study well and they should be aware of their children's knowledge levels in Mathematics. They should encourage their children to solve the mathematical problems prescribed by the school teacher and the tuition class.

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