

Effect of streams of Science studies on Graduation and Classes of Degree, Sri Lanka.

ABSTRACT

This study was carried out to see whether the graduation of students in universities depends on the streams of study in science by using statistical analysis tools. Further, the effect of streams on the status of obtaining a class of Degree also was investigated. The analysis was based on the 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. The study revealed that both graduation and being qualified for a class of Degree are dependent on the stream of study in science.

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 the economic status, living standards and personal qualities[1]. According to Grealish [2], the 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 the government and private sector. Sri Lankan government education consists 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 the private 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 is 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 the collegiate level, will enter universities.

Eastern University, Sri Lanka (EUSL) is one of 16 state universities in Sri Lanka. It is situated in the Batticaloa district in the eastern province of Sri Lanka. Since its' start on 1st August 1981, the 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. Also,

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). Besides, 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 of the semester-based system and Grade Points Average (GP) system in the 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 are 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.

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 of this variation. That is, students are weak in Mathematics than in the subject of Biology. Perhaps, this may have created such a picture in university teachers' minds.

There is no issue that what teachers' belief is. Anyhow, developing such an opinion among students is not a good trend. Since students compel to select the easy stream, this can affect students' lives and the 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 the stream on the graduation, in the literature. In some studies, the 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 education [8].

However, many research 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. Okioga [25] showed that socioeconomic factors influence academic performance. He revealed that low-income families do not much care about their children's education, and it influences their performance in higher education negatively. Anyhow, Pedrosa, Dachs, Maia, Andrade and Carvalho [26] students coming from the 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 been stated that there is no evidence that gender influence on the performance of students by several authors Borde [42], Durden and Ellis [43], Didia and Hasnat [44], Marcal and Roberts [45], and O'Malley Borg and Stranahan [46]. However, Mlambo [47] found a significant association of gender and academic performance which contradicted the findings of the above studies.

Douglas and Sulock [48] says that students' performances are related to their race and their expectations. It has been revealed by Anderson & Benjamine [49] that students' performances depend on the 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 out that school student's performance is affected by the status of classrooms and schools, such as a higher number of students, electricity break-downs, strikes and shutdowns of schools. Devi and Mayuri [51] and Khan *et al.*, [52] have found 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 to 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 the internet, affect academic performance. It has been stated by Karemera [14] that students' academic performance is significantly correlated with the learning environment and the facilities such as a library, computer lab. Kumar and Manjunath [53], Siraj [54] and Kim [55] found that duration of use of the 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 on 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 competence in English is the most important factor which positive effect on students' performance.

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

2. METHODS

The main objective of this study was to test whether graduation and obtaining the lowest class of degree depend on streams of study. 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.

The data were obtained from the Dean's Office, Faculty of Science. Stream of study (biological, physical) was used as the factor, while the status of graduation (graduated, not graduated), and status of obtaining the lowest class of the degree (obtained a class, not obtained a class) were used as the responses. Also, overall grade points averages (GPA) was recorded to make a comparison between the 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.

The 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 equality of proportions of students who qualified and not qualified for graduation and the lowest class. Relative changes 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 odds ratio. Chi-Square test and likelihood ratio Chi-Square test also was performed to confirm the results. Analysis of variance (ANOVA) test was used in making a 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 analysis was used to compare the probabilities of not been qualified for graduation and a class. Logistic regression analysis was carried out with R software. The function "glm" was used for fitting the logistic regression models with and without intercept. Biology stream was the baseline of the explanatory variable (stream) while being qualified for graduation and the class were used as baselines of the response variables (graduated=0: not graduate=1, and obtained class=0: not obtained class=1).

3. RESULTS AND DISCUSSION

Numbers of graduated students in each stream are given in Table 2 with corresponding percentages (within bracket) calculated based on the stream. 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 graduate students and not graduate students in both biological and physical science streams.

Table 2. Number of students graduated

Stream	Not	Graduated	Proportion Test	
	Graduated		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, a 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	The proportion of 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 odds ratio are given in Table 4. The relative risk and odds 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, the relative risk of physical science students for not being qualified for the lowest class is about higher than that of students in the biological science stream. It is 2.68 times than risk of biological science stream students.

Odds ratios also confirm the same. The 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 a higher chance of not obtaining at least the lower class of the degree.

Table 4. Relative Risk and Odds Ratio

Aspect	Relative Risk	Odds 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 evidence 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 the Chi-Square test and Likelihood ratio tests confirm these variations between biology and physical science streams.

Table 5. Results of the 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

Table 6 consists of the results of the logistic regression analysis. Logistic models were fitted with and without an intercept. Both models confirm that the probability of being not 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 for not being graduated.

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

Table 6. Results of logistic regression models

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

* significant at 0.05: ** significant at 0.001

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 the lower side. Physical science stream students have shown both minimum and maximum of GPAs.

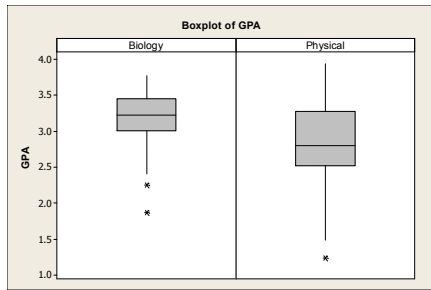


Fig. 1. Distribution of GPA of students in both streams

For comparison of the overall GPA of students in each stream, the ANOVA test was performed. One way ANOVA test produced 0.000 as the P-value. This 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 a 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.

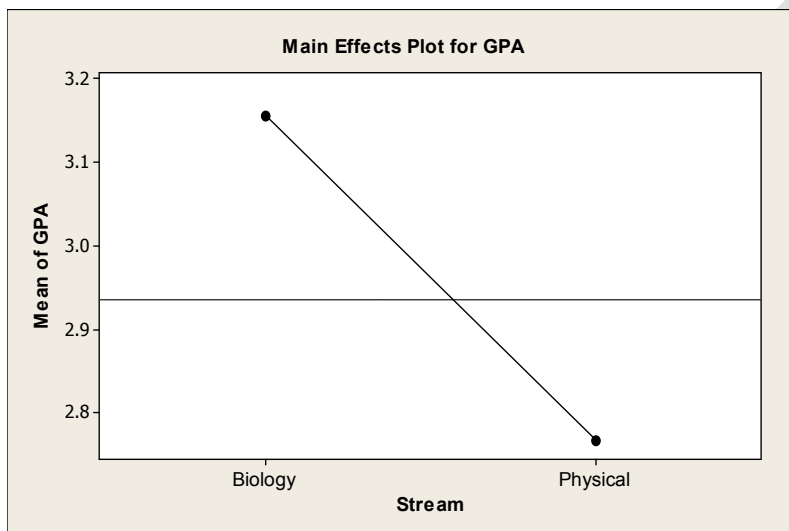


Fig. 2. Main effect plot of GPA

4. CONCLUSIONS

The effect of streams of science study in universities on graduation and being qualified at least for the lowest class of degree was investigated in terms of the number of students qualified and not qualified. This study provides evidence 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 at the university level. Perhaps, there may be more streams than these two streams. Like the sample, the 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 the above limitations.

COMPETING INTERESTS

I declare that I have no competing interests.

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