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Empowering future engineers: The role of process optimization and emerging technologies in industrial engineering at Bulacan State University-Bustos Campus

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Abstract

Aim: This study aimed to examine the integration of process optimization and emerging technologies in enhancing student performance and exam success rates among Industrial Engineering (IE) students at Bulacan State University – Bustos Campus. Specifically, it aimed to determine the effects of process optimization techniques and emerging technologies on the study habits, exam preparation, academic performance, and integration challenges of Industrial Engineering students.

Methodology: The study employed a descriptive-correlational design to examine how process optimization and new technologies affect students' performance and exam success in Industrial Engineering at Bulacan State University-Bustos. It assessed frequency, percentage, and perception regarding study habits, time management, emerging technologies, and process optimization. To identify significant relationships between variables and academic performance, the correlational method was used in analyzing the link between respondents and their General Weighted Average (GWA).

Results: The findings indicated that the adoption of process-optimization strategies and emerging technologies significantly enhanced the academic performance and examination passing rates of Industrial Engineering students at Bulacan State University–Bustos Campus.

Conclusion: The study found that structured study methods significantly influence Industrial Engineering students' academic performance and exam success, positive perceptions of process optimization and emerging technologies, and the effective integration of these strategies, highlighting the need for institutional support in study skills and technology use.

Keywords: *Process Optimization, Bulacan State University, Emerging Technology, Artificial Intelligence, Industrial Engineering, and General Weighted Average*

INTRODUCTION

Industrial Engineering (IE) is a multidisciplinary field concerned with the design, analysis, improvement, and optimization of complex systems and processes across various industrial sectors. Its primary objective is to improve productivity, reduce waste, and enhance operational efficiency, which are critical for maintaining competitiveness in modern industries. Industrial engineers are trained to optimize systems involving people, materials, information, equipment, and energy to ensure efficient system performance and resource utilization. The Industrial Engineering curriculum teaches systems analysis, operations research, quality control, supply chain, and manufacturing systems, preparing students to solve operational and optimization problems in manufacturing, logistics, healthcare, and services.

In Industry 4.0, characterized by increased automation, interconnectivity, and smart technologies transforming manufacturing and industrial processes, engineering education should prepare students for data-driven, automated environments by integrating process optimization principles and emerging technologies like AI, data analytics, and intelligent systems, which support academic performance and readiness for modern digital workplaces.

At Bulacan State University – Bustos Campus, the Industrial Engineering program combines theory and practice through courses like operations research, lean manufacturing, and engineering economics. Despite structured coursework and resources, many students face challenges such as time management, heavy workloads, and stress,

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which can harm academic performance. These issues mirror inefficiencies in industrial systems, caused by poor scheduling, resource allocation, and process bottlenecks. Addressing these requires planning, task prioritization, and resource use, key in process optimization.

Apart from the study strategies, digital technologies such as Artificial Intelligence (AI), Internet of Things (IoT), and online platforms facilitate learning efficiency through personalized feedback and data-driven decision-making. These tools exemplify the principles of Industry 4.0, including system monitoring and optimization. This study explored how the integration of process optimization and emerging technologies can improve learning outcomes and examination performance among students of Industrial Engineering, thereby advancing their success in contemporary industrial and digital settings.

Review of Related Literature and Studies

In this chapter, the authors reviewed existing literature on the integration of process optimization techniques and emerging technologies in improving academic performance, with a specific focus on Industrial Engineering students. They examined the impact of time management, task prioritization, study efficiency, and the role of emerging technologies like Artificial Intelligence (AI) and the Internet of Things (IoT) on student academic success. They also explored challenges, opportunities, and research gaps within this context. They concluded by synthesizing the reviewed literature and identifying gaps in current research.

Process Optimization in Education

Industrial engineering–based process optimization improves education by focusing on time management, task prioritization, and evidence-based study strategies that enhance learning and well-being. Students who organize study schedules and plan workloads perform better, experience less stress, and handle coursework more effectively, following principles that view time as a limited resource to maximize output. Breaking complex tasks into smaller parts further boosts focus, understanding, and performance (Heath & Shine, 2021).

Evidence-based learning techniques such as active recall and spaced repetition also play a critical role in optimizing study processes. Active recall enhances long-term memory through retrieval practice, while spaced repetition schedules reviews to maximize retention and minimize total study time. When integrated into structured study plans, these strategies improve examination readiness and promote durable knowledge acquisition across disciplines (Durrani et al., 2024; Voice & Stirton, 2020). Collectively, these process-optimization practices demonstrate how industrial engineering principles can be effectively applied to educational contexts to improve learning efficiency and academic performance.

Emerging Technologies in Education

The rapid advancement of Artificial Intelligence (AI) and the Internet of Things (IoT) is reshaping educational processes by enabling more personalized and efficient learning experiences. AI-powered learning applications can tailor content, pacing, and feedback to individual student needs, helping identify knowledge gaps and focus practice on priority areas. Empirical studies show that AI-based tutoring systems improve engagement, study-time management, and academic performance through adaptive recommendations and real-time progress monitoring (Avcı et al., 2025; Chinnasamy et al., 2025; Hajeer et al., 2024).

IoT technologies enhance learning by collecting real-time data from wearables and connected devices to optimize study habits, time management, and focus. They can prompt breaks, suggest task switches, and provide insights, turning behavioral data into feedback that supports efficient routines (Mtshali et al., 2022; Kamalov et al., 2023). Online platforms like Moodle, Coursera, and Edmodo offer flexibility, collaboration, and assessment, improved by AI analytics. However, AI and IoT pose ethical issues such as data privacy, transparency, and access. Governance, security, faculty training, and pedagogical alignment are vital to foster critical thinking and autonomy while maximizing benefits (Suparakan et al., 2023; Hajeer et al., 2024; Kamalov et al., 2023). Combining strategies and AI tools enhances academic management, with AI tutors addressing knowledge gaps and IoT devices providing data to improve focus and time management (Sun & Zhou, 2024).

Generative AI and online learning platforms improve performance through personalization, adaptive practice, and immediate feedback. These tools support metacognitive planning, motivation, and mastery beyond test scores. When combined with learning analytics in LMS, students get guidance on study, rest, or task shifts, leading to efficient habits and deeper learning. This approach is especially helpful in Industrial Engineering and STEM, managing heavy workloads with real-time feedback and structured schedules (Sun & Zhou, 2024). However, successful implementation requires attention to ethics, privacy, consent, and access, to prevent bias and

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overdependence. Faculty training and aligned assessments are vital to ensure AI and IoT tools support critical thinking and autonomy. Properly designed, integrating process optimization and analytics can boost study habits, time management, and academic performance (Sun & Zhou, 2024).

Challenges in Integrating Process Optimization and Technology

Enhanced academic performance links process optimization with AI and IoT. AI tools, effective time management, and task prioritization lead to better study patterns, increased concentration, and improved exam results. These technologies personalize learning, monitor goals, and identify areas for improvement via AI tutoring, helping students manage study time and focus on weaknesses (Almaraz-Lopez et al., 2023). Adaptive learning, supported by these technologies, aims to improve academic outcomes (Wu & Yu, 2023).

Developments benefit students, notably in interdisciplinary fields like Industrial Engineering, where AI tools and time management improve exam results and project quality (Buchanan et al., 2021). Combining technology and educational methods enhances planning, engagement, and performance in STEM, especially for struggling students (Yan et al., 2021). Empirical evidence supports AI and IoT's role in transforming study habits: AI tutors boost information retention and test prep (Almaraz-Lopez et al., 2023), while IoT data helps organize studying and prioritize activities (Wu & Yu, 2023). Focusing on time management and prioritization, these technologies lead to better academic outcomes across disciplines (Yan et al., 2021).

Previous studies explore AI in education, IoT-enabled learning, adaptive technologies, and strategies that boost learning efficiency and academic results. They show that emerging technologies and structured strategies can enhance engagement and outcomes. However, most studies examine technologies or strategies independently, with limited research on integrating process optimization principles and emerging technologies as a combined learning system, especially in Industrial Engineering education. The application of concepts like scheduling, resource allocation, workflow planning, and optimization to learning systems remains underexplored. This study filled this gap by investigating how combining process optimization and emerging technologies can improve learning and exam performance for Industrial Engineering students. It contributed by proposing a learning system that integrates industrial engineering principles with educational technologies to enhance efficiency, performance, and readiness for Industry 4.0.

Theoretical Framework

This study is anchored in Systems Theory, which views education as a complex system composed of interrelated elements—students, instructors, technologies, and the learning environment—that must function cohesively to achieve desired outcomes. Guided by this perspective, the study examined how process optimization strategies and emerging technologies interact to enhance examination performance and overall student success among Industrial Engineering students at BulSU Bustos.

It was also informed by the Technology Acceptance Model (TAM), which explains that the adoption of new technologies depends on perceived usefulness and ease of use. Through TAM, the study assessed students' perceptions and utilization of AI, IoT, and online learning platforms and how these factors influence academic performance. Together, these frameworks provide an integrative lens for analyzing how the fusion of optimized study processes and emerging technologies contributes to improved student outcomes.

Furthermore, the study was viewed from an Industrial Engineering perspective, where learning was treated as a system that can be analyzed and optimized using process optimization principles such as scheduling, task prioritization, workflow planning, and resource allocation to improve learning efficiency and academic performance.

Conceptual Framework

The conceptual framework of this study was based on the interaction between process optimization strategies and emerging technologies as independent variables, and student performance and examination outcomes as dependent variables. The Input–Process–Output (IPO) model was used to represent the study as a learning system rather than a physical engineering system. In this framework, the variables were treated as learning system variables that influence learning processes and academic performance.

In the input phase, process optimization strategies like time management, task prioritization, and goal setting served as learning system inputs that organized study activities. Technologies like AI learning platforms, IoT devices, and online resources were also inputs supporting personalized learning and access to information. During the process phase, these inputs were transformed through activities such as time allocation, task prioritization, developing study habits, and using digital tools. These processes enhanced students' ability to manage learning efficiently, similar to engineering system optimization. The output phase presented learning outcomes like exam passing rates, GPAs, and

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academic success. In summary, the IPO framework illustrated how process strategies and technologies influence learning processes, leading to better performance and outcomes.

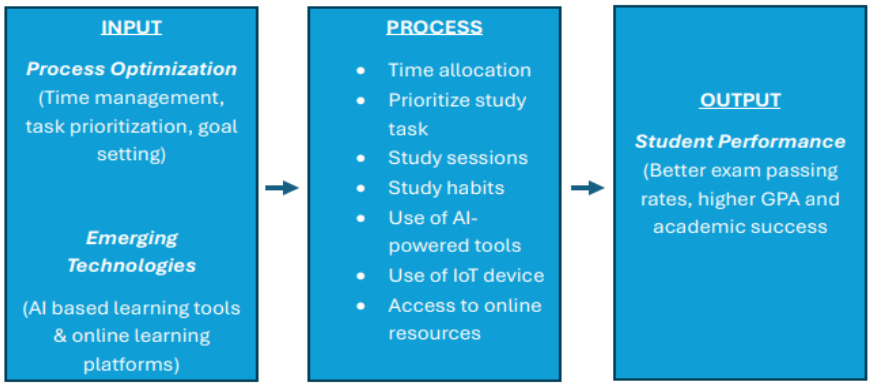

Figure 1. Conceptual Framework Depicting the Learning System Concentrating on Process Optimization and Emerging Technologies

Statement of the Problem

Academic success in engineering education requires not only strong theoretical knowledge but also effective learning strategies and the ability to adapt to emerging technologies. Industrial Engineering students are expected to manage complex coursework, multiple examinations, and demanding analytical tasks. Despite the availability of instructional resources and digital learning tools at Bulacan State University – Bustos Campus, many students continue to experience difficulties achieving consistent academic performance and satisfactory examination results. These challenges are often associated with ineffective study habits, poor time management, high academic workload, and limited strategic utilization of digital learning technologies.

Recent technological advancements, such as artificial intelligence–based learning tools, online learning platforms, and Internet of Things (IoT)–enabled learning environments, offer opportunities to enhance personalized learning, improve study efficiency, and support data-driven academic performance monitoring. However, the adoption and integration of these technologies into students' study routines remain inconsistent and often lack structured implementation.

Similarly, process optimization techniques commonly used in Industrial Engineering—such as time-blocking, task prioritization, and goal setting—have the potential to improve learning efficiency and examination preparedness. Nevertheless, the combined influence of process optimization strategies and emerging technologies on academic performance has not been sufficiently investigated among Industrial Engineering students.

Given these conditions, it is necessary to analyze how process optimization techniques and emerging technologies influence the study habits, examination preparation, and academic performance of Industrial Engineering students. Understanding these relationships can provide insights into how structured study strategies and technology-assisted learning environments may improve student outcomes and support the development of more efficient and technology-integrated engineering education systems.

Research Objectives

General Objective

To examine the integration of process optimization strategies and emerging technologies in enhancing student performance and examination success among Industrial Engineering students at Bulacan State University – Bustos Campus.

Specific Objectives

1. To determine the process optimization techniques that influence the academic performance of Industrial Engineering students in terms of:
   1.1 time management
   1.2 task prioritization

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1.3 study efficiency
1.4 goal setting

2. To assess the contribution of emerging technologies to students' study habits, examination preparation, and academic success in terms of:
   2.1 AI-powered learning tools
   2.2 online learning platforms
   2.3 educational applications
   2.4 IoT-enabled learning tools
3. To analyze the relationship between process optimization strategies and the academic performance of Industrial Engineering students.
4. To identify the challenges encountered by Industrial Engineering students in integrating process optimization techniques and emerging technologies into their study routines.

Research Questions

1. What process optimization techniques influence the academic performance of Industrial Engineering students in terms of time management, task prioritization, study efficiency, and goal setting?
2. How do emerging technologies such as AI-powered learning tools, online learning platforms, educational applications, and IoT-enabled learning tools contribute to students' study habits, examination preparation, and academic success?
3. Is there a significant relationship between the use of process optimization strategies and the academic performance of Industrial Engineering students?
4. What challenges do Industrial Engineering students encounter when integrating process optimization techniques and emerging technologies into their study routines?

Hypothesis

Null Hypothesis (H_0)

There is no significant relationship between the use of process optimization strategies and emerging technologies and the academic performance of Industrial Engineering students.

METHODS

Research Design

This study used a descriptive-correlational design to examine how process optimization and new technologies affect students' performance and exam success in Industrial Engineering at Bulacan State University-Bustos. It assessed frequency, percentage, and perception regarding study habits, time management, emerging technologies, and process optimization. To identify significant relationships between variables and academic performance, the correlational method was used to analyze the link between respondents and their General Weighted Average (GWA).

Population and Sampling

The study sample comprised students from the Industrial Engineering program at Bulacan State University's Bustos Campus. Purposive sampling was used to include only those currently enrolled and who had experienced major examinations, aiming for a sample size of approximately 92 students. This sizable cohort facilitated a robust analysis of the relationships between process optimization strategies, emerging technologies, and academic performance.

Instruments

The researcher received approval from Bulsu-Bustos' Department of Industrial Engineering to conduct the study. An online questionnaire, validated by an expert and refined based on feedback, was developed in six sections: demographic information, study habits and time management, use of new technologies in academics and examinations, perceived impact of emerging technologies and interventions on exam success, and open-ended responses about academic life and strategies. It included multiple-choice and Likert-scale items (1=Strongly Disagree to 5=Strongly Agree) to assess perceptions and responses related to study habits, tech use, and academic impact. The instrument demonstrated acceptable internal consistency (Cronbach's $\alpha = 0.82$).

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Data Collection

The researchers distributed the survey questionnaires to the selected Industrial Engineering students of Bulacan State University – Bustos Campus. Before the distribution of the questionnaires, the purpose of the study and the procedures were explained to the participants. After the explanation, the questionnaires were administered to the respondents for completion. The participants were given one (1) day to complete the survey questionnaire. The completed questionnaires were then collected, checked for completeness, and prepared for data encoding and analysis.

Data Analysis

The data were analyzed statistically to examine relationships between process optimization, technology adoption, and academic performance. Demographics, study habits, and tech use were summarized using frequency and percentage distributions. The Chi-square test was employed to identify significant associations at a 0.05 significance level. Qualitative responses underwent thematic analysis to identify recurring themes. Data collected from the survey were encoded and analyzed with Microsoft Excel. Descriptive statistics such as frequency, percentage, mean, and standard deviation summarized the respondents' profiles and responses. The Chi-square test of independence evaluated whether there was a significant relationship between process optimization strategies, the use of emerging technologies, and student academic performance. This test is suitable because the variables are categorical, and it assesses the association between categorical variables. A significance level of 0.05 was applied for hypothesis testing.

Ethical Considerations

The researcher ensured that all ethical guidelines were followed, including obtaining informed consent from participants and ensuring the confidentiality and privacy of their responses throughout the study.

RESULTS and DISCUSSION

This portion of the study shows the analysis and interpretation of the gathered data from the group of respondents.

1. Demographic Profile of the Respondents

Table 1 demonstrated the respondents' demographics, wherein most respondents were 4th year students (n = 52, 56.5%), with 2nd year students being the smallest group (n = 17, 18.5%). The gender distribution was equal (n = 46 each, 50.0%), indicating balanced representation. Most had a GWA below 2.0 (n = 65, 70.7%), indicating high academic performance, while only 2 (2.2%) had a GWA of 2.5–3.0.

Table 1: Demographic Profile of the Respondents

Variables	N	%
Year Level		
2nd Year	*17*	*18.5%*
3rd Year	*23*	*25.0%*
4th Year	*52*	*56.5%*
Sex		
Female	*46*	*50.0%*
Male	*46*	*50.0%*
GWA		
Below 2.0	*65*	*70.7%*
2.0 - 2.5	*14*	*15.2%*
2.51 – 2.99	*2*	*2.2%*
3.0 - 3.49	*5*	*5.4%*
3.5 - 4.0	*6*	*6.5%*

Legend: Below 2.0 (Excellent); 2.0 - 2.5 (Good); 2.51 – 2.99 (Satisfactory); 3.0-3.4 (Passing); 3.5 - 4.0 (Conditional passed)

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The dominance of senior students suggests greater academic experience and familiarity with examination demands, which is associated with more effective learning strategies (Voice & Stirton, 2020). The equal gender distribution minimizes sex-related bias, implying that differences in performance are more likely attributed to study behaviors rather than gender (Heath & Shine, 2021).

Overall, the high proportion of low GWA values supports the role of effective time management, task organization, and self-regulation in achieving strong academic outcomes, while the presence of higher GWA scores indicates the need for targeted academic support for struggling students.

2. Study Habits and Time Management

Table 2 revealed that the most commonly used study method for exam preparation was reviewing lecture notes (n = 87, 40.7%), while reading textbooks was the least used (n = 17, 7.9%). In terms of time management, the majority applied time-blocking techniques (n = 26, 28.3%), whereas only a few relied on reminders or productivity apps (n = 7, 7.6%). Despite using structured strategies, most respondents reported often feeling overwhelmed during exam preparation (n = 41, 44.6%), with only 6 (6.5%) rarely experiencing this.

Table 2: Study Habits and Time Management

Variables	N	%
Which study methods do you primarily use for exam preparation?		
Reviewing lecture notes	*87*	*40.7%*
Reading textbooks	*17*	*7.9%*
Participating in study groups	*23*	*10.7%*
Practicing with past exams	*52*	*24.3%*
Using online resources or courses	*35*	*16.4%*
How do you manage your time during exam preparation?		
I use a detailed study schedule	*9*	*9.8%*
I study spontaneously when I feel the need	*22*	*23.9%*
I break down topics into manageable chunks	*20*	*21.7%*
I use time-blocking techniques (e.g., study for 25 minutes, take a 5-minute break)	*26*	*28.3%*
I rely on reminders or productivity apps	*7*	*7.6%*
I do not actively manage my time	*8*	*8.7%*
How often do you feel overwhelmed with your workload during exam preparation?		
Never	*0*	*0.0%*
Rarely	*6*	*6.5%*
Occasionally	*20*	*21.7%*
Often	*41*	*44.6%*
Always	*25*	*27.2%*

The preference for lecture notes and past materials indicates a structured, outcome-focused study approach that supports improved engagement and task organization, as noted by Pérez-Sanagustin et al. (2020). However, the high level of perceived overwhelm suggests that time-management strategies alone may not be sufficient to reduce academic stress, as heavy cognitive load and dense coursework can still affect students even when organized study methods are used (Durrani et al., 2024).

3. Use of Emerging Technologies as perceived by the respondents

The results showed that most respondents used AI-based study tools (e.g., AI tutors and ChatGPT) for academic work and exam preparation (n = 72, 45.6%), while only a few utilized VR/AR for simulations (n = 3,

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1.9%). The majority reported occasional use of emerging technologies (n = 39, 42.4%), with fewer using them weekly (n = 23, 25%). In terms of perceived effectiveness, most rated these technologies as slightly effective in improving exam preparation (n = 36, 39.1%), whereas only 3 (3.3%) considered them slightly ineffective.

Table 3. Use of Emerging Technologies as perceived by the respondents

Variables	N	%
Which of the following technologies do you use in your academic work or exam preparation?		
Artificial Intelligence-based study tools (e.g., AI tutors, ChatGPT, etc.)	*72*	*45.6%*
Online learning platforms (e.g., Coursera, edX, Moodle, etc.)	*19*	*12.0%*
Virtual reality (VR) or augmented reality (AR) for Simulations	*3*	*1.9%*
Educational apps (e.g., Quizlet, Khan Academy, etc.)	*41*	*25.9%*
Internet of Things (IoT)-enabled learning tools (e.g., smart notebooks, IoT sensors)	*17*	*10.8%*
I do not use emerging technologies for academic purposes	*6*	*3.8%*
How often do you use emerging technologies for your studies or exam preparation?		
Daily	*30*	*32.6%*
Weekly	*23*	*25.0%*
Occasionally	*39*	*42.4%*
Never	*0*	*0.0%*
In your opinion, how effective are emerging technologies (AI, IoT, online learning platforms) in improving your exam preparation?		
Not Effective At All	*0*	*0.0%*
Slightly Not Effective	*3*	*3.3%*
Moderate	*20*	*21.7%*
Slightly Effective	*36*	*39.1%*
Highly Effective	*32*	*34.8%*

These findings indicated a growing reliance on AI-driven tools that support personalized and efficient learning, aligning with studies showing that AI enhances feedback, individualization, and task-focused academic support, which increases student acceptance of technology-enhanced learning (Avcı et al., 2025; Chinnasamy et al., 2025).

4. Process Optimization and Academic Success

The findings showed that prioritizing key topics was the most common process optimization method (n = 70, 35.7%), while few respondents (n=4, 2%) reported using no technique. Most often, respondents applied process optimization in their studies (n=45, 48.9%), and nearly half found these strategies very helpful for academic performance (n=43, 46.7%), with only one seeing no benefit (1.1%). Task prioritization was seen as the most effective strategy (n=38, 41.3%), compared to limited use of productivity tools or apps (n=6, 6.5%).

Table 4. Process Optimization and Academic Success

Variables	N	%
Do you use any of the following process optimization techniques in your study routine?		
Time-blocking (e.g., study in intervals with breaks)	*38*	*19.4%*
Prioritizing the most important topics	*70*	*35.7%*
Breaking down large topics into smaller, manageable tasks	*44*	*22.4%*
Setting specific goals for each study session	*30*	*15.3%*
Using productivity tools or apps (e.g., task managers, Pomodoro timers)	*10*	*5.1%*

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I do not use any process optimization techniques	*4*	*2.0%*
How often do you utilize process optimization techniques to manage your study time and tasks?		
Always	*27*	*29.3%*
Often	*45*	*48.9%*
Sometimes	*18*	*19.6%*
Never	*2*	*2.2%*
How much do you think process optimization techniques contribute to improving your academic performance?		
Not helpful at all	*1*	*1.1%*
Slightly not helpful	*2*	*2.2%*
Moderately helpful	*16*	*17.4%*
Slightly helpful	*30*	*32.6%*
Very helpful	*43*	*46.7%*
Which of the following process optimization techniques has been most effective in helping you succeed academically?		
Time-blocking	*10*	*10.9%*
Prioritizing tasks	*38*	*41.3%*
Breaking down study topics	*25*	*27.2%*
Setting specific study goals	*13*	*14.1%*
Using productivity tools/apps	*6*	*6.5%*

These results emphasized the importance of systematic planning, prioritization, and breaking down complex topics in supporting self-regulated learning and improving retention, particularly in engineering-related courses, thereby reinforcing the role of process optimization in achieving academic success (Heath & Shine, 2021; Voice & Stirton, 2020).

5. Impact of Emerging Technologies and Process Optimization in Exam Success

The findings in Table 5 indicated that most respondents believe that combining emerging technologies with process optimization techniques improves exam success (n = 58, 63%), while only one person was uncertain (1.1%). Effective study strategies, especially time management and task prioritization, were viewed as the most critical factors in increasing passing rates (n = 52, 56.5%). In contrast, access to academic resources like tutors and online courses was the least preferred option (n = 1, 1.1%). Regarding overall effectiveness, most participants considered these combined strategies to be somewhat effective (n = 45, 48.9%).

Table 5. Impact of Emerging Technologies and Process Optimization in Exam Success

Variables	N	%
Do you believe that combining emerging technologies with process optimization techniques can improve your exam success?		
Yes, significantly	*58*	*63.0%*
Yes, to some extent	*33*	*35.9%*
Not sure	*1*	*1.1%*
No, not at all	*0*	*0.0%*
In your opinion, what is the most important factor in improving your exam passing rates?		
Effective study techniques (time management, task prioritization)	*52*	*56.5%*
Use of emerging technologies (AI, IoT, digital tools)	*11*	*12.0%*

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Consistent study habits and routine	*20*	*21.7%*
Access to academic resources (e.g., tutors, online courses)	*1*	*1.1%*
Personal motivation and discipline	*8*	*8.7%*
How would you rate your overall exam preparation strategy in terms of effectiveness?		
Not effective	*0*	*0.0%*
Slightly not effective	*1*	*1.1%*
Moderately effective	*35*	*38.0%*
Slightly effective	*45*	*48.9%*
Highly effective	*11*	*12.0%*

These results support the view that integrating technology-assisted learning with structured study methods enhances exam readiness and academic performance, as students who employ both systematic planning and digital tools tend to achieve better outcomes than those using isolated approaches (Sun & Zhou, 2024; Wu & Yu, 2023).

6. Impact of Emerging Technologies and Process Optimization on GWA of the respondents

Table 6 shows that the belief in using emerging technologies and process optimization significantly affects GWA, with $\chi^2 = 16.082$ and $p = 0.041$. Other factors, like reasons for exam success or self-assessment of preparation, have no significant impact, with p-values of 0.365 and 0.555, respectively. This indicates a significant link between students' belief in technology use and their GWA.

Table 6. Impact of Emerging Technologies and Process Optimization on GWA of the respondents

Variables	GWA					Chi-square	p value	Interpretation
	Below 2.0	2.0-2.5	2.51-2.99	3.0-3.49	3.5-4.0			
Do you believe that combining emerging technologies with process optimization techniques can improve your exam success?								
Yes, significantly	*43*	*9*	*1*	*2*	*3*	*16.082[a]*	*0.041*	*S*
Yes, to some extent	*22*	*5*	*1*	*3*	*2*			
Not sure	*0*	*0*	*0*	*0*	*1*			
No, not at all	*0*	*0*	*0*	*0*	*0*			
In your opinion, what is the most important factor in improving your exam passing rates?								
Effective study techniques (time management, task prioritization)	*35*	*11*	*0*	*2*	*4*	*17.327[a]*	*0.365*	*NS*
Use of emerging technologies (AI, IoT, digital tools)	*6*	*2*	*0*	*2*	*1*			
Consistent study habits and routine	*17*	*1*	*1*	*1*	*0*			
Access to academic resources (e.g., tutors, online courses)	*1*	*0*	*0*	*0*	*0*			
Personal motivation and discipline	*6*	*0*	*1*	*0*	*1*			
How would you rate your overall exam preparation strategy in terms of effectiveness?								
Not effective	*0*	*0*	*0*	*0*	*0*	*10.695[a]*	*0.555*	*NS*
Slightly not effective	*0*	*1*	*0*	*0*	*0*			
Moderately effective	*25*	*4*	*2*	*2*	*2*			
Slightly effective	*31*	*8*	*0*	*3*	*3*			
Highly effective	*9*	*1*	*0*	*0*	*1*			

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Legend: Significant (S) p<0.05; Not Significant (NS) p>0.05

This result is consistent with the findings of Sun and Zhou (2024), who emphasized that AI-facilitated personalization, together with planned learning plans, improves students' ability to handle demanding academic assignments. On the same note, Wu and Yu (2023) argued that integrated learning conditions give better academic performance improvements than disjointed instruction strategies.

Conclusions

In conclusion, the integration of process optimization and emerging technologies positively affected Industrial Engineering students' academic performance and exam readiness at Bulacan State University. Findings showed that structured study methods like reviewing notes, focusing on key topics, and organizing tasks were common and helpful. Nearly half of the respondents regularly used process optimization strategies, underlining the importance of systematic planning and prioritization in enhancing learning efficiency.

The results also indicated that emerging technologies, particularly artificial intelligence–based learning tools and digital educational platforms, were widely utilized by students and contributed to improved study organization and knowledge reinforcement. Students who perceived greater value in integrating technological tools with structured study methods tended to demonstrate better academic outcomes, as reflected in their General Weighted Average (GWA). The statistical analysis further revealed a significant relationship between students' perceptions of the combined use of emerging technologies and process optimization strategies and their academic performance.

Learning is seen as a system that can be analyzed and optimized with industrial engineering and digital tools. These findings suggest that integrating structured learning and technology-supported environments can improve engineering education by boosting efficiency, exam prep, and outcomes. The study highlights the value of applying industrial engineering principles—like process optimization and systematic planning—to learning systems, fostering more efficient, tech-enhanced environments to better prepare students for digital, data-driven industries.

Recommendations

Based on the findings of the study, the following recommendations are proposed:

1. Industrial Engineering students may adopt systematic study strategies such as reviewing lecture notes, practicing with past examinations, prioritizing essential topics, and applying structured study planning to enhance examination preparedness and academic performance.
2. The integration of emerging educational technologies—particularly artificial intelligence–based learning tools and digital learning applications—may be encouraged to support personalized learning, efficient study management, and improved academic engagement, provided that these technologies complement active learning processes.
3. Engineering educators and academic administrators may develop structured learning support programs that incorporate process optimization strategies, such as time management training, task prioritization techniques, and technology-assisted learning systems to improve student learning outcomes.
4. Educational institutions may strengthen technology-supported learning environments by integrating digital learning platforms, AI-assisted learning tools, and data-driven academic monitoring systems that enhance student engagement and academic efficiency.
5. Future researchers may further investigate additional factors influencing academic performance in engineering education, including digital literacy, learning styles, motivation, and the long-term impact of technology-integrated learning strategies.

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