ACADEMIC PERFORMANCE OF UNDERGRADUATE STUDENTS IN STEM AND ARTS SUBJECTS IN BHUTAN: A GENDER PERSPECTIVE

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ABSTRACT

Academic performance disparities among the gender of students are the cause of concern. Numerous explanations for academic performance disparities, especially in Science Technology Engineering and Mathematics (STEM) and Arts subjects between male and female students, are established in many countries. However, similar studies in Bhutan, especially at the tertiary education level, are scant. Therefore, this study mainly assessed i) students' perception of STEM and Arts subjects, ii) compared male and female academic performance in STEM and Arts subjects, and iii) studied students' perception of the factors affecting their academic performance. Data were collected from 265 students of four constituent colleges (two Science and Arts colleges each) of the Royal University of Bhutan using semi-structured questionnaires. A multistage sampling (comprising a mixture of purposive and random) was employed. The research used a quantitative approach with descriptive and inferential statistics (Chi-square, *t*-tests, and binary logistic regressions). The result showed no significant association between students' gender and their choice of subjects. At Science colleges, female students outperformed male students. In contrast, there were no significant differences in the performance of male and female students at Arts Colleges. Overall, females (71.63 ± 6.35) outperform male (69.57 ± 7.80) students. Hence, there are no stereotypes in STEM and Arts subjects among Bhutanese undergraduate students. However, future research could include parents and lecturers to gather their perspectives on STEM and Arts subjects. Variables, including study hours, communication skills, and Bhutanese educational policies, should also be thoroughly investigated as factors affecting students' academic performance.

1. INTRODUCTION

The Sustainable Development Goals included quality education and gender quality (United Nations Educational, Scientific, and Culture Organization, 2015). Accordingly, female enrolment in school has increased than ever before in the world. For instance, female enrolment in primary school was 87%, while male enrolment was 85%. Female enrolment in high school was 67%, while male enrolment was 59% (World Economic Forum, 2016). However, females usually lack the same opportunities as males to pursue their preferred subjects. They are often overshadowed by prejudices, societal norms, and demands (Goni, 2015). Therefore, males outnumbered females in engineering, computer science, design, manufacturing, and construction in tertiary education (Organization for Economic Cooperation and Development, 2004).

Besides enrolment numbers, many studies have found gender gaps in academic performance between males and females in science and literature subjects (Plante et al., 2013). Females reported underperforming males in mathematics and science subjects (Kiptum et al., 2013). On the other hand, males underperform females in Arts subjects because they regard reading and language as feminine subjects (Plante et al., 2013). Royal University of Bhutan [RUB] got established in 2003 and is the first University in Bhutan for tertiary education. There are ten constituent colleges offering STEM, Arts and teacher education programmes (Royal University of Bhutan, 2021). The existing total capacity of the students' enrolment in the university has increased to around 10,000 per year (College of Natural Resources [CNR], 2021). The choice of programmes in RUB is based on the merit of the academic performance in class twelve (high school). Besides the merit, the programme selection is pre-determined for the stream (science, commerce/business, and arts) a student chooses before entering high school (Ministry of Education [MoE], 2020).

The literacy of the Bhutanese population is 71.4%, where more males (78.1%) are literate than females (63.9%) (Population and Housing Census of Bhutan, 2017). Ministry of Education began documenting the student's enrollment and programmes in tertiary education within and outside Bhutan. Female enrolment into tertiary institutes was relatively lower than males. Though there is gradual increase in enrolment figure for females from 44% in 2014 (MoE, 2014), 46 % in 2018, 47% in 2019, and 48.6% in 2020 (MoE, 2020). Female enrolment has been significantly lower than males. Female representation is lower in some tertiary programs in Bhutan, such as engineering (9.5%) and medical technology (45%). However, it is higher in others, such as law (64 %) and nursing (54%). The discrepancy in college students' number reflects the gender inequality in tertiary education in Bhutan (MoE, 2020). Despite the rise in enrolment number, the academic performance of tertiary students considering STEM and Arts subjects and by gender is not researched in Bhutan. Limited information on academic performance by gender at schools is available, and no similar studies have been undertaken at the tertiary level.

Thus, beyond the reach of traditional stereotypes and traditional values in tertiary education, this study aims to understand students' perceptions of STEM and Arts subjects, as well as their performance in practice. Furthermore, this paper helps explore gender disparities in student academic success in RUB colleges of Bhutan. It also assesses the most significant determinants affecting male and female academic achievement in RUB colleges. Therefore, this study: i) Assessed students' perceptions of STEM and Arts subjects; ii) Compared male and female students' academic performance in STEM and Arts subjects, and iii) Determined factors affecting students' academic performance at colleges of Royal University of Bhutan (RUB).

2. METHODS

2.1. Study Area

The RUB was established as the federated college in June 2003, comprising of ten constituents and two affiliated colleges. However, data for this study were collected from four constituent colleges of the RUB (two Science colleges and two Arts colleges). The College of Language and Cultural Studies (CLCS) and Sherubtse College (SC) were considered Arts colleges. Likewise, the College of Science and Technology (CST) and Jigme Namgyel Engineering College (JNEC) were considered Science colleges. The selection of two colleges each offering the same subjects would give more accurate and representative results; thereby, reducing the variability of collected data. These colleges were chosen to investigate gender gaps in academic achievement in STEM and Arts education at the tertiary level.

2.2. Sample Size

The target population for this study was 11,115 undergraduate students of final years. The sample size of 400 was determined using the Yamane formula (Yamane, 1967) with a 95% confidence interval and 5% error rate. Initially, we planned to collect data from 100 students (50 males and 50 females) from each selected college – making 400 students in total. Despite repeated requests and reminders to fill up the online questionnaire, some students did not respond. Therefore, results in this study are based on responses provided by 265 students (Table 1). However, the response rate was 66%, considered adequate for social science studies (Baruch, 1999).

Table 1 Distribution of students by colleges and gender

Gender	Science College		Arts College		Total
	CST	JNEC	CLCS	SC	
Male	37	32	21	44	134
Female	30	26	39	36	131
Total	67	58	60	80	265

2.3. Sampling Method

The study employed a multistage (three steps) mixed-method sampling technique (Olufemi et al., 2018). In the first steps, four colleges (i.e., 36.36%) were selected purposively to include students from both Arts and Science colleges. The second step involved the purposive selection of two modules in Arts colleges (Academic Communication Skills and Dzongkhag Communication Skills) and Science colleges (Statistics and Environmental Engineering). The third step involved a random selection of final-year students in each selected college. Only final year students are included because they have already completed studying the selected modules and possess better information on modules. Most importantly, final year students had academic scores for the selected modules that could be compared.

2.3. Data Collection

Quantitative data were collected using online self-administered semi-structured questionnaires in the form of Google Docs via emails. The questionnaires consisted of three parts: personal information (1), perceptions of STEM and Arts subjects (2), and factors influencing male and female students' academic performance in STEM and Arts subjects (3). The questionnaire was pretested to eight students (two students from each college, including

one male and one female). These eight students were excluded from the actual sample. Almost all students could answer all questions during the pretest; hence, the questionnaire was finalized with minor changes to improve its readability. In this research, ethical concerns were considered based on topics that infringed on the participants' interests. The College of Natural Resources sent official letters to the Presidents of all four Colleges on behalf of researchers, specifying that the data will be used exclusively for academic purposes. Questionnaires were emailed to students assuring them that their information would be kept confidential. Thus, data were collected upon getting formal approval from colleges and consent from students.

2.3. Data Analysis

The data were entered, coded, and cleaned using Microsoft Excel 2010. The cleaned data were imported into the Statistical Package for Social Science (SPSS) version 26. Descriptive statistics such as mean, standard deviation, frequency, and percentage were computed. Inferential statistics included Chi-square tests to find relationships between categorical variables and two independent sample t-tests to compare academic scores males and females. The study also employed binary logistic regressions to determine factors influencing academic performance as follow:

$L = \ln (Pi /1 - Pi) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots \beta_{16} X_{16} + \varepsilon$
Where: L = logit model
            β_0 = intercept term,
            $\beta_1 - \beta_{16}$ = coefficient of independent variables, and
            $X_1 - X_{16}$ = Independent Variables (see Annexure 1)

3. RESULTS AND DISCUSSION

3.1. Socio-Demographic Profile of the Students

The sample comprised more males (50.57%) than females (49.43%). Most students (38%) were aged between 22 and 23 years, indicating that college students in Bhutan are primarily in their early twenties. Most students (43.57%) in Arts colleges were between 22 and 23 years, while most students (47.20%) in Science colleges were between 20 and 21 years (Table 2). This finding reveals slightly younger students in Science colleges compared to Arts colleges. The choice of college mainly was self-decision of the students (77%), followed by parents (14.3%) and teachers (3.4%). Most students (41.9%) reported that they were happy in their respective colleges, followed by very happy (30.6%) and satisfactory (19.25%). The happiness pattern was similar in both Science and Arts colleges.

Table 2 Students' socio-demographic profile

Profile	Category	Science college n (%)	Arts college n (%)	Total n (%)
Age of students in completed years	18-19	04 (3.20)	1 (0.71)	5 (1.89)
	20-21	59 (47.20)	31 (22.14)	90 (33.96)
	22-23	40 (32.00)	61 (43.57)	101 (38.11)
	24-25	22 (17.60)	47 (33.57)	69 (26.04)
Who influenced your choice of college?	Self-Decision	91 (72.8)	113 (80.7)	204 (77.0)
	Parents	30 (24.0)	8 (5.7)	38 (14.3)
	Friends	0 (0.0)	2 (1.4)	2 (0.8)
	Teachers	0 (0.0)	9 (6.4)	9 (3.4)

	Society's View	3 (2.4)	1(0.7)	4 (1.5)
Level of happiness	No option	1 (0.8)	7 (5.0)	8 (3.0)
	Unhappy	8 (6.4)	14 (10.0)	22 (8.3)
	Satisfactory	30 (24.0)	21 (15.0)	51 (19.2)
	Happy	53 (42.4)	58 (41.4)	111 (41.9)
	Very happy	34 (27.2)	47 (33.6)	81 (30.6)
Total		125 (47.2)	140 (52.8)	265 (100)

3.2. Gender and Perceptions on STEM and Arts Subjects

Chi-square tests were computed to determine the association between gender and three perception statements on STEM and Arts subjects (Table 3). The result showed that the gender and the perception statement "There is a stereotype in STEM and Arts subjects for male and female students in general" was not significant, where x^2 (1, $N = 265$) = 1.119, $p > 0.05$. The perception statement "Female can score high in Arts, and a male can score high in STEM subjects" was also not significantly related to the gender of the students, where x^2 (1, $N = 265$) = 1.07, $p > 0.05$. Moreover, the gender is independent of the perception statement "Observed differences in the academic performance of male and female students in STEM and Arts subjects", where x^2 (1, $N = 265$) = 0.604, $p > 0.05$. The findings indicate that most RUB students do not have stereotypical feelings towards STEM and Arts subjects for gender. However, the current findings contradict other studies, where they supported that those students perceived females could perform well in Arts subjects, while males could perform better in science subjects (Nosek et al., 2002; Hill et al., 2010; Steffens et al., 2010; Atovigba et al., 2012). The positive perception in Bhutan could be possibly due to no or minimum discrimination among the male and female children regarding their capabilities in terms of their STEM and Arts academic performance in the country. To this end, there are no stereotypes of STEM or Arts education for gender among tertiary students in Bhutan.

Table 3 Chi-square test on the perception of students on STEM and Arts subjects

Perceptions	Gender	Yes (%)	No (%)	x^2	P
Perception on stereotype in STEM and Arts subjects for male and female students	Male	17.7	32.91	1.119	0.296
	Female	14.3	35.09		
Perception on females can only score high in Arts, and a male can score high in STEM subjects	Male	5.89	45	1.07	0.301
	Female	3.11	46		
Perception on the differences observed in the academic performance of male and female students in STEM and Arts subjects	Male	17.73	32.99	0.604	0.437
	Female	20.27	29.01		

3.3. Gender and Academic Performance in STEM and Arts Subjects

The study compared the academic scores of males and females (Table 4). Overall, females (71.63 ± 6.35) significantly outperformed males (69.57 ± 7.80), where $t(263) = -2.35$, $p = 0.01$. The possible argument could be that female students are more enthusiastic about their studies than male students. According to Khwaileh & Zaza (2011), male students are more likely to participate in extracurricular activities than female students. Hence, female students spent more time on studies achieving greater academic success than males. Moreover, females can better adapt to new environments than males (Ghazvini & Khajehpour, 2011).

Corroborating this result, several studies (Dayioğlu & Türüt-Aşik, 2007; Khwaileh & Zaza, 2011) have also reported female students outperforming their male counterparts.

Academic scores of two Arts subjects were compared between males and females. The result shows that the academic performance of the subject Academic Communication Skills did not significantly differ between males (73.78 ± 7.69) and females (72.12 ± 7.55), where $t(138) = 1.287$, p = 0.200. Arts subject Dzongkhag Communication Skills also did not significantly differ between males (76.51 ± 7.9) and females (75.08± 6.48); $t(138) = 1.174$, $p = 0.243$. These findings indicate that both male and female students can achieve the same academic scores in Arts subjects. Contrarily, some studies reported that female students perform better than male students in Arts subjects (Begum & Phukan, 2001; Karthigeyan & Nirmala, 2012).

The study also compared the academic scores of two Science subjects. The academic scores of the subject Environmental Engineering were significantly greater for female students (69.25 ± 7) than male students (64.74 ± 5.72), where $t(123) = -3.966$, $p = 0.001$. Female students (63.90 ± 8.51) also performed significantly greater than male students (63.90 ± 6.99), where $t(123) = -3.499$, $p = 0.000$. The findings contradict (Yun, 2001), who reported that male students outperformed their female counterparts in science subjects. This finding implies that Bhutanese female students can achieve greater academic scores than their male counterparts, even in science subjects.

Table 4 Gender and academic performance in STEM and Arts subjects

College	Subjects	Gender	N	$\bar{X}$	SD	t	p
Overall Academic Performance		Male	134	69.57	7.8	-2.356	.019
		Female	131	71.63	6.35		
Arts College	Academic Communication Skill	Male	65	73.78	7.69	1.287	.20
		Female	75	72.12	7.55		
	Dzongkha Communication Skill	Male	65	76.51	7.9	1.174	.243
		Female	75	75.08	6.48		
Science College	Environmental Engineering	Male	69	64.74	5.72	-3.966	.001
		Female	56	69.25	7		
	Statistic	Male	69	63.9	6.99	-3.499	.000
		Female	56	68.75	8.51		

3.4. Perception of Students' on the Factors Affecting their Academic Performance

The binary logistic regression was computed to determine the factors affecting the students' academic performance (Table 5). The dependent variable was the students' academic scores, coded 0 for scoring less than 70 and 1 for above 70. Independent variables are shown in Table 5. They were also coded 0 (if students perceived that the variable did not affect their academic scores) and 1 (if students perceived the variable affects their academic scores). Tolerance values were greater than the 0.1 minimum thresholds, and Variance Inflation Factors were less than a five-cut-off point (Senaviratna & Cooray, 2019), showing no multicollinearity issues. The model Chi-square was significant, where $x^2(16) = 43.732$, $p < 0.001$. The model also correctly classified 67.9% of the observations. As desired, the Hosmer-Lemeshow was insignificant, where $x^2(8) = 10.842$, $p = 0.211$. R^2 for this study was 0.203.

Out of 16 students' perceptions in the current model, only five perception statements significantly influenced academic performance, as discussed in this paragraph. When the gender of the students changed from male to female, the odds of scoring high marks increased by 2.19 times. Female students are academically better than male students because males are more involved in extra-curricular events diverting their attention from the study (Dayioglu &

Türüt-Aşik, 2007; Khwaileh & Zaza, 2010; Ghazvini & Khajehpour, 2011). Students who believed family's occupation affected their academic performance significantly increased the odds of scoring higher marks by 1.89 times. Parental occupation is vital for parents' ability to provide financial assistance and basic instructional materials needed by students to succeed (Omolade et al., 2014; Akinsanya et al., 2014; Odoh et al., 2017). Students who perceived that self-efficiency affects their academic scores were 1.15 times more likely to score high academic marks. The finding revealed the importance of students' confidence, trust, and motivation for academic success, as supported by other studies (Pritchard & Wilson, 2003; (Ridgell & Lounsbury, 2004; Köseoglu, 2015). Students believing peer influence affects their academic score decreased their odds of achieving academic scores by 0.52 times, indicating the importance of selecting friends in the college. Several studies also reported significant results (Black & Wiliam, 1998; Van Zundert et al., 2010). Students who reported that the usage of reading material affects their academic performance decreased the odds of scoring high academic performance by 0.32 times. A probable argument for the contrasting result to previous studies (Wong & Webb, 2011; Banleman & Adjoa, 2017) could be that students might not have used the reading materials, though they perceive the benefits of reading materials.

Table 5 Effect of perceptions on academic performance of students

Variables	B	S.E	Wald	p	Exp(B)
Gender of the Students	0.784	0.282	7.741	0.005	2.19
Family's occupation	0.639	0.308	4.314	0.038	1.894
Family's income	-0.295	0.228	1.682	0.195	0.744
Family's education	-0.200	0.129	2.429	0.119	0.818
Lecturer's qualification	0.605	0.386	2.447	0.118	1.83
Lecturer's attitude	-0.269	0.527	0.261	0.609	0.764
Lecturer's competence	0.332	0.534	0.387	0.534	1.394
Regard certain subject as male and female subject	-0.954	0.594	2.579	0.108	0.385
Stereotype school subjects can define male and female academic performance	0.185	0.416	0.197	0.657	1.203
Considered English as feminine and science as a masculine subject	0.389	0.660	0.347	0.556	1.475
Gender of the friend	-0.308	0.165	3.492	0.062	0.735
Peer significance	0.347	0.37	0.88	0.348	1.415
Peer influence	-0.649	0.343	3.58	0.050	0.522
Self-efficiency	0.138	0.308	0.202	0.040	1.148
Reading materials available in the library	-0.381	0.303	1.579	0.209	0.687
Usage of reading materials	-1.150	0.445	3.688	0.010	0.317
Constant	0.992	0.787	1.589	0.207	2.696
Model x^2	43.732			0.000	
Hosmer-Lemeshow test (x^2)	10.842				
Percentage correctly predicted	67.6				
Nagelkerke R^2	0.203				

4. CONCLUSION

Students at colleges of the RUB do not have a stereotypical perception of STEM and Arts subjects. Academically, female students significantly outperformed male students. Moreover, female students scored significantly greater academic marks than male students in science subjects. However, the subject-wise comparison showed no significant difference in academic scores between male and female students. The study results imply that regardless of the gender disparity imposed by society, both male and female students can excel in STEM or

Arts subjects. As students did not have gender stereotypes about their ability in arts and science subjects, social expectations have little impact on male and female educational achievement. Furthermore, the gender of the students, family background, peer influence, self-efficacy, peer influence, and use of library reading resources influenced the students' academic performance. The study was restricted to RUB colleges in Bhutan, excluding two associated colleges, Royal Thimphu College and Norbu Rigter College, because making assumptions only for RUB colleges was more convenient. Furthermore, respondents for the study was restricted to final year students because of the completion of selected subjects in previous semesters. Common subjects offered in both the colleges were chosen, and other subjects belonging to STEM and Arts were neglected to maintain uniformity of the subjects. Thus, this study explored perception, academic performance, and factors affecting students' academic performance in RUB colleges. Accordingly, we recommend the need for colleges to develop a positive understanding of peer group influence through seminars and career talks. However, this study is solely based on students' self-reported data. Therefore, future researchers could include parents' and lecturers' perspectives on STEM and Arts subjects and understand the influence on academic performance and gender. Other factors, including hours of study, teachers of the same gender, communication skills, and education policy, could also be considered to understand the overall influence of these factors on academic performance and gender.

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Annexure 1 Description of variables used in the logistic regression

Variables	Code	Type	Description
Dependent variable			
Academic Performance		Dummy	1 if the mark is above 70 0 if the mark is below 69
Independent variables			
Gender of student	X_1	Dummy	1 if it affected 0 if it did not affect
Family's occupation	X_2	Dummy	1 if it affected 0 if it did not affect
Family's Income	X_3	Dummy	1 if it affects 0 if it did not affect
Family's education	X_4	Dummy	1 if it affected 0 if it did not affect
Lecturer's qualification	X_5	Dummy	1 if it affected 0 if it did not affect
Lecturer's attitude	X_6	Dummy	1 if it affected 0 if it did not affect
Lecturer's competence	X_7	Dummy	1 if it affected 0 if it did not affect
Regard certain subject as male and female subject	X_8	Dummy	1 if regarded 0 if did not regard
Stereotype school subjects can define male and female academic performance	X_9	Dummy	1 if it affected 0 if it did not affect
Considered English as feminine and science as a masculine subject	X_{10}	Dummy	1 if it affected 0 if it did not affect
Gender of the friend	X_{11}	Dummy	1 if it affected 0 if it did not affect
Peer significance	X_{12}	Dummy	1 if it affected 0 if it did not affect
Peer influence	X_{13}	Dummy	1 if it affected 0 if it did not affect
Self-efficiency	X_{14}	Dummy	1 if it affected 0 if it did not affect
Reading materials available in Library	X_{15}	Dummy	1 if it affected 0 if it did not affect
Usage of Reading materials	X_{16}	Dummy	1 if it affected 0 if it did not affect