Effects of Course Related Factors on Academic Performances of Undergraduates-A Study with Science Courses

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Author's contribution

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

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ABSTRACT

Aims: Academic performances of undergraduate students may depend on many factors. Researches in literature have taken different factors into consideration and these effects may vary depending on different aspects such as place, period and group. This study aimed to identify effects of course related factors on academic performances, which are linked with design of courses. As the course related factors, subject of course, type of course (theoretical, practical), volume of course (number of credits), and level of course (year of study) were considered.
Place and Duration of Study: This study was carried out at Faculty of Science, Eastern University, Sri Lanka with the undergraduate courses in the science stream and results of students in a batch completed the degree recently.
Methodology: A group of all students in a batch that recently passed out from the faculty was used as the sample and there were 109 students. Data including gender, stream of study, subject of course, type of course (theoretical/practical), volume of course in terms of numbers of credits, levels of courses were gathered as the factors and grades of courses was taken as the measure that represents academic performances of students. Grades were transformed to grade point values and then it was used as the main response. Analysis was carried out with both parametric and nonparametric statistical approaches.
Results: It could be revealed that academic performances of undergraduates depend on course

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related factors tested. Performances tend to decrease with the increase in number of credits of the course meanwhile higher performances could be observed in practical courses compared with theory based courses. Irrespective of other factors, performances for courses in the third year of study were higher than that of courses in other years of studies.

Conclusion: Academic performances of undergraduates are dependent on these factors related to courses. However, it needs further work to generalize the results.

1. INTRODUCTION

The achievement in learning process is linked with the life satisfaction of all human being [1] and it affects the career of the students [2, 3]. Academic performance of undergraduate students is an important aspect in their life and students are also more concerned about their performances, because it has become the key tool of recruitments in Sri Lanka.

Academic performances of undergraduates may depend on many factors. Identification of factors that affects academic performances of undergraduates is much vital in order to improve the performances of students in universities. Researchers in the field of education are also keen on academic performances of students [4, 5]. Many researches that reveal the factors affect academic performances of students are in the literature. A broad list of factors such as social status, economical status, health status, learning environment has been identified as the influencing factors for students' performances. Effect of these factors may not be same everywhere and every time. Depending on the aspects such as time, place, person, course, effect of these factors may vary. Apart from these sorts of factors, there may be many other factors.

There is a rapid change in education system and degree programmes offered by Sri Lankan universities are also different. Universities offer differently structured courses in various degree programme. For a long time, there is a belief among staff and students that academic performances of students may depend on courses of study programme as well, since there are some changes among these courses and evidences for this belief are lacking in the literature. This study aimed to test this belief with a sample of students in Faculty of Science, Eastern University, Sri Lanka.

Eastern University, Sri Lanka (EUSL) is one of the state Universities in Sri Lanka, situated in the eastern province and University has six faculties including Agriculture, Arts and Culture, Commerce and Management, Science, Healthcare Sciences, and Technology. In addition, Trincomalee campus and Swami Vipulananda Institute of Aesthetics Studies are also affiliated with the Eastern University, Sri Lanka.

Faculty of Science (FOS) offers B.Sc. (General) degrees of 3 years and B.Sc. (Special) degrees of four years duration in both biological and physical science streams. Two different curriculums are in the faculty now and no any batch has passed out under the new curriculum. Faculty follows 6 months semester based credit system. Volumes of these degrees are defined in terms of credits and credits are defined by number of face to face lecture hours. One credit course is equal to 15 face to face lecture hours. Students should complete 90 credits, under the selected subject combination (a combination of three subjects), to be eligible for the general degree and 120 credits for the special degree. Both offline and online teaching take place in the faculty with the support of a leaning management system (LMS). However, marks of students are manually managed.

Seven principle subjects: Botany(BT); Chemistry(CH); Computer Science(CS); Applied Mathematics(AM); Pure Mathematics(PM); Physics(PH); and Zoology(ZL) are offered under five departments namely: Botany; Chemistry; Mathematics; Physics; and Zoology. Special degrees are offered in all these subjects. Biological students have only one subject combination Botany+Chemistry+Zoology, mean while physical science stream students are offered several combinations of three subjects. 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 to courses of these principle subjects, students are offered some compulsory courses (CC) and optional courses (OC) among which some are common for both biological and physical science stream students. Both theoretical and practical courses are in each subject. Academic performances of students are evaluated based on Grade Points (GP) system. Grades Points Average (GPA) is used as a measure of overall performances.

There are several changes in the courses offered by the Faculty of Science. Courses are different in terms of streams (biological, physical), subjects (BT, CH, AM, PM, CS, PH, ZL), types (theoretical, practical), levels of study (1st, 2nd, 3rd), and volume (in terms of number of credits).

Hence, the objective of this study was to investigate whether the academic performances of undergraduate in the Faculty of Science, EUSL, depend on these sorts of course related factors: especially subject of courses, type of courses, level of courses and volume of courses. In literature, it is difficult to find a research that considers effects of these sorts of course related factors on students' academic performances. Therefore, this research is vital. However, it can be seen many other factors influencing academic performances in the literature.

1.1 Literature Review

A broad list of socio-economic, health, and learning environment related factors is in the literature. Students' performances are related with status in previous schooling and type of secondary education institute has a large impact on students' performances compared with individual factors [4]. Learning environment related factors such as overcrowded lectures room, break-downs of electricity supply, continuous strikes and closure of school has a significant impact on student's performance [5, 6, 7, 8, 9, 10, 11]. Further it has been found that teaching and learning materials affect students' performances [8, 9, 12].

Usage of educational technology also affects students' performances [8, 9]. Among other factors, school climate is also an important factor [8, 9]. It has been found that students' health related variables are associated with academic performances [13]. Family income plays an important role on students' academic achievements [10, 14, 15, 16, 17]. Parent's educational back ground has been discovered as

a more significant factor in students' academic improvement [14, 17, 18, 19, 20, 21, 22].

Performances of students in studies depend on the gender of students too [14, 23, 24, 25, 26, 27] and in general female students' performances are better than the male students [25]. However, contrary to that, it has been found that male students perform better than female students in studies in some occasions [28]. Other more considerable factor is the students' attendance for lectures or classes [14, 28, 29], which affect positively and negatively. In case of students' marks, teacher's related factors such as experience, training, skills have significant effect [14, 30, 31, 32]. Lack of human resources including lack of teachers, tutors is also behind students' low performances [30].

Students' drugs usage also gives a higher contribution for having low performances [18, 33, 34]. Instructions, guidance, counseling of teacher or lecturers are also linked with performances of students [14, 25, 33, 34]. Attitudes of both students and teachers on study process and subject also determine the level of success in studies [11, 18, 32, 35]. At the same time discipline of students within the learning environment also provide opportunity for teachers to develop students' skills and subject knowledge [31, 32, 35].

Competitiveness among students leaves a positive impact in developing students' performances [36]. Having internet connection for students at home become a factor that motivates students for study related activities [12, 37]. Those students who have better communication skills show higher performances in education [7, 10, 14, 25]. Not only that but also learning facilities in class room also highly related with students' talents [12, 38]. Overall performances of students depend on English efficiency [12], responsibility of students and teachers [10], leadership skills of teaching staff [18, 33, 34], and stress of students and teachers [18, 23].

Quality of academic staff, university facilities, education program, training environment and student satisfaction are mediated by academic performance [6]. Academic achievement of university students are affected by factors such as professional qualifications and practices, managerial services and practices, communication, personal responsibility, and physical environment and hardware[10].

Among the factors affect students' performance, class schedules, class size, English text books, class test result, homework complexity of course material, exams system also take great attention [12]. Some studies have pointed out teacher-student ratio, experiences of teacher, distance of the school are also affecting students' performances [14]. Further, it has been experienced that students' achievement depend on self-motivation, learning preference, poor study habits examination malpractice, peer influence, lack self-confidence, use of social media, insufficient sleep [18]. Stress, lower self-efficiency, tolerance, and social support also make influences on academic performance [23]. Submission of assignments, and time spend for study were also found to have influences on academic achievement [27].

2. MATERIALS AND METHODS

2.1 Data Collection

This study was planned as a descriptive analysis mainly based on comparisons by using secondary data. A group of all students in a batch that recently passed out as the general degree holders from Faculty of science, EUSL, was used for the study as the sample. This batch consisted of 47 biological science stream students and 62 physical science stream students.

The main purpose of this study was to investigate the effects of course related factors on academic performances of undergraduates. As the course related factors, subjects of courses (BT, CH, AM, PM, CS, PH, ZL), type of courses (theoretical, practical), levels of courses (1st, 2nd, 3rd), and volume of courses (1C, 2C, 3C) were recorded. Apart from these factors, stream of study (biological, physical), gender (male, female), were also recorded since those information were available. As the variable represents academic performances, grades of courses were recorded. These data were collected from the Faculty Dean's Office.

2.2 Analysis

Academic performance is widely measured in terms of grades and test scores. In this study, grades were transformed to Grade Points (GP). Then, average of these grades points (Grade Points Averages, GPA) was used as the response or dependent variable that represents undergraduates' overall academic performances. Main objective of this study was to test the effects of subject of courses, type of courses, level of courses, and volume of courses on overall academic performances(GPA). Therefore, following hypotheses were mainly tested under this study.

H1: GPA depends on subject of courses.
H2: GPA depends on types (theoretical, practical) of courses.
H3: GPA depends on level of courses
H4: GPA depends on volume (in terms of credits) of courses.

In addition to above main hypotheses, following hypotheses were also tested.

H5: GPA depends on stream of study.
H6: GPA depends on gender.

Averages of grade points, GPAs, were obtained according to the analysis. For example, for making a comparison of performance between biological and physical science streams students, averages of all biological courses and physical science courses followed during the degree program were calculated separately. Averages of grades points of courses in each level of study were used for comparing performances in each level. Similarly, averages of grades points were obtained subject-wise, gender-wise, course types-wise (theoretical, practical), and course volume-wise (1C, 2C, 3C). Each analysis was carried out for biological science and physical science streams separately. Effects of type of courses (theoretical, practical), and number of credits were analyzed separately for each subject. That was to remove the effects from other factors.

For the analysis, both parametric and non-parametric quantitative analysis techniques were used. When both assumptions, homoscedasticity and normality were satisfied, ANOVA test was performed to test whether GPA depends on each factor, since parametric approaches become the most powerful tests when assumptions are valid. In case, only normality assumption was satisfied by data, T-test was used for making comparison between two groups, mean while comparisons were made by using Krusskal-wallis test when data did not follow both assumptions. Minitab 14 version was used for the analysis.

3. RESULTS AND DISCUSSION

As mentioned above, apart from the effect of course related factors, effect of stream of study, and gender were also analyzed.

Results of Krushkal-Wallis test that was performed to compare the academic performance(GPA) of biological and physical science stream students are given in Table 1 with summary measures: mean, standard error of mean(SEM-within the bracket), and median.

Krushkal-Wallis test confirms that there is a significant difference between GPAs of biological and physical science stream students. GPA of biological science students is about 3.1 meanwhile physical science stream students show a mean of 2.3 which is less than that of GPA of biological science stream students. These results emphasize that academic performances of biological science stream students are higher than the performances of physical science stream students. This difference between biological and physical science student in overall performances (GPA) is due to the combinatory effects of all specific features in each stream such as complexity and nature of courses, teaching and learning practices, and students' involvement, etc.

GPA of male students and females students were compared under both streams separately by using two samples T-test. The corresponding results are given in Table 2.

Figures in this table provide evidences that performances of female students are higher compared with performances of male students and this is common for students in both biological and physical science streams. On average, difference between GPA of biological and physical science stream students is about 0.5. Further, mean values in this table also indicate that performances of biological science students are higher relatively to performances of physical science stream students.

A comparison of GPA of each level of study was made for each stream separately. Results of these comparisons are given in Table 3.

Krushkal-Wallis test confirms that GPAs of each level of study are not same. This result does not differ stream-wise. Students in both biological science and physical science streams have recorded the highest GPA in their 3rd level of study. However, no any similar pattern could be observed during the study period of 1st and 2nd levels. Fig. 1 provides evidence for this matter. Mean values in this table clearly show the differences of performances of students in biological and physical science streams.

Performances (GPA) of students in each subject also were compared under both biological and physical science streams by using Krushcal-Wallis test. The corresponding results are in Table 4.

This analysis was carried with all courses (including CC and OC) and only with principle subjects separately. *P*-values for the analysis only with principle subjects are in brackets. According to *P*-value of Krushkal-Wallis test, it is clear that there are some differences in GPA among subjects when CC and OC courses also taken into account.

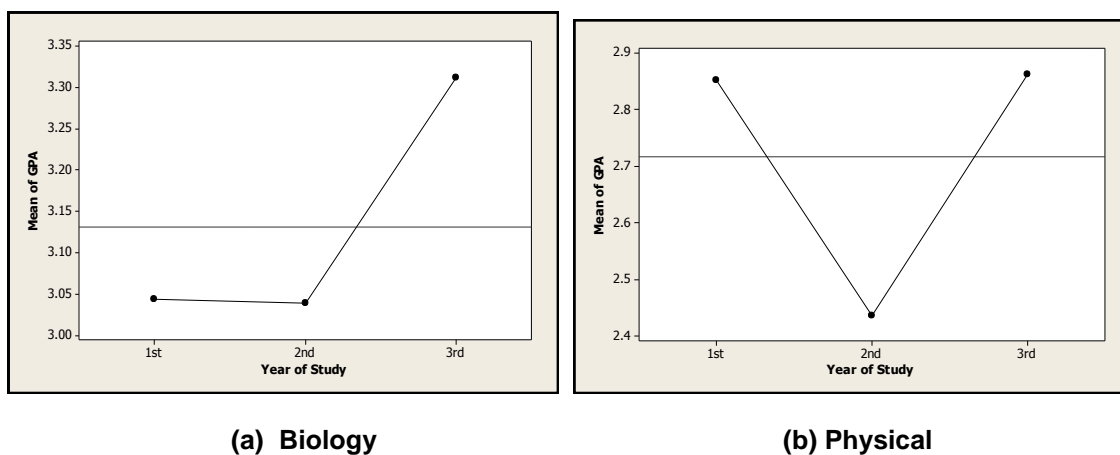**Table 1. Stream-wise comparison of GPA**

Stream	Mean(SEM)	Median	Test	*P*-value
Biological	3.1781 (0.0488)	3.23	KW	0.000
Physical	2.7677 (0.0795)	2.80		

Table 2. Gender wise comparison of GPA

Stream	Gender	Mean (SEM)	Median	Test	*P*-value
Biological	Male	2.8500(0.1420)	2.96	T-test	0.023
	Female	3.2560(0.0421)	3.26		
Physical	Male	2.4970(0.1070)	2.58	T-test	0.000
	Female	3.1190(0.0798)	3.05		

Table 3. Level wise comparison of GPA

| Stream	Level of Course	Mean (SEM)	Median	Test	*P*-value
Biological	1st	3.0430 (0.0593)	3.06	KW	0.000
	2nd	3.0389 (0.0565)	3.09		
	3rd	3.3117 (0.0464)	3.32		
Physical	1st	2.8527 (0.0793)	2.79	KW	0.000
	2nd	2.4352 (0.0842)	2.44		
	3rd	2.8626 (0.0800)	2.88		

(a) Biology

(b) Physical

Fig. 1. Distribution of GPA – Level wise

Table 4. Subjects wise comparison of GPA

Stream	Subject	Mean (SEM)	Median	Test	*P*-value
Biological	BT	3.1447 (0.0456)	3.20	KW	0.000 (0.623)
	ZL	3.1896 (0.058)	3.21		
	CH	3.1596 (0.0567)	3.20		
	CC	3.2238 (0.0777)	3.20		
	OC	1.6319 (0.245)	2.00		
Physical	PH	2.895 (0.0869)	2.99	KW	0.000(0.001)
	AM	2.5863 (0.0928)	2.51		
	PM	2.2896 (0.120)	2.33		
	CH	2.7853 (0.0975)	2.94		
	CS	2.6647 (0.0793)	2.60		
	CC	2.5006 (0.0663)	2.50		
	OC	2.5092 (0.0875)	2.52		

Table 5. Credit-wise comparison of GPA of biological subjects

Subject	No of credits			Test	*P*-value
	1	**2**	**3**		
	Mean(SEM), Median	**Mean(SEM), Median**			
BT	3.2291(0.0272), 3.30	2.9753(0.0477), 3.30	-	KW	0.000
ZL	3.2116(0.0412), 3.30	3.1851(0.0272), 3.30	-	KW	0.000
CH	3.1058(0.0242), 3.30	3.4676(0.0557), 3.70	-	KW	0.000
CC	3.1085(0.0640), 3.30	3.6851(0.0929), 4.00	-	KW	0.000
OC	3.8101(0.0784), 4.00	3.1480(0.1300), 3.30	-	KW	0.000
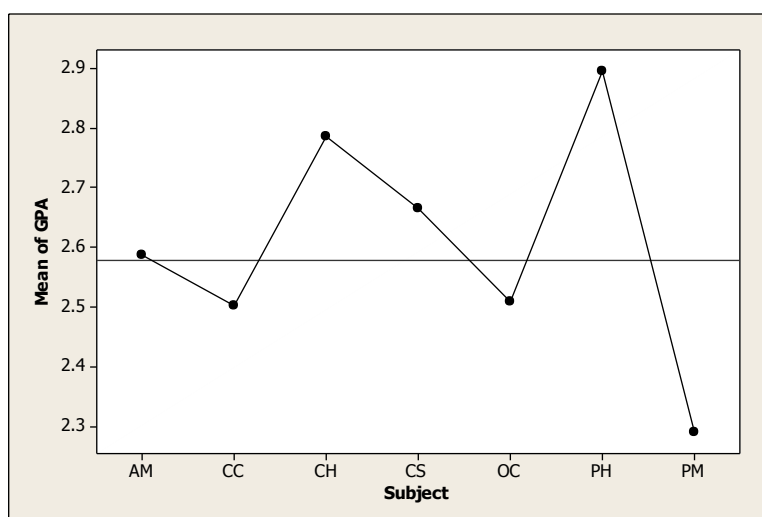
Fig. 2. Distribution of GPA of subjects wise- physical science

However, when only principle subjects in biology stream are considered, performances of students in subjects in biological science stream do not show a significant variation, mean while some significant differences could be observed among subjects in physical science stream. Among the subjects in physical science stream, Physics shows the highest GPA while the minimum GPA is recorded by Pure Mathematics. Fig. 2 illustrates it clearly.

OC courses are optional courses for students. Biological students' performances in OC courses are lower than the physical science students. This may be due to lack of biological students' interest and unfamiliarity with concepts in OC courses.

Results of credit wise comparison of GPA that calculated separately for each biological courses are given in Table 5. All biological subjects are having 1 credit or 2 credits courses only. No any 3 credits courses available for biological science stream students. According to GPA of 1 credit courses and 2 credits courses, it is clear that one credit courses show a higher mean in cases of principle subjects: Botany and Zoology. Krushkal-Wallis test confirms that GPAs of one credit and 2 credits courses are significantly different. Subject Chemistry shows a deviation from this pattern. Average of 2 credits courses is higher than the average of one credit courses. There were 25 Chemistry courses of 1 credit and 3 Chemistry courses of 2 credits out of which all 2 credits courses were practical courses. This may be the reason why Chemistry courses of 2 credits show a higher GPA.

Comparison of grade points averages of all courses in each physical science subject also was made and results are given in Table 6.

Table 6. Credit wise comparison of GPA of Physical science subjects

Subject	No of credits			Test	*P*- value
	1	**2**	**3**		
	Mean(SEM), Median	Mean(SEM), Median	Mean(SEM), Median		
AM	2.6149(0.0756), 2.70	2.6770(0.0658), 2.70	2.4434(0.0768), 2.00	KW	0.000
PM	-	2.4987(0.0894), 2.70	2.2114(0.0744), 2.00	KW	0.01
CH	2.7265(0.0426), 2.70	3.2176(0.1050), 3.30	-	KW	0.000
CS	2.7992(0.0436), 2.70	2.5615(0.0392), 2.70	-	KW	0.000
PH	2.8630(0.0370), 3.00	1.3650(0.8350), 1.00	-	T-test	0.000
CC	2.9607(0.0980), 3.00	2.3890(0.1010), 4.00	2.7435(0.084), 2.70	KW	0.000
OC	3.0738(0.0888), 3.30	2.2064(0.0950), 2.30	-	KW	0.000

Table 7. Types wise comparison of GPA of Biological science Subjects

Subject	Theory Mean(SEM), Median	Practical Mean(SEM), Median	Test	*P*-value
BT	3.0038(0.0344), 3.00	3.2984(0.0337), 3.30	KW	0.000
ZL	3.0229(0.0292), 3.00	3.5227(0.0274), 3.70	KW	0.000
CH	3.0227(0.0269), 3.00	3.4908(0.0345), 3.70	KW	0.000
CC	3.1092(0.0764), 3.30	3.3957(0.0796), 3.70	KW	0.001

Table 8. Types wise comparison of GPA of Physical science Subjects

Subject	Theory Mean(SEM), Median	Practical Mean(SEM), Median	Test	*P*-value
AM	2.5913(0.0422), 1.00	1.2175(0.0223), 1.00	KW	0.000
PM	2.7700(0.0400), 3.00	3.1290(0.0450), 3.30	KW	0.000
CH	2.5811(0.0465), 2.70	3.2644(0.0617), 3.30	KW	0.000
CS	2.5875(0.0474), 2.70	2.8319(0.0493), 2.80	KW	0.001
CC	2.8512(0.0650), 2.70	3.3890(0.1010), 4.00	KW	0.000
OC	2.6316(0.0798), 2.70	3.1140(0.1420), 3.30	KW	0.01

Among the principle subjects of physical science stream, only Applied Mathematics (AM) and Pure Mathematics (PM) courses are having courses of 3 credits. Even though there are some Applied Mathematics (AM) courses of one credit, no any 1 credit Pure Mathematics course is available. All other principle subjects are having 1 credit and 2 credits courses.

The Kruskal-Wallis test and T-test confirm that performances of students are dependent on number of credits. Further, it is clear that, students' performances in all of the principle subjects except in Chemistry (CH), decrease when number of credits increase. All two credits courses of Chemistry (CH) are practical courses. It is the reason for sowing higher performance in Chemistry courses of 2 credits. Figures in this table also provide evidence that students' performances in Pure Mathematics subject are less than performances in other subjects. The maximum and the minimum performances have been recorded by Physics courses of one credit and two credits respectively.

Table 7 and Table 8 consist of the results of the comparison that made by taking grade point averages for theoretical and practical courses separately in biological and physical science streams respectively.

P-values of Krushkal-Wallis tests indicate that performances of students differ depending on type (theoretical, practical) of the courses of each subject. Further, figures in the table confirm that performances of students are higher in practical courses than that of theoretical courses. A reasonable difference could be observed between theoretical and practical courses in each biological subject.

Type (theoretical, practical) based comparison of courses of physical science stream subjects also was made. The relevant results are in Table 8.

Krushkal-Wallis test confirms that there is a difference between performances in theoretical courses and practical courses in almost all the subjects. Performances of students in practical courses are greater than that of performances in theoretical courses. However, it can be seen a deviation of this pattern in the subject Applied Mathematics. There is only one practical course and 12 theoretical courses of Applied Mathematics subject. These theoretical courses gave a mean of 2.5913. This may be the reason of this deviation.

4. CONCLUSIONS

Academic performances of students at Faculty of Science, Eastern University, Sri Lanka are depending on the factors related with courses. Performances of students depend on subjects, streams of study, levels of courses, types of courses, and number of credits of courses. Performances of students in biological science stream are higher compared with performances of physical science stream students.

In this study it was observed that performances in practical courses are higher compared with performances in theoretical courses irrespective of subjects. It has been found that practical work effect overall students' academic attainment in science [39]. Further, practical work improves students' attitudes and motivation on learning in science [40, 41]. It was found that practical experience has a positive effect on theoretical knowledge [42].

According to this study, performances of students depend on volume of courses (number of credits). The performances are higher for the courses of one credit while the lowest performances are recorded in courses of three credits irrespectively to the subjects. It is stated that workload is associated with all outcomes of courses [43] and perceptions of students differ depending on number of hours required by course work [44]. In general, work load increases with number of credits. Then number of credits or volume of learning links with perception and performances for courses.

This study further revealed that students' performances vary depending on levels of courses while students show the highest performances at the third level, which is the last. This is a common feature for students in both streams. This result is confirmed by the results that satisfaction of students on courses is associated with academic year [45].

Performances of students depend on subjects too. Students in physical science stream show the lowest performances in Pure Mathematics. However, there is no variation in the performances among principle subjects: Botany; Chemistry; Zoology in the biological science stream. It has been confirmed by previous results that course experience could affect and determine academic achievement [46] and social skills levels depend on elective courses [47].

Even though, compulsory courses (CC) and optional courses (OC) were also included in the study, main attention was given to principle subjects only. Effects of stream of study and gender were also analyzed because they were key factors according to the literature. Number of students follow these subjects are not same. Perhaps, this also can make a change in these results.

Complexity of subject matters is different from subject to subject. Pure Mathematics showed the lowest GPA. This may be due to the complexity of Pure Mathematics concepts. According to this analysis, students' performances decline with the number of credits of the courses. More courses in Pure Mathematics are of 3 credits. This can be another reason behind this variation. Perhaps, both aspects complexity and number of credits may jointly affected students' performances. These effects are compounding.

For the confirmation of these results, it was able to find a few studies that have considered effects of these sorts of course related factors on academic performances of undergraduate students in the literature.

In this study, effects of basic science courses available at the Faculty of Science, Eastern University, Sri Lanka were considered. However, there are many more science courses in other University. Those courses also could be incorporated for further study. In this study, analysis was carried out by using the results of one batch of students. Since there were more than 100 students in the selected batch, results of this study are reliable. However, more batches could be considered for this study is extended. Further, this study can be expanded to other disciplines such as Arts, Agriculture, Commerce and Management, and Medicine in this university and other Universities as well.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the authors.

RECOMMENDATION

Designing a curriculum for undergraduates' degree programme has to be done with much care because objectives of the degree programs are highly related with the curriculum and it has to fulfill social needs as well. In designing such a curriculum, so many factors have to be taken in to account. Results of this study can be used in designing structures of courses by minimizing the effects due to variation among courses.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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