Effect of streams of Science studies on Graduation and Classes of Degree

ABSTRACT

This study was carried out to see whether graduation of students in universities depends on the streams of study in science by using statistical analysis tools. Further, effect of streams on the status of obtaining a class of Degree also was investigated. The analysis was based on number of students qualified for the graduation and the class of degree. All students in a batch that recently completed studies from Faculty of Science, Eastern University, Sri Lanka was used as the sample. Study revealed that both graduation and being qualified for a class of Degree are dependent on the stream of study in science.

1. INTRODUCTION

Education is an important sector in any country and it helps to enhance economical status, living standards and personal qualities[1]. According to Grealish [2], role of educated people in the development of a country and its' administration is significant. Educated people are considered as the backbone of any country.

Education in Sri Lanka is given by both government and privet sector. Sri Lankan government education consist several stages: primary (year 1-5); junior secondary (year 6-9); senior secondary (year 9-11); collegiate (year 12-13), and tertiary (university) education. Stages in privet education system may be slightly different. A barrier exam is scheduled at the end of senior secondary and collegiate stages. After passing the barrier exam, General Certificate of Education of Ordinary level (GCE (O/L)) examination, at the senior secondary level, students are allowed to enter into collegiate level where students can continue their studies only in one of 5 fields: Arts; Biological; Physical; Commerce; and Technology. Both biological and physical stream are coming under the science stream. The subjects Chemistry and Physics are common for both biological and physical science streams. Mathematics (Pure Mathematics and Applied Mathematics) is the other subject of physical science stream while Biology (Zoology and Botany) is the third subject in the biological science stream. Those who are qualified at General Certificate of Education of Advanced level (GCE (A/L)) examination, the barrier exam at collegiate level, will enter to universities.

Eastern University, Sri Lanka (EUSL) is one of 16 state Universities in Sri Lanka. It is situated in the Batticalao district in eastern province of Sri Lanka. Since its' start on 1st August 1981, university has given education in science under the Faculty of Science. Agriculture, Arts and Culture, Commerce and Management, Healthcare Sciences, and Technology are the other faculties in the University. In addition, there is an affiliated campus, called Trincomalee campus and an institute named as Swami Vipulananda Institute of Aesthetics Studies.

Faculty of Science (FOS) offers science education in two streams namely biological science and physical science. B.Sc.(General) degrees of three years and B.Sc.(Special) degrees of four years are offered by the faculty in both biological and physical science streams. Seven principle subjects Botany(BT), Chemistry(CH), Computer Science(CS), Applied Mathematics(AM), Pure Mathematics(PM), Physics(PH), and Zoology(ZL) are offered. Special degrees are in all these subjects. Biological students have only one subject combination (Botany, Chemistry, Zoology), while several subject combinations of three subject are offered for physical science stream students. They are (Chemistry, Applied Mathematics, Physics), (Pure Mathematics, Applied Mathematics, Chemistry), (Pure Mathematics, Applied Mathematics, Computer Science), (Pure Mathematics, Applied Mathematics, Physics), (Applied Mathematics, Physics, Computer Science), and (Pure Mathematics, Computer Science, Chemistry). In addition, some compulsory courses (CC) and optional courses (OC) are offered. Some are common for both biological and physical science stream students.

Faculty follows six months semester based system and Grade Points Average (GP) system in evaluation of performances. Overall Grades Points Average (OGPA) is used as a measure of overall performances. Academic performances are represented by grades and test scores([3],[4]). As a measure that indicates academic achievement of undergraduates, Grade Point Average (GPA) is used around the world ([5],[6], [7],[8]).

Objectives

There is a belief among university students and teachers that biological courses are easy to learn compared with physical science courses. Hence, biological science stream students are supposed to have a higher chance for graduation than physical science stream students. As a person who has worked for a long period, a university teacher may develop such a feeling. Otherwise, this belief may be due to some other publications. Some annual reports of department of education have also reported that percentage of students who passed all subjects in biological science stream at GCE(A/L) is higher than the corresponding percentage for physical science stream. Figures in Table 1 exhibit this clearly.

Table 1. Percentage of students, in science stream, passed all subjects in GCE(A/L)

Stream	Year				
	2008	2009	2010	2011	2012
Biological	35.3	38.5	38.8	50.6	53.8
Physical	33.8	33.1	36.2	46.2	44.7

At the GCE(A/L), both Chemistry and Physics are the common subjects for both streams. Hence, this directly implies that the third subject in each stream is the cause for this variation. That is, students are weak in Mathematics than in the subject Biology. Perhaps, this may has created such a picture in university teachers' minds.

There is no issue that what teachers' belief is. Anyhow, developing such a opinion among students, is not a good trend. Since students compel to select the easy stream, this can affect students' lives and entire education system in that field. Therefore, this study aimed to test this belief with the help of some statistical analysis tools.

Literature review

It seems to be difficult to find a past study that directly reveals the effect of stream on the graduation, in the literature. In some studies, stream of study has been considered as a factor. The development in all sectors of any country is directly linked with academic achievements. It also has stated that it is essential to study status and factors affect students academic performance to develop the education [8].However, many researches are on academic performances of students ([9], [10], [11]) and a broad list of factors that affect academic performances of undergraduates are in the literature. This may be due to

84   educational qualification is considered as a key tool of recruitments all over the world. Students are also
85   much keen on their educational performances.
86
87   Robert and Keil [12], Gramlich and Greenlee [13], Woessmann [14], Karemera *et. al*. [15], Mushtaq and
88   Khan [16], Eweniyi [17], Okolie *et. al*. [18], Akessa and Dhufera [19], , Rai, et.al. [20] have revealed that
89   students' performances are related with family characteristics such as parents' education level, financial
90   status, family type, family size, and family stress. Onocha [21], Musgrave [22], and Grissmer [23] also
91   have reported that students' academic achievements are linked with parents' educational level.
92
93   Smith and Naylor [24] found that children of unskilled workers performed significantly worse than children
94   of professional workers. Okioga [25] showed that socio-economic factors influences academic
95   performance. He revealed that low income families do not much care their children's education, and it
96   influences their performance in higher education negatively. Anyhow, Pedrosa, Dachs, Maia, Andrade
97   and Carvalho [26] students coming from poor educational and socio-economical background, have a
98   higher relative performance than their complementary group.
99   Haverman and Wolf [27] found that children attainment depends on the social investment in children; the
100   parental investment in children; and the choices that children make, given the investments in and
101   opportunities available to them. But in Bangladesh this kind of choice is limited to a section of urban
102   students.
103   Reddy et.al. [28] have found that demographic factors (age, gender) are associated with students' overall
104   academic achievement. Win & Miller [29], Everett and Robins [30], Dancer and Fiebig[31], Ramsay and
105   Baines[32], Smyth et. al., [33], Abbott-chapman et. al. [34], Manan and Mohamad [35], have discovered
106   that the female students obtain better performance than their male students. Contrary to that, Borg et. al.
107   [36], Tay [37], Myatt and Waddell [38], Anderson et.al. [39], Gramlich and Greenlee [40], Sattayanuwat
108   [41] reported that male students obtain better performance than their female students. Further it has been
109   stated that there is no evidence that gender influence on the performance of students by several authors
110   Borde [42], Durden and Ellis [43], Didia and Hasnat [44], Marcal and Roberts [45], and O'Malley Borg and
111   Stranahan [46].   However, Mlambo [47] found significant association of gender and academic
112   performance which contradicted the findings of above studies.
113   Douglas and Sulock [48] says that students' performances are related to their race and their expectations.
114   It has been revealed by Anderson & Benjamine [49] that students' performances depend on status of
115   schools. By confirming this Win and Miller [29] also states that secondary education determines students'
116   performances than other individual factors.
117   Osaikhiuwa [50] has pointed that school student's performance are affected by status of class rooms and
118   schools, such as higher number of students, electricity break-downs, strikes and shut downs of schools.
119   Devi and Mayuri [51] and Khan *et al.,* [52] have founded a significant relationship between academic
120   performance and College facilities provided to the students. According to Karemera *et. al*.[14],
121   educational performances of student are related with college climate.
122
123   Some studies have revealed that academic performances are dependent on educational facilities.
124   Mushtaq and Khan[15], Rai, et.al.[19] have found that communication, learning facilities, and proper
125   guidance, use of internet, affect academic performance. It has been stated by Karemera [14] that
126   students' academic performance is significantly correlated with learning environment and the facilities
127   such as library, computer lab. Kumar and Manjunath [53], Siraj [54] and Kim [55] found that duration of
128   use of internet positively linked with academic performance.
129
130
131   Devadoss and Folt [56], Durden and Ellis [57], Park & Kerr [58] and Schmidt [59], have stated that
132   academic performances are positively related with attendance for lectures. Astin [60] stated that a
133   negative relationship exists between academic performance and students working hours. Applegate and
134   Daly [61] showed that a negative impact in academic performance when students work more than 22
135   hours per week. Ruesga-Benito et. al. [62] have found that academic performances of students working

136 at least 15 hours per week are less than the academic performance than students who do not work. Harb
137 and El-Shaarawi [63] found that the competence in English is the most important factor which positive
138 effect on students' performance.
139
140 Kernan, Bogart and Wheat [64], academic performances of graduate student are related with health.
141 There is negative relationship between college credit and stress but weak relationship between GPA
142 (Grade Point Average) and stress[65]. Khan *et al.,*[66] has revealed that participation in sports can
143 improve the Grade Point Average.
144
145
146 **2. METHODS**

147 The main objective of this study was to test whether graduation and obtaining the lowest class of degree
148 depend on streams of study. As the sample, all students of 2014/2015 batch were used. There were 109
149 students in this batch including 47 biological science stream students and 62 physical science stream
150 students.

151 The data were obtained from Dean's office, Faculty of Science. Stream of study (biological, physical) was
152 used as the factor, while status of graduation (graduated, not graduated), and status of obtaining the
153 lowest class of the degree (obtained a class, not obtained a class) were used as the responses. In
154 addition, overall grade points averages (GPA) also was recorded to make a comparison between
155 performances of students in biological and physical science streams. Geiser and Santelices [67] showed
156 that high-school grade point average is the best predictor of college performance, overcoming other
157 instruments used to select students, such as standardized admission's tests.
158

159 Analysis was carried out with several statistical techniques such as proportion test, relative risk, odds
160 ratio, chi square test, logistic regression analysis, and ANOVA test. The proportion test was used for
161 testing equality of proportions of students who qualified and not qualified for graduation and the lowest
162 class. Relative chances of physical science stream students not to be qualified for the graduation and the
163 lowest class compared with biological science students were discussed by using measures of relative risk
164 and odd ratio. Chi Square test and likelihood ratio Chi Square test also were performed to confirm the
165 results. Analysis of variance (ANOVA) test was used in making comparison of overall GPA between two
166 streams. Proportion test, chi square test, odd ratio tests and ANOVA test were performed by using
167 Minitab version 14. In some cases, manual calculations also were used. Some graphs also were used for
168 graphical representation of some results.

169 Further, logistic regression analysis was used to compare the probabilities of not been qualified for
170 graduation and a class. Logistic regression analysis was carried out with R software. The function "glm"
171 was used for fitting the logistic regression models with and without intercept. Biology stream was the
172 baseline of explanatory variable (stream) while being qualified for graduation and the class were used as
173 baselines of the response variables (graduated=0: not graduate=1, and obtained class=0: not obtained
174 class=1).

175

176 **3. RESULTS AND DISCUSSION**

177 Numbers of graduated students in each stream are given in Table 2 with corresponding percentages
178 (within bracket) calculated based on stream. Percentage (2.13%) of biological students who were not
179 graduated is lower than the corresponding percentage(16.13) for physical science stream. P-values of the
180 proportion tests confirm that there is a significant difference in numbers of graduated students and not
181 graduated students in both biological and physical science streams.

182 Table 2. Number of students graduated

Stream	Not Graduated	Graduated	Proportion Test	
			P-value	95% con. Interval
Biology	1(2.13)	46(97.87)	.0000	(0.9375,1.0000)
Physical	10(16.13)	52(83.87)	.0000	(0.7472,0.9303)

Numbers and percentages of students who qualified at least for the second class lower grade are given in Table 3. Figures in the table show that compared with biological students, higher number of physical science students have failed to obtain at least the lowest class of degree. Percentages of not qualified students in biological and physical science streams are 37 and 63 respectively. Both p-values and confidence intervals of the proportion test verify that proportions of students who qualified and not qualified are significantly different. The same pattern can be seen in both streams.

Table 3. Details(numbers) of qualified students for class

Stream	Not Graduated	Graduated	Proportion Test-P value	
			P-value	95% con. Interval
Biology	11(23.40)	36(76.60)	0.0000	(0.1129,0.3551)
Physical	39(62.90)	23(37.10)	0.042	(0.5087,0.7493)

Values of relative risk and odd ratio are given in Table 4. The relative risk and odd ratio were calculated for not been qualified for graduation and the lowest class of degree for physical science students relatively to biological science students. Risk of physical science stream students of not been graduated is 7.58 times higher than the risk of biological science. Further, relative risk of physical science students for not been qualified for the lowest class is about higher than that of students in biological science stream. It is 2.68 times than risk of biological science stream students.

Odds ratios also confirm the same. Odds ratio of physical science students not to be graduated is 8.84 relatively to biological science students. Further, compared with biological science students, physical science students having higher chance for not obtaining at least the lower class of the degree.

Table 4. Relative Risk and Odd Ratio

Aspect	Relative Risk	Odd Ratio
Graduated/ Non Graduated	7.581	8.846
Qualified/ Not Qualified for Class	2.687	5.549

Results of Chi square test are given in Table 5. Figures in the table provide evidences for confirmation of the results that showed by other tests. In case of being qualified for both graduation and the lowest class, a difference can be observed between biology and physical science streams. Both Chi Square test and Likelihood ratio tests confirm these variations between biology and physical science streams.

Table 5. Results of Chi Square test

Aspect	Pearson Chi-Squre		Likelihood Ratio test	
	Statistics	P-Value	Statistics	P-Value
Graduated/ Not Graduated	5.776	0.016	6.844	0.009
Qualified/ Not Qualified for Class	16.798	0.000	17.441	0.000

209

210 Table 6 consists of results of the logistic regression analysis. Logistic models were fitted with and without
211 an intercept. Both models confirm that probability of being not qualified for graduation changes stream-
212 wise. With compared to biological science students, physical science students have 2.18 (= -1.6487-(-
213 3.8286)) times of chance for not being graduated.

214 In case of obtaining a class too, such a variation can be observed. Physical science stream students
215 show 0.5281(= 1.7137-(-1.1856)) times of chance for obtaining a class with compared to biological
216 science stream students.

217 Table 6. Results of logistic regression models

	Models	Component	estimate	Std. Error	P-value	AIC
Graduation	With	Intercept	-3.829	1.011	.000152**	
	intercept	Physical	2.18	1.068	.041256*	
	Without	Biology	-3.8286	1.0108	.000152**	68.462
	intercept	Physical	-1.6487	0.3453	1.8e(-6)**	
Obtaining a class	With	Intercept	-1.1856	0.3445	.000579**	
	intercept	Physical	1.7137	0.4334	7.6e(-5)**	
	Without	Biology	-1.1856	0.3445	.000579**	136.92
	intercept	Physical	0.5281	0.2629	.044581*	

218 * significant at 0.05: ** significant at 0.001
219

220 Box plots of GPA are given separately for students in each stream in Fig.1. This figure implies that on
221 average GPA of biological science stream students is higher with compared to physical science streams
222 students. The range of GPA of physical science stream students is wider than the corresponding range of
223 biological science stream students. Some higher deviation of GPA can be observed in both streams from
224 lower side. Physical science stream students have shown the both minimum and maximum of GPAs.
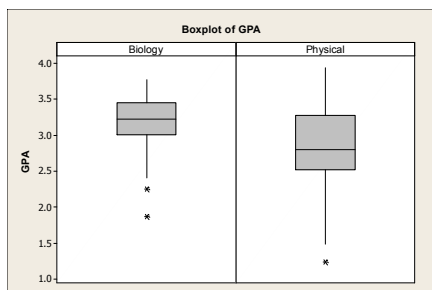
Fig. 1. Distribution of GPA of students in both streams

For the purpose of comparison of overall GPA of students in each stream, ANOVA test was performed. One way ANOVA test produced 0.000 as the P-value. This clearly indicates that averages of GPA of biological and physical science stream students are different. Biological science stream students show an average of 3.1568 with standard deviation of 0.3828 meanwhile the relevant values of physical science stream students are 2.7677 and 0.6262 respectively. The main effect plot in the following Fig. 2., exhibits the difference in averages of GPA of students in each stream.
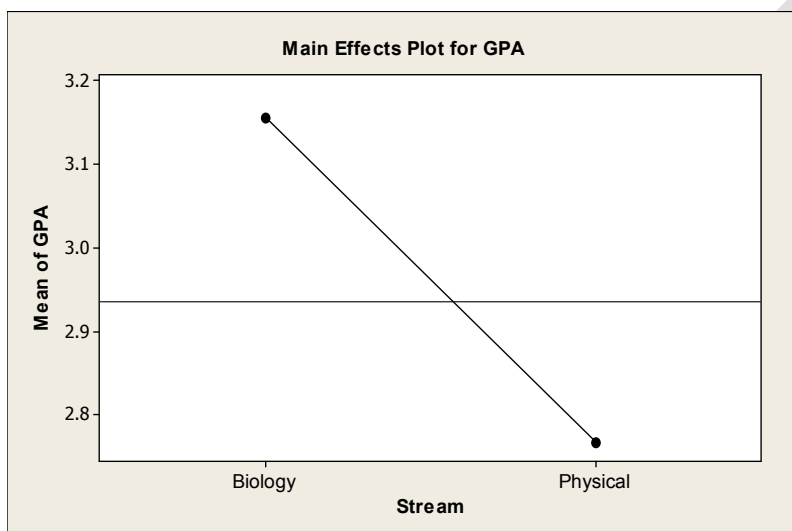

Fig. 2. Main effect plot of GPA

4. CONCLUSIONS

The effect of streams of science study in universities on the graduation and being qualified at least for the lowest class of degree was investigated in terms of number of students qualified and not qualified. This study provides evidences that being qualified for the graduation and the classes of degree is dependent on streams(biological and physical) of science studies in universities. Compared with physical science stream students, students in biological science stream are having higher possibilities to be graduated.

This study was carried out with two common streams(biological and physical) in science studies in university level. Perhaps, there may be more streams than these two streams. As the sample, only single batch was considered for the study based on the availability of data. This study can be extended for other disciplines as well by ignoring above limitations.

247 **COMPETING INTERESTS**

248 I declare that I have no competing interests.

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