

Non-STEM Engineering Bridging Program through the Lens of ABCD Evaluation Model

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ABSTRACT

Higher institutions offer bridging programs to address challenges experienced by senior high school graduates. This study evaluated the effectiveness of the bridging program for non-STEM Engineering students in terms of its process and operations, results, and impact using Ochave's ABCD Model. This study utilized a descriptive-evaluative design involving Engineering students selected using convenience sampling. The quantitative data were gathered through a questionnaire and analyzed using frequency, percentage, and weighted mean. On the other hand, a semi-structured interview was employed to collect qualitative insights and further analyzed using thematic analysis. Findings revealed that the students are satisfied with the learning resources, curriculum, and instructional strategies employed during their bridging program. Furthermore, data show that the bridging program is perceived to be good in relation to the students' knowledge acquired, skills developed, and perceived readiness. Moreover, the bridging program has a positive impact on the satisfactory performance of the students in their Engineering courses as well as on the department's increasing retention rate. To further optimize the program's effectiveness, this study recommends updating learning resources, managing instructional pacing, and expanding the duration of the bridging program.

Keywords: *Non-STEM engineering, Bridging Program, Ochave's Model*

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INTRODUCTION

The transition from senior high school to college presents significant challenges for students. Senior high school (SHS) graduates struggle with increased academic demands, changes of social environment, and unfamiliarity with college-level expectations (Wolters & Brady, 2020). The non-alignment of the SHS track with their chosen college degree further complicates this transition. This difficulty is evident particularly for engineering students not from the Science, Technology, Engineering, and Mathematics (STEM) track (Ng, 2024). Engineering students from non-STEM track experience struggles as they lack fundamental knowledge and skills such as problem-solving and practical applications, which are essential for many engineering courses (Yu et al., 2024). Engineering courses require a solid understanding of advanced Mathematics and Science concepts, which non-STEM students may lack proficiency in these areas, as these are not studied heavily at the senior high school level. These challenges may lead to increased anxiety and a higher risk of failing, which will eventually hinder their progress in Engineering.

To address these challenges, the Commission on Higher Education (CHED) issued policies stating that Grade 12 students are entitled to pursue college regardless of their track in senior high school (CHED Memorandum Order No. 105, Series of 2017). CHED then allowed higher education institutions (HEIs) to offer a Bridging Program for SHS graduates to support them as they pursue a degree not aligned with their track. Bridging is a short-term educational program designed to help students acquire specific knowledge and skills needed to transition to a new program. HEIs, specifically with engineering programs, provide a bridging program to support the academic preparedness of non-STEM graduates, thus meeting the demands of the engineering curriculum. However, given academic freedom, CHED emphasized that the HEIs have the discretion to prescribe or not to prescribe any form of bridging program.

Though offering the bridging program is not mandatory, some HEIs include bridging in their curricula as one of their admission policies. This endeavor recognizes the impact of the bridging program on the students' development. Research suggests that bridging programs facilitate a smoother transition for non-STEM students into engineering studies, preparing them for technical knowledge, learning skills development, and community-building activities (Dang et al., 2023; Lane et al., 2020). Bridging program provides students with courses integrating a student-centered approach, promoting the sustained development and comprehensive improvement of student learning outcomes in the discipline (Zhao et al., 2014). Utilizing a student-centered approach allows students to adapt to the requirements of the Engineering discipline. Furthermore, Bradford et al. (2020) confirmed that bridging program markedly enhanced the students' academic performance, specifically in their first year. First-year students generally performed well as they acquired pre-requisite knowledge and skills while participating in the bridging program. By acquiring this fundamental knowledge and skills, the bridging program can influence students' academic achievements and lay a solid foundation for Engineering studies.

The effectiveness of the bridging programs goes beyond academic performance as these also develop essential skills among students. Cao (2023) noted that students' confidence and time management skills were enhanced as they participated in these programs. Students were able to develop better planning, priority setting, and organizational skills. On the other hand, there was also a significant improvement in student engagement (Huang & Chang, 2018; Paul & Variawa, 2023) as bridging program integrated activities that arouse their curiosity and interests allowing learners to freely participate in their class activities. Black (2023) highlighted the role of bridging programs in student persistence and retention, particularly among students from disadvantaged backgrounds. These skills are essential for students to succeed in the Engineering discipline.



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Being one of the private Catholic schools offering a Civil Engineering program in the Southern Leyte region, this higher education institution offers a bridging program specifically for non-STEM graduates who want to enroll in the engineering program. This bridging program is offered before the start of the school year as part of the admission requirement for non-STEM students. This bridging program consists of four courses – Pre-Calculus, Basic Calculus, Chemistry, and Physics- taken by STEM students in senior high school. Non-STEM students are required to take and pass these subjects as these are prerequisites to major subjects they will take later in their course.

This institution has adopted the bridging program for over five years, yet no formal evaluation in the said institution was conducted as to its effectiveness in preparing non-STEM students for engineering, which makes it an important area for evaluation. The researcher believes that this research will make a unique contribution by being the first to determine whether this program successfully enhances students' understanding, confidence, and preparedness for advanced engineering subjects. This study, hence, aims to evaluate the effectiveness of the bridging program using Ochave's ABCD Model. The model examines four components: A) Beneficiaries or participants, B) Operations and processes, C) Results, and D) Impact (Nava et al., 2017). By employing this model, this study ensures that bridging initiatives effectively meet diverse student needs, contribute to higher education success, and reveal gaps in implementation, effectiveness, and social impact, thereby guiding improvements. The research findings will improve engineering education, ensuring non-STEM students adequately prepare for their academic journey.

Research Questions

This study aims to assess the effectiveness of the bridging program for non-STEM engineering students using Ochave's ABCD Model. Specifically, it aims to answer the following objectives:

1. Identify the profile of the intended program participants in terms of their senior high school strand and weighted average of core mathematics and science subjects.
2. Examine the level of satisfaction with the program's process and operations regarding the learning resources utilized, curriculum, and instructional strategies.
3. Determine the programs' implementation results regarding knowledge acquisition, skills development, and readiness for engineering.
4. Recognize the programs' impact in terms of weighted average of subsequent engineering courses and retention rate.
5. Propose recommendations to enhance the implementation of the program.

Framework of the Study

The study comprehensively evaluates the effectiveness of the bridging program for non-STEM students using Ochave's ABCD Model (2003). The model explicitly evaluates the program's four core components – Participants, Process and Operations, Results, and Impact. This model provides a valuable framework to understand the interconnection of these components and analyze the alignment between intended plans and actual realities. This framework further ensures a continuous program flow from the implementation phase to evaluating social benefits.



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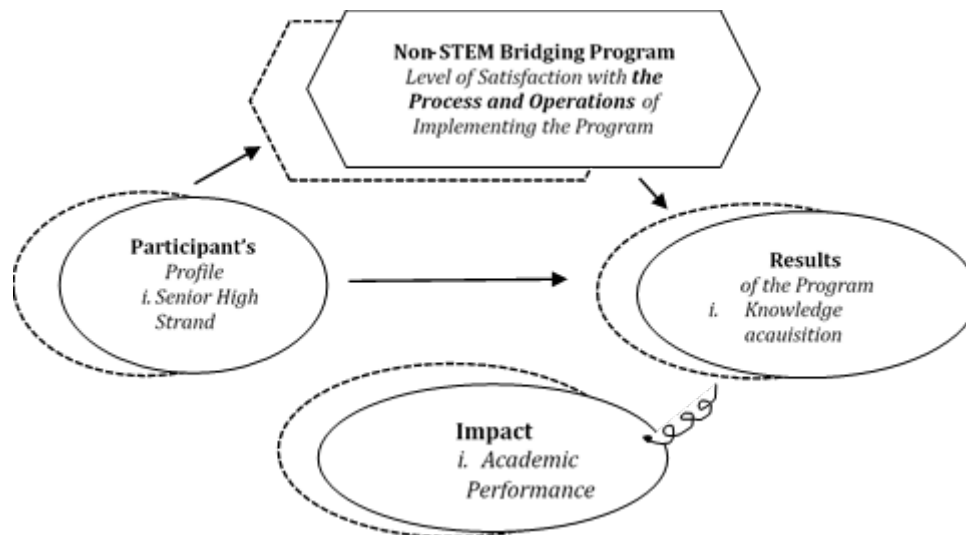


Figure 1. Bridging Program Evaluation Using ABCD Model Framework

Component A: Participant

The participant component serves as the foundation of the evaluation framework, as student characteristics directly influence program implementation and outcomes. In this study, this component focused on the characteristics of students entering the bridging program, such as (i) Senior High Strand indicating previous academic pathway as well as their (ii) Senior High School GPA in Core Mathematics and Science subjects such as General Mathematics, Statistics and Probability, Earth and Life Science, and Physical Science representing their academic preparation level. Senior High Strand and GPA in core subjects were analyzed to have an overview of the diverse academic backgrounds of the students as well as their educational knowledge and skills in relevant areas.

Component B: Process and Operations

The process component represents the operational core of the program. According to Ochave (2003), this component includes all elements of program delivery that directly influence student outcomes. In this study, the process component was assessed by determining the satisfaction of the participants with crucial elements of the implementation of the program, such as (i) the Learning Resources utilized, (ii) the Curriculum, and lastly, (iii) the Instructional Strategies employed as these directly influence student learning, engagement, and, ultimately, the program's effectiveness.

Component C: Results

This component measures the immediate outcomes of the bridging program. These are typically measured immediately or shortly after program completion and are considered more personal to the participants. In this study, results were measured in terms of (i) knowledge acquired, (ii) skills developed, and (iii) Perceived Engineering Readiness representing the direct consequence of students' participation on the bridging program.

Component D: Impact

Impact represents the broader, longer-term consequences of the program. In this study, this component assessed the longer-term effects of the bridging program, such as (i) their Academic Performance in subsequent engineering courses, namely Calculus 1, 2, and 3, Physics and Chemistry for Engineering (both Laboratory and Non-Laboratory), and (ii) the Retention Rate of the non-STEM students for the last



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five years. These elements comprehensively assess the bridging program's long-term impact on student learning, academic success, and institutional outcomes.

Overall, using Ochave's ABCD framework for evaluating a non-STEM bridging Program can offer a comprehensive yet flexible structure that captures the full scope of program evaluation, from inputs (participants) through processes (program operations) to both immediate results and long-term impacts.

METHODS

Study Design

This study employed a descriptive-evaluative research design using Ochave's ABCD Model to assess the effectiveness of the bridging program. This approach described the program's implementation and evaluated its outcomes and impact (Creswell & Creswell, 2018). This design descriptively determine the profile of the participants of the bridging program as well as their satisfaction on its process and operations. Furthermore, it evaluates the results and impact of the program in terms of the academic performance and retention rate. This approach provides a holistic view of the program's strengths and areas for improvement.

Population and Sample

The study participants were non-STEM students enrolled in an engineering bridging program in a selected higher education institution. As there was no existing official list of students who participated in the bridging program and at the same time are enrolled for the current school year, the researcher used convenient sampling. This non-random sampling approach was necessary given the institutional constraints but limits the generalizability of the findings. One-hundred Engineering students across year levels were conveniently selected. These students were selected using the following inclusion criteria: i) completed the bridging program, ii) enrolled in the Engineering program for the second semester of the academic year 2024 - 2025. Additionally, 10 engineering instructors who were directly involved of the bridging program were selected to provide qualitative insights into the program's effectiveness. These are the five instructors for the bridging program and five instructors for the engineering courses relevant to the subjects offered in the bridging program. The findings and conclusions of this study should be interpreted in light of these sampling limitations.

Setting

The study was conducted in a private Catholic institution in Southern Leyte. This institution has offered a Civil Engineering program for over five years. One of its policies is to ask non-STEM first-year students to enroll in a bridging program before they can be officially admitted into the academic program. This bridging program is offered before the start of the school year and lasts almost two months, covering the four pre-requisite courses: pre-calculus, Basic Calculus, Chemistry, and Physics.

Data Collection Methods

The researcher utilized researcher-made survey questionnaires and semi-structured interview guides. The survey questionnaire is composed of three sections. The first section determined the demographic profile of the participants in terms of their SHS strand and GPA for core mathematics and science subjects. The second section assessed the students' satisfaction with the learning resources, curriculum, and teaching strategies. Lastly, the third section is a self-assessment of the results of the



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bridging program in terms of knowledge acquired, skills developed, and perceived readiness. These last two sections are in a Likert scale format. Open-ended questions were also included in the survey, asking students to share their experiences during their enrolment in the bridging program. These tools were validated by experts in the field of program design and evaluation. Additionally, to establish the survey's reliability, the researcher conducted a pilot study on a separate group of students, and the internal consistency was measured using Cronbach's Alpha. The scores for each section were as follows: a) students' satisfaction ($\alpha=0.89$), b) self-assessment of knowledge acquired ($\alpha=0.92$), c) skills developed ($\alpha=0.85$), and d) perceived readiness ($\alpha=0.91$). These scores indicate a high degree of internal consistency, confirming the reliability of the survey.

Two semi-structured interview guides for the bridging program instructors and engineering instructors were used to gather qualitative insights on the program's implementation, such as the program's process, results, and impact. Data on the participants' GPAs in the subsequent engineering courses and the retention rate of the non-STEM engineering students for the last five years were retrieved.

Data Gathering Procedure

Before data gathering, the researcher asked two experts to validate the instrument. Afterward, the researcher asked permission to conduct the study from the Dean of the College of Engineering and Architecture through a letter. On the other hand, ethics clearance was secured from the institution's research ethics committee. Once approved, recruitment was done based on the identified sampling design and criteria. An orientation was done, explaining the purpose and nature of the study and asking for their consent to participate. Student - participants were informed that they needed to answer an online survey questionnaire regarding the effectiveness of the bridging program.

Moreover, the instructors were interviewed semi-structured based on their availability. A one-on-one interview in a comfortable environment was secured. In addition, data mining on non-STEM students' GPAs in selected Engineering courses and retention rates was retrieved to determine the program's impact.

After gathering data from the students and teachers, the researcher organized the survey data for quantitative analysis and transcribed audio recordings for qualitative analysis. Both data sets were integrated to provide a rich understanding of the effectiveness of the bridging program.

Data Analysis Procedure

The researcher utilized both quantitative and qualitative analysis. Frequency and percentage were computed to summarize the demographic profiles of the students, specifically in terms of their Senior High School Strand. General Percentage Average (GPA) was retrieved for the grades of the students in their core SHS mathematics and science subjects and in the selected Math and Science Engineering courses. Mean and standard deviation were used to analyze Likert-scale survey responses on satisfaction with the process and operations, knowledge acquired, skills developed, and perceived readiness of the students. Retention rate was also computed to determine the institutional impact of the bridging program.

On the other hand, direct quotes from the instructors and students' open-ended responses were used to illustrate and support the identified quantitative results on the satisfaction with learning resources, curriculum, and instructional strategies, as well as the result of the program regarding knowledge acquired, skills developed, and perceived readiness. Integrating these qualitative insights alongside the



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quantitative data allows for a more nuanced and comprehensive understanding of the bridging program's effectiveness.

Ethical Considerations

This study observed ethical standards throughout the process. The researcher informed the participants about the nature of the process, informing them that their participation is voluntary and that they can withdraw at any time. After that, they signed the informed consent form. Identifiable data were excluded or masked from the report to protect participants' privacy. Since the study involved internal operations, the researcher secured permission from department administration to access academic records and conduct interviews. Data storage and archiving followed institutional data protection protocols. Lastly, transparency and accountability guide the research process, ensuring honest reporting and handling of ethical findings (Resnik, 2020).

RESULTS

Component A: The Intended Participants

Profile of the Program Participants in Terms of their Senior High School Strand

Table 1. Demographic Profile of the Participants in Terms of their Senior High School Strand

| Senior High School Strand | Frequency | Percentage (in %) |
|--|-----------|-------------------|
| Academic – Accountancy, Business, and Management (ABM) | 18 | 18 |
| Academic – Humanities and Social Sciences (HUMSS) | 43 | 43 |
| Academic – General Academic Strand (GAS) | 16 | 16 |
| Technical – Vocational – Livelihood (TVL) | 22 | 22 |
| Arts and Design | 1 | 1 |
| Sports | 0 | 0 |

Table 1 shows the demographic profile of the respondents enrolled in the bridging program for non-STEM engineering students, categorized by their Senior High School (SHS) strand. As shown from the data, almost half of the participants are from the Humanities and Social Sciences (HUMSS) strand, comprising 43% of the respondents. This percentage suggests that students with a social science background shift to a more technical field, such as engineering. Twenty-two percent (22%) of the participants are from the Technical-Vocational-Livelihood (TVL) strand, followed closely by the Accountancy, Business, and Management (ABM) strand with 18% and the General Academic Strand (GAS) with 16%. Only one (1) student came from the Arts and Design strand; notably, no students were from the Sports track. The distribution presents a diverse academic background among students in the bridging program, emphasizing the role of the bridging program in equipping non-STEM senior high graduates with the necessary competencies to succeed in engineering courses.

Profile of the Program Participants in Terms of General Percentage Average of Senior High School Core Mathematics and Science Subjects

Table 2. Demographic Profile of the Participants in Terms of their Core Mathematics and Sciences Weighted Average



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| Subject | GPA | Standard Deviation | Description |
|----------------------------|-------|--------------------|-------------------|
| General Mathematics | 87.26 | 10.68 | Very Satisfactory |
| Statistics and Probability | 87.46 | 10.71 | Very Satisfactory |
| Earth and Life Science | 88.57 | 10.64 | Very Satisfactory |
| Physical Science | 86.91 | 14.47 | Very Satisfactory |

Legend: 90-100 – Outstanding, 85-89 – Very Satisfactory, 80-84– Satisfactory, 75-79– Fairly Satisfactory, Below 75– Did Not Meet Expectations

Table 2 presents the GPA of the participants in selected core mathematics and science subjects taken during their SHS. Students attained a Very Satisfactory performance across the four core Mathematics and Science subjects. Specifically, students got the highest weighted average in Earth and Life Science, with a weighted average of 88.57, closely followed by Statistics and Probability and General Mathematics, with a weighted average of 87.46 and 87.26, respectively. Though lowest, students still perform very satisfactorily in Physical Science with a weighted average of 86.91. These results indicate that, despite coming from non-STEM backgrounds, the students demonstrated a generally strong academic performance in foundational subjects related to science and mathematics. When supported by the bridging program, these may contribute to their potential success in engineering-related subjects.

Components B: Process and Operation

Level of Satisfaction with the Operations and Processes in the Implementation of the Bridging Program

Table 3. Mean Rating on the Level of Satisfaction with the implementation of the Bridging Program

| Indicators | Mean | Std. Dev. | Verbal Interpretation |
|--|-------------|-------------|-----------------------|
| A. Learning Resources | 3.03 | 0.70 | Satisfied |
| 1. The learning materials provided were straightforward to understand. | 3.07 | 0.69 | Satisfied |
| 2. Technology (e.g., online tools and software) enhanced my learning experience. | 3.02 | 0.74 | Satisfied |
| 3. The references and supplementary resources were relevant and helpful. | 3.07 | 0.68 | Satisfied |
| 4. The materials were updated and aligned with current engineering concepts. | 2.99 | 0.72 | Satisfied |
| 5. The availability of learning resources was sufficient throughout the program | 3.02 | 0.70 | Satisfied |
| B. Curriculum | 3.00 | 0.70 | Satisfied |
| 1. The curriculum content covered the essential topics needed for my engineering course. | 2.96 | 0.74 | Satisfied |
| 2. The subjects offered were well-structured and logically sequenced. | 3.00 | 0.70 | Satisfied |
| 3. The assessments (quizzes, tests, assignments) were fair and reflected the curriculum content. | 3.04 | 0.74 | Satisfied |
| 4. The program balanced theory and practical applications effectively. | 3.03 | 0.65 | Satisfied |



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| | | | |
|---|-------------|-------------|------------------|
| 5. The subject matter addressed my specific learning needs as a non-STEM student. | 2.98 | 0.70 | Satisfied |
| C. Instructional Strategies | 2.98 | 0.71 | Satisfied |
| 1. The instructors used varied teaching methods to maintain my interest. | 3.00 | 0.66 | Satisfied |
| 2. The teaching strategies encouraged me to participate in class actively. | 3.00 | 0.73 | Satisfied |
| 3. The instructors provided clear explanations and examples. | 2.98 | 0.74 | Satisfied |
| 4. The pace of instruction was appropriate for my level of understanding. | 2.96 | 0.72 | Satisfied |
| 5. The instructors were approachable and supportive when I needed help. | 2.99 | 0.70 | Satisfied |
| OVERALL | 3.00 | 0.70 | Satisfied |

Legend: 3.26 - 4.0 – Very Satisfied, 2.51 – 3.35 – Satisfied, 1.70 – 2.50 – Slightly Satisfied, 1.0 – 1.75 – Dissatisfied

Table 3 presents the mean rating on the students' satisfaction level regarding the operations and process of the bridging program, focusing on three areas. Overall, the participants expressed satisfaction ($M = 3.00$) with the bridging program reflecting a generally positive perception of the program. However, the relatively high standard deviation of 0.70 implying diverse experiences and perspectives among the participants during their bridging program.

Regarding learning resources, data suggest that the participants are Satisfied with the highest rating on the clarity of materials ($M = 3.07$) and the relevance of the supplementary resources ($M = 3.07$). These findings are consistent with the experiences shared by the instructors. For example, Instructor 1 stated,

"We provide each one of them modules for every topic to be discussed, assignments, videos related to the topics, and board work."

This is supported by Instructor 4, who shared,

"I have made my materials like video tutorials, printed materials such as handouts, modules, for them as a guide."

This manifests the efforts to provide diversified resources, as these are paramount in improving students' performance and making the learning process more interesting and stimulating (Ahmed et al., 2024). However, participants rated the alignment of materials with current engineering concepts the lowest, with a mean of only 2.99. This finding implies a critical gap where the resources themselves are clear and accessible, yet their content may be outdated or fail to adequately prepare students for the modern engineering curriculum they will encounter. This directly contradicts the core purpose of a bridging program—to provide a smooth transition. The instructors' efforts to provide materials are commendable, but a deeper analysis of the content's relevance to modern industry and academic standards is needed to truly enhance the program's effectiveness.

Furthermore, the curriculum dimension recorded a mean of 3.00, which was also interpreted as Satisfactory. The assessment component of the curriculum ($M = 3.04$) received the highest satisfaction as participants reported that,



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"weekly assessment can improve how students understand the specific lessons for that week."

Instructor 1 also shared that.

"I gave them quizzes after every module/topic discussion and had board works, assignments, and class participation."

However, addressing the curriculum to meet the specific learning needs as a non-STEM student had the lowest mean at 2.98. This result aligns with insights from Instructor 5, who emphasized the need for a *"relearning of background lessons to support students from diverse academic backgrounds."*

Similarly, Instructor 6 advocated for

"Integration of varied learning strategies/activities to cater to the diversity of students' academic intelligence."

This finding points to a fundamental flaw in the curriculum's design: it may be a "one-size-fits-all" model that fails to account for the diverse academic gaps of students from different non-STEM backgrounds. Studies such as Gentry et al. (2023) and Stingo (2024) underscore the importance of differentiating instruction. They highlight that while the curriculum is functional, it may require further differentiation and scaffolding to meet the specific needs of bridging students, especially those from non-STEM backgrounds.

Moreover, instructional strategies obtained a slightly lower mean of 2.98 but were still within the satisfactory range. Among the items under this category, the highest satisfaction was recorded in teaching methods encouraging participation (M = 3.00). In the open-ended responses, Instructor 3 emphasized hands-on learning:

"Groupwork and dyad activities work best. These activities help students learn through practice rather than relying on lengthy discussions."

Meanwhile, Instructor 1 noted the effectiveness of

"problem-solving, brainstorming, and collaborative techniques."

These methods resonate with students' desire for active and applied learning experiences (Li, 2023), which could explain the relative satisfaction in this domain. Despite these efforts, some instructors faced logistical and operational challenges that likely impacted instructional delivery, which caused the lowest satisfaction rating among students about the pacing of instruction (M = 2.96). A student mentioned that:

"One of the challenges I encountered during the program was adjusting to the fast-paced schedule. Some topics were covered quickly, and it was sometimes difficult to fully understand everything before moving on to the next."

This challenge underscore an issue where the program may be trying to cover too much material in too little time. This operational flaw undermines the very effectiveness of the engaging teaching methods, as students may not have enough time to fully grasp the foundational concepts, which are essential for their future success in engineering.

To address this, Instructor 7 suggested that



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“Prioritize accommodating augment hours for courses to really cover necessary foundations, which is a pre-requisite to the course alignment to assure a well-transitioned learning process.”

In general, students are clearly satisfied with the instructor's effort to provide varied resources, modify instruction, and respond to students' needs. However, better material alignment, improved curriculum differentiation for non-STEM students, and a manageable class schedule must be addressed to improve students' satisfaction with the process and operation of the bridging program.

Component 3: Results

Result of the Bridging Program

Table 4. Mean Rating of the Result of the Bridging Program

| Indicators | Mean | Std. Dev | Verbal Interpretation |
|--|-------------|-------------|-----------------------|
| A. Knowledge Acquired | 3.10 | 0.69 | Good |
| 1. The program significantly improved my understanding of mathematical concepts. | 3.12 | 0.75 | Good |
| 2. I gained a better grasp of essential science topics through the program. | 3.10 | 0.66 | Good |
| 3. The bridging program helped me connect prior knowledge to new concepts. | 3.14 | 0.67 | Good |
| 4. I feel more competent in the foundational subjects required for engineering. | 3.07 | 0.71 | Good |
| 5. The knowledge gained will help me succeed in my first-year college courses. | 3.10 | 0.65 | Good |
| B. Skills Developed | 3.07 | 0.69 | Good |
| 1. I have improved my problem-solving abilities | 3.07 | 0.68 | Good |
| 2. I can apply critical thinking skills to engineering-related problems. | 3.05 | 0.69 | Good |
| 3. The program enhanced my ability to apply mathematical techniques to solve engineering problems. | 3.06 | 0.70 | Good |
| 4. I feel more confident in applying scientific methods to engineering problems. | 3.08 | 0.70 | Good |
| 5. The program improved my ability to work collaboratively on engineering tasks. | 3.11 | 0.69 | Good |
| C. Perceived Readiness | 3.06 | 0.66 | Good |
| 1. I believe I can keep up with the pace and demands of the engineering curriculum. | 3.03 | 0.69 | Good |
| 2. I am confident in my ability to succeed in an engineering program. | 3.05 | 0.67 | Good |
| 3. I am aware of the expectations and assessment styles in engineering courses. | 3.04 | 0.64 | Good |
| 4. I believe this program has provided me with a solid foundation for future engineering studies. | 3.07 | 0.68 | Good |



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| | | | |
|--|-------------|-------------|-------------|
| 5. I feel prepared to take introductory engineering courses. | 3.11 | 0.64 | Good |
| OVERALL | 3.08 | 0.68 | Good |

Legend: 3.26 - 4.0 – Very Good, 2.51 – 3.35 – Good, 1.70 – 2.50 – Fair, 1.0 – 1.75 – Poor

Table 4 presents the mean ratings and standard deviations for the program's results in terms of perceived gains Knowledge Acquisition, Skills Development, and Perceived Readiness. It is important to note that this data reflects the students' self-assessments, which may differ from their actual, measurable gains. This finding, however, provides valuable overview on the overall success of the bridging program in preparing students for their first year in engineering, particularly in addressing foundational gaps in knowledge and skills.

Specifically, students perceive that the knowledge they have acquired is good ($M = 3.10$). The participant highly rated to the idea that the program helps them connect prior knowledge to new concepts ($M = 3.14$). Cao (2023) and Chand (2024) support this finding as bridging programs enhance students' ability to adapt to new subject requirements, thus bridging gaps between previous learning and new academic demands. However, this success seems to be limited to basic transfer of knowledge as a more critical look reveals a slightly lower rating for feeling more competent in foundational subjects ($M = 3.07$) indicating that while knowledge transfer is strong, there may still be room to strengthen students' confidence in fundamental areas required for engineering. Instructor 3 noted,

"Yes, students still struggle with advanced concepts like trigonometric identities and sketching trigonometric functions,"

while Instructor 4 pointed out that

"they tend to use wrong formulas, especially for parabola."

These insights suggest that while the program lays a good foundation, it may require strengthening basic mathematical or scientific concepts to understand complex engineering concepts.

Similarly, skills development is perceived as good, with the highest mean rating in the program improving the student's ability to work collaboratively on engineering tasks ($M = 3.11$). This could be because of how the learning tasks in the program are facilitated, as Instructor 6 emphasized that students

"developed teamwork skills through hands-on activities, collaborative tasks, and real-world problem tasks."

This supports evidence that bridging programs positively impact academic performance and foster teamwork skills, which are necessary in engineering practice (Whannell et al., 2014). However, applying critical thinking skills to engineering-related problems ($M = 3.05$) got the lowest rating. This result suggests that while the program provides opportunity for students to work together on tasks, they may not be trained to independently or collectively engage in the complex, integrative thinking required to solve open-ended engineering challenges, as highlighted by Yaki et al. (2019). This is a critical area for improvement, as engineering is fundamentally a discipline of critical problem-solving, not just task completion.

Concerning student-perceived readiness, improvements in confidence and independence were evident as students were prepared to take introductory engineering courses ($M = 3.11$) indicating that students generally feel capable of beginning their formal engineering education. The insights provided by the faculty support this. For instance, Instructor 6 remarked,



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"They transitioned gradually, developed stronger independence in learning, and became somehow ready for engineering."

This perception is supported by the study of Metcalf and Wiener (2020), which noted that the confidence they acquired in the bridging program predicts their success in undergraduate engineering studies. On the other hand, there is a slightly lower rating on their readiness to keep up with the pace and demands of the engineering curriculum (M = 3.03), which indicates that they need ongoing support aside the bridging course. This finding points to a potential mismatch between the pace of the bridging program and the reality of a rigorous engineering curriculum. While students may *feel* ready, they may not be fully prepared for the demanding workload, high-speed lectures, and independent learning required in their first year, indicating a need for more rigorous pacing or a structured transition support system beyond the bridging course itself.

Overall, the mean ratings across the three core dimensions—*Knowledge Acquired* (M = 3.10), *Skills Development* (M = 3.07), and *Perceived Readiness* (M = 3.06)—all fall within the “Good” range. These quantitative results suggest that students felt the program adequately supported their academic transition, particularly by enhancing their understanding of key concepts in mathematics and science. These findings align with existing literature that emphasizes the importance of transition programs in helping students bridge their learning gaps between secondary and tertiary education, particularly in STEM-related courses (Morgan, 2020).

Component 4: Impact

Impact of the Program in terms of General Point Average of Subsequent Engineering Courses

Table 5. General Point Average of the Students in Subsequent Mathematics and Science Engineering Courses

| Course | GPA | Std. Dev | Description |
|--|------|----------|---------------------|
| Calculus 1 (Differential) | 2.24 | 0.50 | Satisfactory |
| Calculus 2 (Integral) | 2.34 | 0.35 | Satisfactory |
| Differential Equations | 2.67 | 0.44 | Fairly Satisfactory |
| Chemistry for Engineers | 2.11 | 0.42 | Satisfactory |
| Chemistry for Engineers (Lab) | 1.83 | 0.43 | Satisfactory |
| Physics for Engineers (Calculus Based) | 2.34 | 0.35 | Satisfactory |
| Physics for Engineers (Lab) | 2.06 | 0.46 | Satisfactory |

Legend: 1.00 – 1.24 – Outstanding, 1.25 – 1.74 – Very Satisfactory, 1.75 – 2.49 – Satisfactory, 2.50 – 3.00 – Fairly Satisfactory, 5.00 – Did Not Meet Expectations

**Note: This grading scale is specific to the institution's internal system for this program, as outlined in the Student Handbook Version 2022.*

As shown in Table 5, bridging programs for non-STEM engineering students have demonstrated academic well, as shown by students' performance in their subsequent core courses. According to the data, participants in the program achieved reasonably satisfactory performance in all the included



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courses. Students excelled in applied and laboratory-based subjects such as Chemistry Lab (GPA= 1.83) and Physics Lab (GPA = 2.06). In support, Instructor 6 emphasizes that students

“tend to excel in teamwork and practical applications/hands-on learning, as well as doing laboratory projects. They often showed strengths in practical applications.”

This result, supported by the study of Bradford et al. (2021), shows that the bridging program strongly develops practical and hands-on skills, which are the focus of laboratory-based courses.

Theoretical courses, including Calculus 1 (GPA = 2.24) and Calculus 2 (GPA = 2.34), also showed consistent and positive outcomes, supporting findings from related studies that bridging programs enhance conceptual understanding of STEM among non-STEM engineering students (Cançado et al., 2018). Instructor 7 mentioned that

“The Bridging program of the institution gives a great opportunity for the non-STEM graduates to at least have a basic mathematics background.”

However, among the courses, students got the lowest general point average in Differential Equation (GPA = 2.67), described as Fairly Satisfactory. This result highlights the need for additional support for non-STEM students towards advanced mathematics courses. This lower performance suggests that the school should provide targeted interventions for students' success in higher mathematics by integrating enhanced problem-solving modules or peer mentoring, to address specific academic challenges (Stefanek et al., 2020).

Impact of the Program in terms of Retention Rate

Table 6. Semestral Retention Rate of the Non-STEM Engineering Students for the Last Five Years

| Academic Year/Semester | Retention Rate (in %) |
|--|------------------------------|
| 2020 – 2021 (1 st Semester) | 100 |
| 2020 – 2021 (2 nd Semester) | 73.68 |
| 2021 – 2022 (1 st Semester) | 90.48 |
| 2021 – 2022 (2 nd Semester) | 90.41 |
| 2022 – 2023 (1 st Semester) | 95.45 |
| 2022 – 2023 (2 nd Semester) | 94.85 |
| 2023 – 2024 (1 st Semester) | 94.57 |
| 2023 – 2024 (2 nd Semester) | 90.00 |
| 2024 – 2025 (1 st Semester) | 88.89 |
| 2024 – 2025 (2 nd Semester) | 92.76 |

Table 6 presents the retention data for the past five years. All the participants from the bridging program enrolled in Engineering for the first semester of 2020–2021, as evidenced by the 100% retention rate. However, a sharp drop of 73.68% retention rate was observed for the following semester. This decline occurred at the onset of the COVID-19 pandemic, during which students experienced challenges in



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continuing their studies, such as the lack of technological resources. This decline shouldn't be seen as a program failure but as proof that even well-prepared students can struggle with major outside events. This data highlights what kind of holistic support is truly needed in a crisis.

However, from the academic year 2021–2022 onward, retention rates quickly became stable with a consistent percentage between 90% and 95%. This result is a sign of the program's long-term effectiveness which became one of the primary reasons why students stayed in engineering. The highest peak is 95.45% in the first Semester of 2022–2023. This retention rate suggests that students become persistent in continuing their Engineering studies despite the challenges they encounter along the way. The students' experiences in the program contribute to their strong academic persistence.

Compared with findings from related studies, the positive effect of the bridging program becomes even more apparent. Meta-analyses and program evaluations of similar bridge initiatives have shown medium to significant positive effects on first-year retention and persistence in STEM fields (Howard et al., 2019; Barth et al., 2021). The faculty also observed the consistently high retention rates, as Instructor 1 noted that

"Because of the bridging programs, the retention rates in Engineering programs improved as students are prepared to face the challenges and improve their academic performance."

Overall, the bridging program has had a substantial positive impact on retention, keeping rates significantly higher. This impact highlighted the role of the bridging program in preparing the students to be persistent. The bridging program was able to provide comprehensive support, which helped them sustain and stay in the field of Engineering.

CONCLUSION

This study reveals that the bridging program of the institution is generally effective in addressing the academic preparedness of the non-STEM engineering students. Students from diverse academic backgrounds express satisfaction with its operational process as they felt it helped them acquire knowledge, develop skills, and feel ready for their engineering studies. These positive feelings are associated with good academic performance and high retention rates in the engineering program. However, due to the limitation on not using a control group, this study cannot claim that the program is the sole cause of student success. Instead, the findings provide a strong basis for higher education institutions to develop and implement policies that improve bridging programs, ensuring non-STEM students are adequately prepared for the academic rigors of engineering courses.

This study also recognizes that despite the program's effectiveness and impact on the participants, various problems challenged its implementation. Thus, based on the results of the study, the following recommendations are proposed:

1. The department may restructure the class scheduling to reduce the class size. Divide the students into smaller groups and provide each group with an alternating schedule, allowing for more focused instruction and better student engagement.
2. Teachers may conduct regular formative assessments, not just summative, to help students receive immediate feedback to reinforce learning. This approach will further help students to monitor their progress more closely.



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3. Teachers may improve the pacing of instruction to ensure that students have adequate time to absorb material, avoid rushed delivery, and allow for deeper understanding.
4. The department may create a policy that admits students based on a defined performance standard from the bridging program and for those who don't meet it, offer options like probationary status, a reduced course load, or alternative academic pathways, which is crucial because the program currently lacks a clear performance benchmark.
5. The department may consider extending the duration of the program to a full semester or even a year to give students a more gradual transition, but this would require careful planning and budgeting for the increased costs and faculty workload.
6. Future studies should employ random sampling to ensure a more representative selection of participants ensuring generalizability of the findings.
7. Further comparative studies may be done to compare satisfaction levels or performance among students from different SHS strands to better understand the specific needs of each group.

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