

The Effectiveness of Blended Learning to General Engineering Students of Holy Angel University: Combining Traditional Instruction with Online Resources

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ABSTRACT: This study investigates the effectiveness of blended learning for general engineering students at Holy Angel University. Blended learning combines traditional face-to-face classroom instruction with online resources. The research aims to determine if this approach improves academic achievement, fosters a deeper understanding of engineering concepts, and enhances student engagement compared to traditional instruction alone. The study will involve general engineering students exposed to blended learning courses. This curriculum will integrate online resources such as simulations, tutorials, and interactive exercises alongside traditional lectures, discussions, and hands-on activities. Surveys to assess student perceptions of blended learning, including its impact on understanding, engagement, and self-directed learning skills. The findings of this research will contribute to the growing body of knowledge on blended learning in engineering education. The results will be particularly relevant to Holy Angel University, informing decisions about the potential benefits of implementing blended learning programs for general engineering students. By analyzing the effectiveness of blended learning on academic achievement, understanding, and engagement, the study will provide valuable insights for educators seeking to improve the learning experience for future generations of engineers.

KEYWORDS: Blended Learning, Engineering Education, Traditional Instruction, Online Resources, Learning Experience, Student Perception

I. INTRODUCTION

Higher education is constantly changing to satisfy the demands of a generation of students raised in the digital age. Traditional teaching approaches must utilize technology's opportunities for deeper learning and full engagement. Worldwide, educational institutions are seeing a huge trend toward integrating technology into their teaching and learning methods due to technological advancements and the improvement of online educational materials (Harahap et al., 2019). Many innovations are being adopted by the teaching and learning environment, and one of these is the utilization of technology through blended learning, which combines in-person and online teaching and learning (Kintu et al., 2017). Learning materials were previously exclusively available to educators and students in libraries, but with the development of the Internet, many materials are now accessible online. New subjects can now be studied online at home by educators and students. Technology has become a bigger part of teaching and learning in recent years, and as a result, educators are now substituting innovative teaching strategies for more conventional ones.

This research investigates the effectiveness of blended learning in improving student satisfaction among general engineering students at Holy Angel University. Some study says that incorporating online resources into engineering

curricula can foster a more engaging and interactive learning environment (Goy et al., 2020). Online resources can provide a rich repository of simulations, tutorials, and collaborative tools to enhance understanding of engineering concepts. Furthermore, fostering a supportive learning environment that encourages student interaction and collaboration, both online and offline, is crucial for maximizing the benefits of blended learning. This study explores whether a well-designed blended learning approach can cultivate a more satisfying learning experience for general engineering students at Holy Angel University. The research wants to provide a picture of the effectiveness of blended learning in this specific context by understanding student satisfaction.

Statement of the Problem

This research will assess the impact of implementing a blended learning approach on the academic performance, engagement, and learning experience of general engineering students at Holy Angel University. This research will address the following problems:

1. Effectiveness on Learning Outcomes: Does a blended learning approach that combines online resources with traditional instruction lead to significant improvement in academic performance compared to traditional instruction alone?

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2. Impact on Engagement: Does blended learning increase student engagement with the course material and overall learning process compared to traditional instruction?
3. Learning Experience: Do students perceive the blended learning environment as more positive, supportive, and effective compared to traditional instruction?
4. Optimal Design: What specific elements of the blended learning design (e.g., types of online resources, frequency of face-to-face interaction) contribute most effectively to positive learning outcomes and engagement?

Research Objectives

1. This study aims to determine if a blended learning approach leads to a statistically significant improvement in academic performance, measured by grades and test scores, compared to traditional instruction for general engineering students at Holy Angel University.
2. To investigate the impact of blended learning on student engagement and motivation in general engineering courses at Holy Angel University, compared to traditional instruction. This will involve measuring factors such as student participation, self-reported motivation, and overall satisfaction with the learning experience.
3. To investigate student perceptions of the blended learning environment in general engineering courses at Holy Angel University. This will involve measuring student opinions on factors like clarity, organization, and overall support provided by the blended learning approach compared to traditional instruction.
4. To identify and analyze the specific elements of the blended learning design (e.g., types of online resources, frequency of face-to-face interaction) that contribute most effectively to positive learning outcomes and student engagement in general engineering courses at Holy Angel University.

Theoretical/Conceptual Framework

This research focuses on the blended learning approach, which combines online resources with traditional classroom instruction, as the independent variable and its effectiveness as the dependent variable. The use of blended learning as a teaching strategy affects the independent variable. The researcher is measuring the dependent variable's effectiveness - the effectiveness of blended learning for Holy Angel University's general engineering students. This can be measured through student satisfaction.

Scope and Limitations of the Study

This research's respondents are the general engineering students at Holy Angel University. The intervention is the implementation of blended learning that combines traditional classroom instruction with online resources. The outcome variable is student satisfaction. While the research mentions effectiveness, this research will focus only on student satisfaction as a measure of blended learning effectiveness.

The research does not need to identify the specific levels of general engineering students (first-year, second-year students, etc.) for the course level. It does not mention the types or specific platforms used for online resources. The comparison group receiving only traditional instruction is not part of this research. While the title mentions effectiveness, the focus is only on student satisfaction. The research will not explore other potential impacts like academic performance or skill development. These delimitations help manage this research and make it more focused.

Significance of the Study

The study's significance addresses the needs of digital learners, who believe that engineering education must adapt to meet the changing requirements of technology-proficient students. This research can shed light on whether blended learning, which uses online resources, can improve student engagement and accommodate this generation's preferred methods of learning.

II. METHODS AND PROCEDURES

Research Design

The study will use a quantitative research approach. The researcher will use numerical data to analyze and interpret the research problems. The research focuses on student satisfaction as the main effectiveness indicator, assessed through survey questionnaires with scales or ratings. This data can be statistically analyzed and quantified.

Locale of the Study

The study was conducted at the School of Engineering and Architecture (SEA) of Holy Angel University (HAU). The School of Engineering and Architecture at Holy Angel University is an academic unit that provides quality engineering and architecture education in the Philippines. Established in 1963, SEA has a long history of educating engineering and architecture professionals. SEA offers Bachelor of Science degrees in various engineering disciplines, including Civil Engineering, Mechanical Engineering, Electrical Engineering, Industrial Engineering, Electronics Engineering, Computer Engineering, and Aeronautical. SEA also offers a Bachelor of Science degree in Architecture.

Respondents

The respondents in this research are the general engineering students at Holy Angel University (HAU). The general engineering students comprise first- and second-year engineering students from the seven engineering programs (Aeronautical, Civil, Computer, Electrical, Electronics, Industrial, and Mechanical Engineering) of the School of Engineering and Architecture. From their prior education, which included physics, chemistry, calculus, and early engineering topics, this group is probably well-versed in math, science, and fundamental engineering concepts. Depending on the year of education, their technical skill set

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may differ; some may know data analysis, computer-aided design (CAD), or basic programming.

There are a lot of learning styles. Some students prefer traditional classroom instruction, where they can connect directly with instructors. In contrast, others feel more comfortable and perform better in a learning environment, focusing on technology and using online resources. Access to and proficiency with technology also differs. Although they will probably have access to computers and the internet as engineering students, their comfort and skill levels when using educational technology tools or online learning platforms may vary.

This study will also take into account the specific demographics of HAU's general engineering population. Students' responses to blended learning strategies can be influenced by various factors, including age, gender, and engineering program. Knowing these features enables the research to be modified to the specific needs and experiences of the participants, producing more significant findings regarding the effectiveness of blended learning at Holy Angel University.

Research Instruments

The quantitative research utilizes a survey questionnaire. The questionnaire has 5-point Likert Scale items, which measure the respondents' agreement or disagreement with statements related to the research objectives. Demographic questions were also included to gather relevant information such as age, gender, and engineering program. The survey questionnaire is the instrument for collecting data that will be analyzed and interpreted to address the research goals and objectives.

Data Gathering Procedure

The survey was conducted online through Google Forms. The general engineering students will receive it via email and Canvas announcements. They are given enough time to complete the survey to respond, ensuring data collection efficiency. All survey responses will be collected anonymously to keep data security and confidentiality. Respondents were informed that their participation is confidential and that individual responses will not be identifiable.

Data Analysis Technique

The researchers will employ descriptive statistics as a fundamental data analysis component, drawing upon established statistical methodologies (Nicholas, 2006). This analytical approach will offer a comprehensive overview of the quantitative data gathered from the survey. Descriptive statistics involve the computation of key metrics, including the mean, median, standard deviation, and frequency distributions. These computations will be applied to different data types, such as Likert scale items, multiple-choice questions, and demographic information. The respondents are

asked to provide the following demographic information: age, gender, and engineering program.

The survey questionnaire has been divided into four categories:

1. *Effectiveness on Learning Outcomes:* These questions are designed to measure if a blended learning approach that combines online resources with traditional instruction improves academic performance compared to traditional instruction alone.

2. *Impact on Engagement:* These questions are designed to measure if blended learning increases student engagement with the course material and overall learning process compared to traditional instruction.

3. *Learning Experience:* These questions are designed to measure whether students perceive the blended learning environment as more positive, supportive, and effective than traditional instruction.

4. *Optimal Design:* These questions are designed to identify which elements of the blended learning design most effectively contribute to positive learning outcomes and engagement.

III. RESULTS AND DISCUSSION

Demographic Profile of the Respondents

This part includes the demographic profile of the students in terms of age, gender, and engineering program. In addition to the questions to measure the effectiveness of blended learning, it is also essential to ask some demographic questions to better understand the general engineering students of Holy Angel University.

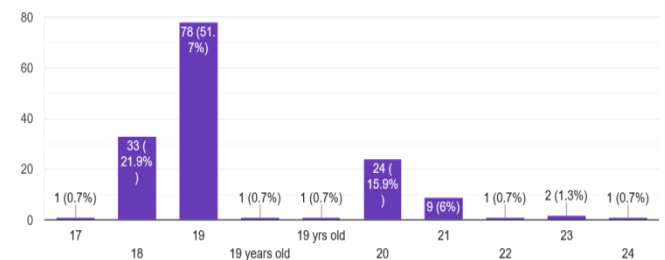


Figure 1.1 Respondent's Age Distribution

A total of 151 general engineering students answered the survey. The figure shows that most students who answered the survey questions are 18 (21.9%) or 19 (51.7%) years old. These results reflect the majority of the first—and second—year engineering students' ages.

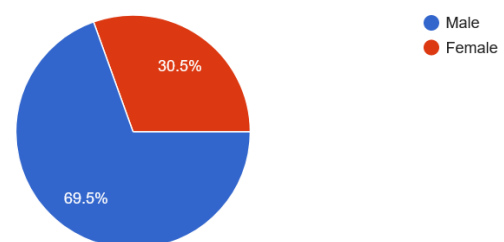


Figure 1.2 Respondent's Gender Distribution

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As seen in the figure, 105 (69.5%) of the 151 respondents are male, and 46 (30.5%) are female. Based on these results, the majority of the general engineering students who answered the survey were male.

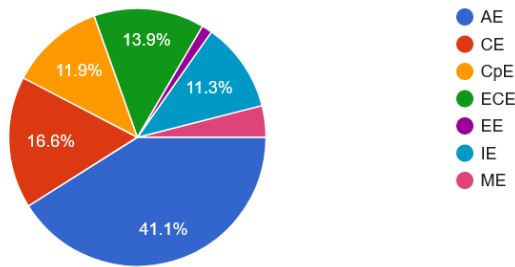


Figure 1.3 Respondent’s Engineering Course/Program

Table I Respondent’s Engineering Course/Program

Program	No. of Respondents	Percentage (%)
Aeronautical Engineering (AE)	62	41.1
Civil Engineering (CE)	25	16.6
Computer Engineering (CpE)	18	11.9
Electrical Engineering (EE)	21	13.9
Electronics Engineering (ECE)	2	1.3
Industrial Engineering (IE)	17	11.3
Mechanical Engineering (ME)	6	4.0

The result shows that 62 (41.1%) respondents identified as Aeronautical Engineering students. This high percentage indicates a strong focus on Aeronautical Engineering among Holy Angel University's general engineering students. It is possible that Aeronautical Engineering has a larger cohort size compared to other engineering programs.

Survey Questionnaire Results and Discussion

Table II-A Effectiveness on Learning Outcomes

Effectiveness on Learning Outcomes						
Questions	1	2	3	4	5	Mean
Compared to traditional classroom lectures, the online resources used in the blended learning program helped me prepare better	3	17	41	45	45	3.74

for exams and quizzes in this general engineering course.						
The online activities and practice problems in the blended learning program improved my understanding of the material covered in exams and tests compared to traditional classroom instruction.	3	16	31	61	40	3.79
I believe the blended learning approach (combining online and in-class components) contributed to my overall academic performance in this general engineering course.	1	11	35	39	65	4.03
I felt more confident in my ability to apply the learned concepts from this general engineering course to exam and test questions due to the blended learning approach.	0	15	44	49	43	3.79
The feedback and assessments provided during the online components of the blended learning program helped me identify areas	0	17	35	61	38	3.79

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where I needed improvement for exams and tests.						
The blended learning program offered opportunities for self-paced learning and additional practice, which positively impacted my performance in exams and quizzes.	0	14	30	52	55	3.98
Compared to a traditional, the blended learning approach required me to spend more time studying and preparing for exams and tests, but this extra effort led to better results.	3	15	39	48	46	3.79
Overall, I found the blended learning experience in this general engineering course to be more effective for achieving high grades in exams and tests compared to traditional lecture-based classes.	2	14	39	51	45	3.81
Considering the workload and learning outcomes, I believe the blended learning approach helped me achieve a deeper	2	21	38	48	42	3.71

understanding of the material, which ultimately benefited my performance in exams.						
Based on my experience, I believe the blended learning approach has the potential to improve academic performance in General Engineering courses at Holy Angel University.	2	11	33	52	53	3.95
Average Mean =						3.84

The average mean of 3.84 suggests that the respondents are generally neutral about the effectiveness on learning outcomes of blended learning approach at Holy Angel University. However, the highest mean of 4.03 for the question "I believe the blended learning approach (combining online and in-class components) contributed to my overall academic performance in this general engineering course." suggests that on average, students who participated in the survey perceived the blended learning approach to be beneficial for their academic performance in the general engineering courses.

Table II-B Impact on Engagement

Impact on Engagement						
Questions	1	2	3	4	5	Mean
The blended learning approach (combining online and classroom activities) encouraged me to participate more actively in this general engineering course compared to traditional	3	28	40	48	32	3.52

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lecture-based classes.							during online discussions and activities in the blended learning program.						
I felt a sense of accomplishment and satisfaction from completing online activities and assignments in the blended learning program.	2	11	29	58	51	3.96	The blended learning program provided opportunities for self-reflection and assessment of my learning progress in this general engineering course.	0	10	35	70	36	3.87
The blended learning program (combining online and in-class components) helped me stay more focused and motivated to learn the material in this general engineering course.	3	19	42	60	27	3.59	Compared to a traditional engineering course, the blended learning approach made me feel more responsible for my own learning in this general engineering course.	0	11	23	72	45	4.00
The online resources and activities in the blended learning program sparked my curiosity and interest in learning more about the topics covered in this general engineering course.	0	16	45	58	32	3.70	Overall, I found the blended learning experience in this general engineering course to be more engaging and stimulating than traditional classroom instruction.	8	21	39	51	32	3.52
I felt comfortable asking questions and seeking clarification	1	29	46	42	33	3.51	If given a choice, I would prefer to take future general engineering courses at Holy Angel University that	3	16	32	53	47	3.83

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utilize a blended learning approach.						
Considering both the learning experience and the level of engagement, I would recommend the blended learning approach for future general engineering courses at Holy Angel University.	2	11	36	54	48	3.89
Average Mean =						3.74

The average mean of 3.74 suggests that the respondents are generally neutral about the impact of the blended learning approach on students' engagement at Holy Angel University. However, the highest mean was 4.00 for the question "Compared to a traditional engineering course, the blended learning approach made me feel more responsible for my own learning in this general engineering course." and a mean of 3.96 for the question "I felt a sense of accomplishment and satisfaction from completing online activities and assignments in the blended learning program." suggests that blended learning approach in general engineering courses had a positive impact on student engagement, specifically in terms of increased ownership on learning. It indicates that students felt greater control and responsibility for their learning in the blended learning approach, possibly due to the online resources offering self-paced learning and exploration opportunities. The blended learning approach in general engineering courses also positively impacted student engagement in terms of motivation and accomplishment. It suggests that students found online activities and assignments in the blended learning program motivating. Completing these activities and assignments provided a sense of achievement, further boosting their engagement.

Table II-C Learning Experience

Learning Experience						
Questions	1	2	3	4	5	Mean
I found it challenging to manage my time effectively between online activities and in-class sessions in the blended learning program.	6	32	51	39	23	3.27
The technology used in the blended learning program (e.g., online platform, software) was not user-friendly or reliable.	25	62	36	20	8	2.50
I lacked adequate technical skills or knowledge to participate effectively in the online components of the blended learning program.	36	45	48	18	4	2.40
The workload associated with the online activities and assignments in the blended learning program felt overwhelming compared to traditional courses.	19	24	48	45	15	3.09
I experienced difficulty staying focused and motivated during the	11	22	46	47	25	3.35

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online components of the blended learning program.						
Adjusting to the balance between online activities and in-class sessions in the blended learning program was challenging.	14	27	34	49	27	3.32
I found it difficult to stay motivated and engaged during the online components of the blended learning program compared to traditional classroom instruction.	14	25	47	48	17	3.19
The online learning environment in the blended program required more self-discipline and time management skills compared to traditional courses.	8	10	44	49	40	3.68
The blended learning program did not provide me with enough opportunities for interaction and collaboration with classmates, especially during online components.	15	32	55	36	13	3.00

I lacked access to reliable technology or a stable internet connection, which hindered my participation in the online components of the blended learning program.	31	44	42	24	10	2.59
Average Mean =						3.04

The average mean of 3.04 suggests that the respondents are generally neutral about the impact of the blended learning approach on students' learning experience at Holy Angel University. However, the highest mean of 3.68 for the question "The online learning environment in the blended program required more self-discipline and time management skills compared to traditional courses." suggests that students perceived the blended learning program as requiring them to be more self-disciplined and managing their time effectively compared to traditional courses aligns with the purpose of blended learning, which is to promote self-paced learning and independent exploration of online resources. Also, the question "I lacked adequate technical skills or knowledge to participate effectively in the online components of the blended learning program." with the lowest mean of 2.40, indicates that most students felt they had sufficient technical skills to participate effectively in the online components.

Table II-D Optimal Design

Optimal Design						
Questions	1	2	3	4	5	Mean
a. Focus on Online Resources						
The online resources used in the blended learning program (e.g., simulations, tutorials, videos) helped me understand the course	0	9	37	56	49	3.96

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material more effectively than traditional textbooks.						
The online activities and assignments in the blended learning program were engaging and helped me apply the learned concepts to real-world engineering problems.	1	10	51	58	31	3.72
The online discussion forums in the blended learning program provided valuable opportunities to interact with classmates and clarify doubts about the course material.	0	17	54	57	23	3.57
b. Focus on Face-to-Face Interaction:						
The frequency of face-to-face interaction in the blended learning program (e.g., lectures, workshops) was sufficient to address any questions or	1	15	43	65	27	3.68

difficulties encountered with online components.						
The in-class sessions in the blended learning program effectively complemented the online learning and helped me solidify my understanding of the key concepts.	0	9	36	71	35	3.87
The instructor's use of active learning strategies (e.g., group work, problem-solving activities) during in-class sessions in the blended program enhanced my learning and engagement.	0	5	31	74	41	4.00
c. Focus on Design Balance:						
The blended learning program found a good balance between the time spent on online activities and in-class sessions, facilitating efficient learning.	0	10	49	57	35	3.77

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The online components of the blended learning program did not take away from the value of face-to-face interaction in the course.	1	19	47	58	26	3.59
Overall, the blended learning design (combining online resources and face-to-face elements) contributed more effectively to my learning and engagement compared to a traditional lecture-based course.	1	11	36	56	47	3.91
Average Mean =						3.79

The average mean of 3.79 suggests that the respondents are generally neutral about the overall design of the blended learning program at Holy Angel University. Under the effectiveness of online resources, the question with the highest mean of 3.96 is "The online resources used in the blended learning program (e.g., simulations, tutorials, videos) helped me understand the course material more effectively than traditional textbooks." indicates that student found online resources more helpful for understanding the course material compared to traditional textbooks, it also suggests that the online resources were well-designed and engaging, effectively complementing the traditional learning materials. Under the importance of face-to-face interaction, the question with the highest mean of 4.00 is "The instructor's use of active learning strategies (e.g., group work, problem-solving activities) during in-class sessions in the blended program enhanced my learning and engagement." highlights the importance of active learning strategies used by the instructor

during in-class sessions. These strategies enhanced their learning and engagement; it also suggests that the face-to-face component provided valuable opportunities for collaboration, application of knowledge, and deeper understanding beyond the online resources. Under the power of balance, the question with the highest mean of 3.91 is "Overall, the blended learning design (combining online resources and face-to-face elements) contributed more effectively to my learning and engagement compared to a traditional lecture-based course." it indicates that students felt that the overall blended learning design, combining online resources and face-to-face elements, contributed more effectively to their learning and engagement compared to traditional lecture-based courses. This also indicates that the blended learning program successfully balances the benefits of online learning and the value of in-class interaction.

IV. CONCLUSIONS&RECOMMENDATIONS

Summary of Findings

Based from the results of the survey questions it suggests that:

1. The blended learning program at Holy Angel University has the potential to positively contribute to student achievement in general engineering courses.
2. The blended learning approach has made students feel more in charge of their learning journey, and the online activities keep them motivated and satisfied with their progress. It can also lead to deeper engagement with the course material as students become more invested in learning.
3. While the blended program required students to be more self-directed and manage their time well, most students felt comfortable with the level of technical skills needed to participate effectively in the online aspects. It also indicates that the blended program design likely offered sufficient support or assumed a baseline level of technical competency that most students met.
4. The students found the online resources valuable for understanding the material. The in-class sessions with active learning strategies further solidified their learning, and the overall design led to a more engaging and effective learning experience than traditional lecture-based courses.

Conclusions

Based on the survey results, the blended learning program experienced by the general engineering students at Holy Angel University successfully promotes student engagement and potentially improves learning outcomes. Students stated that they felt more responsible for their education and considered online resources such as videos, tutorials, and simulations more beneficial than traditional textbooks. It implies that the program encouraged a sense of responsibility and offered useful resources for self-directed

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learning. Furthermore, research appears that the focus on strategies for active learning during in-class sessions, like group projects and problem-solving exercises, has improved student engagement and strengthened their comprehension of the subject matter.

In addition, compared to traditional lecture-based courses, most students believed that the blended design, which combines online resources with in-person interaction, contributed more effectively to their learning and engagement. It shows that the program successfully combined the social and collaborative advantages of in-person engagement with the flexibility and self-paced nature of online learning. Lastly, even though the survey's results were based entirely on student perceptions, the high mean of the question about how the combination of strategies affected academic performance suggests that it may have had a good effect on student achievement.

Overall, the survey results prove that Holy Angel University's blended learning approach is effective for teaching general engineering students. It encourages student participation, provides useful learning resources, and could result in better academic performance. However, these findings might be strengthened by more studies using measurable indicators of student accomplishment, such as exam results. Furthermore, looking at the program's adjustments to different learning styles may yield insightful information for future program improvement.

Recommendations

Based on the positive survey results regarding the blended learning program at Holy Angel University, here are some recommendations and suggestions for further improvement:

1. According to the survey, students are responding positively to the blended learning program, which has the potential to improve their learning experience. The university can provide these general engineering courses under this program and plans to apply them to other academic courses. Continuous assessment and improvement are also needed. Finding improvement areas will be easier by constantly collecting feedback from students and evaluating performance statistics like test results and completion rates.
2. The survey indicates that students find the online resources valuable. However, there is also room for improvement. The university may consider:
 - Expanding the scope of online materials to include interactive simulations, tests, and gamified assessments could improve student engagement even further while accommodating various learning preferences.
 - One key component of an inclusive learning environment is ensuring that all online materials are usable by students with impairments.

- Providing training for instructors on effectively integrating online resources into their teaching to maximize their impact.
1. The blended learning program encourages student responsibility for their learning. The university can find ways to support this, such as:
 - Offering workshops or online resources on time management strategies that can equip students with the skills needed to thrive in a self-paced learning environment.
 - Setting up discussion boards or forums on online platforms can give students a space to interact, exchange questions and opinions, and encourage one another on their learning journey.

By implementing these recommendations and continuously refining the program, Holy Angel University can solidify the effectiveness of its blended learning approach and ensure a consistent positive learning experience for its general engineering students.

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