PAPER

Exploring the Academic Preparation and Performance to the Comprehensive Examination of First-Year Engineering Students

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ABSTRACT

A comprehensive examination is an academic exercise that aims to determine students' performance relevant to their achievements in the previous years of their studies. In the old curriculum of the College of Engineering at Camarines Sur Polytechnic Colleges, Philippines, a comprehensive examination is given to second-year students of all engineering programs. With the change in curriculum due to the K-12 implementation, this comprehensive examination is being planned to be given to first-year engineering students. This study aims to explore the influence of students' academic preparation and academic performance on the comprehensive examination of first-year engineering students. The researcher analyzed the data from 468 first-year engineering students for the academic year 2018–2019 to determine the degree of correlation between their academic preparation, academic performance, and comprehensive examination. Findings showed that senior high school (SHS) tracks have no relationship with the academic performance of civil, electronics, and mechanical engineering students. However, for electrical engineering students, there is a relationship between the SHS tracks and their academic performance. Also, the college entrance test (CET) and academic performance showed a relationship with the comprehensive examination. Findings revealed that higher ratings in the CET and academic performance tend to go with higher ratings in the comprehensive examination and vice versa. Thus, a comprehensive examination is an effective way to determine the extent of achievement of students in engineering mathematics and sciences. This study did not consider any other factors that may affect the result of the comprehensive examination.

KEYWORDS

comprehensive examination, academic performance, college entrance test (CET), academic preparation, senior high school (SHS) tracks

1   INTRODUCTION

In today's educational setting, there are major challenges being encountered. The changing landscape in terms of the industrial and labor markets calls for initiatives to enhance curricular programs that will suit current needs. Likewise, teaching and learning methods equip graduates with the competencies they need for current and new jobs [1].

The K-12 program was introduced in the Philippines in 2012 and consists of kindergarten, six years of primary education, four years of junior high school, and two years of senior high school (SHS). This program is designed to prepare graduates for tertiary education, middle-level skill development, employment, and entrepreneurship [2]. Likewise, the Department of Education explained that the K-12 system is not just adding two more years to high school but to consider the three practical benefits of schooling under the said system: preparedness for tertiary learning, readiness to join the workforce, and skill competency in the global market.

With the K-12 implementation, various changes and updates in the curriculum of engineering programs were considered. The previous five-year coverage of engineering programs was compressed to cover only four years, considering that the students to be admitted to college have been graduates of the science, technology, engineering, and mathematics (STEM) strand of the academic track of the SHS of the K-12 curriculum. STEM is the track designed for engineering. This requires a balance between theoretical bases and practice [3] and a learning environment that will suit the learning styles of students [4], and thus, STEM education must set a good foundation for students to be ready for engineering programs.

The Commission on Higher Education (CHED) Memorandum Order No. 105 s. 2017 orders that all grade 12 graduates are eligible to enter college regardless of the track or strand taken in the SHS. Thus, colleges and universities in the Philippines are ordered not to decline enrollees. As a result, the tracks that were previously designed in the K-12 curriculum for SHS were not considered. For example, a graduate of the STEM strand can only enroll in higher education that covers science, technology, engineering, and mathematics-related programs. With this order from the CHED, colleges and universities in the Philippines admitted first-year students to their various programs regardless of the students' track and strand in the senior high school.

The College of Engineering of Camarines Sur Polytechnic Colleges admitted the first batch of SHS students from various secondary institutions in the Bicol region. With the implementation of the above-cited CMO, the college considered enrollees from different tracks and strands, considering only that these students had passed the college admission test. No further screening has been done as to what and how these students are prepared to face the curriculum of the engineering programs. As per records of the College of Engineering, students had been admitted coming from the various tracks and strands, which included the academic track, the STEM, the humanities and social sciences (HUMMS), the accounting, business, and management (ABM), the general academic strand (GAS), the technical-vocational-livelihood (TVL) track, and others.

The engineering curriculum was designed for SHS graduates under the STEM strand. To enhance the outcomes of students coming from various tracks, the College of Engineering included a course on Fundamentals of Engineering Mathematics in the first semester of the first-year level in all programs as a preparatory course since the majority of the students have been graduates of SHS tracks and strands other than STEM. The outcomes of student learning can be determined by how well an educational institution designs and implements the entire curriculum for a specific program [5]. Instructional interventions had been done by the professors

handling the mathematics and science courses to improve the students' performance in these areas, as they serve as the basic foundation of all engineering programs.

The college entrance examination (CEE) is the sole determinant of college admission—students gain entry into ranked schools based solely on their CEE results [6]. In CSPC, the college entrance test (CET) is a mandatory exam for all incoming first-year students. The passing percentage to be admitted to the college is 75%, and the college admission office administers it.

The comprehensive examinations for second-year engineering students is compulsory for regular second-year students in the old curriculum of the college's engineering programs. This assessment activity is significant in determining the current status and performance of the students in mathematics and sciences, as these serve as the leading foundations in the higher courses in their respective engineering fields.

With the first batch of the college's new curriculum for engineering programs due to the K-12 transition, the first-year engineering students had already complied with a similar scope for the comprehensive examination. A comprehensive examination for first-year engineering students was conducted with the approval of the college president.

With these, the researcher decided to conduct a correlational study. This study aims to explore the influence of students' academic preparation and academic performance on the comprehensive examination of first-year engineering students. An analysis of the academic preparation, academic performance, and comprehensive examination results was conducted to determine if there is a significant relationship between these performances. With the results of the correlational study, the researcher can recommend a policy on incorporating a comprehensive examination as a requirement for first-year engineering students. With the results of a comprehensive examination, instructional interventions can be designed that may result in well-prepared students before their admission to the second-year level of their respective engineering programs.

2   LITERATURE REVIEW

According to a survey, college admission examinations are among the most significant tests in Chinese students' academic careers. By examining four empirical questions about the CEE's ability to predict college performance, the study adds to the body of scholarship in this area. The study acquired administrative data covering various majors from two distinct colleges. The study's findings, which both colleges support, show that high school success and admissions paths are important predictors of college grades. Additionally, the four-year undergraduate grade point average (GPA) is significantly predicted by the college entrance exam [6].

It was discovered that high school transcripts were the primary predictor of college performance for both program pre-service instructors, outweighing the effects of high school GPA and high school transcripts. This demonstrates why high school transcripts should be given more weight when establishing criteria for college admission than high school GPA [7].

Grade point average is a factor that has been identified to influence examination passing rates. Licensure examinations in the Philippines have been an important stage in determining how graduates will perform in their respective professions. Various studies and literature proved that academic performance was a good predictor of licensure examinations. Several studies proved that academic performance was a predictor of licensure examinations for teachers [8, 9, 10, 11, 12]. Also, other studies confirmed that academic performance was a predictor of various

engineering licensure examinations [13, 14]. On nursing licensure examinations, studies also confirmed that academic performance is a good predictor in their licensure examination [15, 16]. Likewise, academic performance in maritime and agricultural technologists' licensure examinations, respectively, forms part of the above-said examinations [17, 18].

The academic achievements of students are significant in predicting comprehensive examinations. According to emotional intelligence and educational status indices, the academic performance of medical students in a comprehensive examination of the basic sciences was predicted. The research is a cross-sectional, descriptive, and analytical study conducted on medical students at the universities of medical sciences in Isfahan, Tehran, and Mashhad. The findings showed that the markers of independence from an emotional intelligence test and average scores from the first and third semesters of school were relevant in predicting the students' academic success on the comprehensive basic sciences examination [19].

A correlation between comprehensive examinations and licensure examinations among music, arts, physical education, and health (MAPEH) graduates was conducted [20]. The study revealed that most of the MAPEH graduates excelled better in the general subject components of the comprehensive exam and licensure examination for teachers (LET) than in the professional and major subjects. The study's results show no significant relationship between the comprehensive result and the respondents' LET rating.

The discussed literature and studies have likewise supported the findings of this present study. There is a lot of evidence that students' academic preparation is a predictor of their academic performance and other academic activities.

3   METHODOLOGY

This research employed a descriptive-correlational study using secondary data from multiple sources. The research established the relationship between the independent variable, the dependent variable, and the expected output of the study. Correlational analysis was used to find the degree of correlation between the students' academic preparation, academic performance, and comprehensive examination performance.

Figure 1 shows the framework that was used in the study.
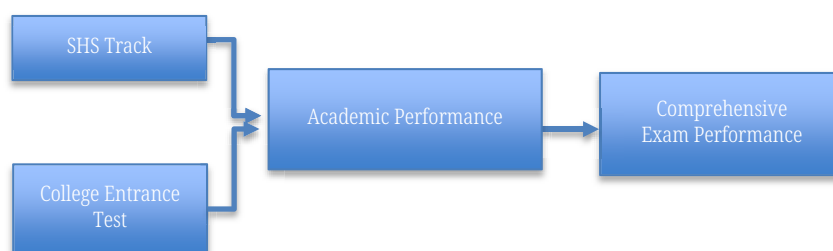
Fig. 1. Research framework

As shown in the figure, the SHS track and the CETs are academic preparations. The figure likewise showed the relationship between the variables used in the study. Moreover, a relationship between the SHS track and academic performance, the CET and academic performance, and academic performance and a comprehensive examination were explored.

The subjects of the study were the 505 first-year engineering students in the academic year 2018–2019. Information regarding students' academic preparations (tracks or strands in SHS and CET results), academic performances, and comprehensive examination performances was collected from a total of 147 students in the Bachelor of Science in Civil Engineering (BSCE), 127 students in the Bachelor of Science in Electrical Engineering (BSEE), 101 students in the Bachelor of Science in Electronics Engineering (BSECE), and 130 students in the Bachelor of Science in Mechanical Engineering (BSME).

Due to the incomplete data of some students, these were excluded from the dataset. The total number of students included was 468, which is composed of 132 for civil engineering, 120 for electrical engineering, 92 for electronics engineering, and 124 for mechanical engineering.

The students' academic preparation consists of the tracks and strands taken during their high school years and the results of their CET. Data on these were requested at the College of Engineering dean's office and the college admission center, respectively.

The students' GPA in their engineering mathematics and science courses and the results of the comprehensive examination were considered. These include engineering mathematics and science courses, specifically the fundamentals of engineering mathematics, differential calculus, integral calculus, chemistry for engineers, and physics for engineers. Data on academic performance were requested at the college registrar's office.

For providing a qualitative description of the level of academic performance of the students, the scale used by the college was adopted and is presented in Table 1.

Table 1. Grading system

Percentage Equivalent	CSPC Rating	Descriptive Rating
95–100	1.3–1.0	Excellent
90–94	1.75–1.4	Very Good
85–89	2.2–1.8	Good
80–84	2.6–2.25	Fair
75–79	3.0–2.7	Poor
74 and below	5.0	Failed

Source: Camarines Sur Polytechnic Colleges Standard Rating System.

The rating scale of the CET and comprehensive examination is shown in Table 2.

Table 2. Scale for the rating in the college entrance test and comprehensive examination

Numerical Rating	Descriptive Rating
95–100	Excellent
90–94	Very Good
85–89	Good
75–84	Fair
75	Passing
74 and below	Failed

Source: Camarines Sur Polytechnic Colleges Standard Rating System.

Percentage was used in determining the relative distribution of the various data of the students' performances. GPA was used to indicate the level of academic performance of the students in engineering mathematics and science courses in the first year of their respective programs.

Pearson Product-Moment Correlation was used to determine the strength or magnitude of the relationship between two variables. Correlation coefficients vary from –1.0 to +1.0. The closer the correlation coefficient to +1.0 or –1.0, the stronger the relation between the variables. The researcher used the indices shown in Table 3 in interpreting the coefficients of correlation, both simple and multiple [21].

Table 3. Coefficient of correlation

Correlation Coefficient	Interpretation
±0.00 – ±0.09	Negligible
±0.10 – ±0.29	Small
±0.30 – ±0.49	Medium
±0.50 – ±1.00	Large

4   RESULTS AND DISCUSSIONS

The profile of the students is grouped based on their SHS tracks, the results of the CETs, academic performance, and the comprehensive exam results. The SHS tracks of the students are presented in Table 4.

Table 4. Senior high school track

Track	BSCE		BSEE		BSECE		BSME		Over-All	
	f	%	f	%	f	%	f	%	f	%
STEM	75	56.82	53	44.17	44	47.83	72	58.06	244	52.14
GAS	28	21.21	31	25.83	21	22.83	30	24.19	110	23.50
TVL	10	7.58	27	22.50	17	18.48	7	5.65	61	13.03
ABM	13	9.85	8	6.67	9	9.78	9	7.26	39	8.33
Others	6	4.54	1	0.83	1	1.09	6	4.84	14	2.99
Total	132	100	120	100	92	100	124	100	468	100

It is observed that the majority of the enrolled students in the four engineering programs are composed of students on the STEM track, followed by the GAS, TVL, and others. The 14 students under others are comprised of students with tracks on HUMMS, AD, and non-SHS graduates.

Table 5 shows the results of the CETs. It is noted that the majority of students have ratings of 76–84, followed by 85–89 and 75. There were a few students who got 90 or above. However, some students had ratings of 74 and below. This is due to the fact that these students were admitted for the purpose of completing the target number of students in each of the engineering programs.

Table 5. Results of the college entrance test

Rating	BSCE		BSEE		BSECE		BSME		Over-All	
	f	%	f	%	f	%	f	%	f	%
95–100	1	0.76		0.00		0.00		0.00	1	0.21
90–94	1	0.76		0.00	2	2.17		0.00	3	0.64
85–89	26	19.70	2	1.67	7	7.61	12	9.68	47	10.04
76–84	85	64.39	61	50.83	55	59.78	84	67.74	285	60.90
75	17	12.88	9	7.50	4	4.35	10	8.06	40	8.55
74 and below	2	1.52	48	40.00	24	26.09	18	14.52	92	19.66
Total	**132**	**100**	**120**	**100**	**92**	**100**	**124**	**100**	**468**	**100**

Table 6 shows the average ratings in the CET presented per SHS track or strand. It is shown that students who graduated in the STEM track have the highest entrance examinations, followed by the ABM, others, and GAS, while TVL has the lowest rating.

Table 6. Average ratings in the college entrance test when grouped according to track

Track	Program									
	BSCE		BSEE		BSECE		BSME		Over-All	
	Rating	SD	Rating	SD	Rating	SD	Rating	SD	Rating	SD
STEM	81.84	4.78	78.74	3.93	79.14	4.75	80.64	3.71	80.32	4.47
GAS	78.04	2.68	73.74	3.45	77.19	3.82	76.30	3.01	76.19	3.63
TVL	79.10	3.51	74.59	3.67	74.76	4.65	75.00	4.57	75.43	4.37
ABM	79.15	3.48	76.75	3.23	78.33	3.74	76.78	3.33	77.92	3.62
Others	79.67	3.54	79.00	0	80.00	0	74.83	4.74	77.57	4.55
Over-All	**80.46**	**4.45**	**76.38**	**4.32**	**77.82**	**4.71**	**78.71**	**4.31**	**78.43**	**4.69**

Table 7 shows the academic performance of the students. These are their ratings in the mathematics and science courses taken during their first-year level. As shown, most students have ratings of 2.60–2.21. This was followed by 2.20–1.76, then 3.00–2.61. There were only a few students who got ratings of 1.75 and above.

Table 7. Academic performance

Rating	BSCE		BSEE		BSECE		BSME		Over-All	
	f	%	f	%	f	%	f	%	f	%
1.30–1.00										
1.75–1.31	6	4.55	1	0.83	3	3.26	2	1.61	12	2.56
2.20–1.76	56	42.42	12	10.00	26	28.26	46	37.10	140	29.91
2.60–2.21	67	50.76	92	76.67	48	52.17	67	54.03	274	58.55
3.00–2.61	3	2.27	15	12.50	15	16.30	9	7.26	42	8.97
5.0										
Total	**132**	**100**	**120**	**100**	**92**	**100**	**124**	**100**	**468**	**100**

Table 8 shows the academic performance of students presented per track or strand. It is shown that STEM has the highest rating, followed by ABM, GAS, and TVL, while others have the lowest rating.

Table 8. Academic performance when grouped according to track

Track	Program									
	BSCE		BSEE		BSECE		BSME		Over-All	
	Rating	SD	Rating	SD	Rating	SD	Rating	SD	Rating	SD
STEM	2.16	0.26	2.33	0.18	2.28	0.31	2.23	0.24	2.24	0.26
GAS	2.24	0.19	2.52	0.13	2.30	0.25	2.36	0.17	2.37	0.21
TVL	2.12	0.30	2.44	0.12	2.46	0.24	2.25	0.19	2.37	0.24
ABM	2.17	0.13	2.38	0.20	2.30	0.19	2.35	0.16	2.28	0.19
Others	2.28	0.12	2.59	0	2.96	0	2.45	0.10	2.42	0.21
Over-All	**2.18**	**0.24**	**2.41**	**0.18**	**2.33**	**0.29**	**2.28**	**0.22**	**2.29**	**0.25**

Table 9 shows the results of the comprehensive examination. Based on the result, it was found that the majority of the students got ratings of 74 and below, and they were considered to have failed the comprehensive examination. Around 150 students out of 468 passed the comprehensive examination, which means that only 32% of the students passed the comprehensive examination.

Table 9. Results of the comprehensive examination

Rating	BSCE		BSEE		BSECE		BSME		Over-All	
	f	%	f	%	f	f	f	%	f	%
95–100										
90–94										
85–89	2	1.52			1	1.09			3	0.64
76–84	46	34.85	22	18.33	12	13.04	24	19.35	104	22.22
75	13	9.85	9	7.50	6	6.52	15	12.10	43	9.19
74 and below	71	53.79	89	74.17	73	79.35	85	68.55	318	67.95
Total	132	100	120	100	92	100	124	100	468	100

The relationship between the SHS track and academic performance is shown in Table 10. It was found that for the BSCE, BSME, and BSECE programs, there were no relationships between the two variables. Results showed that the students' academic performance in these programs had nothing to do with the tracks they had taken during their high school years. There are various factors that may affect the students' performance. Based on studies, academic performance in college is a result of the complex interplay of various factors such as habits, personality traits, and personal interests of students [22], socio-economic status [23], and other factors such as communication, learning facilities, and proper guidance [24].

Table 10. Results of the relationship between the SHS track and academic performance

Program	x^2	df	Critical Value at 0.05 Level of Significance	Decision on H_0	Interpretation
BSCE	9.361	12	21.026	Accept	Not Significant
BSEE	28.888	12	21.026	Reject	Significant
BSME	17.991	12	21.026	Accept	Not Significant
BSECE	13.635	12	21.026	Accept	Not Significant

For the BSEE students, results show that academic performance is related to their tracks in the SHS. Data on students in the BSEE program showed that those who graduated with STEM tracks also got high ratings regarding their academic performance. This implies that the SHS track of students contributed to their academic performance. However, there was no concrete evidence showing that the SHS track or strand contributes to the academic performance of the students in college since, as mentioned earlier, various factors may affect the academic performance of students.

The relationship between the CET and academic performance is shown in Table 11. Findings revealed that for BSCE and BSECE, there is a large negative correlation, while for BSEE and BSME, there is a medium negative correlation. These results mean that there is a tendency for high ratings in the college entrance test to go with low values of academic performance (the college uses the ratings in which the lower values, i.e., 1.0, 1.1, etc., signify a higher equivalent percentage while higher values, i.e., 3.0, 2.9, etc., signify a lower equivalent percentage) and vice versa. Thus, students with high ratings in the college entrance test also have higher equivalent ratings regarding their academic performance. These results support the findings that there is a significant relationship between the entrance examination and the academic performance of students in various fields and disciplines [25, 26, 27, 28].

Table 11. Results of the relationship between the college entrance test and academic performance

Program	Correlation Coefficients	Interpretation
BSCE	−0.5478	Large
BSEE	−0.4851	Medium
BSME	−0.3851	Medium
BSECE	−0.5696	Large

The relationship between academic performance and comprehensive exam results is shown in Table 12, which shows the relationship between academic performance and comprehensive exam results. Findings revealed that for BSCE and BSECE, there is a large negative correlation, while for BSEE and BSME, there is a medium negative correlation. These results mean that there is a tendency for high ratings in the comprehensive exam to go with low values of academic performance (the college uses the ratings in which the lower values, i.e., 1.0, 1.1, etc., signify a higher equivalent percentage while higher values, i.e., 3.0, 2.9, etc., signify a lower equivalent percentage) and vice versa. Thus, students with high ratings in the comprehensive exam also have higher equivalent ratings regarding their academic performance.

Table 12. Results of the relationship between the academic performance and comprehensive exam result

Program	Correlation Coefficients	Interpretation
BSCE	−0.6276	Large
BSEE	−0.4736	Medium
BSME	−0.4228	Medium
BSECE	−0.6650	Large

5 CONCLUSIONS AND RECOMMENDATIONS

A comprehensive examination can be a basis for determining the performance of students in their previous years of studies before they can proceed to the next year of their studies. In this study, the comprehensive examinations showed a higher correlation between the CET and students' academic performance. Thus, the comprehensive examination to be given to first-year engineering students can be an effective way to determine the extent of achievement of students in engineering mathematics and sciences. By doing so, necessary interventions may be given to further enhance the students' knowledge, skills, and competencies.

It is necessary to conduct a comprehensive examination for first-year engineering students as a pre-requisite before they can pursue the second year of their respective engineering program. This is to determine the extent of achievement of the students relevant to their knowledge, skills, and competencies in engineering mathematics and sciences. It is suggested to craft a policy guideline for Board of Trustees (BOT) approval on the conduct of the comprehensive examinations for first-year engineering students. Accordingly, it is suggested to be included in the policy that, students who failed the said exam must enroll in an enhancement class to be taken during the midyear term. This will serve as a requirement or pre-requisite before they can enroll in the program's second year. Test questions in the comprehensive examination must undergo validation. Other factors affecting the comprehensive examination, such as emotional and social factors, attitudes, and other external factors, may be considered for future studies.

6 ACKNOWLEDGMENT

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