Comparative Study on The Academic Performance of STEM And Non-STEM Major Civil Engineering Freshmen In DHVSU, Main Campus

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Abstract: - Quality Education has been in question in these past few years, the passing rate of the Civil Engineering board exam in the Philippines and DHVSU had a declining trendline which began from the year the K-12 curriculum was implemented. The proponents of this study suspected that it could be from the mismatching of senior high school students and their chosen strand, specifically those who chose a strand that had no relation to Civil Engineering and its disciplines. The purpose of this study was to have a comparative analysis between STEM and Non-STEM students and show the importance of choosing a Senior High School strand that aligns with the chosen future college program of the students, especially those who chose Civil Engineering. The study utilized a quantitative design wherein the proponents' collected data from the students through the use of demographic profiling. Other data were gathered from the civil engineering faculty and investigated the differences in the academic performance of STEM and Non-STEM graduates that are currently in their first year in Civil Engineering program with their major subjects purely in terms of their Midterms and Finals Exam scores and overall grades. The respondents of this study were freshmen from the Don Honorio Ventura State University Civil Engineering Department. After the data collection and analysis, the results showed statistically significant differences between STEM and non-STEM in Midterm and Final Exam scores and Grades in Mathematics in the Modern World, Midterm and Final Grades in Solid Mensuration and Midterm Exam scores in Differential Calculus. In the data analysis, each strand was compared separately first and then finally compared by group, having STEM and non-STEM performances combined. In conclusion, choosing a Senior high school strand that can correlate with one's chosen college program is extremely important.

Key Words: — ***Education, Course Mismatch, Civil Engineering, Freshmen, STEM, non-STEM.***

I. INTRODUCTION

Education is a vital component of human development, and it plays a significant role in shaping individuals, communities, and societies. Quality education equips learners with the skills, knowledge, and attitudes necessary to navigate the complexities of the world and contribute to their communities. However, many countries struggle to provide quality education to their citizens, which can lead to inequalities and hinder economic and social progress. This highlights the need to examine the factors contributing to the challenges of providing quality education and explore evidence-based strategies for addressing these challenges.

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Due to the alarming decline in educational quality, the Philippines' education system has come under scrutiny recently.

The United Nations (UN) is an international organization that was created in 1945 with the objective of discussing and resolving issues that are relevant to humanity. The United Nations have agreed to the 2030 Agenda for Sustainable Development Goals. The SDGs are a set of goals that aim to act as a strategic plan that benefits all of humanity in each category: economic, social, and environmental as per The Impact Investor (2023).

Along with that, the K-12 program is one of the milestones attained by the government as a result of the Sustainable Development Although there are some cases of students who have experienced program mismatches that are not aligned with their chosen strands. This event may hinder students in their selected program resulting in them being unmotivated in college. Quintos (2020) stated that between senior high school students and the program they enrolled in college exists a high rate of mismatch among them. In addition, those who did not take programs that align with their strand stated their reasons such as pressures from their own family, peer pressure, confusion about the profession to be pursued, family status, and other reasons. The goal of this study is to identify whether there is an existing mismatch between the STEM and non-STEM freshmen students enrolled in the civil engineering program at Don Honorio Ventura State University.

II. METHODOLOGY

2.1 Requesting Permission from the Department

Letter of Permissions were made to be given to the faculty-in-charge of each subject, to the chairperson and lastly to the college dean for approval in releasing the grades of students.

2.2 Gathering of Research Instrument

The instrument to be used were the subjects to be evaluated which were the following indicators: Mathematics in the Modern World, Solid Mensuration and Differential Calculus. The instructors that were in charge of these subjects gave their consent and distributed the Midterm Exam Score, Midterm Grade, Final Exam Score and Final Term Grade of the students conforming with the R.A 10173 (Data Privacy Act of 2012). The specific academic performances measured by the departmental exams were stated from the syllabus and is in line with CHED Memorandum Order of 2017 Article V Section 11.

2.3 Data Gathering Process

The demographic profiling sheets were collected from the freshmen per section by utilizing the Total Population sampling which took the entirety of the civil engineering freshmen including Regular, Irregular students as well as those who dropped from the program. The profile consists of their name, section and their chosen strand in their senior high school year. The total population number is 656 including those who dropped with 504 being STEM graduate students, 75 ABM, 33 GAS, 24 HUMMSS and 20 TVL graduates.

2.4 Statistical Analysis

After compiling all the data, statistical inferential procedures were conducted by utilizing the Shapiro-Wilk and Kolmogorov-Smirnov normality test to observe if the data is normally distributed which then branches into two separate methods: One-Way Anova or Mann-Whitney U and Kruskal-Wallis proceeding to post-Hoc.

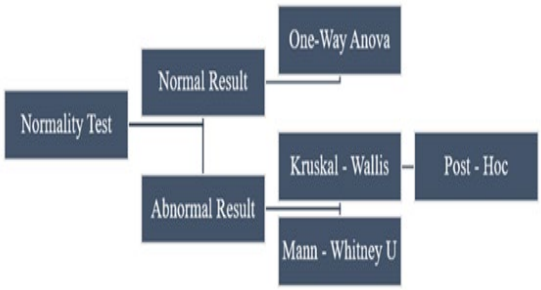

Fig.1. Statistical Inferential Process

III. RESULTS AND DISCUSSIONS

The results from the normality test per subjects showed that all were not normally distributed as per the Shapiro-Wilk and Kolmogorov-Smirnov test hence the analysis proceeded to use the Kruskal-Wallis test to assess if there were significant differences for each of the following indicators. Based on the outcomes of the analysis from MathWorld, it was observed that STEM students outperformed non-STEM students in terms of the four indicators. In Solid Mensuration, the results revealed that STEM students academically excelled against non-STEM students with respect to their Midterm Exam Scores and Midterm grades. In comparison, STEM students were outperformed based on the mean rank scores against GAS, this might be due to factors affecting the mean scores like the scarce population of the said strand within the said subject hence showing high mean rank results.

Finally in Differential Calculus, the results indicated that non-STEM specifically GAS has surpassed the STEM students with respect to their Midterm Exam Scores and Grades while ABM students were almost at par with the STEM in terms of Final Exam Scores. Still, STEM students dominated the academic performance among the three subjects.

Table.1. kruskal-wallis test: difference in the academic performance of students in mathematics in the modern world

Indicator	Strand	Mean Rank	X^2	p-value	Remarks
Midterm Exam	STEM	287.84	47.045	0.000	Significant
	ABM	187.06			
	GAS	238.07			
	TVL	106.38			
	HUMSS	204.85			
Final Term Exam	STEM	287.18	54.018	0.000	Significant
	ABM	195.50			
	GAS	263.77			
	TVL	63.91			
	HUMSS	199.24			
Midterm Grade	STEM	288.85	51.417	0.000	Significant
	ABM	189.81			
	GAS	222.11			
	TVL	89.15			
	HUMSS	208.18			
Final Term Grade	STEM	286.59	46.948	0.000	Significant
	ABM	194.85			
	GAS	257.23			
	TVL	88.26			
	HUMSS	200.06			

Table.2. Mann-Whitney U Test: Difference in the Academic Performance of Students in Mathematics in the Modern World (STEM vs NON-STEM)

Indicator	Strand	Mean Rank	U	p-value	Remarks
Midterm Exam	STEM	287.84	15105.50	0.000	Significant
	NON-STEM	187.51			
Final Term Exam	STEM	287.18	15376.50	0.000	Significant
	NON-STEM	189.81			
Midterm Grade	STEM	288.85	14688.00	0.000	Significant
	NON-STEM	183.97			
Final Term Grade	STEM	286.59	15620.00	0.000	Significant
	NON-STEM	191.87			

Table.3. Kruskal-Wallis Test: Difference in Academic Performance of Students in Solid Mensuration When Grouped According to SHS Strand Taken

Indicator	Strand	Mean Rank	X^2	p-value	Remarks
Midterm Exam	STEM	170.12	7.993	0.092	Not Significant
	ABM	141.24			
	GAS	172.72			
	TVL	102.18			
	HUMSS	158.61			
Final Term Exam	STEM	166.91	6.911	0.141	Not Significant
	ABM	154.82			
	GAS	190.64			
	TVL	100.77			
	HUMSS	160.72			
Midterm Grade	STEM	178.01	23.691	0.000	Significant
	ABM	126.42			
	GAS	112.89			
	TVL	97.68			
	HUMSS	120.50			
Final Term Grade	STEM	175.22	18.426	0.001	Significant
	ABM	146.81			
	GAS	120.14			
	TVL	117.00			
	HUMSS	79.61			

Table.4. Mann-Whitney U Test: Difference in the Academic Performance of Students in Solid Mensuration (STEM vs NON-STEM)

Indicator	Strand	Mean Rank	U	p-value	Remarks
Midterm Exam	STEM	170.12	7970.00	0.046	Significant
	NON-STEM	145.20			
Final Term Exam	STEM	166.91	8785.00	0.392	Not Significant
	NON-STEM	156.22			
Midterm Grade	STEM	178.01	5967.00	0.000	Significant
	NON-STEM	118.14			
Final Term Grade	STEM	175.22	6676.00	0.000	Significant
	NON-STEM	127.72			

Table.5. Kruskal-Wallis Test: Difference in the Academic Performance of Students in Differential Calculus When Grouped According to SHS Strand Taken

Indicator	Strand	Mean Rank	X^2	p-value	Remarks
Midterm Exam	STEM	246.12	9.605	0.048	Significant
	ABM	209.21			
	GAS	254.08			
	TVL	169.95			
	HUMSS	144.42			
Final Term Exam	STEM	243.81	6.415	0.170	Not Significant
	ABM	228.47			
	GAS	242.58			
	TVL	178.95			
	HUMSS	133.58			
Midterm Grade	STEM	245.99	7.932	0.094	Not Significant
	ABM	211.51			
	GAS	214.06			
	TVL	168.18			
	HUMSS	294.17			
Final Term Grade	STEM	244.31	6.362	0.174	Not Significant
	ABM	234.75			
	GAS	219.94			
	TVL	166.64			
	HUMSS	154.50			

Table.6. Mann-Whitney U Test: Difference in the Academic Performance of Students in Differential Calculus (STEM vs NON-STEM)

Indicator	Strand	Mean Rank	U	p-value	Remarks
Midterm Exam	STEM	246.12	16018.00	0.027	Significant
	NON-STEM	211.80			
Final Term Exam	STEM	243.81	16893.50	0.136	Not Significant
	NON-STEM	220.64			
Midterm Grade	STEM	245.99	16070.00	0.030	Significant
	NON-STEM	212.32			
Final Term Grade	STEM	244.31	16704.00	0.100	Not Significant

IV. Conclusion

The results of the study have shown that non-STEM students experienced difficulties during their learning process in the program and how much a bridging program could positively assist them in building their fundamental knowledge. According to the research there were plenty of them that had difficulties understanding the technical knowledge and abilities

required in the program which could heavily affect their academic performance. A bridging program could possibly provide non-STEM students the opportunity to learn and understand the foundational knowledge required in this field. This could cover subjects like basic algebra and physics. Finally, an increase in units taken for the civil engineering program would allow the inclusion of foundational subjects that are relevant to the course by allowing them to take subjects such as trigonometry and geometry to enable students to enhance their academic knowledge when they proceed in more advanced subjects in their later years.

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