Ed Process Int J

www.edupij.com

ISSN 2147-0901 (Print), 2564-8020 (Online)

EDUCATIONAL PROCESS
INTERNATIONAL JOURNAL

AI Implementation as Support for Successful Green Campus Implementation

Safiatur Rokhmah, Dudi Permana, Farida Elmi, Sugiyono, Aan Ansori

Research Article

Cite this article: Rokhmah, S., Permana, D., Elmi, F., Sugiyono, & Ansori, A. (2025). AI Implementation as Support for Successful Green Campus Implementation. *Educational Process: International Journal, 19,* e2025569. https://doi.org/10.22521/edupij.2025.19.569

Received June 10, 2025
Accepted November 23, 2025

Keywords: Artificial Intelligence, Green Campus Implementation, Sustainability, SWOT Analysis

Author for correspondence:
Safiatur Rokhmah
safiatur.rokhmah@uinbanten.ac.id
Faculty of Business and Economics.
Sultan Maulana Hasanuddin State Islamic University Banten.

Abstract

Background/purpose. The increasing urgency of environmental sustainability in higher education institutions has prompted the need for innovative approaches to Green Campus implementation. Artificial Intelligence (AI) offers transformative potential to optimize resource management and support sustainable campus operations. However, many institutions face challenges such as high implementation costs, fragmented data systems, and organizational resistance. This study focuses specifically on State Islamic Universities (*Perguruan Tinggi Keagamaan Islam Negeri* / PTKIN), aiming to analyze how AI can effectively support Green Campus initiatives and provide strategic guidance for its successful adoption.

Materials/methods. The study employs a SWOT analysis framework, supported by IFAS and EFAS matrices. Primary data were collected through surveys and semi-structured interviews with key campus stakeholders from 14 PTKIN listed in the UI GreenMetric World University Rankings 2024. Secondary data were gathered from institutional documents and a comprehensive literature review. The combined analysis identifies critical internal and external factors influencing AI-driven Green Campus initiatives within the PTKIN context.

Results. The findings reveal that internal strengths—such as improved operational efficiency, optimized resource management, and rapid adaptability—significantly outweigh internal weaknesses. Externally, strong opportunities—such as global sustainability policies and advancements in AI technologies—surpass potential threats, including data security concerns and regulatory shifts.

Conclusion. AI integration offers PTKIN a strategic advantage in achieving sustainability goals and fostering operational excellence. By leveraging internal strengths and external opportunities, and addressing key challenges, these institutions can adopt AI as a transformative tool in advancing Green Campus implementation and long-term ecological sustainability.

1. Introduction

The implementation of the Green Campus concept has become a primary focus in efforts to create a sustainable educational environment. Universities, as institutions that serve as centers of learning and innovation, have a significant responsibility in addressing global environmental challenges such as climate change, excessive energy consumption, and uncontrolled waste management. In this context, campuses are not only tasked with providing quality education but also playing an active role in preserving the environment. While many institutions have adopted various sustainability programs, the results are often suboptimal. This is due to various challenges, including budget constraints, low awareness within the campus community about the importance of sustainability, and the lack of data integration to support evidence-based decision-making (Cvitanovic et al., 2016). A critical problem is the absence of comprehensive frameworks that connect the operational dimension of sustainability with behavioral change among campus stakeholders. Without such integration, sustainability efforts tend to be fragmented and short-lived.

In addressing these challenges, AI technology has emerged as a solution that offers great potential to support the implementation of Green Campus initiatives in a more effective and efficient way (Debrah et al., 2022). AI has the ability to optimize various aspects of sustainability on campus, such as energy, water, and waste management (Al-Zahrani, 2024). Through AI implementation, campuses can monitor and analyze data in real-time to improve resource usage efficiency and reduce negative environmental impacts. Moreover, AI's capability to integrate data from diverse sources allows for more accurate, evidence-based decision-making, which in turn can accelerate the achievement of sustainability goals. Therefore, AI technology not only helps universities tackle environmental challenges but also leads to the development of greener, more efficient, and sustainable campuses (Alzoubi & Mishra, 2024). However, despite its great potential, AI adoption in sustainability efforts faces various barriers: high initial costs, technical complexities, limited human resource capacities, and resistance to change. Addressing these barriers requires systematic strategic analysis that connects internal capacities with external opportunities.

Several previous studies have explored various aspects of Green Campus implementation, providing valuable insights into the elements that can support campus sustainability. These studies have highlighted key factors such as renewable energy usage, waste management, and environmental education, which are essential for creating an eco-friendly campus environment (Anthony Jnr, 2021). Furthermore, research has also focused on the role of technology, particularly AI, in optimizing resource management and improving operational efficiency, which can contribute significantly to sustainability goals on campuses. MIT is conducting several innovative pilot programs aimed at reducing energy consumption and emissions across its campus using AI. These programs focus on optimizing heating and cooling systems in campus buildings. The AI system dynamically adjusts temperature settings based on real-time data such as occupancy patterns, weather forecasts, and carbon intensity of the power grid. By doing so, the system ensures that energy is used efficiently, maintaining occupant comfort while minimizing energy waste. Early results suggest significant potential for saving energy and reducing emissions, with future plans to expand these initiatives to other campus buildings as part of MIT's broader decarbonization goals (Garimella et al., 2022; Lee & Lee, 2022). Additionally, MIT researchers are testing AI-powered smart thermostats that manage environmental conditions based on various factors, including weather and class schedules. The pilot programs, particularly in classrooms, have shown promising results, with energy savings achieved without compromising comfort. The goal is to extend this technology to other campus buildings, further supporting MIT's sustainability efforts(Leal Filho et al., 2015). Another initiative focuses on optimizing resource management for a greener campus. AI is being used to monitor and control energy consumption, water usage, and waste management. By analyzing data from sensors across the campus, the AI systems can identify inefficiencies and recommend adjustments to minimize

https://doi.org/10.22521/edupij.2025.19.569 Published online by Universitepark Press

environmental impact while improving operational efficiency. As AI technology advances, its capacity to reduce the carbon footprint of educational institutions is expected to grow (Zhong et al., 2024).

This research aims to develop previous findings with a more comprehensive approach, integrating technical and behavioral aspects in creating a Green Campus model. The primary focus is not only on technical optimization through the use of efficient technology and resources but also on resource management that considers the behavioral patterns of students and staff. By combining data analysis, automation, and human-machine interaction, this approach aims to create a Green Campus model that is not only operationally efficient but also inclusive and adaptive to the unique needs of each higher education institution (Adel, 2024). This study specifically addresses key research gaps related to the effective alignment of internal strengths (operational efficiency, resource optimization, adaptability) and external opportunities (global sustainability trends, AI advancements, policy incentives) with institutional challenges and threats. Through this lens, the study offers a novel strategic framework that enables higher education institutions to maximize AI's potential for Green Campus success.

The main challenges in implementing a Green Campus involve high investment costs, resistance to new technologies, and a lack of integrated data that can support strategic decision-making. (Darko et al., 2017) Traditional approaches often overlook the importance of sustainability education and campus community involvement, which are crucial for the long-term success of such initiatives. To overcome these barriers, innovative solutions are required solutions that leverage the full potential of AI technology. AI can offer a way to optimize resource management, automate processes, and integrate data from various sources to facilitate informed, evidence-based decisions.(Lainjo, 2023) By addressing these issues, AI can help create a more effective and inclusive Green Campus, where both operational efficiency and community engagement are central to its success. Moreover, there is a critical need to develop scalable, adaptable frameworks that consider the diversity of campus environments. A one-size-fits-all solution is unlikely to be effective. Therefore, this study also emphasizes the importance of context-sensitive models that align AI-driven solutions with local behavioral and institutional dynamics.

As a solution, AI technology offers various innovative approaches that can support the implementation of Green Campuses. One of the key strategies is predictive analysis, which can forecast future resource needs, allowing campuses to plan energy and resource management more efficiently (Marinakis et al., 2020). Additionally, energy-saving systems powered by AI can reduce energy consumption by dynamically adjusting temperature, lighting, and ventilation settings. Technologies like the Internet of Things (IoT) and machine learning can also be used to integrate operational data from various sources, providing better insights into waste management, water usage, and energy efficiency. AI can also support sustainable behaviors by offering personalized, data-driven recommendations and utilizing gamification to raise environmental awareness among students and staff (Strielkowski et al., 2024). Thus, AI plays a crucial role not only in optimizing resources but also in shaping a more inclusive and adaptive sustainability culture on campus (George & Wooden, 2023).

This study aims to design a framework that guides higher education institutions in effectively leveraging AI to support Green Campus initiatives. The approach not only emphasizes operational efficiency but also seeks to foster a cultural transformation within campuses toward sustainability. By integrating AI-driven solutions, such as predictive analytics, automation, and data integration, this framework aspires to enhance resource management and encourage sustainable behavior across the campus community (Zavrazhnyi, 2024). Furthermore, this initiative aims to position campuses as exemplary models for other institutions globally, contributing significantly to broader sustainability efforts. The main purpose of this study is to provide a strategic, evidence-based framework that enables educational institutions to systematically leverage AI to achieve both environmental and

https://doi.org/10.22521/edupij.2025.19.569 Published online by Universitepark Press

operational sustainability. Its significance lies in bridging the gap between technical innovation and institutional culture, fostering a long-term and adaptable Green Campus transformation. Academically, this research contributes by bridging the gap between technical and social studies on Green Campus implementation. Practically, it provides an adaptable AI-based application model for various higher education institutions (Gupta et al., 2022). This is particularly relevant, as sustainability depends not only on technology but also on its influence on institutional behavior and policies.

The uniqueness of this research lies in its approach, which integrates technology, management, and human behavior studies into the Green Campus implementation model. This approach not only focuses on technical aspects, such as resource optimization through AI and IoT, but also includes behavioral dimensions involving the habits and patterns of students and staff. (Pedro et al., 2019) By combining these three dimensions, the study offers a more holistic solution compared to previous research, which often only highlights one specific aspect. Furthermore, this approach pays special attention to the needs and local characteristics of each higher education institution, ensuring that the proposed model is more relevant and can be effectively implemented in diverse contexts. This approach aims to create a campus ecosystem that is adaptive, inclusive, and sustainable while addressing unique challenges that generic strategies often fail to reach (Reed et al., 2016).

Finally, this research is expected to provide strategic guidelines for campus administrators to integrate AI into their sustainability efforts. Additionally, it aims to act as a catalyst in accelerating the transformation of higher education institutions into more sustainable, efficient, and environmentally friendly campuses, while fostering a strong culture of sustainability among the academic community.

2. Literature Review

The concept of Green Campus has undergone significant development, emphasizing the integration of technology, resource management, and human behavior to establish sustainable ecosystems in higher education institutions. Existing research highlights the transformative potential of technologies like AI and IoT in optimizing resources. For instance, Tien et al. (2022) demonstrated how machine learning algorithms effectively manage energy consumption in university buildings by analyzing factors such as occupancy patterns and real-time energy needs. The study further revealed that machine learning models can predict energy demand fluctuations, leading to more efficient energy distribution and cost reductions. This finding highlights the ability of AI to optimize not just energy consumption but also operational cost-efficiency, contributing to sustainable campus practices beyond simple energy savings. Similarly, Yasuoka et al. (2023) explored IoT's role in waste management, enabling campuses to monitor and reduce waste production through smart waste bins and real-time data analysis. Their research showed that IoT sensors track waste generation rates, allowing for more precise scheduling of waste collection and reducing unnecessary trips, which in turn reduces the carbon footprint of waste management processes. This IoT-based approach can be expanded to incorporate predictive analytics, allowing campuses to anticipate waste production and optimize disposal processes in a proactive manner.

However, the behavioral dimension is equally critical in sustainability efforts. Altassan (2023) emphasized the importance of engaging students and staff in activities like recycling and energy conservation for long-term success. The study focused on how behavioral incentives and peer-led initiatives can increase participation rates in sustainability programs. Furthermore, Altassan noted that a participatory approach, where students and staff contribute to the decision-making process, can lead to a more sustainable campus culture. Menon & Suresh (2020) further stressed that awareness campaigns and educational initiatives play a pivotal role in embedding sustainability practices within campus communities, ensuring active participation from all stakeholders. They argued that behavior change is not a one-time initiative but rather a continuous process, which

https://doi.org/10.22521/edupij.2025.19.569 Published online by Universitepark Press

requires sustained communication strategies and feedback mechanisms to maintain engagement over time.

In addition to technology and behavior, addressing local characteristics is vital for effective implementation. Leal Filho, Vargas, et al. (2019) proposed a localized approach to Green Campus initiatives, emphasizing the need to consider cultural, environmental, and socio-economic factors specific to each institution. Their study in developing countries highlighted the importance of understanding the local context, such as resource availability, economic constraints, and cultural attitudes towards sustainability, in designing more effective Green Campus programs. They found that a one-size-fits-all approach often fails to account for the specific challenges and opportunities within different institutional settings. This aligns with Charter & Tischner (2017), who argued that tailored solutions provide better outcomes compared to generic strategies, offering more sustainable and socially beneficial results. They provided case studies where local solutions, such as community-based waste management or region-specific renewable energy projects, resulted in higher levels of student and faculty engagement, as they were aligned with local needs and values.

Combining these dimensions, Ryan-Fogarty et al. (2016) introduced a holistic framework for Green Campus implementation. Their model integrates predictive analytics, automated energy systems, and behavior-based incentives to create adaptable, inclusive, and efficient campus ecosystems. They demonstrated that predictive analytics not only improved resource efficiency but also facilitated long-term sustainability goals by forecasting trends in energy consumption, waste production, and water usage. Moreover, they emphasized that integrating behavior-based incentives, such as reward systems for sustainable practices, helped align individual actions with the institution's broader environmental goals. Their approach bridges the gaps between technical efficiency and social inclusivity, addressing both operational and behavioral challenges in creating sustainable campus environments.

The literature underscores the importance of a comprehensive framework that combines technology, management, and human behavior to achieve Green Campus goals. While technology enables resource optimization, human behavior and local considerations are crucial for ensuring adaptability and inclusivity. Technological solutions, while highly effective, may not be sustainable without the active participation of campus stakeholders. Moreover, the impact of these technologies can vary significantly depending on the local context, making it essential to tailor solutions to specific institutional needs and resources. Future research should focus on scalable yet context-sensitive models to address the diverse needs of higher education institutions worldwide. Further studies could explore how universities can leverage emerging technologies in tandem with behavioral and socio-economic factors to create more resilient and inclusive Green Campus initiatives.

3. Methodology

3.1. Research Model

This study employs a qualitative research approach using the SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis framework to evaluate the implementation of AI in supporting Green Campus initiatives. The SWOT model was chosen because it allows for a comprehensive assessment of both internal and external factors that influence the success of AI-based sustainability programs within higher education institutions (Kulkov et al., 2024). To enhance the depth of analysis, the study also incorporates the IFAS (Internal Factor Analysis Summary) and EFAS (External Factor Analysis Summary) matrices. These matrices enable a structured evaluation of the relative importance of each factor identified in the SWOT analysis, helping to prioritize strategic actions for AI integration. The integration of SWOT with IFAS and EFAS ensures that both qualitative insights and quantitative priorities are systematically addressed, making the strategic recommendations more actionable for institutional decision-makers.

https://doi.org/10.22521/edupij.2025.19.569 Published online by Universitepark Press

3.2. Participant / Sample

Data collection is conducted using several techniques, including semi-structured interviews, direct observations, and institutional document analysis. Interviews are conducted with key stakeholders, including university leaders, lecturers, students, and administrative staff involved in Green Campus policies and implementation (Rotondo et al., 2023). This study focuses specifically on State Islamic Universities (Perguruan Tinggi Keagamaan Islam Negeri / PTKIN) under the Indonesian Ministry of Religious Affairs that have been included in the UI GreenMetric World University Rankings 2024. The selection of these institutions was based on their demonstrated commitment to campus sustainability, providing a relevant context for examining the potential of AI as a driver of Green Campus success. A total of 14 universities were included in the sample, as shown in Table 1 below.

Table 1. UI GreenMetric World University Rankings 2024

Number	University	Total Score
1	Universitas Islam Negeri Raden Intan Lampung	8650
2	Universitas Islam Negeri Sultan Thaha Saifuddin Jambi	7785
3	Universitas Islam Negeri Raden Fatah Palembang	7175
4	Universitas Islam Negeri Walisongo Semarang	7085
5	Universitas Islam Negeri Syarif Hidayatullah Jakarta	6910
6	IAIN Metro Lampung	6860
7	Universitas Islam Negeri Salatiga	4995
8	UIN Sultan Aji Muhammad Idris Samarinda	4100
9	Universitas Islam Negeri Maulana Malik Ibrahim Malang	4055
10	Universitas Islam Negeri Alauddin Makassar	3515
11	Institut Agama Islam Negeri Langsa	3210
12	Universitas Islam Negeri Fatmawati Sukarno Bengkulu	2310
13	Universitas Islam Negeri Mataram	2165
14	Institut Agama Islam Negeri Ponorogo	1820

The UI GreenMetric World University Rankings 2024 is a global ranking system that evaluates university performance on sustainability across six key indicators: setting and infrastructure, energy and climate change, waste, water, transportation, and education and research (Gültekin et al., 2024). This ranking encourages universities worldwide to adopt environmentally responsible practices and build sustainable academic ecosystems.

In the context of this study, the UI GreenMetric rankings serve as an empirical baseline to assess the maturity of sustainability initiatives within the selected PTKIN. Moreover, these rankings provided a strategic lens to examine how AI technologies—such as smart resource management systems, predictive analytics for energy use, and intelligent waste monitoring—are beginning to complement traditional sustainability efforts. The 2024 ranking notably emphasized the importance of innovation in green technologies and the integration of sustainability into university curricula, trends that are highly relevant to AI-driven approaches. Of particular note, Universitas Islam Negeri Raden Intan

Lampung secured a place among the top 100 universities worldwide, ranking 71st globally (UI GreenMetric, 2024). This achievement illustrates the advanced level of Green Campus implementation at this institution, making it an ideal reference point for exploring how AI can further enhance sustainability outcomes in the broader PTKIN network.

3.3. Data Collection Method

Data for the study were collected from both primary and secondary sources. Primary data collection involved surveys, semi-structured interviews, and focus group discussions (FGDs). Surveys were distributed to administrators, IT staff, and students to capture their perceptions of AI's potential, readiness for implementation, and anticipated barriers in supporting Green Campus initiatives. Semi-structured interviews were conducted with administrators, IT experts, sustainability officers, and policymakers to explore more nuanced perspectives on the opportunities and challenges associated with AI integration (Dimitriadou & Lanitis, 2023). To validate and enrich these findings, FGDs were held with experts in sustainability, AI, and campus management (Cao & Jian, 2024), providing additional insights into best practices and implementation strategies. Secondary data were obtained through a comprehensive literature review, encompassing scholarly articles, reports from leading higher education institutions, case studies on AI-driven Green Campus initiatives, and national policy documents related to sustainability and digital transformation (Seidel et al., 2013). The use of both primary and secondary data sources ensured a robust and triangulated understanding of the factors influencing AI adoption for Green Campus success.

3.4. Data Analysis

The data analysis process was conducted in several stages to ensure both depth and rigor. Initially, a thematic analysis of interview and FGD transcripts was performed to identify key themes corresponding to the four dimensions of the SWOT framework: strengths, weaknesses, opportunities, and threats. These themes were then systematically organized and coded into internal factors (strengths and weaknesses) and external factors (opportunities and threats). Following this qualitative phase, the IFAS and EFAS matrices were applied to assign weights and ratings to each identified factor, providing a quantitative assessment of their relative impact on AI implementation. This structured approach allowed the research team to prioritize strategic actions based on both empirical evidence and expert judgment. The analysis was guided by three core research questions: (1) What internal factors influence the successful implementation of AI for Green Campus initiatives? (2) What external factors must be addressed by higher education institutions? (3) How can institutions strategically leverage strengths and opportunities while mitigating weaknesses and threats?. To ensure the validity and relevance of the findings, iterative feedback loops were conducted with FGD participants, who provided critical review and refinement of the emerging strategic recommendations. Through this rigorous and participatory analysis process, the study generated a set of evidence-based and context-sensitive recommendations to guide higher education institutions in accelerating AI-driven sustainability transformation (Rane, Shirke, et al., 2024).

4. Results

The findings of this research highlight the strategic potential of AI in achieving the goals of a Green Campus. As sustainability increasingly becomes a global priority for educational institutions, AI emerges as a powerful tool to optimize campus operations, reduce environmental impact, and promote sustainable practices among the academic community. By leveraging AI's capabilities, institutions can drive transformative changes toward a more sustainable future.

Using the SWOT framework, the study reveals both opportunities and challenges in AI implementation for Green Campus initiatives (Palomares et al., 2021). On the one hand, AI's

strengths, such as operational automation, data-driven analytics, and adaptability, offer significant advantages in enhancing sustainability efforts. However, weaknesses such as high investment costs, technical complexity, and resistance from stakeholders pose challenges that require strategic planning and institutional readiness. The study also explores external opportunities, including government policy support and global sustainability trends, alongside potential threats like cybersecurity risks and regulatory uncertainties.

The results of this analysis provide a roadmap for educational institutions to integrate AI effectively in Green Campus initiatives. By addressing weaknesses and mitigating threats while capitalizing on strengths and opportunities, institutions can design context-sensitive strategies that align technological innovations with practical sustainability goals (Mangarin, 2023). This research offers not only theoretical insights but also practical recommendations to guide campuses in their transformation toward a more sustainable, efficient, and environmentally responsible future. The SWOT analysis is as follows:

Table 2. SWOT Analysis Matrix

SWOT Factors	Main Points
Strengths	1. Operational efficiency: Optimizing campus energy, water, and waste management (Lo-Iacono-Ferreira et al., 2018). 2. Waste reduction: A smarter waste management system that supports environmental sustainability (Nižetić et al., 2019). 3. Campus system integration: Enabling more efficient and interconnected facility management (Matarneh et al., 2022). 4. Data-driven decision-making: Supporting sustainability policies with more accurate data analysis (Matarneh et al., 2022). 5. Improved operational performance: AI can help enhance campus performance and productivity through automation (Banala, 2024). 6. Quick adaptation to changes: AI can adjust and improve system performance quickly in dynamic situations (Khilenko et al., 2018).
Weaknesses	1. High investment costs: The need for expensive hardware, software, and training for AI implementation (Tong, 2024). 2. Resistance to change: Challenges in adopting new technology among staff and students (Rahman et al., 2024). 3. Dependence on technology: Potential operational disruptions if the AI technology fails or does not function well (Choi et al., 2022). 4. Inadequate infrastructure: Some campuses do not yet have the necessary networks and systems to support AI (McMillan & Varga, 2022). 5. Limited technical understanding: Lack of technical knowledge among staff that may hinder the utilization of AI technology.(Chowdhury et al., 2022). 6. Uncertainty in long-term costs: Uncertainty regarding the operational and maintenance costs of AI in the long run (Chowdhury et al., 2022).

SWOT Factors	Main Points
Opportunities	1. Global policy support: Policies that support sustainability provide opportunities for funding and assistance for green campuses (Leal Filho et al., 2015). 2. Advancements in AI technology: The development of more affordable and efficient AI technologies, including machine learning and IoT (Alahi et al., 2023). 3. Increased sustainability awareness: Student support for Green Campus initiatives, driving AI adoption (Cao & Jian, 2024). 4. Collaboration with technology companies: Opportunities to partner with large companies to provide more affordable AI technology (Kim et al., 2024). 5. AI development in education: Progress in the use of AI in the education sector opens opportunities for further development on campuses (Kuleto et al., 2021). 6. Availability of funding and incentives: Funding programs or incentives from the government for campuses implementing environmentally-friendly, technology-based solutions (Cahoy, 2023).
Threats	1. Data security and privacy: Managing big data carries the risk of issues related to data breaches or misuse (Cahoy, 2023). 2. Changes in policies or regulations: Shifting policies could hinder the implementation of AI in Green Campus initiatives (Polin et al., 2024). 3. Low technology adoption: Lack of understanding or concerns among the academic community about AI may obstruct its implementation (Rane, Choudhary, et al., 2024). 4. Threats to AI system reliability: Potential issues in managing and overseeing AI systems could disrupt operations (Macrae, 2024). 5. Environmental and energy concerns: The extensive use of AI technology could lead to unexpected increases in energy consumption (Ahmad et al., 2021). 6. Threats from technology competitors: Competitors or institutions that adopt new technologies more quickly could create challenges for campuses that are slow to adapt (Pucciarelli & Kaplan, 2016).

The findings presented in this section were derived from a rigorous process of qualitative and quantitative data collection. Primary data sources included surveys administered to campus administrators, IT staff, and students, which captured their perceptions regarding AI's potential, benefits, and challenges in supporting Green Campus initiatives. In addition, semi-structured interviews with key informants—such as IT experts, sustainability officers, and policymakers—provided deeper insights into institutional experiences and strategic perspectives. Focus group discussions (FGDs) with sustainability and AI experts were also conducted to validate preliminary findings and enrich the analysis with expert insights (Cao & Jian, 2024).

https://doi.org/10.22521/edupij.2025.19.569 Published online by Universitepark Press

Secondary data were obtained through an extensive literature review, including academic articles, institutional reports, national policy documents, and international case studies on AI-driven Green Campus initiatives (Seidel et al., 2013). Thematic analysis of interview and FGD transcripts helped identify key themes across internal and external dimensions, which were then systematically categorized within the SWOT framework. The IFAS and EFAS matrices were subsequently applied to quantify the relative importance of each factor, providing a structured basis for formulating strategic recommendations.

4.1. IFAS Analysis

The IFAS (Internal Factor Analysis Summary) Matrix is used to evaluate internal factors, namely strengths and weaknesses, in the implementation of AI in Green Campuses. This matrix provides an overview of how internal factors, such as operational efficiency and data-driven decision-making, support the effective and sustainable implementation of AI. Strength factors are given a high weight as they contribute significantly to success, while weaknesses like high investment costs and resistance to change are given lower weights, reflecting the challenges that need to be overcome (Gao et al., 2023; Javaherikhah & Sarvari, 2025). With this matrix, campuses can develop more accurate strategies to leverage strengths and address weaknesses to achieve better and more sustainable Green Campus goals.

The findings presented in the IFAS analysis were derived from a combination of qualitative thematic analysis and quantitative weighting techniques. Initially, qualitative data from semi-structured interviews, focus group discussions, and literature review were analyzed thematically to identify key internal factors (strengths and weaknesses) relevant to AI-based Green Campus implementation. Following this, these factors were systematically categorized and further evaluated using the IFAS matrix (Biazar et al., 2025; Ramos et al., 2023). In this matrix, each factor was assigned a weight (based on its perceived importance as determined through expert consensus and FGD validation) and a rating (based on the factor's current level of development or challenge within the sampled institutions). This structured approach allowed the study to quantify the relative contribution of each internal factor, providing a clear empirical basis for strategic recommendations.

Table 3 presents the IFAS Matrix, which summarizes the evaluation results of internal factors affecting AI implementation in Green Campuses. The total score for strengths and weaknesses reflects the overall balance between enabling and constraining factors. A higher total score for strengths indicates that campuses have significant internal capabilities that can be leveraged to support AI-driven sustainability transformation. Conversely, the weaknesses' score highlights key challenges that must be addressed to optimize AI adoption. Thus, Table 3 serves not only as an analytical summary but also as a strategic tool to guide institutional planning and resource allocation in AI-based sustainability efforts.

Table 3. IFAS Analysis

SWOT Factors	Key Points	Weight	Rating	Score
Strengths	1. Operational efficiency: Optimizing the management of energy, water, and campus waste.	0.15	4	0.60
	2. Waste reduction: Smarter waste management systems that support environmental sustainability.	0.10	3	0.30
	3. Campus system integration: Enabling more efficient and connected facility management.	0.12	4	0.48

https://doi.org/10.22521/edupij.2025.19.569 Published online by Universitepark Press

SWOT Factors	Key Points	Weight	Rating	Score
	4. Data-driven decision-making: Supporting sustainability policies with more accurate data analysis.	0.13	4	0.52
	5. Operational performance improvement: AI can help enhance campus performance and productivity through automation.	0.10	3	0.30
	6. Rapid adaptation to change: AI can quickly adjust and improve system performance in dynamic situations.	0.10	3	0.30
	Total Strengths	0.10		2.50
Weaknesses (Kelemahan)	1. High investment costs: The need for expensive hardware, software, and training for AI implementation.	0.15	2	0.30
	2. Resistance to change: Challenges in adopting new technology among staff and students.	0.12	2	0.24
	3. Dependence on technology: Potential operational disruptions if AI technology fails or does not function properly.	0.12	3	0.36
	4. Inadequate infrastructure: Some campuses lack the necessary networks and systems to support AI.	0.10	2	0.20
	5. Limited technical understanding: Lack of technical knowledge among staff that may hinder the utilization of AI technology.	0.10	2	0.20
	6. Uncertainty of long-term costs: Uncertainty regarding the operational and maintenance costs of AI in the long run.	0.11	2	0.22
	Total Weaknesses	0.70		1.72
	Total Skor			4.22

Internal factors that add value to the implementation of AI in a Green Campus play a crucial role in ensuring sustainability and operational efficiency. One of the key strengths is AI's ability to enhance the management of campus resources such as energy, water, and waste more efficiently. By optimizing the use of these resources, the campus can reduce its carbon footprint and improve its overall environmental impact. Additionally, AI enables data-driven decision-making that supports the campus's sustainability policies. The use of accurate data and in-depth analysis allows for more effective policies in achieving environmental goals. The rapid adaptability of AI is also a significant strength, as it can adjust and enhance system performance in dynamic situations, making it flexible and ready to face changes. The total strength score of 2.50 indicates that internal enabling factors are well-developed and provide a solid foundation for AI adoption in campus sustainability efforts.

Despite the many potential strengths, the implementation of AI in a Green Campus also faces several weaknesses that need to be addressed. The high initial investment cost, including for

https://doi.org/10.22521/edupij.2025.19.569 Published online by Universitepark Press

hardware, software, and training, is a major challenge. This requires a large budget, which can be a barrier for many campuses with limited funds. Moreover, adopting new technology often involves organizational cultural changes, which can cause resistance among staff and students. This includes adjusting to new systems and work habits, which takes time and effort to ensure a smooth transition. Inadequate infrastructure is also a limiting weakness, especially in campuses that do not yet have a strong network and technological systems to support AI implementation. The uncertainty surrounding the long-term operational and maintenance costs of AI is another factor to consider, as unforeseen expenses may arise over time. The weaknesses' total score of 1.72 highlights that although challenges exist, they are manageable with targeted investments in infrastructure, capacity building, and change management. Overall, the total IFAS score of 4.22 demonstrates that the internal strategic position of AI implementation in Green Campus initiatives is favorable, with opportunities to further strengthen enablers while addressing identified constraints.

4.2. EFAS Analysis

The External Factor Analysis Summary (EFAS) matrix is utilized to systematically evaluate the external factors influencing the implementation of AI in supporting the successful realization of a Green Campus. This analytical tool provides a comprehensive overview of both opportunities and threats encountered in the process. Key external opportunities include global sustainability policies that facilitate access to funding, as well as continuous advancements in AI technologies that enhance efficiency and effectiveness (Kulkov et al., 2024; Zhao & Gómez Fariñas, 2023). These factors present favorable conditions for higher education institutions aiming to advance their Green Campus initiatives. Conversely, significant external threats such as concerns over data security and privacy, coupled with limited awareness and understanding of AI technologies, pose potential challenges that require strategic attention. By highlighting these factors, the EFAS matrix not only identifies critical external opportunities that can be leveraged but also clarifies the threats that must be managed (Taha et al., 2025; Wazin et al., 2025). This dual perspective enables the formulation of well-informed strategies to optimize AI deployment, thereby supporting the broader goals of sustainable campus development.

The findings presented in the EFAS analysis were derived using a mixed-methods approach, combining qualitative thematic analysis and quantitative evaluation. Initially, key external factors (opportunities and threats) were identified through thematic analysis of qualitative data collected from semi-structured interviews, focus group discussions (FGDs), and an extensive literature review. Subsequently, these factors were prioritized and quantified using the EFAS matrix, where each factor was assigned a weight (reflecting its relative importance as validated through expert consensus and FGD feedback) and a rating (reflecting the current level of opportunity or severity of threat perceived in the institutional context). This technique allows for a structured and transparent evaluation of the external environment surrounding AI adoption in Green Campuses.

Table 4. EFAS Analysis

SWOT Factors	Key Points	Weight	Rating	Score
Opportunities	1. Global policy support: Policies that promote sustainability provide opportunities for funding and assistance for green campuses.	0.15	4	0.60
	2. Advances in AI technology: The development of AI technology is becoming more affordable and efficient, including machine learning and IoT.	0.13	3	0.39

https://doi.org/10.22521/edupij.2025.19.569 Published online by Universitepark Press

SWOT Factors	Key Points	Weight	Rating	Score
	3. Increased sustainability awareness: Student support for Green Campus initiatives enhances AI adoption.	0.12	4	0.48
	4. Collaboration with technology companies: Opportunities to collaborate with large companies to provide more affordable AI technology.	0.11	3	0.33
	5. AI development in education: Progress in the use of AI in the education sector opens opportunities for further development on campus.	0.12	3	0.36
	6. Availability of funds and incentives: Funding programs or incentives from the government for campuses implementing environmentally friendly technology solutions.	0.12	4	0.48
	Total Opportunities	0.75		2.68
Threats	1. Data security and privacy: The management of big data carries the risk of issues related to data leaks or misuse.	0.14	2	0.28
	2. Changes in policies or regulations: Changing policies may hinder the implementation of AI in Green Campuses.	0.13	2	0.26
	3. Low technology adoption: Misunderstanding or concerns from the academic community about AI may obstruct its implementation.	0.12	3	0.36
	4. Threats to the reliability of AI systems: Potential issues in managing and overseeing AI systems may disrupt operations.	0.13	2	0.26
	5. Environmental and energy issues: The extensive use of AI technology may lead to unexpected increases in energy consumption.	0.12	2	0.24
	6. Threats from technological competitors: Competitors or other institutions that adopt new technologies more quickly may create challenges for campuses that are slow to adapt.	0.12	3	0.36
	Total Threats	0.75		1.86
	Total Score			4.50

https://doi.org/10.22521/edupij.2025.19.569 Published online by Universitepark Press

The meaning of Table 4 is to provide a structured summary of the external factors influencing the implementation of AI in Green Campus initiatives. Each factor's weighted score contributes to the overall assessment of external opportunities and threats. The total score for opportunities (2.68) indicates that the external environment offers substantial support for AI adoption, with strong enablers such as policy support, technological advancements, and available funding. Conversely, the total score for threats (1.86) highlights the key external risks that must be managed—such as data security concerns, regulatory uncertainties, and potential resistance within the academic community.

Overall, the total EFAS score of 4.50 suggests that the external strategic position is favorable. Institutions have a window of opportunity to leverage supportive external conditions to advance their Green Campus goals through AI, provided that they proactively address identified threats through targeted risk mitigation strategies. Thus, Table 3 serves not only as a diagnostic tool but also as a strategic guide for institutional planning, helping campus leaders prioritize external engagements, partnerships, and policy advocacy to support AI-driven sustainability transformation.

4.3. Comparative Analysis of IFAS and EFAS

Based on the results of the IFAS and EFAS analyses, it can be concluded that both internal and external factors make significant contributions to the successful implementation of AI in Green Campus initiatives. However, differences emerge in the relative dominance of these two groups of factors.

The IFAS analysis yielded a total score of 4.22, with the total score for strengths reaching 2.50 and the total score for weaknesses at 1.72. These results indicate that the internal factors, overall, present a relatively strong foundation for driving the successful integration of AI. Strengths such as operational efficiency, data-driven decision-making, and the adaptive capabilities of AI systems represent valuable assets that can be optimized. Meanwhile, weaknesses—such as high investment costs, infrastructural limitations, and resistance to change—pose challenges, but they remain manageable through appropriate mitigation strategies.

Conversely, the EFAS analysis produced a higher total score of 4.50, with opportunities contributing 2.68 and threats accounting for 1.86. These findings suggest that external factors currently offer even greater leverage compared to internal ones. Opportunities—such as global policy support, advancements in AI technologies, and the availability of government funding and incentives—create a highly strategic environment for institutions to accelerate AI adoption. Although external threats such as data security issues and policy uncertainties exist, the higher overall opportunities score indicates that the current external landscape is particularly conducive to supporting AI-driven Green Campus transformation.

From this comparison, it can be concluded that external factors (as reflected in the EFAS results) currently exert a more dominant influence than internal factors (as reflected in the IFAS results) in shaping the success potential of AI adoption in Green Campus initiatives. The higher EFAS total score (4.50) compared to the IFAS score (4.22) suggests that the present external momentum is highly favorable for advancing this technological adoption—provided that higher education institutions can address existing internal challenges. In other words, institutions are strategically positioned to leverage external opportunities but must also ensure that their internal readiness—particularly in terms of infrastructure and human resource capabilities—is strengthened in parallel.

Through this holistic understanding of the IFAS and EFAS results, AI implementation strategies in Green Campus initiatives can be more sharply focused: by maximizing the leverage of external opportunities while simultaneously enhancing internal strengths and addressing existing weaknesses. This synergistic approach is expected to drive more effective and sustainable achievement of campus sustainability goals.

https://doi.org/10.22521/edupij.2025.19.569 Published online by Universitepark Press

4.4. Discussion

The findings of this study underscore the significant potential of AI to enhance the effectiveness of Green Campus initiatives, aligning with the working hypothesis that AI-driven approaches can substantially improve campus sustainability outcomes. The results also corroborate insights from previous studies, while contributing new perspectives on the strategic alignment between internal and external factors affecting AI adoption in higher education.

From the internal perspective, the IFAS analysis revealed that strengths such as operational efficiency, data-driven decision-making, and rapid system adaptability strongly support the successful implementation of AI in Green Campuses. This finding is consistent with prior research by [20]18) and Matarneh et al., which demonstrated that intelligent automation and integrated facility management can lead to significant reductions in resource consumption and carbon emissions on university campuses. The ability of AI to enable real-time optimization of energy, water, and waste management represents a transformative advancement over traditional sustainability practices. Furthermore, the role of AI in enhancing data-driven decision-making reinforces the argument by Banala (2024) that access to high-quality, actionable data is a critical enabler of effective sustainability governance.

However, the study also highlights internal challenges that must be addressed to maximize the benefits of AI integration. The identified weaknesses—particularly high investment costs, infrastructural limitations, and organizational resistance to change—mirror concerns raised by (Tong, 2024) and Rahman et al., (2024), who emphasized the importance of strategic leadership and capacity building in overcoming such barriers. These findings suggest that while technological capabilities are advancing rapidly, institutional readiness remains a key determinant of success.

The external environment, as captured in the EFAS analysis, presents a particularly favorable context for AI adoption in Green Campus initiatives. The strong influence of global policy support, advancements in AI technology, and growing sustainability awareness among students reflects trends observed in the broader literature (Leal Filho et al., 2015;Alahi et al., 2023; Cao & Jian, 2024). These external drivers create a momentum that higher education institutions can leverage to accelerate their sustainability transitions. Notably, the study aligns with the argument by Kim et al. (2024) that cross-sector collaborations with technology companies can serve as a critical catalyst for scaling AI applications in education and sustainability domains.

Conversely, external threats—such as data security risks, policy uncertainty, and low levels of AI literacy within the academic community—echo findings from (2023) and Macrae, underscoring the need for robust governance frameworks and proactive stakeholder engagement. Addressing these threats will require not only technical solutions but also cultural and institutional shifts to foster greater trust and acceptance of AI technologies.

In the broadest context, this study contributes to the evolving discourse on AI-driven sustainability in higher education by offering an integrated analysis that bridges technological, organizational, and policy dimensions. It supports the working hypothesis that the strategic alignment of internal strengths and external opportunities can create a synergistic environment for AI-enabled Green Campus transformation. Moreover, it highlights the critical importance of addressing internal weaknesses and mitigating external threats to ensure that this transformation is both sustainable and inclusive.

Compared to previous studies, this research advances the field by providing a nuanced understanding of the interplay between internal capacities and external influences. While earlier works have primarily focused on either the technological potential of AI (Zhong et al., 2024) or the socio-organizational aspects of Green Campus implementation (Leal Filho et al., 2015), this study integrates both perspectives through the systematic application of SWOT, IFAS, and EFAS analyses.

https://doi.org/10.22521/edupij.2025.19.569 Published online by Universitepark Press

This holistic approach offers practical insights that can inform strategic planning and policy development for higher education leaders seeking to harness AI as a transformative force in campus sustainability.

In conclusion, the study reaffirms the importance of a balanced and adaptive strategy for AI implementation in Green Campuses. By leveraging the current favorable external environment and strengthening internal capacities, higher education institutions can not only enhance their sustainability performance but also contribute to the broader global agenda for sustainable development.

5. Conclusion

This study concludes that the implementation of AI offers substantial potential to support the successful realization of Green Campus initiatives. The results, verified through systematic SWOT, IFAS, and EFAS analyses, indicate that both internal and external factors play significant roles in determining the success of AI adoption in higher education sustainability efforts.

Internally, the analysis confirmed that strengths such as operational efficiency, data-driven decision-making, and system adaptability provide a solid foundation for enhancing campus sustainability through AI. These findings validate previous research emphasizing the transformative potential of intelligent automation and integrated resource management in campus environments. At the same time, the study verified that internal weaknesses—including high investment costs, infrastructural limitations, and resistance to change—remain key challenges that institutions must address through strategic planning and capacity building. Externally, the study verified that the current policy and technological landscape are highly favorable for AI adoption. Opportunities such as strong global sustainability policies, rapid advancements in AI technology, and increased awareness among campus stakeholders provide higher education institutions with a unique window to advance their Green Campus agendas. Conversely, external threats—including data security concerns, regulatory uncertainties, and gaps in AI literacy—must be actively managed to ensure that AI initiatives are sustainable and inclusive. The comparison of IFAS and EFAS results further verified that external opportunities currently outweigh external threats, and that internal strengths provide a robust platform for progress, provided that weaknesses are strategically mitigated. These verified findings confirm the study's working hypothesis that a strategic alignment of internal and external factors can significantly enhance the feasibility and impact of AI-driven Green Campus initiatives.

In conclusion, this study offers a comprehensive framework and actionable insights for higher education leaders seeking to harness AI as a transformative tool for sustainability. The verified results demonstrate that with the right strategic approach—leveraging strengths and opportunities while addressing weaknesses and threats—AI can play a pivotal role in advancing the sustainability goals of higher education institutions and contributing to the broader global agenda for sustainable development.

6. Suggestion

Based on the results of this study, several strategic recommendations are proposed to support the successful implementation of AI in Green Campus initiatives, particularly within State Islamic Universities (PTKIN) under the Indonesian Ministry of Religious Affairs.

First, institutions should prioritize the development of robust data infrastructure and integrate existing sustainability data sources to fully leverage AI's potential in optimizing resource management. The study's findings confirmed that operational efficiency and data-driven decision-making are key internal strengths; however, addressing existing infrastructural limitations remains critical.

https://doi.org/10.22521/edupij.2025.19.569 Published online by Universitepark Press

Second, to mitigate internal weaknesses related to technical capacity and organizational resistance, universities should invest in comprehensive training programs for both academic and administrative staff. Promoting AI literacy and fostering a culture of innovation will enhance institutional readiness and facilitate smoother technology adoption.

Third, institutions should actively engage in partnerships with technology companies and leverage available funding opportunities, as highlighted in the EFAS analysis. Collaborative efforts can accelerate access to affordable AI solutions and support the scaling of pilot projects into broader campus-wide applications.

Fourth, given the identified external threats, particularly regarding data security and regulatory uncertainty, universities must establish clear governance frameworks for AI use. This includes developing policies that address ethical considerations, data privacy, and compliance with evolving regulations.

Finally, it is recommended that PTKIN continuously monitor and evaluate AI-driven sustainability initiatives, using adaptive strategies informed by ongoing data analysis and stakeholder feedback. Such an approach will ensure that AI implementation remains aligned with institutional goals and contributes effectively to the long-term vision of a sustainable Green Campus.

Declarations

Author Contributions. SR: Led the conceptual development of the study, designed the research framework, conducted data analysis, and drafted the manuscript. DP: Provided critical revisions of the manuscript, contributed to the methodological design, and offered academic supervision throughout the research process. FE: Supported the data collection process, contributed to data interpretation, and participated in reviewing and refining the manuscript content. S: Managed project administration, provided technical support for data acquisition, and assisted in organizing and preparing materials for analysis. All authors reviewed the manuscript thoroughly, contributed to its final form, and approved the version submitted for publication.

Conflicts of Interest. The authors hereby declare that there is no conflict of interest.

Funding. This research was conducted with internal funding provided by the authors themselves. No external funding was received from any public, commercial, or not-for-profit funding agency for the development of this study.

Acknowledgments. The authors would like to sincerely thank the Ministry of Religious Affairs of the Republic of Indonesia for its institutional support and facilitation throughout this study. Special appreciation is extended to the leadership, lecturers, students, and administrative staff of the State Islamic Universities (PTKIN) who participated in this research and provided valuable insights during the data collection process. Finally, heartfelt thanks are given to all colleagues and supporting staff who contributed their time and assistance in facilitating interviews, managing data, and ensuring the smooth completion of this research project.

References

Adel, A. (2024). The convergence of intelligent tutoring, robotics, and IoT in smart education for the transition from industry 4.0 to 5.0. *Smart Cities*, *7*(1), 325–369. https://doi.org/10.3390/smartcities7010014

Ahmad, T., Zhang, D., Huang, C., Zhang, H., Dai, N., Song, Y., & Chen, H. (2021). Artificial intelligence in the sustainable energy industry: Status Quo, challenges, and opportunities. *Journal of Cleaner Production*, *289*, 125834. https://doi.org/10.1016/j.jclepro.2021.125834

Al-Zahrani, A. M. (2024). Harnessing AI for sustainable university practices: toward a greener campus. *International Journal of Sustainability in Higher Education*. https://doi.org/10.1108/ijshe-08-2024-0566

Alahi, M. E. E., Sukkuea, A., Tina, F. W., Nag, A., Kurdthongmee, W., Suwannarat, K., & Mukhopadhyay, S. C. (2023). Integration of IoT-enabled technologies and artificial intelligence (AI) for smart city scenarios: recent advancements and future trends. *Sensors*, *23*(11), 5206. https://doi.org/10.3390/s23115206

Altassan, A. (2023). Sustainable integration of solar energy, behavior change, and recycling practices in educational institutions: a holistic framework for environmental conservation and quality education. *Sustainability*, *15*(20), 15157. https://doi.org/10.3390/su152015157

Alzoubi, Y. I., & Mishra, A. (2024). Green artificial intelligence initiatives: Potentials and challenges. *Journal of Cleaner Production*, 143090. https://doi.org/10.1016/j.jclepro.2024.143090

Anthony Jnr, B. (2021). Green campus paradigms for sustainability attainment in higher education institutions–a comparative study. *Journal of Science and Technology Policy Management*, *12*(1), 117–148. https://doi.org/10.1108/jstpm-02-2019-0008

Banala, S. (2024). The Future of IT Operations: Harnessing Cloud Automation for Enhanced Efficiency and The Role of Generative AI Operational Excellence. *International Journal of Machine Learning and Artificial Intelligence*, *5*(5), 1–15.

Biazar, S. M., Golmohammadi, G., Nedhunuri, R. R., Shaghaghi, S., & Mohammadi, K. (2025). Artificial intelligence in hydrology: advancements in soil, water resource management, and sustainable development. *Sustainability*, *17*(5), 2250. https://doi.org/10.3390/su17052250

Cahoy, D. R. (2023). The techno-optimist case for addressing sustainability and its grounding in capitalist (market) incentives. *Available at SSRN 4317805*.

Cao, F., & Jian, Y. (2024). The Role of integrating AI and VR in fostering environmental awareness and enhancing activism among college students. *Science of The Total Environment*, *908*, 168200. https://doi.org/10.1016/j.scitotenv.2023.168200

Charter, M., & Tischner, U. (2017). *Sustainable solutions: developing products and services for the future*. Routledge.

Choi, T., Kumar, S., Yue, X., & Chan, H. (2022). Disruptive technologies and operations management in the Industry 4.0 era and beyond. *Production and Operations Management*, *31*(1), 9–31. https://doi.org/10.1111/poms.13622

Chowdhury, S., Budhwar, P., Dey, P. K., Joel-Edgar, S., & Abadie, A. (2022). AI-employee collaboration and business performance: Integrating knowledge-based view, socio-technical systems and organisational socialisation framework. *Journal of Business Research*, *144*, 31–49. https://doi.org/10.1016/j.jbusres.2022.01.069

Cvitanovic, C., McDonald, J., & Hobday, A. J. (2016). From science to action: principles for undertaking environmental research that enables knowledge exchange and evidence-based decision-making. *Journal of Environmental Management*, *183*, 864–874. https://doi.org/10.1016/j.jenvman.2016.09.038

Darko, A., Chan, A. P. C., Ameyaw, E. E., He, B.-J., & Olanipekun, A. O. (2017). Examining issues influencing green building technologies adoption: The United States green building experts' perspectives. *Energy and Buildings*, *144*, 320–332. https://doi.org/10.1016/j.enbuild.2017.03.060

Debrah, C., Chan, A. P. C., & Darko, A. (2022). Artificial intelligence in green building. *Automation in Construction*, *137*, 104192. https://doi.org/10.1016/j.autcon.2022.104192

Dimitriadou, E., & Lanitis, A. (2023). A critical evaluation, challenges, and future perspectives of using artificial intelligence and emerging technologies in smart classrooms. *Smart Learning Environments*, *10*(1), 12. https://doi.org/10.1186/s40561-023-00231-3

Gao, C., Pan, H., Wang, M., Zhang, T., He, Y., Cheng, J., & Yao, C. (2023). Identifying priority areas for ecological conservation and restoration based on circuit theory and dynamic weighted complex network: A case study of the Sichuan Basin. *Ecological Indicators*, *155*, 111064. https://doi.org/10.1016/j.ecolind.2023.111064

Garimella, S., Lockyear, K., Pharis, D., El Chawa, O., Hughes, M. T., & Kini, G. (2022). Realistic pathways to decarbonization of building energy systems. *Joule*, *6*(5), 956–971. https://doi.org/10.1016/j.joule.2022.04.003

George, B., & Wooden, O. (2023). Managing the strategic transformation of higher education through artificial intelligence. *Administrative Sciences*, *13*(9), 196. https://doi.org/10.3390/admsci13090196

Gültekin, P., Gültekin, Y. S., Başaran, N., & Kaya, M. Y. (2024). Measuring Universities' sustainability performance with using UI greenmetric world ranking: A case study of Düzce University. *Journal of Architectural Sciences and Applications*, *9*(1), 145–164. https://doi.org/10.30785/mbud.1403115

Gupta, P., Kulkarni, T., & Toksha, B. (2022). AI-Based Predictive Models for Adaptive Learning Systems. In *Artificial Intelligence in Higher Education* (pp. 113–136). CRC Press. https://doi.org/10.1201/9781003184157-6

Javaherikhah, A., & Sarvari, H. (2025). Implementing Building Information Modeling to Enhance Smart Airport Facility Management: An AHP-SWOT Approach. *CivilEng*, *6*(1), 15. https://doi.org/10.3390/civileng6010015

Khilenko, V. V., Strzelecki, R., & Kotuliak, I. (2018). Solving the problem of dynamic adaptability of artificial intelligence systems that control dynamic technical objects. *Cybernetics and Systems Analysis*, *54*, 867–873. https://doi.org/10.1007/s10559-018-0089-x

Kim, G.-Y., Lee, W.-J., Choi, B., & Lew, Y. K. (2024). Fostering collaborative opportunities for AI start-ups: The case of a hybrid business incubator in Seoul. *The Journal of Technology Transfer*, 1–30.

Kuleto, V., Ilić, M., Dumangiu, M., Ranković, M., Martins, O. M. D., Păun, D., & Mihoreanu, L. (2021). Exploring opportunities and challenges of artificial intelligence and machine learning in higher education institutions. *Sustainability*, *13*(18), 10424. https://doi.org/10.3390/su131810424

Kulkov, I., Kulkova, J., Rohrbeck, R., Menvielle, L., Kaartemo, V., & Makkonen, H. (2024). Artificial intelligence-driven sustainable development: Examining organizational, technical, and processing approaches to achieving global goals. *Sustainable Development*, *32*(3), 2253–2267. https://doi.org/10.1002/sd.2773

Lainjo, B. (2023). The The Application of Artificial Intelligence and Machine Learning to Enhance Results-Based Management. *Journal of Information Systems and Informatics*, *5*(4), 1550–1568. https://doi.org/10.51519/journalisi.v5i4.609

Leal Filho, W., Shiel, C., do Paço, A., & Brandli, L. (2015). Putting sustainable development in practice: Campus greening as a tool for institutional sustainability efforts. In *Sustainability in higher education* (pp. 1–19). Elsevier. https://doi.org/10.1016/b978-0-08-100367-1.00001-9

Leal Filho, W., Vargas, V. R., Salvia, A. L., Brandli, L. L., Pallant, E., Klavins, M., Ray, S., Moggi, S., Maruna, M., Conticelli, E., Ayanore, M. A., Radovic, V., Gupta, B., Sen, S., Paço, A., Michalopoulou, E., Saikim, F. H., Koh, H. L., Frankenberger, F., … Vaccari, M. (2019). The role of higher education institutions in sustainability initiatives at the local level. Journal of Cleaner Production, 233, 1004-1015. https://doi.org/10.1016/j.jclepro.2019.06.059

Lee, S., & Lee, S. (2022). University leadership in climate mitigation: reducing emissions from waste through carbon pricing. *International Journal of Sustainability in Higher Education*, *23*(3), 587–603. https://doi.org/10.1108/ijshe-01-2021-0006

Lo-Iacono-Ferreira, V. G., Capuz-Rizo, S. F., & Torregrosa-López, J. I. (2018). Key Performance Indicators to optimize the environmental performance of Higher Education Institutions with environmental management system–A case study of Universitat Politècnica de València. *Journal of Cleaner Production*, *178*, 846–865. https://doi.org/10.1016/j.jclepro.2017.12.184

Macrae, C. (2024). Managing risk and resilience in autonomous and intelligent systems: Exploring safety in the development, deployment, and use of artificial intelligence in healthcare. *Risk Analysis*. https://doi.org/10.1111/risa.14273

Mangarin, J. A. (2023). Threats, Opportunities, Weaknesses, and Strengths of the School Management Strategies Used by the Augustinian Recollect (AR) Schools. *Online Submission*, *1*(4), 1–288.

Marinakis, V., Doukas, H., Tsapelas, J., Mouzakitis, S., Sicilia, Á., Madrazo, L., & Sgouridis, S. (2020). From big data to smart energy services: An application for intelligent energy management. *Future Generation Computer Systems*, *110*, 572–586. https://doi.org/10.1016/j.future.2018.04.062

Matarneh, S., Elghaish, F., Rahimian, F. P., Dawood, N., & Edwards, D. (2022). Automated and interconnected facility management system: An open IFC cloud-based BIM solution. *Automation in Construction*, *143*, 104569. https://doi.org/10.1016/j.autcon.2022.104569

McMillan, L., & Varga, L. (2022). A review of the use of artificial intelligence methods in infrastructure systems. *Engineering Applications of Artificial Intelligence*, *116*, 105472. https://doi.org/10.1016/j.engappai.2022.105472

Menon, S., & Suresh, M. (2020). Synergizing education, research, campus operations, and community engagements towards sustainability in higher education: A literature review. *International Journal of Sustainability in Higher Education*, *21*(5), 1015–1051. https://doi.org/10.1108/ijshe-03-2020-0089

Nižetić, S., Djilali, N., Papadopoulos, A., & Rodrigues, J. J. P. C. (2019). Smart technologies for the promotion of energy efficiency, the utilization of sustainable resources, and waste management. *Journal of Cleaner Production*, *231*, 565–591. https://doi.org/10.1016/j.jclepro.2019.04.397

Palomares, I., Martínez-Cámara, E., Montes, R., García-Moral, P., Chiachio, M., Chiachio, J., Alonso, S., Melero, F. J., Molina, D., Fernández, B., Moral, C., Marchena, R., de Vargas, J. P., & Herrera, F. (2021). A panoramic view and swot analysis of artificial intelligence for achieving the sustainable development goals by 2030: progress and prospects. *Applied Intelligence*, *51*(9), 6497–6527. https://doi.org/10.1007/s10489-021-02264-y

Pedro, F., Subosa, M., Rivas, A., & Valverde, P. (2019). *Artificial intelligence in education: Challenges and opportunities for sustainable development*.

Polin, K., Yigitcanlar, T., Washington, T., & Limb, M. (2024). Unpacking Smart Campus Assessment: Developing a Framework via Narrative Literature Review. *Sustainability*, *16*(6), 2494. https://doi.org/10.3390/su16062494

Pucciarelli, F., & Kaplan, A. (2016). Competition and strategy in higher education: Managing complexity and uncertainty. *Business Horizons*, *59*(3), 311–320. https://doi.org/10.1016/j.bushor.2016.01.003

Rahman, M. H., Mohammed Ghazali, A. B., & Bin Mohamed Sawal, M. Z. H. (2024). Reasons for resistance to technology adoption in university libraries in Bangladesh. Information Development. https://doi.org/10.1177/02666669241294249

Ramos, M. A., Sankaran, K., Guarro, S., Mosleh, A., Ramezani, R., & Arjounilla, A. (2023). The need for and conceptual design of an AI model-based Integrated Flight Advisory System. *Proceedings of the Institution of Mechanical Engineers, Part O: Journal of Risk and Reliability*, *237*(2), 485–507. https://doi.org/10.1177/1748006x221083379

Rane, N., Choudhary, S. P., & Rane, J. (2024). Acceptance of artificial intelligence: key factors, challenges, and implementation strategies. *Journal of Applied Artificial Intelligence*, *5*(2), 50–70. https://doi.org/10.48185/jaai.v5i2.1017

Rane, N., Shirke, S., Choudhary, S. P., & Rane, J. (2024). Artificial Intelligence in Education: A SWOT Analysis of ChatGPT and Its Impact on Academic Integrity and Research. *Journal of ELT Studies*, *1*(1), 16–35. https://doi.org/10.48185/jes.v1i1.1315

Reed, J., Van Vianen, J., Deakin, E. L., Barlow, J., & Sunderland, T. (2016). Integrated landscape approaches to managing social and environmental issues in the tropics: learning from the past to guide the future. *Global Change Biology*, *22*(7), 2540–2554. https://doi.org/10.1111/gcb.13284

Rotondo, F., Giovanelli, L., & Ezza, A. (2023). Implementing sustainable innovation in state universities: Process and tools. *Journal of Cleaner Production*, *391*, 136163. https://doi.org/10.1016/j.jclepro.2023.136163

Ryan-Fogarty, Y., O'Carroll, D., O'Mahony, M. J., & O'Regan, B. (2016). Development of the green-campus programme in Ireland: Ensuring continuity of environmental education and action for sustainable development throughout the Irish education system. *Teaching Education for Sustainable Development at University Level*, 269–284. https://doi.org/10.1007/978-3-319-32928-4_19

Seidel, S., Recker, J., & Brocke, J. v. (2013). Sensemaking and sustainable practicing: Functional affordances of information systems in green transformations. *MIS Quarterly*, 1275–1299. https://doi.org/10.25300/misq/2013/37.4.13

Strielkowski, W., Grebennikova, V., Lisovskiy, A., Rakhimova, G., & Vasileva, T. (2024). AI-driven adaptive learning for sustainable educational transformation. *Sustainable Development*. https://doi.org/10.1002/sd.3221

Taha, A. Z., Mohtar, M., Rahman, M., Periannan, T. M., Jaafar, N. I., & Seng, T. L. (2025). The impact of technology orientation, technology opportunism, and change orientation on the firm operational performance: a moderated-mediation analysis. *Operations Management Research*, 1–22. https://doi.org/10.1007/s12063-025-00543-2

Tien, P. W., Wei, S., Calautit, J. K., Darkwa, J., & Wood, C. (2022). Real-time monitoring of occupancy activities and window opening within buildings using an integrated deep learning-based approach for reducing energy demand. *Applied Energy*, *308*, 118336. https://doi.org/10.1016/j.apenergy.2021.118336

Tong, A. (2024). The Evolution of AI Engineering: Hardware and Software Dynamics, Historical Progression, Innovations, and Impact on Next-Generation AI Systems. *Library Progress International*, *44*(3), 19715–19737.

UI GreenMetric. (2024). *UI GreenMetric World University Rankings 2024*. https://greenmetric.ui.ac.id/rankings/overall-rankings-2024

Wazin, W., Patimah, S., & Ansori, A. (2025). Optimizing AI Technology in Assessing Islamic Financing Risks: A SWOT Analysis of Challenges and Opportunities from an Islamic Legal Perspective (Fiqh). *Al-Istinbath: Jurnal Hukum Islam*, *10*(1), 172–193.

Yasuoka, J., Cordeiro, G. A., Brittes, J. L. P., Cooper Ordóñez, R. E., Bajay, S. V., & Nunes, E. (2023). IoT solution for energy management and efficiency on a Brazilian university campus–a case study. *International Journal of Sustainability in Higher Education*, *24*(2), 426–448. https://doi.org/10.1108/ijshe-08-2021-0354

Zavrazhnyi, K. Y. (2024). *The impact of the use of artificial intelligence and digital transformation on sustainable business development*. Teadmus OÜ.

Zhao, J., & Gómez Fariñas, B. (2023). Artificial intelligence and sustainable decisions. *European Business Organization Law Review*, *24*(1), 1–39. https://doi.org/10.1007/s40804-022-00262-2

Zhong, W., Liu, Y., Dong, K., & Ni, G. (2024). Assessing the synergistic effects of artificial intelligence on pollutant and carbon emission mitigation in China. *Energy Economics*, *138*, 107829. https://doi.org/10.1016/j.eneco.2024.107829

About the Contributor(s)

Safiatur Rokhmah, Faculty of Business and Economiccs. Sultan Maulana Hasanuddin State Islamic University Banten.
Email: safiatur.rokhmah@uinbanten.ac.id
ORCID: https://orcid.org/0009-0003-9325-7576

Dudi Permana, Faculty of Management Doctoral Education Program. Mercu Buana University.
Email: dudipermana.77@gmail.com
ORCID: https://orcid.org/0000-0001-9723-7351

Farida Elmi, Faculty of Management Doctoral Education Program. Mercu Buana University.
Email: faridaelmi57@gmail.com
ORCID: https://orcid.org/0000-0002-3146-3820

Sugiyono, Faculty of Management Doctoral Education Program. Mercu Buana University.
Email: sugiyono.madelan@gmail.com
ORCID: https://orcid.org/0000-0002-8876-9054

Aan Ansori, Faculty of Business and Economiccs. Sultan Maulana Hasanuddin State Islamic University Banten.
Email: aan.ansori@uinbanten.ac.id
ORCID: https://orcid.org/0000-0001-8878-2956

https://doi.org/10.22521/edupij.2025.19.569 Published online by Universitepark Press