



Effect of Streams of Science Studies in Eastern University, Sri Lanka on Graduation and Class of Degree

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

The ultimate reward of a degree program is the graduation. Class of the degree is also an aspect associated with the graduation. Both graduation and class of degree are the indicators of academic performances of a graduate. Academic achievement of a graduate is affected by many factors. Hence, graduation and class of degree of a graduate also may be dependent on the same factors. A belief is among academic community that obtaining a degree in some streams are rather difficult compared with some other. That is graduation is dependent on stream of study. This study was carried out to see whether graduation in science depends on the streams (biological, physical) of science studies in Eastern University, Sri Lanka. Further, effect of streams on class of degree also was aimed to investigate. This study was carried out by using all students in a batch, of size of 109 that recently completed studies from Faculty of Science, Eastern University, Sri Lanka. The analysis was based on number of students who qualified for the graduation and the class of degree. Statistical techniques such as proportion test, chi square test, odds ratio, relative risk, logistic regression and ANOVA test were used for the analysis. Study reveals that graduation and class of degree is dependent on streams of science studies. Proportions of physical science students who qualified for graduation and the lowest class of degree are less than the

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corresponding proportions of biological science stream students. Stream for higher education should be selected carefully and action should be taken accordingly to promote the stream/subjects that students omit. Further, factors behind this variation also might be investigated.

Keywords: Students performance; graduation; stream of study; grade point average (GPA); undergraduates.

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 private sector. The government education consists of 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 private education system may be slightly different. In government education system, 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. Combined Mathematics (Pure Mathematics and Applied Mathematics), Physics and Chemistry or Information Technology are the subjects of physical science stream while subjects Biology (Zoology and Botany), Chemistry, and Physics or Agricultural Science are 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.

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.

However, there is a belief among collegiate students and teachers that biological subjects are easy to learn compared with physical

subjects even though some subjects are common for both biological and physical science stream. It could be observed that a similar opinion is among undergraduates in Faculty of Science, Eastern University, Sri Lanka.

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. At the moment, studies are under two different curriculums. Faculty follows six months semester based system and credits based 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].

According to old curriculum, students should select a subject combination of three subjects and continue studies under the selected subject combination through the entire period of general degree program. Biological students have only one subject combination (Botany, Chemistry,

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

Stream	Year						
	2008	2009	2010	2011	2012	2014	2015
Biological	35.3	38.5	38.8	50.6	53.8	50	53
Physical	33.8	33.1	36.2	46.2	44.7	47	49

Sources: Ministry of education. 2015. 2014 Annual performance report. Colombo; University grant commission, 2015; Sri Lanka university statistics 2014; Colombo: 2015 data from Ministry of education, data management unit

Zoology), meanwhile several subject combinations 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.

Under new curriculum, subjects combinations (Chemistry, Mathematics-I, Physics), (Mathematics-I, Mathematics-II, Chemistry), (Mathematics-I, Mathematics-II, Computer Science), (Mathematics-I, Mathematics-II, Physics), (Mathematics-I, Physics, Computer Science), and (Pure Mathematics-I, Computer Science, Chemistry) are offered for physical science stream students, while the same subject combination is available for biological science stream students.

Beginning of the first year of study, students are supposed to select a subject combination and follow studies under the selected three subjects. But, at the end of the first year of study, students may drop a subject in the selected subject combination and continue studies in other two subjects in the second and third year of studies by taking more courses from them according to requirements on credits.

Students who entered under the new curriculum now are in the second year of study. In the process of selection of subjects for the second year and third year studies, a trend that students try to avoid mathematics subjects because of the opinion among students, discussed above. They believe that subject Mathematics is difficult to learn and it is the reason for the low performances of students in physical science stream, because Mathematics is in all subject combinations of physical science stream.

Hence, students believe that physical science stream students are having a less chance for graduation than biological science stream students.

Since students compel to select the easy stream, this can affect students' lives and education system in science discipline in the university. Anyhow, developing such opinion among students is not a good trend, especially when evidences to confirm such a view are lacking in the literature, even though, as shown in literature review below, many researches are on the factors that affects academic performances of students. Therefore, this study aimed to test whether there is an effect from stream of studies in science on the graduation and obtaining a class of degree. That is to see whether there is a difference in chances for being qualified for graduation and a class of degree, between biological and physical science stream.

2. LITERATURE REVIEW

It seems to be difficult to find studies that directly reveal the effect of stream on the graduation, in the literature. The development in all sectors of any country is directly linked with academic achievements. It also has being 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 educational qualification is considered as a key tool of recruitments all over the world. Students are also much keen on their educational performances.

Robert and Keil [12], Gramlich and Greenlee [13], Woessmann [14], Karemera et al. [15], Mushtaq and Khan [16], Eweniyi [17], Okolie et al. [18], Akessa and Dhufera [19], Rai et al. [20] have revealed that students' performances are related with family characteristics such as parents' education level, financial status, family type, family size, and family stress. Onocha [21],

Musgrave [22], and Grissmer [23] also have reported that students' academic achievements are linked with parents' educational level.

Smith and Naylor [24] found that children of unskilled workers performed significantly worse than children of professional workers. Okiooga [25] showed that socio-economic factors influences academic performance. He revealed that low income families do not much care their children's education, and it influences their performance in higher education negatively. Anyhow, Pedrosa, Dachs, Maia, Andrade and Carvalho [26] students coming from poor educational and socio-economical background, have a higher relative performance than their complementary group.

Haverman and Wolf [27] found that children attainment depends on the social investment in children; the parental investment in children; and the choices that children make, given the investments in and opportunities available to them. But in Bangladesh this kind of choice is limited to a section of urban students.

Reddy et al. [28] have found that demographic factors (age, gender) are associated with students' overall academic achievement. Win & Miller [29], Everett and Robins [30], Dancer and Fiebig [31], Ramsay and Baines [32], Smyth et. al., [33], Abbott-chapman et. al. [34], Manan and Mohamad [35], have discovered that the female students obtain better performance than their male students. Contrary to that, Borg *et. al.* [36], Tay [37], Myatt and Waddell [38], Anderson *et. al.* [39], Gramlich and Greenlee [40], Sattayanuwat [41] reported that male students obtain better performance than their female students. Further it has being stated that there is no evidence that gender influence on the performance of students by several authors Borde [42], Durden and Ellis [43], Dida and Hasnat [44], Marcal and Roberts [45], and O'Malley Borg and Stranahan [46]. However, Mlambo [47] found significant association of gender and academic performance which contradicted the findings of above studies.

Douglas and Sulock [48] says that students' performances are related to their race and their expectations. It has being revealed by Anderson & Benjamine [49] that students' performances depend on status of schools. By confirming this Win and Miller [29] also states that secondary education determines students' performances than other individual factors.

Osaikhiuwa [50] has pointed that school student's performance are affected by status of class rooms and schools, such as higher number of students, electricity break-downs, strikes and shut downs of schools. Devi and Mayuri [51] and Khan et al., [52] have founded a significant relationship between academic performance and College facilities provided to the students. According to Karemera et al. [14], educational performances of student are related with college climate.

Some studies have revealed that academic performances are dependent on educational facilities. Mushtaq and Khan [15], Rai, et.al. [19] have found that communication, learning facilities, and proper guidance, use of internet, affect academic performance. It has being stated by Karemera [14] that students' academic performance is significantly correlated with learning environment and the facilities such as library, computer lab. Kumar and Manjunath [53], Siraj [54] and Kim [55] found that duration of use of internet positively linked with academic performance.

Devadoss and Folt [56], Durden and Ellis [57], Park & Kerr [58] and Schmidt [59], have stated that academic performances are positively related with attendance for lectures. Astin [60] stated that a negative relationship exists between academic performance and students working hours. Applegate and Daly [61] showed that a negative impact in academic performance when students work more than 22 hours per week. Ruesga-Benito et al. [62] have found that academic performances of students working at least 15 hours per week are less than the academic performance than students who do not work. Harb and El-Shaarawi [63] found that the competence in English is the most important factor which positive effect on students' performance.

Kernan, Bogart and Wheat [64], academic performances of graduate student are related with health. There is negative relationship between college credit and stress but weak relationship between GPA (Grade Point Average) and stress [65]. Khan et al., [66] has revealed that participation in sports can improve the Grade Point Average.

3. MATERIALS AND METHODS

According to students' opinion, taking Mathematics as a principle subject affect

graduation and class of degree. Since, the first batch of students who entered under the new curriculum, is still in the second of year of study, detail about their graduation and class of degree are not available to make a comparison between students who take Mathematics and who do not take Mathematics as principle subject during the period of second year and third year of study.

But, in old curriculum, Mathematics was in all subject combinations and hence, it was a compulsory subject for physical science stream students meanwhile no any biological science stream student take Mathematics. Hence, as an alternative, it was decided to make a comparison of status of graduation and obtaining a class of degree, of physical and biological science streams students who completed degree recently under the old curriculum.

Data for this study were obtained from Dean's office, Faculty of Science. As the sample, all students of 2014/2015 batch were used. There were 109 students in this batch including 47 biological science stream students and 62 physical science stream students. Stream of study (biological, physical) was used as the factor or explanatory variable, while status of graduation (qualified for graduation, not qualified for graduation), and status of obtaining the lowest class, second class (lower division), of the degree (qualified for a class, not qualified for a class) were used as the responses depending on the analysis. In addition, overall grade points averages (GPA) also were recorded to make a comparison between performances of students in biological and physical science streams. Geiser and Santelices [67] showed that high-school grade point average is the best predictor of college performance, overcoming other instruments used to select students, such as standardized admission's tests.

Analysis was carried out with several statistical techniques such as proportion test, relative risk, odds ratio, chi square test, logistic regression analysis, and ANOVA test. The proportion test was used for testing the equality of proportions of students who qualified and not qualified for graduation and the lowest class. Chances of physical science stream students not to be qualified for the graduation and the lowest class compared with biological science students were discussed by using measures of relative risk and odd ratio. Chi Square test and likelihood ratio Chi Square test also were performed to confirm the

results. Analysis of variance (ANOVA) test was used in making comparison of overall GPA between two streams. Proportion test, chi square test, odd ratio tests and ANOVA test were performed by using Minitab version 14. In some cases, manual calculations also were used. Some graphs also were used for graphical representation of some results.

Further, logistic regression model of the form of

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X$$

was used to compare the probability (p) of physical science stream students for not being qualified for graduation and the class of degree, relatively to biological science stream students.

The response variable was the status of being qualified for the graduation and the class that defined as

$$Y = \begin{cases} 1: \text{not qualified for graduation/ class} \\ 0: \text{qualified for the graduation/ class.} \end{cases}$$

Stream (biological, physical) was the explanatory variable and it was defined as,

$$X = \begin{cases} 1: \text{Physical} \\ 0: \text{Biological.} \end{cases}$$

Biology stream was the baseline of the explanatory variable while being qualified for the graduation and the class of degree were used as the baselines of the response variable Y . Logistic regression analysis was carried out with R software. The function "glm" was used for fitting the logistic regression models with and without intercept.

4. RESULTS AND DISCUSSION

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

Table 2. Number of students graduated and results of proportion test

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)

Table 3. Number of qualified students for class and results of proportion tests

Stream	Not qualified for the class	Qualified for class	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)

Table 4. Relative risk and odd ratio

Aspect	Relative risk	Odds ratio
Graduated/ Non graduated	7.581	8.846
Qualified/ Not qualified for class	2.687	5.549

Numbers and percentages of students who qualified at least for the second class lower grade (the lowest class of degree) 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 for the class of degree in biological and physical science streams are 23 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 in both streams.

Values of relative risk and odd ratio are given in Table 4. The relative risk and odd ratio were calculated for not being 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 being graduated is 7.58 times higher than the risk of biological science. Further, relative risk of physical science students for not being qualified for the lowest class is 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 5.55 times higher chance for not obtaining at least the lower class of the degree.

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 these two streams.

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

In case of not obtaining a class too, such a variation can be observed. Physical science stream students show 1.7137 ($= 0.5281 - (-1.1856)$) times of chance (log odd) for not obtaining a class with compared to biological science stream students.

Box plots of GPA are given separately for students in each stream in Fig. 1. This figure implies that on average GPA of biological science stream students is higher with compared to physical science streams students. The range of GPA of physical science stream students is wider than the corresponding range of biological science stream students. Some higher deviation of GPA can be observed in both streams from lower side. Physical science stream students

have shown the both minimum and maximum of GPAs.

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.

Table 5. Results of chi square test

Aspect	Pearson chi-square		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

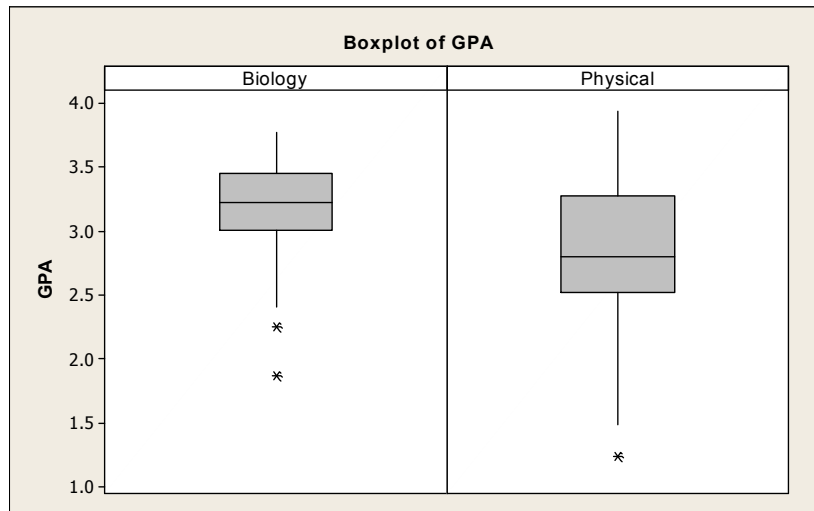


Fig. 1. Distribution of GPA of students in both streams

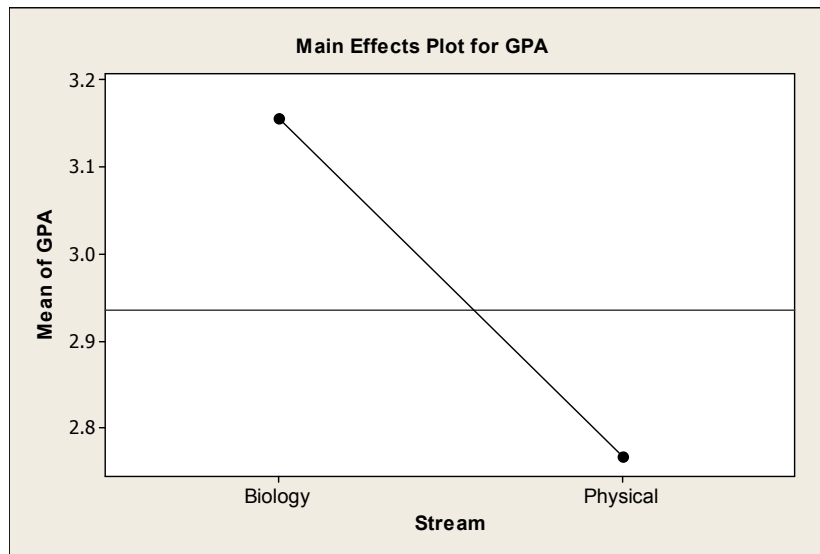


Fig. 2. Main effect plot of GPA

Table 6. Results of logistic regression models

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

* significant at 0.05: ** significant at 0.001

As mentioned in the literature review above, no study that investigate the effect of streams on academic performances or graduation, could be found in the literature. Therefore, comparison of results of this study is unable to perform.

5. CONCLUSIONS AND RECOMMENDATIONS

As the main objective this study, the effect of streams of science study in Eastern University on the graduation and being qualified for at least the lowest class of degree was investigated in terms of number of students. 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 the University. Compared with biological science stream students, students in physical science stream show a less probability for obtaining degree and class of degree.

Since, students believe strongly that status of graduation depends on stream of science studies in the University and it is true according to recent past data, students will be compelled to select only easy stream for their higher studies. Further, students will avoid some important subjects as Mathematics in the degree program. This will affect the quality of science graduates and create a lack of graduates in certain fields. Therefore, it is essential to draw the attention of higher authorities in university to take necessary actions to change this trend.

This study was carried out with a single batch of students passed out recently. This study can be done again with results of more batches. Further, only two streams (biological and physical) were considered in this study. Perhaps, there may be more streams than these two streams in other Universities. Those streams and status of other universities also can be considered in future studies. Furthermore, same study can be

extended for other disciplines of studies in Universities and other higher educational institutes.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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