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iJEP International Journal of Engineering Pedagogy

iJEP | eISSN: 2192-4880 | Vol. 15 No. 6 (2025) | OPEN ACCESS

https://doi.org/10.3991/ijep.v15i6.56505

PAPER

Analysis of Factors Influencing Student Interest in Particular Engineering Programs of Bulacan State University

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ABSTRACT

This study examines the factors influencing low enrollment in manufacturing, mechatronics, and electronics engineering programs using a mixed-methods approach. A cross-sectional retrospective survey of 578 students surveyed demographics, enrollment influences, and perceptions of program value using a 5-point Likert scale and qualitative analysis of three open-ended questions using Braun and Clarke's 6-Step Thematic Analysis. The study findings reveal that Manufacturing Engineering's (MFE) high response rate but low first-choice preference indicates reliance on reconsideration admissions, while MEE and Electronics Engineering (ECE) attract stronger initial interest. Gender distribution shows MFE and Mechatronics Engineering (MEE) as male-dominated, while ECE is more balanced. Quantitative results highlight strong agreement on program value but lower scores for promotion, particularly for MEE and ECE. Qualitative insights emphasize inadequate program visibility, the need for hands-on learning, and industry exposure. Recommendations include enhancing marketing through social media and alumni networks, integrating experiential learning, modernizing curriculum, and strengthening industry partnerships. These strategies aim to align programs with student expectations, improve enrollment, and enhance career preparation, addressing gaps in awareness and engagement across BulSU's engineering programs.

KEYWORDS

engineering education, student interest, mixed-method, thematic analysis, enrollment, higher education

1 INTRODUCTION

Engineering programs are fundamental to the innovation of technology [1], the promotion of economic development, and the resolution of societal challenges through applying scientific principles and practical solutions [2]. These engineering programs equip students with the vital skills to design, develop, and maintain

Bual, R. C., Bual, C. L. C., Gatdula, M. M. V. (2025). Analysis of Factors Influencing Student Interest in Particular Engineering Programs of Bulacan State University. *International Journal of Engineering Pedagogy (iJEP)*, 15(6), pp. 65–83. https://doi.org/10.3991/ijep.v15i6.56505

Article submitted 2025-05-09. Revision uploaded 2025-09-12. Final acceptance 2025-09-12.

the infrastructure, systems, and technologies that are the building blocks of today's world [3], [4]. In the Philippines, Bulacan State University (BulSU), established as a state university under Republic Act 7665, is a significant provider of accessible higher education, particularly within the region's engineering field. BulSU's College of Engineering offers eight prominent programs: Civil Engineering (CE), Mechanical Engineering (ME), Electrical Engineering (EE), Electronics Engineering (ECE), Computer Engineering (CPE), Industrial Engineering (IE), Manufacturing Engineering (MFE), and Mechatronics Engineering (MEE) [5]. These programs have achieved notable accreditations, with CE, ME, EE, ECE, CPE, IE, and MEE holding AACCUP Level III accreditation, MFE at Level II, and all awarded Certificate of Program Compliance (COPC) by the Commission on Higher Education (CHED), signifying adherence to national quality standards [5]. Despite BulSU's established reputation, recent years have seen stagnation or weakened enrollment figures, raising pertinent questions regarding the long-term sustainability of specific programs within a competitive higher education environment.

As the sole state university in the province of Bulacan, BulSU fulfills a crucial role as a regional hub for engineering education, catering not only to local students but also to those from neighboring provinces and cities. The BulSU University Admission Office manages admission to these programs by administering the Admission Test (ATBulSU), wherein applicants prioritize two programs (AY 2023–2025) and previously three programs (AY 2022–2023) on their application form, ranked according to their preference. Registration requires a minimum grade weighted average (GWA) of 87% for AY 2024–2025 (previously 90% for AY 2023–2024 and 85% for AY 2022–2023) for programs with licensure examinations. For non-licensure programs, the requirement is 85% for AY 2023–2025 (previously 83% for AY 2022–2023). However, the enrollment process faces challenges, including protracted result release times, which may lead some students to pursue alternative higher education institutions (HEIs). This issue may be attributed to the high volume of ATBulSU applicants, exceeding 24,000 [6]. Furthermore, the university implements two admission paths: passing a qualification on ATBulSU and admission through reconsideration for applicants who did not initially qualify but may be offered available slots in their preferred engineering programs (if not full) or in other college programs with remaining capacity, following a validation of their requirements and a ranking process.

Moreover, the study observed higher reconsideration rates in specific programs, particularly those shown in Figure 2, which also included the survey respondents. Notably, ECE exhibits a higher trend in reconsideration admissions, aligning with findings from Joaquin [7] regarding ECE enrollment trends in the Philippines. MEE and MFE show a consistent volume of reconsideration students, potentially attributable to their relatively younger establishment dates (2003 and 2004, respectively) compared to ECE (established in 1994). Recent studies, such as the employability of the MFE program [8], recommended active outreach to senior high schools (K11 and K12) to improve student awareness and engagement, given the program's perceived lower popularity, which also explains its enrollment trends. A similar situation may exist for MEE, but this is less likely for ECE, which has historically been a well-established, popular, and foundational engineering program in the Philippines.

In light of the ongoing trend in enrollment statistics, this study employs an innovative data retrieval technique to explore the reasons behind and students' perceptions of the decreasing or consistently low enrollment in BulSU's particular engineering programs. Additionally, it examines how currently enrolled students view their chosen engineering disciplines. Consequently, the research aims to uncover factors contributing to enrollment trends and propose actionable strategies by capturing these insights. The findings are expected to be significant for BulSU, other Philippine universities facing similar challenges, and international HEIs grappling with comparable downward or stagnant trends in engineering enrollment.

2 LITERATURE REVIEW

Studies globally highlight a decline in STEM enrollment, particularly in engineering and technology. Love [9] found that limiting class sizes reduces safety hazards in hands-on STEM instruction. Senthil [10] in India linked declining engineering enrollment to difficulties, high costs, unemployment risks, limited research and development (R&D), and misaligned goals, advocating for Active Learning Methodologies (ALM) to increase engagement. Ong [11] in Malaysia identified perceived difficulty and lack of interest as drivers of low STEM enrollment, with teacher influence, robotics, STEM classes, and self-motivation predicting STEM interest and enrollment, and robotics enhancing interest irrespective of gender. Gomez [12] in Spain noted that while interest and outcome expectations drive engineering career choices for both genders, lower female self-efficacy and limited prior exposure due to stereotypes contribute to under-representation. Joaquin [7] in the Philippines predicted a continued decline in Electronics Engineering enrollment post-K-12 due to licensure exam performance, graduate output, and student perceptions. Ford [13] in the U.S. indicated economic factors, rather than birth rates, drive anticipated enrollment declines, with flagship universities being more resilient. Yehia [14] attributed the significant decline in civil engineering enrollment in the Middle East and the U.S. to outdated curricula that lack modern technology integration. Rahman [15] found that tuition fees, campus facilities, and career interests primarily influence enrollment in the Bachelor of Technology program, despite STEM policy efforts.

Additionally, studies worldwide highlight a significant underrepresentation of women in STEM fields, particularly in engineering and technology, influenced by societal, cultural, and institutional barriers. Rahman [16] found that only 9% of female college students in Bangladesh pursue STEM due to patriarchal societal norms, stereotypes, safety concerns, limited resource access, underrepresentation, and low self-esteem. Mau [17] in the U.S. linked the shortage of female and minority students in STEM careers to underrepresentation and projected job growth, identifying gender, race, socioeconomic status, parental expectations, math achievement, interest, and self-efficacy as predictors of STEM aspirations, with stereotypes and low confidence as key barriers for female and minority high school students. Melak [18] in Ethiopia found that expected salary, family background of engineering professionals, role models, and high school performance drive women's engineering choices, while socioeconomic and cultural factors have a lesser impact. Kaewrat [19] in Thailand emphasized the relevance of the curriculum, faculty expertise, and financial factors in Computer Engineering and AI program enrollment, noting the need to address gender and socioeconomic disparities. Özmen [20] in Turkey reported a 40% female STEM enrollment nationally (compared to 33% in some Organization for Economic Co-operation and Development countries), with regional disparities influenced by population, budget, and academic staff, but without significant gender-based regional differences. Walters [21] found that interest and career prospects primarily motivate women to pursue engineering degrees, with family background being less influential. Melak [22] also found that prior university information, institutional support, peer learning, and infrastructure boost women's STEM performance in Ethiopia, while harassment and family engineering connections negatively affect it.

Likewise, studies reveal that academic challenges, socioeconomic factors, and institutional shortcomings hinder STEM participation and retention. Kayan-Fadlelmula [23] in GCC countries found that cultural, school, and student-level barriers affect STEM aspirations and achievement. Calle Müller [24] at a minority-serving institution observed a 48% STEM dropout rate (2003–2009) attributed to poor teaching, curriculum difficulty, and a lack of belonging, with interventions improving retention. Tsui [25] linked strong mathematics performance to better engineering outcomes, noting the challenges faced by older students and those with separate math/engineering instruction in Australia. Ryan [26] found that ALEKS math placement exams create barriers and increase dropout rates for underrepresented minority and first-generation students without improving Calculus 1 grades, highlighting inequities. Copeland [27] noted that systemic barriers hinder low-income families and families of color from enrolling in early childhood education (ECE), suggesting digital passports as a potential solution.

Similarly, institutional and policy challenges in STEM education involve competition, resource allocation, and policy impacts on enrollment and quality. Kelly [28] found that pre-college outreach enhances QIST career aspirations and self-concept, particularly among students with prior coursework in physical science, although interest may not increase. Petrović [29] observed that first-year students in electrical and computer engineering tend to favor computing topics over emerging fields, indicating a potential misalignment with future industry needs. Joshi [30] identified family income, peer motivation, opportunities for fulfillment, government policies, academic marks, and institute opportunities as significant factors shaping the aspirations of first-year engineering students in India, with institute opportunities and government policies being the most influential, particularly industry placement as the top priority.

Moreover, addressing inequities in STEM access and success for underrepresented groups, including minorities, low-income, and first-generation students, is crucial. Studies highlight various factors influencing student enrollment decisions globally. According to Chhor's study [31], their research in Cambodia found that parental influence, career opportunities, family support, and personal characteristics significantly drive enrollment, with family influence particularly strong for female students, while university reputation had a minimal impact. Similarly, a study in Chile by Leal [32] on engineering programs indicated that labor market factors (employability, work areas) and career-specific aspects (leadership, entrepreneurship) were the primary drivers, with university reputation being more influential for certain programs and having a minimal impact from parents/friends, likely due to the first-generation demographics. In France, the study by Gille [33] reveals that the appeal of engineering schools within the Grandes Écoles system is significantly shaped by the preparatory class model, alongside individual, social, economic, and institutional factors such as social prestige and alumni networks, which attract talented students. These studies collectively underscore the multifaceted nature of enrollment decisions, emphasizing the importance of intrinsic motivation, career prospects, and varying degrees of influence from family, social networks, and institutional reputation, depending on the context and student demographic.

Furthermore, academic challenges, socioeconomic factors, and institutional shortcomings create barriers to student participation and persistence in STEM, as highlighted in various studies. For instance, research in Malaysia by Nayan [34] revealed that secondary teachers possess moderate knowledge, attitudes, and practices in 21st-century education, with gender influencing knowledge and attitude, and both positively impacting practice, where attitude showed a more potent effect. Furthermore, issues such as absenteeism and student engagement negatively impact institutional effectiveness and reputation, a concern echoed by studies examining the rise in absenteeism. A study by Mas de les Valls [35] at the Barcelona School of Industrial Engineering identified expository teaching and low perceived class value in mass enrollment programs as significant contributors to absenteeism. The study noted a correlation between attendance and higher grades and suggested hands-on activities and non-standardized exams as potential solutions.

Collectively, the diverse viewpoints presented in this review highlight the complex interaction of individual perceptions, socioeconomic realities, institutional practices, and policy implications that shape student interest and enrollment in STEM, specifically within engineering disciplines. Factors such as perceived difficulty, career prospects, teacher influence, curriculum relevance, financial considerations, and societal norms all contribute to enrollment trends and the persistent underrepresentation of women and other marginalized groups. Additionally, emphasize the need for multifaceted interventions, including the adoption of active learning methodologies, the mitigation of systemic barriers, the modernization of curricula and courses, and targeted outreach efforts to cultivate greater interest and ensure equitable access to engineering programs, ultimately strengthening STEM programs. Thus, this review will serve as input for the creation of survey Likert items and open-ended questions.

3 METHODOLOGY OF THE STUDY

This study employs a mixed-methods approach to investigate the factors influencing enrollment trends in engineering programs, specifically ECE, MEE, and MFE, at BulSU. The research conducts a comprehensive analysis of students' perceptions and experiences through the integration of quantitative and qualitative approaches. A cross-sectional, retrospective survey method was employed to collect data from ECE, MEE, and MFE programs currently enrolled in the 2024–2025 academic year. The survey, as shown in Table 1, focused on two classifications: the level of agreement with the enrolled program and the level of influence on the decision to enroll in the program. The latter was further divided into three groups: program offerings, students' perceptions of the program, and external factors. These factors form the basis of the research hypotheses (H) outlined below, which guide the study's investigation into enrollment decisions.

- H1: Higher levels of agreement with the program's value, including its ability to drive innovation and economic growth, provide valuable skills and knowledge, offer diverse career opportunities, be challenging yet fulfilling, and be adequately promoted, are associated with greater enrollment satisfaction and retention in ECE, MEE, or MFE programs.
- H2: Program offerings, including curriculum design, faculty and staff support, program features, extracurricular opportunities, career prospects, compensation potential, and opportunities for professional growth, positively influence students' decisions to enroll in ECE, MEE, or MFE programs.
- H3: Students' perceptions of the program, including perceived social standing, program awareness, accessibility at BulSU, alignment with personal interests and hobbies, and academic fit with relevant disciplines, positively affect enrollment decisions in ECE, MEE, or MFE programs.
- H4: External factors, such as influence from family, friends, or peers and the lack of specific preferences or alternative options, positively contribute to students' choices to enroll in ECE, MEE, or MFE programs.

Table 1. Matrix of influential factors in decision to enroll

Classification		Likert Items
1. Level of agreement with the enrolled program		**1.1.** The program develops students and produces graduates that drive innovation and economic growth
		1.2. The program provides students with valuable skills and knowledge
		1.3. The program offers diverse career opportunities
		1.4. The program is challenging yet fulfilling program
		1.5. The program is adequately promoted to potential students
Level of influence regarding the decision to enroll in the program.	**2.** Program Offering	**2.1.** Curriculum design
		2.2. Faculty and staff support
		2.3. Program features (You are inspired by the program features such as co-op/internship opportunities, research opportunities, and industry partnerships)
		2.4. Extra-curricular opportunities (You are thrilled about the program's participation in local, regional, national, and international competitions)
		2.5. Career prospects (The program has opportunities for immediate job placement)
		2.6. Prospect of attractive compensation (The program has better compensation, salary, and benefits)
		2.7. Potential for professional growth and development (You believe the program will provide opportunities for continuous professional growth, such as certifications, training, and seminars)
		2.8. Potential for international career opportunities (You believe that the enrolled program degree offers the potential for international work opportunities)
	3. Student's perception of the program	**3.1.** Perceived social standing of the profession (You believe that graduating with the enrolled program degree will be a source of pride and accomplishment)
		3.2. Program Awareness (You learned about the program details through flyers, infographics, and social media platforms)
		3.3. Accessibility of the program at the desired institution (You are willing to enroll in any engineering program at BulSU)
		3.4. Personal interests and hobbies
		3.5. Academic excellence in relevant disciplines (Your strong performance in math and science subjects suggests that an engineering program would be well-suited to your interests and abilities)
	4. External Factors	**4.1.** Family/friends/peer influence (The engineering program was recommended by someone)
		4.2. Lack of a specific preference or alternative option

In the quantitative component, the study employed a 5-point Likert scale to measure students' agreement or disagreement with statements related to the program's value and the level of influence of factors identified in the hypotheses, facilitating structured data collection, analysis, and interpretation. The Likert items, as shown in Table 1, directly test the hypotheses through descriptive analysis. To ensure the reliability of the survey items, Cronbach's alpha was calculated for each Likert item using Minitab software to assess internal consistency. Descriptive statistics, including means and standard deviations, were calculated to summarize responses and evaluate the variability of perceptions across the MFE, MEE, and ECE programs.

Table 2. Likert scale, interpretation, range intervals

Likert Scale	Description/Interpretation	Likert Scale Range Interval
5	Strongly Agree (SA)/Extremely Influential (EI)	4.21–5.00
4	Agree (A)/Very Influential (VI)	3.41–4.20
3	Neutral (N)/Moderate Influential (MI)	2.61–3.40
2	Disagree (D)/Slight Influential (SI)	1.81–2.60
1	Strongly Disagree (SD)/Not Influential (NI)	1.00–1.80

Moreover, the Likert scale, score interval, and description are exhibited in Table 2. Moreover, this study utilized the same range score interval as Nyutu [36] did, serving as the basis for descriptive interpretation in this study. The qualitative component involved a thematic analysis of responses to three open-ended questions: "What do you think could be done to increase enrollment in your engineering program?", "How can your engineering program better engage students and promote interest in the field?", and "Do you have any other suggestions or comments to improve the program?", utilizing Braun and Clarke's 6-Step Thematic Analysis [37] shown in Figure 1. These questions allow students to give their ideas, insights, and inventive solutions to enrollment issues in their respective programs. This approach enabled the identification of recurring themes and various insights that complement the quantitative findings, offering a deeper understanding of the factors influencing enrollment as hypothesized.

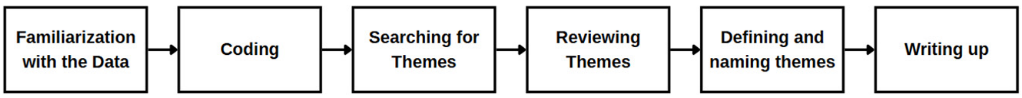

Fig. 1. Braun & clarke's 6-step thematic analysis process [37]

Furthermore, the survey required respondents to give their demographic and enrollment-related information, including their name, email address, age, gender, and year level. Additionally, participants indicated their mode of admission to BulSU (choices: passed the ATBulSU or reconsideration), their priority program during admission (choices: first choice, second choice, or not listed), and their current enrolled program (choices: ECE, MEE, or MFE). These variables were vital for contextualizing the data and identifying patterns in enrollment trends. The combination of descriptive statistics, Likert item reliability, and thematic analysis provided a robust framework for understanding the factors contributing to the stagnant, low, or downward enrollment trends in BulSU's identified engineering programs in this study. The findings are intended to inform targeted recruitment strategies and institutional improvements as part of research-based policy.

4 RESULTS AND DISCUSSION

4.1 Demographics of respondents

The survey conducted among students in the MFE, MEE, and ECE programs at BulSU provides critical insights into the admission patterns, program preferences, and demographic distribution of respondents. The data reveal diverse trends across the three programs, with MFE showing the highest response rate, as more than half of the program's student population participated in the survey. Contrary to MEE and ECE, where less than half of their respective populations responded.

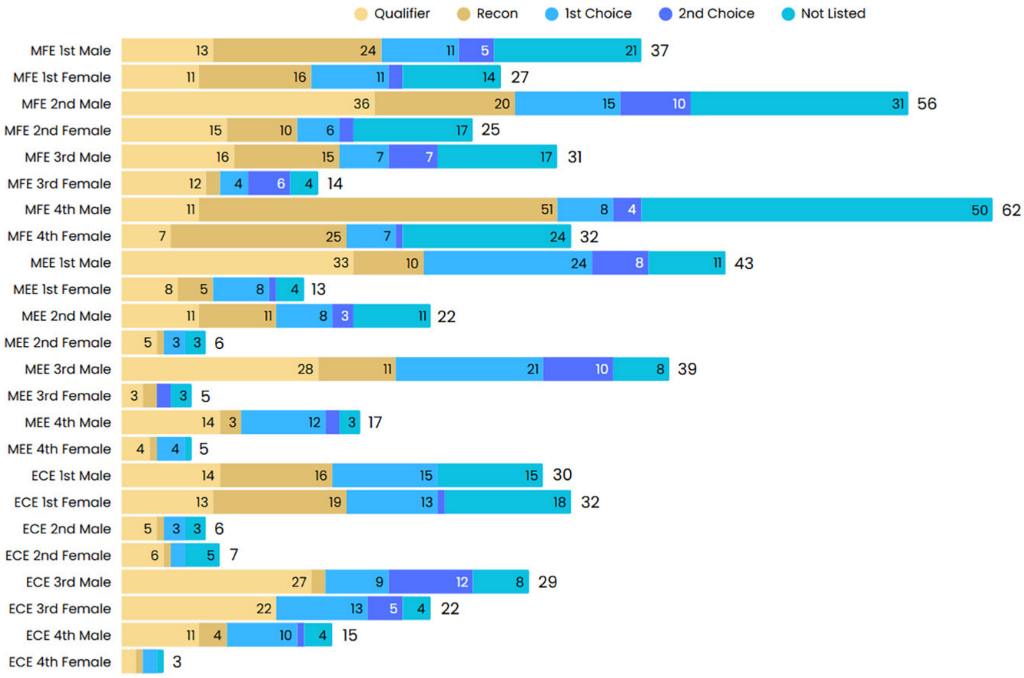

Fig. 2. Stacked chart of respondents' demographics

For the MFE program, 284 students responded to the survey, with 121 ATBulSU passers and 163 admitted by reconsideration. This indicates a significant reliance on an alternative admission way, which occurs every academic year. Notably, only 69 students selected MFE as their first choice during the admission process, while 178 did not list the program among their preferences. The MFE program shows a male-dominated student body, particularly in higher-level years, with 36 second-year males compared to 15 females and 11 fourth-year males compared to 7 females. Contrary to the MEE program, which has 150 respondents, with 106 passing the ATBulSU exam and 44 admitted through reconsideration. Eighty students included MEE as their first choice, and only 44 did not list it among their preferences. Compared to MFE, this indicates a more substantial initial interest in MEE.

Additionally, the gender distribution in MEE is similarly male-skewed, having 33 first-year males compared to 8 females and 14 fourth-year males compared to 4 females. The lower reconsideration numbers suggest that either MEE attracts students who are better prepared for the entrance exam or their examiners are significantly higher. Moreover, the ECE program, with 144 respondents, showed that 100 students passed the ATBulSU and 44 were admitted by reconsideration. Alike to MEE, 67 students selected ECE as their first choice, and 58 did not include it in their preferences, reflecting moderate initial interest in the program. Compared to MFE and MEE, ECE demonstrated a more balanced gender distribution in certain years, particularly in the third year, with 27 males and 22 females. However, in earlier years, there was a slight inclination towards males.

Furthermore, the high response rate in MFE compared to MEE and ECE was the result of the faculty's extensive efforts to encourage and motivate students to complete the survey. However, the lower first-choice preference for MFE indicates that many students enroll in the program due to limited options rather than genuine interest. Conversely, MEE and ECE appear to attract students with stronger initial interest, as evidenced by higher first-choice selections.

4.2 Quantitative survey result

This study examines student perceptions and factors influencing enrollment in three engineering programs: MFE, MEE, and ECE. The data were collected through a 5-point Likert-scale survey, which evaluates four key dimensions: the level of agreement with the program's value and the level of influence regarding the decision to enroll in the program, including program offerings, students' perceptions of the program, and external factors. The outcomes reveal specific distinctions among student drivers and highlight key aspects that require program improvement.

Table 3. Frequency distribution of responses to the likert items on influential factors in the decision to enroll

LI	MFE LS: Respondents						MEE LS: Respondents						ECE LS: Respondents					
	5	4	3	2	1	T	5	4	3	2	1	T	5	4	3	2	1	T
1.1	181	91	12	0	0	284	69	71	10	0	0	150	86	49	9	0	0	144
1.2	185	88	11	0	0	284	82	62	5	1	0	150	85	55	4	0	0	144
1.3	213	54	17	0	0	284	97	40	13	0	0	150	108	32	4	0	0	144
1.4	169	99	15	1	0	284	85	57	6	1	1	150	94	38	10	2	0	144
1.5	155	98	30	1	0	284	60	59	18	10	3	150	59	54	23	7	1	144
2.1	73	132	68	7	4	284	30	69	37	7	7	150	25	57	44	11	7	144
2.2	111	107	51	9	6	284	53	48	25	11	13	150	32	54	41	9	8	144
2.3	115	117	44	6	2	284	50	59	31	6	4	150	50	57	25	6	6	144
2.4	104	95	68	9	8	284	38	52	39	13	8	150	33	57	37	9	8	144
2.5	138	113	27	6	0	284	58	60	27	3	2	150	78	44	20	1	1	144
2.6	98	123	52	11	0	284	44	60	33	8	5	150	56	57	28	2	1	144
2.7	144	110	28	2	0	284	64	63	18	3	2	150	77	46	17	2	2	144
2.8	158	99	26	1	0	284	80	50	16	3	1	150	80	46	14	3	1	144
3.1	122	118	35	4	5	284	46	56	34	9	5	150	68	54	15	3	4	144
3.2	66	107	65	27	19	284	31	44	39	19	17	150	25	37	44	21	17	144
3.3	125	99	42	9	9	284	51	55	23	15	6	150	50	42	37	6	9	144
3.4	69	115	77	13	10	284	44	54	37	10	5	150	34	51	35	13	11	144
3.5	78	123	59	14	10	284	42	58	30	13	7	150	39	49	41	9	6	144
4.1	79	82	58	28	37	284	46	32	36	14	22	150	54	32	29	12	17	144
4.2	57	77	88	32	30	284	26	36	39	27	22	150	30	26	44	18	26	144

Note: *LI = Likert Items, LS = Likert Scale, and T = Total.

Table 3 presents the frequency distribution of responses to Likert items assessing influential factors in the decision to enroll across the three engineering programs of MFE, MEE, and ECE. Each item is rated on a 5-point Likert scale, with the total number of responses (T) indicated for each item and program. The data highlights variations in response patterns across the programs, reflecting differences in the perceived importance of enrollment factors.

Table 4. Likert item analysis by degree program with reliability metrics

LI	Mean, Standard Deviation, and Interpretation of MFE, MEE, ECE, and Likert Item Cronbach's Alpha									
	MFE			MEE			ECE			Cronbach's Alpha
	M	SD	Int	M	SD	Int	M	SD	Int	
1.1	4.5951	0.5715	SA	4.3933	0.6119	SA	4.5347	0.6135	SA	0.88029
1.2	4.6127	0.5620	SA	4.5000	0.5992	SA	4.5625	0.5511	SA	0.88198
1.3	4.6901	0.5786	SA	4.5600	0.6500	SA	4.7222	0.5079	SA	0.88353
1.4	4.5352	0.6139	SA	4.4933	0.6730	SA	4.5556	0.6873	SA	0.88136
1.5	4.4331	0.6925	SA	4.0867	0.9826	A	4.1319	0.9026	A	0.87961
2.1	3.9261	0.8479	VI	3.7200	0.9907	VI	3.5694	1.0218	VI	0.87519
2.2	4.0845	0.9398	VI	3.7800	1.2471	VI	3.6458	1.0674	VI	0.87825
2.3	4.1866	0.8218	VI	3.9667	0.9722	VI	3.9653	1.0338	VI	0.87453
2.4	3.9789	0.9945	VI	3.6600	1.1102	VI	3.6806	1.0686	VI	0.87522
2.5	4.3486	0.7388	EI	4.1267	0.8693	VI	4.3681	0.7999	EI	0.87723
2.6	4.0845	0.8236	VI	3.8667	1.0078	VI	4.1458	0.8276	VI	0.87536
2.7	4.3944	0.6928	EI	4.2267	0.8366	EI	4.3472	0.8472	EI	0.87673
2.8	4.4577	0.6738	EI	4.3667	0.8062	EI	4.3958	0.8040	EI	0.87892
3.1	4.2254	0.8481	EI	3.8600	1.0300	VI	4.2431	0.9255	EI	0.87666
3.2	3.6127	1.1394	VI	3.3533	1.2593	MI	3.2222	1.2372	MI	0.87826
3.3	4.1338	0.9928	VI	3.8667	1.1153	VI	3.8194	1.1445	VI	0.87962
3.4	3.7746	0.9832	VI	3.8133	1.0388	VI	3.5833	1.1677	VI	0.87852
3.5	3.8627	0.9905	VI	3.7667	1.0955	VI	3.7361	1.0577	VI	0.87842
4.1	3.4859	1.3384	VI	3.4400	1.3926	VI	3.6528	1.3655	VI	0.89170
4.2	3.3486	1.2218	MI	3.1133	1.3033	MI	3.1111	1.3644	MI	0.89770

Note: *LI = Likert Items, M = Mean, SD = Standard Deviation, Int = Interpretation.

The descriptive survey results, presented in Table 4, are organized into four sections that assess students' perceptions and influences on enrollment decisions across the three engineering programs. These sections include the level of agreement with the enrolled program, followed by the level of influence from program offerings, students' perceptions of the program, and external factors.

For the level of agreement with the enrolled program, the results reflect strong positive perceptions across most items. All groups strongly agreed (SA) that the program develops students into graduates who drive innovation and economic growth, with MFE (M = 4.5951, SD = 0.5715), MEE (M = 4.3933, SD = 0.6119), and ECE (M = 4.5347, SD = 0.6135). The program was highly valued for providing valuable skills and knowledge, with means of 4.6127 (MFE, SD = 0.5620), 4.5000 (MEE, SD = 0.5992), and 4.5625 (ECE, SD = 0.5511), all indicating strong agreement. Diverse career opportunities were also strongly endorsed, with ECE rating highest (M = 4.7222, SD = 0.5079), followed by MFE (M = 4.6901, SD = 0.5786) and MEE (M = 4.5600, SD = 0.6500), aligns with research emphasizing employability and job prospects as key drivers of engineering enrollment [21], [30], [32]. However, variations across disciplines may reflect perceived difficulties and gender-based gaps in self-efficacy [7], [12]. Respondents across all groups strongly agreed that the program is challenging yet fulfilling, with means of 4.5352 (MFE, SD = 0.6139), 4.4933 (MEE, SD = 0.6730), and 4.5556 (ECE, SD = 0.6873). This aligns with research indicating that perceived difficulty is a barrier to STEM engagement [11], although Active Learning Methodologies may enhance fulfillment [10]. However, the promotion of the program received lower scores, particularly in MEE (M = 4.0867, SD = 0.9826) and ECE (M = 4.1319, SD = 0.9026), which only agreed (A), indicating a need for enhanced marketing efforts to attract potential students. In contrast, MFE students strongly agreed (M = 4.4331, SD = 0.6925) on the program's promotion, likely reflecting the practical promotional and marketing efforts by the MFE faculty during 2021–2023. Correspondingly, the findings strongly support H1, indicating that the program is highly regarded for its impact, skill development, career opportunities, and overall fulfillment. However, promotional strategies, particularly for MEE and ECE, may require enhancement to reach potential students.

Additionally, for the level of influence from program offerings, curriculum design was rated as very influential, with MFE participants reporting a mean of 3.9261 (SD = 0.8479), MEE a mean of 3.72 (SD = 0.9907), and ECE a mean of 3.5694 (SD = 1.0218), underscoring its consistent role in shaping program appeal. This underscores its consistent role in shaping program appeal and aligns with research highlighting the negative impact of outdated [14] or misaligned curricula on engineering enrollment and engagement [24], [29]. Faculty and staff support similarly emerged as Very Influential for MFE (M = 4.0845, SD = 0.9398), MEE (M = 3.78, SD = 1.2471), and ECE (M = 3.6458, SD = 1.0674), highlighting the critical role of institutional guidance in enhancing the appeal of engineering programs [19], [22]. These findings align with research indicating that faculty expertise and institutional support enhance STEM engagement and retention, particularly for underrepresented groups [22], [24]. Program features, including co-op/internship opportunities, research prospects, and industry partnerships, were deemed Very Influential by MFE (M = 4.1866, SD = 0.8218), MEE (M = 3.9667, SD = 0.9722), and ECE (M = 3.9653, SD = 1.0338), reflecting broad inspirational impact [22]. Extracurricular opportunities, such as participation in local, regional, national, and international competitions, were also Very Influential across groups, with MFE at a mean of 3.9789 (SD = 0.9945), MEE at 3.66 (SD = 1.1102), and ECE at 3.6806 (SD = 1.0686). The Extremely Influential ratings of career prospects, particularly immediate job placement, for MFE (M = 4.3486, SD = 0.7388) and ECE (M = 4.3681, SD = 0.7999), and Very Influential for MEE (M = 4.1267, SD = 0.8693), align with research emphasizing employability and industry placement as key drivers of engineering enrollment [15], [30], [32]. Slight variations in MEE's lower rating may reflect differing priorities influenced by program-specific labor market factors [32]. The prospect of attractive compensation, encompassing better salary and benefits, was consistently Very Influential for MFE (M = 4.0845, SD = 0.8236), MEE (M = 3.8667, SD = 1.0078), and ECE (M = 4.1458, SD = 0.8276), align with research highlighting expected salary and financial factors as key drivers of engineering enrollment [18], [19]. Variations in influence, particularly lower for MEE, may reflect differing program-specific expectations or socioeconomic considerations [19]. Potential for professional growth and development, including access to certifications, training, and seminars, was rated Extremely Influential by all groups—MFE (M = 4.3944, SD = 0.6928), MEE (M = 4.2267, SD = 0.8366), and ECE (M = 4.3472, SD = 0.8472)—demonstrating strong consensus on long-term skill enhancement. Finally, the potential for international career opportunities was Extremely Influential across MFE (M = 4.4577, SD = 0.6738), MEE (M = 4.3667, SD = 0.8062), and ECE (M = 4.3958, SD = 0.804), emphasizing global mobility as a key motivator, aligning with research emphasizing labor market factors like employability and career-specific opportunities as primary drivers of engineering enrollment [32]. These findings robustly support H2, revealing that while most attributes were perceived as Very Influential, career-related factors such as prospects, growth, and international opportunities were particularly salient, often reaching Extremely Influential levels. MFE and ECE showed marginally higher means in several domains compared to MEE, suggesting nuanced group-specific priorities in program evaluation.

Moreover, for the level of influence from students' perceptions of the program, particularly the perceived social standing of the profession, specifically the belief that graduating with the enrolled program degree would be a source of pride and accomplishment, MFE (M = 4.2254, SD = 0.8481) and ECE (M = 4.2431, SD = 0.9255), obtained Extremely Influential remark and Very Influential for MEE (M = 3.86, SD = 1.03), reflect the role of professional pride in shaping engineering program appeal [33]. However, gender-based stereotypes and low self-efficacy may moderate these perceptions, particularly for underrepresented groups [16], [17]. Regarding program awareness through flyers, infographics, and social media platforms, MFE rated it as Very Influential with a mean of 3.6127 (SD = 1.1394). In contrast, MEE and ECE both rated it as Moderately Influential, with means of 3.3533 (SD = 1.2593) and 3.2222 (SD = 1.2372), respectively. Accessibility of the program at the desired institution, measured by willingness to enroll in any engineering program at BulSU, was consistently Very Influential across groups, with MFE at a mean of 4.1338 (SD = 0.9928), MEE at 3.8667 (SD = 1.1153), and ECE at 3.8194 (SD = 1.1445). The Very Influential role of personal interests and hobbies for MFE (M = 3.7746, SD = 0.9832), MEE (M = 3.8133, SD = 1.0388), and ECE (M = 3.5833, SD = 1.1677) aligns with research highlighting interest as a key driver of engineering career choices [11], [21], [30]. However, lower female self-efficacy and limited prior exposure may moderate interest-driven enrollment, particularly for underrepresented groups [12]. Finally, the Very Influential rating of academic excellence in mathematics and science for MFE (M = 3.8627, SD = 0.9905), MEE (M = 3.7667, SD = 1.0955), and ECE (M = 3.7361, SD = 1.0577) aligns with research linking strong high school performance to engineering suitability and aspirations [18], [25]. However, barriers such as low self-efficacy and stereotypes may hinder the engagement of underrepresented groups, despite their academic preparedness [12], [17], [26]. Thus, the findings support H3, highlighting slight differences in influential factors among the groups, with MFE consistently demonstrating higher ratings, particularly in terms of social standing and accessibility. At the same time, personal and academic elements uniformly drove program choice.

Furthermore, for the level of influence from program offerings in terms of external factors, the Very Influential ratings of family, friends, or peer influence for MFE (M = 3.4859, SD = 1.3384), MEE (M = 3.4400, SD = 1.3926), and ECE (M = 3.6528, SD = 1.3655) align with research highlighting family support and peer motivation as significant drivers of engineering enrollment, particularly for women [18], [30], [31]. Variations in influence, slightly higher for ECE, may reflect stronger familial encouragement in specific cultural contexts [31]. In contrast, for addressing the lack of a specific preference or alternative option, MFE respondents had a mean of 3.3486 (SD = 1.2218), rated as Moderately Influential; MEE respondents reported a mean of 3.1133 (SD = 1.3033), Moderately Influential; and ECE respondents exhibited a mean of 3.1111 (SD = 1.3644), also Moderately Influential. These findings partially support H4, highlighting the predominant role of interpersonal recommendations across all groups, while the absence of alternatives exerted only a moderate influence.

Finally, the reliability of these survey items is supported by high Cronbach's alpha values (ranging from 0.87453 to 0.89770), confirming excellent internal consistency and indicating that the Likert items consistently measure the intended enrollment factors across the MFE, MEE, and ECE programs.

4.3 Qualitative analysis result

Table 5 below summarizes the results of the thematic analysis conducted using Braun and Clarke's 6-Step Thematic Analysis framework, based on student responses to three open-ended questions about improving their respective enrolled engineering programs, specifically across three disciplines: MFE, MEE, and ECE. The analysis reveals key themes, the frequency across the disciplines, and the ranked importance based on total mentions.

Table 5. Thematic analysis result for 3 open-ended questions

	Frequency				Rank
	MFE	MEE	ECE	Total	
Themes for Q1: What do you think could be done to increase enrollment in your enrolled engineering program?					
Program Awareness and Promotion	187	100	89	376	1
Outreach to Schools	69	31	50	150	2
Highlighting Career Opportunities	63	27	43	133	3
Enhancing Program Appeal	54	30	41	125	
Collaboration and Partnerships	0	8	10	18	
Themes for Q2: How can your enrolled engineering program better engage students and promote interest in the field?					
Hands-On and Practical Learning	98	59	64	221	1
Industry Exposure and Career Opportunities	116	34	50	200	2
Program Awareness and Promotion	86	43	48	177	3
Student Motivation and Engagement	62	30	32	124	
Innovative and Modern Teaching Methods	33	8	20	61	
Themes for Q3: Do you have any other suggestions or comments to improve your enrolled engineering program?					
Enhancing Practical Learning	44	23	26	93	1
Curriculum Modernization	40	25	17	82	2
Student Experience and Support	16	21	12	49	3
Program Delivery Improvements	20	10	10	40	
Industry Engagement	25	5	8	38	
Program Promotion and Awareness	15	9	7	31	

For Question 1, a total of 376 mentions makes the Program Awareness and Promotion the highest-ranked theme. Common responses included improving program marketing through social media, brochures, videos, and in-person promotions at secondary education institutions. This suggests that respondents strongly believe enhanced marketing and visibility efforts are critical to attracting more students. The second-ranked theme, "Outreach to Schools," garnered 150 mentions. Frequent answers included conducting outreach programs, providing training or seminars aligned with the engineering program, offering expertise consultations in research, and organizing joint programs such as robot competitions and math quizzes for secondary education institutions. This indicates the importance of engaging with pre-university students to spark early interest [28]. Under the theme "Highlighting Career Opportunities," there were 133 mentions, with numerous shared responses suggesting that prominent alumni should conduct career opportunities seminars or webinars. Other suggestions included highlighting alumni champions in their respective industries or fields and that the program should initiate, participate in, or collaborate on career job fairs, emphasizing the need to showcase job prospects to prospective students [15], [21], [32]. These findings align with research identifying career interests and employability as primary drivers of student aspirations [18], [30]. Other themes, such as "Enhancing Program Appeal" (125 mentions) and "Collaboration and Partnerships" (18 mentions), were less frequently cited, while vague or individual-focused responses totaled 33 mentions.

Then, for Question 2, which focused on how the program could better engage students and promote interest in engineering, "Hands-On and Practical Learning" emerged as the top theme with 221 mentions. Recurring responses include conducting hands-on activities for courses with lab units, enhancing lab experiences by providing updated lab units, equipping educators with knowledge of lab equipment, explaining real-world scenarios through laboratory exercises, conducting field-based projects, and incorporating more hands-on activities and simulations, among other suggestions. These highlight a strong preference for experiential learning to sustain student engagement [10], [24]. Additionally, this aligns with research advocating for Active Learning Methodologies and highlighting the negative impact of outdated curricula and expository teaching on student retention [14], [35]. "Industry Exposure and Career Opportunities" ranked second with 200 mentions. Common answers included discussing industry-updated trends, highlighting career-industry opportunities through field trips and field-based coursework, and forming industry partnerships that bridge student knowledge and graduate visibility, underscoring the value of connecting academic learning to real-world applications to boost engineering enrollment [15], [30], [32]. This aligns with research identifying career prospects and employability as key motivators [18], [21]. "Program Awareness and Promotion" was third with 177 mentions, suggesting that ongoing visibility efforts are also crucial for engagement. Additional themes included "Student Motivation and Engagement" (124 mentions) and "Innovative and Modern Teaching Methods" (61 mentions), while 87 responses provided no specific suggestions.

Lastly, for Question 3, which invited supplementary suggestions for program improvement, "Enhancing Practical Learning" was the most frequently mentioned theme, with 93 mentions, strengthening the demand for hands-on experiences. "Curriculum Modernization" ranked second with 82 mentions, indicating a need to update course content to align with current industry trends. "Student Experience and Support" was third with 49 mentions, reflecting matters about academic and personal support for students. Other themes, such as "Industry Engagement" (38 mentions), "Program Delivery Improvements" (40 mentions), and "Program Promotion and Awareness" (31 mentions), were less prevalent. Notably, numerous respondents (315 mentions: 162 from MFE, 73 from MEE, and 80 from ECE) provided no suggestions that indicate satisfaction with the currently enrolled program or a lack of specific ideas.

5 CONCLUSION AND RECOMMENDATIONS

This study investigates the factors influencing low or declining enrollment in BulSU's MFE, MEE, and ECE engineering programs using a mixed-methods approach. It combines quantitative analysis of Likert-scale survey responses with qualitative analysis of three open-ended questions, following Braun and Clarke's 6-step thematic analysis. A total of 578 students participated (144 from ECE, 150 from MEE, 284 from MFE). Findings reveal distinct enrollment patterns: MFE has the highest response rate but the lowest first-choice preference, relying heavily on reconsideration admissions. In contrast, MEE and ECE attract students with stronger initial interest, as indicated by higher first-choice admissions rates and lower reconsideration rates. Gender distribution also varies, with MFE and MEE being male-dominated, while ECE shows more balanced representation in some years.

The quantitative and qualitative findings reveal a complementary relationship between students' perceptions and influences on enrollment in the MFE, MEE, and ECE engineering programs. Quantitatively, students across all programs strongly agree that their programs foster innovation, provide valuable skills, and offer diverse career opportunities, aligning with research that emphasizes employability and job prospects as key drivers of enrollment. However, promotional efforts, particularly for MEE and ECE, scored lower, which indicates a need for improved marketing. Program offerings, such as curriculum design, faculty support, and career prospects, were rated as Very to Extremely Influential, with MFE often receiving higher ratings, reflecting a slight difference in program-specific priorities. Qualitative data reinforces these findings, with Program Awareness and Promotion (376 mentions) and Outreach to Schools (150 mentions) as top themes, highlighting the need for enhanced visibility and early engagement with pre-university students. Hands-On and Practical Learning (221 mentions) and Industry Exposure (200 mentions) emerged as critical for engagement, aligning with the quantitative emphasis on career opportunities and modern curricula. Both datasets emphasize the importance of aligning programs with industry needs, enhancing practical learning, and refining promotional strategies to boost enrollment and engagement. Slight variations across programs suggest that tailored approaches may be necessary.

Based on these findings, to enhance the effectiveness of BulSU's MFE, MEE, and ECE programs, it is recommended that marketing efforts be strengthened through social media, outreach to schools, and alumni engagement, particularly in addressing the lower promotional scores for MEE and ECE. Prioritize hands-on learning by upgrading lab facilities, adapting innovative learning styles [38], refining evaluation strategies [39], and integrating field-based projects, aligning with the qualitative emphasis on practical learning and the quantitative value of career-relevant skills. Modernize curricula to reflect industry trends (e.g., AI technology [40]), ensuring alignment with career prospects rated Very to Extremely Influential. Enhance student support through mentorship, peer systems, and extracurricular opportunities, such as competitions, to foster qualitative engagement. These targeted improvements will enhance visibility, enrollment, and student satisfaction while addressing specific program needs.

6 ACKNOWLEDGEMENT

This work was funded by the BSU Research Grant System.

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