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Article

Enhancing Electricity Resource Efficiency on University Campuses in Malaysia: Strategies for Reducing Electricity Wastage Through Green Energy and Sustainable Management Practices

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Abstract: This study explores strategies to enhance the efficiency of electricity resources on Malaysian university campuses, focusing on reducing energy waste through action management, personnel management, and sustainable management practices. Green energy technologies are also examined as a mechanism for supporting sustainable development. This study adopts a sequential explanatory design with mixed methods (MMSE), covering three public universities in Malaysia: University of Malaya (UM), Multimedia University (UTM), and University of Malaysia (UKM). The study will first conduct quantitative campus statistics and surveys to diagnose energy consumption patterns, and then analyze the impact of behavioral and institutional factors on campus electricity conservation through qualitative semi-structured interviews and focus group discussions. The study infers that the intensity of technical intervention, the degree of participation in behavioral intervention, the maturity of operational practices, the effect and outcome, and cost-effectiveness have key influences on university electricity resource conservation.

Keywords: MMSE; Campus electricity resources; Green energy technology; Sustainable management

1. Introduction

With the rapid development of China's social and economic conditions, the shortage and waste of electricity energy have become one of the important factors restricting economic development. As high-energy-consuming and high-cost units, universities need to carry out energy-saving management of electricity to play a very important role in alleviating the problem of energy shortage [1-2]. Currently, major universities in China have begun to promote the spirit of innovation, firmly adhere to the concept of energy conservation and emission reduction, and creatively carry out energy-saving work. Many universities have introduced advanced intelligent water and electricity detection technologies and excellent skills management concepts to carry out energy-saving management of their own universities [3], and through certain data, the skills management work of universities has achieved certain results, but there are still some problems, such as insufficient capital investment and backward energy-saving equipment [4-5].

In recent years, many universities have begun to implement relevant measures to reduce greenhouse gas emissions and promote the construction of green campuses. Razman, R et al. conducted a survey of 30 international green universities to formulate measures for achieving sustainability through campus operations [6]. Zhu, B et al. took Zhejiang University as a research case and pointed out that the key way to achieve the goal of a green and low-carbon campus is to use renewable energy to replace fossil fuel energy to achieve energy and resource conservation [7]. Xu, P expounded that Shandong Normal University adopted a technical solution of "complementary of multiple energy sources, 100% utilization of renewable energy, combined centralized demonstration and popularization promotion", providing beneficial experience for campus clean and low-carbon energy utilization and achieving sustainable development, and setting up an advanced model [8].

Academic research on campus green energy and sustainable management of electricity resources has been conducted by Madabathula, C et al. who combined the XGBoost algorithm in machine learning with reinforcement learning (RL) to propose an intelligent green energy management system (SGEMS) for real-time monitoring of energy monitoring [9]. Barbato, A et al. constructed an intelligent campus power management framework, which ingeniously combined renewable energy, battery packs, and controllable loads to achieve dynamic response interaction of power demand [10]. Chen, M and Fu, X proposed a comprehensive energy scheduling framework, which integrated rooftop photovoltaic (PV) systems, energy storage systems (ESS), etc., and the study showed that this scheme could reduce the annual power demand and carbon emissions of the power grid by 24.83% [11]. Zhang, W et al. proposed an energy scheduling optimization method oriented to student behavior, and by taking Sichuan University as a case study, it was found that this optimization strategy could reduce the energy consumption of high-energy-consuming buildings during the day by approximately 16.35%, the peak load of high-energy-consuming buildings at night by 16.02%, and the overall energy efficiency by nearly 20% [12]. Wang, X et al. proposed a comprehensive life cycle carbon footprint optimization framework, which combined life cycle assessment (LCA) with mixed integer linear programming (MILP), and achieved a 7.00% reduction in the university's electricity emissions and a 26.92% reduction in seasonal load adjustment by taking the university campus as an example [13].

In addition, Lazaroiu, A proposed a multi-source power supply system, which consists of photovoltaic panels, wind power generation systems, fuel cells, hydrogen generators, etc., and applied it to provide energy supply for student dormitories in Romanian university campuses, aiming to increase the proportion of green energy application and reduce pollutant emissions [14]. Jamaludin, A et al. conducted an actual investigation on the twelve residential college buildings on the campus of the University of Malaya and found that the average electricity consumption ranged from 24 to 120 kWh/m^2/year. Through energy-saving strategies such as natural lighting and natural ventilation, the electricity usage efficiency reached an ideal level (24 to 34 kWh/m^2/year) [15]. Oladipo, S et al. developed a multi-hybrid adaptive neural fuzzy inference system (ANFIS) based on the improved PSO algorithm, which can monitor and predict the energy consumption of university student dormitories in real time [16]. Sim, M et al. proposed an optimization model based on multi-objective particle swarm optimization for Korean campus buildings. This model can ensure economic optimization and reduce energy consumption [17]. However, there are still some problems in the current research on "green campus" in universities: Firstly, there is a lack of correct standards for quantifying carbon emissions in university campuses, and there is no complete and continuous research data support; Secondly, there is a lack of systematic measures to implement "green campus" actions, and the enthusiasm of university students to take action has not been mobilized.

The core issue that this research focuses on is the persistent and measurable inefficiency of electricity consumption on the campuses of Malaysian public universities. The investigation is conducted by examining the actual electricity consumption patterns of Malaysian public universities. Based on the data collected from three selected Malaysian universities, the study explores the institutional and behavioral mechanisms that affect the energy-saving practices on campus. Through systematic data evaluation, the research examines the application of green energy and sustainable management in the auxiliary power operation of university campuses.

2. Research Methods

2.1. Research Framework Design

This study adopts a mixed-method sequential explanatory design (MMSE), where quantitative data collection and analysis are conducted prior to the qualitative research. The qualitative stage aims to explain and clarify the background and context of the quantitative results. This design is suitable for studies that aim to measure the scale and distribution of electricity consumption patterns (quantitative objective) as well as understand the institutional and behavioral factors driving these patterns (qualitative objective). The MMSE design has been widely applied in campus sustainability research and is highly suitable for the complexity of multi-site investigations in higher education.

The quantitative stage (the first stage) includes an audit of campus infrastructure and structured questionnaire surveys to establish baseline electricity consumption data and assess the attitudes, norms, and behaviors of campus users.

The data from the first stage directly responds to Research Question 1 (RQ1: Examining the current electricity and water consumption patterns on university campuses), providing an empirical basis for the subsequent qualitative stage. The qualitative stage (the second stage) includes semi-structured interviews and focus group discussions, aiming to interpret the research findings from the first stage and explore the institutional and behavioral mechanisms behind the observed patterns.

The data from the second stage mainly addresses Research Question 2 (RQ2: Exploring the impact of behavioral factors and institutional factors on electricity and water conservation practices), and provides support for Research Question 3 (RQ3: Exploring strategies for enhancing sustainable electricity and water management in universities).

The integration analysis stage (the third stage) combines the quantitative and qualitative research results to construct a policy framework for sustainable development that responds to Research Question 3. In terms of integration, the quantitative research will identify the main electricity usage patterns and behavior trends in each facility, while qualitative interviews and focus groups will further clarify the institutional and cultural factors influencing electricity efficiency practices. Therefore, the qualitative stage is not isolated but is carefully designed and sampled specifically to deeply explore the high-energy-consuming areas and behavior patterns revealed in the first stage and combine the two in the third stage, ultimately forming a power management strategy framework.

This study will also incorporate an assessment phase before and after the intervention in the second stage. After collecting baseline data, targeted energy-saving measures will be implemented on each campus (including installing smart meters, upgrading LED lighting, and conducting structured promotional activities). After a six-month intervention period, energy consumption and behavior data will be collected again to evaluate the effectiveness of the intervention measures.

2.2. Selection of Research Field

This study was conducted at three public research universities in Malaysia: University of Malaya (UM) in Kuala Lumpur, Multimedia University (UTM) in Petaling Jaya, and University of Malaya (UKM) in Bangi, Selangor. These three institutions were selected due to differences in their infrastructure construction years, sustainability maturity, and geographical background, which are crucial for obtaining generalizable and comparable research results.

By submitting formal research permission applications to the research management centers and facility management departments of each university, access to the three universities was obtained. Research ethics approval was granted by the Research Ethics Committee of University of Malaya. Before data collection, negotiations and signed data sharing agreements covering smart meter readings, utility bill records, and building management system logs were conducted with the facility management departments of the three universities.

2.3. Sampling and Data Collection

This study integrated multiple data sources, each of which had different research populations and sampling methods. Below, we will explain the samples and research populations for each type of data.

2.3.1. Infrastructure and Smart Meter Data

All power-consuming facilities (buildings, rooms and systems) within the three universities, covering approximately 300 to 500 buildings across three campuses. Sample: The infrastructure audit will select 12 facilities as representative samples - 4 types of buildings (laboratories, dormitories, libraries and administrative buildings) will be chosen from each university. The selection of facility-level samples is based on the availability of installed smart electricity meters and the representativeness of high-power-consuming facilities. All individual or multiple smart electricity meters installed in these 12 facilities will be fully collected (using the census method at the facility level).

2.3.2. Survey Participants

The participants came from all students, faculty members, and administrative staff of three universities (the combined estimated number was approximately 80,000). The sample selection was conducted using stratified random sampling method, aiming to recruit 400 survey respondents. The stratification was based on institutions (UM = 150 people, UTM = 150 people, UKM = 100 people), roles (students, faculty members, administrative staff), and gender. The sample framework would be obtained from the student affairs and human resources offices of each university. The sample size was based on a minimum requirement of at least 100 respondents per university to support variance analysis comparisons. It is expected that the response rate would be 60% to 70%, and approximately 600 people would need to be initially distributed the survey.

2.3.3. Interview Participants

The participants came from the campus directors, sustainable development officers, facility managers, and student environmental representatives of three universities. The sample was selected using purposive sampling method, with 15 respondents selected from each university (5 from each university: one campus director, one sustainable development officer, one facility manager, one faculty member involved in sustainable development, and one student environmental leader). To maximize diversity, the participants of the focus group discussions will be recruited separately from the interview participants.

2.3.4. Paired assessment before and after intervention

During the pre- and post-intervention assessment phases, each participant will be paired based on the individual tracking code assigned to them at the baseline survey. All respondents who agreed to participate in the longitudinal study will be assigned a unique anonymous code. This code will be used in the post-intervention survey (conducted six months after the intervention begins) to achieve individual-level paired comparisons. Infrastructure audit data will be paired at the facility level, using twelve facilities that are common to the two measurement points. For participants who cannot be matched between different time points (such as those who withdraw halfway or graduate), they will be excluded from the paired analysis and the situation of missing data will be transparently reported.

2.4. Investigation and Interviews

This study employed a series of complementary tools, aiming to systematically address three main research questions. Each tool was developed, reviewed, and piloted to ensure its effectiveness, reliability, and contextual applicability.

2.4.1. Questionnaire

Based on the construct design questionnaire of the Theory of Planned Behavior (TPB) [18], this survey was used to evaluate the performance of students and staff in terms of sustainable development-related behaviors, attitudes, subjective norms, perceived behavioral control, and behavioral intentions regarding the utilization of power resources. Additionally, measurement items for the perception of changes in power consumption behavior were added, and specific intervention measures were evaluated. The scales used have all been validated in the field of environmental psychology, and internal consistency was confirmed using the Cronbach's alpha coefficient (≥ 0.70) [19].

2.4.2. Semi-structured Interview Plan

The interview plan will collect the views of stakeholders on the behavioral drivers, operational obstacles and governance structure. Key issues include the challenges in implementing energy-saving measures, stakeholder participation, and institutional leadership, among others. The interviews will help support research questions 2 and 3 by obtaining background insights regarding technology, behavior, and governance.

2.4.3. Pilot Testing and Validation

All the tools will undergo a two-stage validation process. Firstly, scholars and practitioners in the field of sustainable development of energy resources will review the clarity, content validity, and consistency with the theoretical framework of the tools. Secondly, a pilot study involving approximately 30 respondents and 4 to 5 interview participants will be conducted. The reliability of the survey will be evaluated using the Cronbach's alpha coefficient (≥ 0.70), and the interview records will be checked for their thematic consistency and clarity.

2.5. Data Collection Methods

We will conduct semi-structured interviews and focus group discussions to understand the perspectives of students, teachers, staff, facility managers, and sustainable development officials regarding the institutional and behavioral factors that affect electricity consumption. The interviews will be centered around the research objectives, while allowing for discussions on emerging topics. The focus groups will be organized by stakeholder type for comparative analysis. All interviews and focus group discussions will be recorded and transcribed verbatim. The review of policy documents will systematically analyze the university's sustainable development strategy, energy management plan, green campus policy, and environmental audit report. The data sources include the official website, internal reports, and certification agencies.

2.6. Data Analysis Techniques

2.6.1. Descriptive Statistical Methods

Descriptive statistics will be used to summarize and present the patterns of electricity consumption and the survey results. Through indicators such as mean, frequency, percentage, and standard deviation, the differences in sustainable development awareness, self-reported behaviors, and consumption levels among various institutions and facility types will be analyzed. Bar charts and histograms will be used to visualize the electricity consumption patterns of different building types and institutions, providing a basis for targeted intervention strategies.

2.6.2. Inferential Statistical Methods

A paired-sample t-test was employed to assess the differences in electricity consumption and behavior scores before and after the intervention, comparing the data of the same participants or facilities at the two measurement points. The paired data were constructed using the individual tracking codes. Before the analysis, the Shapiro-Wilk test was used to check the normality of the difference scores; if the normality assumption was not met, the non-parametric method Wilcoxon signed-rank test [20] was adopted. When significant differences were found, post-hoc tests would be conducted. All quantitative analyses were performed using SPSS software.

2.6.3. Topic Analysis Method

The interview and focus group discussion data will be systematically analyzed based on a six-step framework - including familiarization, coding, theme construction, review, definition and reporting. The data will be managed and coded using NVivo software to ensure the transparency and traceability of the analysis process. The analysis method will combine deductive coding based on a theoretical framework with inductive coding to capture novel themes emerging from the participants' narratives.

3. Results and Analysis

3.1. Data Descriptive Statistics

Based on the framework design proposed in Chapter 2, the research actions were carried out, and relevant data were collected. Regarding Question 1, the current power and water consumption patterns on the campuses of the three universities are described in Tables 1 to 3. These tables successively show the power consumption situations of the University of Malaya (UM), the University of Technology Malaysia (UTM), and the National University of Malaysia (UKM). Quantitative surveys indicate that the University of Malaya performs the worst in key core indicators of power and water resource utilization, such as HVAC efficiency, lighting efficiency, and water system integrity. This is consistent with the current situation of the University of Malaya, which has a long history and outdated energy infrastructure. The National University of Malaysia follows closely behind, and this university is formulating sustainable development policies and partially deploying intelligent electricity meter infrastructure. The efficiency of power and water resource utilization is higher than that of the University of Malaya. In contrast, the University of Technology Malaysia performs the best in power and water resource utilization. It has made significant investments in green energy utilization and sustainable management and has established an energy monitoring system across the entire campus, setting an exemplary model for sustainable operation in public universities in Malaysia.

Table 1. The current power and water consumption patterns of the university of UM

Variable	Dimensions	Mean	Min	Max	Percentage (%)	Standard deviation
Infrastructure inefficiency	HVAC efficiency	2.29	1	3	22.52	0.452
	lighting efficiency	2.76	1	4	27.14	0.361
	Building envelope	3.18	2	4	31.27	0.561
	Water system integrity	2.48	1	3	24.39	0.478
Behavioral waste	Attitudes	2.72	2	4	24.03	0.382
	Norms	2.94	2	3	25.97	0.384
	Perceived behavioral control	2.82	1	3	24.91	0.432
	Actual practices	2.84	2	4	25.09	0.418
Monitoring and governance gaps	Smart metering coverage	2.29	1	4	20.89	0.333
	Audit frequency	2.97	2	4	27.1	0.428
	Real-time feedback	3.14	1	4	28.65	0.516
	Role clarity	2.56	1	3	23.36	0.392
Facility use profile	Labs	3.04	1	4	30.4	0.353
	Dormitories	2.68	2	4	26.8	0.584
	Libraries	2.17	1	4	21.7	0.339
	Admin	2.11	1	4	21.1	0.587

Table 2. The current power and water consumption patterns of the university of UTM

Variable	Dimensions	Mean	Min	Max	Percentage	Standard deviation
Infrastructure inefficiency	HVAC efficiency	3.01	2	4	23.44	0.584
	lighting efficiency	2.54	1	4	19.78	0.596
	Building envelope	3.52	2	4	27.41	0.456
	Water system integrity	3.77	1	4	29.36	0.476
Behavioral waste	Attitudes	2.98	1	3	24.63	0.47
	Norms	2.63	3	4	21.74	0.579
	Perceived behavioral control	3.22	1	3	26.61	0.303
	Actual practices	3.27	1	3	27.02	0.392
Monitoring and governance gaps	Smart metering coverage	3.26	2	4	27.1	0.406
	Audit frequency	3.18	3	4	26.43	0.471
	Real-time feedback	2.79	2	4	23.19	0.327
	Role clarity	2.8	1	3	23.28	0.507
Facility use profile	Labs	3.55	3	5	28.98	0.399
	Dormitories	2.95	1	3	24.08	0.403
	Libraries	3.45	3	3	28.16	0.36
	Admin	2.57	2	3	20.98	0.495

Table 3. The current power and water consumption patterns of the university of UKM

Variable	Dimensions	Mean	Min	Max	Percentage	Standard deviation
Infrastructure inefficiency	HVAC efficiency	3.37	3	5	23.11	0.323
	lighting efficiency	3.03	4	5	20.78	0.346
	Building envelope	3.45	2	4	23.66	0.532
	Water system integrity	4.73	3	5	32.44	0.522
Behavioral waste	Attitudes	3.09	4	5	20.16	0.381
	Norms	4.21	3	5	27.46	0.537
	Perceived behavioral control	3.43	3	5	22.37	0.573
	Actual practices	4.6	2	4	30.01	0.433
Monitoring and governance gaps	Smart metering coverage	3.58	5	5	24.67	0.468
	Audit frequency	3.27	4	5	22.54	0.543
	Real-time feedback	3.12	3	5	21.5	0.451
	Role clarity	4.54	3	5	31.29	0.457
Facility use profile	Labs	4.11	4	5	26.25	0.547
	Dormitories	4.44	3	5	28.35	0.398
	Libraries	4.14	4	5	26.44	0.468
	Admin	2.97	2	4	18.97	0.404

3.2. Inference of Key Factors

By implementing intervention measures in three universities, the improvement effect of the utilization efficiency of electricity and water resources was evaluated from five aspects: technical intervention intensity, behavioral intervention participation, operational practice maturity, effect outcome, and cost-effectiveness. The differences before and after the resource utilization efficiency intervention in the universities of Malaysia, Malaysia University of Technology, and National University of Malaysia are shown in Tables 4 to 6. The intervention measures in the universities of Malaysia and Malaysia National University achieved significant improvements (at a significance level of 0.001) in all five aspects of resource utilization. The five indicators of the National University of Malaysia also achieved significant improvements, but only the behavioral intervention participation and effect outcome aspects had a significance level of 0.05. The intervention in the University of Malaysia Technology was relatively poor, and it did not achieve significant improvement in the cost-effectiveness indicator, while the other four indicators only had a significance level of 0.05. This is because the existing green energy and sustainable management strategies for electricity at the University of Malaysia Technology have achieved certain results, and the intervention measures cannot have more improvements.

Table 4. The effect of energy and water resource conservation interventions of UM

Variable	Before the intervention	After the intervention	t	p
Technological intervention intensity	2.02	3.92	23.031	***
Behavioral intervention engagement	2.58	3.82	11.678	***
Operational practice maturity	2.33	3.74	19.103	***
Effectiveness outcomes	2.68	4.92	24.672	***
Cost-effectiveness	2.03	4.05	19.028	***

Table 5. The effect of energy and water resource conservation interventions of UTM

Variable	Before the intervention	After the intervention	t	p
Technological intervention intensity	3.56	4.91	3.007	**
Behavioral intervention engagement	3.34	4.65	6.305	**
Operational practice maturity	3.52	4.78	4.206	**
Effectiveness outcomes	3.24	4.63	4.807	**
Cost-effectiveness	3.68	4.19	1.077	0.124

Table 6. The effect of energy and water resource conservation interventions of UKM

Variable	Before the intervention	After the intervention	t	p
Technological intervention intensity	2.55	4.10	10.288	***
Behavioral intervention engagement	3.2	4.28	6.321	**
Operational practice maturity	2.88	4.49	22.822	***
Effectiveness outcomes	3.20	4.55	7.344	**
Cost-effectiveness	3.08	4.45	12.629	***

3.3. Summary of the Theme and Management Insights

Based on the analysis of electricity and water usage in Malaysian universities, key themes that have significant impacts on the energy consumption of schools were further identified, and their current situations were determined. According to the qualitative analysis results of NVivo, the four main themes are power operation management, renovation of university buildings, personal energy conservation, and energy conservation in campus building design. The core focus of power operation management is to optimize operation and implement intelligent control. The renovation of university buildings mainly involves hardware upgrades and energy efficiency improvements. The focus on individuals is on awareness cultivation and behavior guidance. Energy conservation in campus building design is mainly studied from the source control and long-term benefits. The research provides the following insights for the power and water energy conservation management strategies of Malaysian universities:

(1) Start large equipment in batches: Start large equipment in the research laboratories at different times to avoid simultaneous and concentrated operation of multiple high-power devices. Eliminate standby energy consumption: Completely power off small devices such as computers and printers after they are turned off to prevent ineffective energy consumption from long-term standby. Utilize off-peak periods for maintenance: Utilize the low-load periods such as summer to power off the distribution substations in low-load areas for maintenance, shut down idle transformers, and reduce power loss from no-load operation. Upgrade power distribution facilities: Replace old transformers and high-voltage and low-voltage distribution cabinets, and lay new cables to improve power supply reliability and stability.

(2) Periodic lighting control: During holidays, the main road street lamps in the campus adopt a staggered lighting mode, and the landscape lights are uniformly turned off. Replace efficient equipment: Install first-level energy efficiency split-type air conditioners and achieve centralized control; replace high-energy-consuming large refrigeration equipment with magnetic suspension water chillers. Intelligent air conditioning management: Install air conditioning intelligent control sockets to achieve remote control, fault diagnosis, and switching of custom scene modes. Upgrade insulation and heat preservation: Use vacuum insulation boards as the main material for wall insulation, and extruded polystyrene foam boards for roof and ground insulation.

(3) Conduct thematic activities: Through activities such as the Energy Conservation Week and the National Low-Carbon Day, enhance the energy conservation awareness of teachers and students. Integrate into curriculum teaching: Offer general courses on carbon neutrality and green finance to establish a low-carbon education system that includes theoretical cognition, value shaping, and behavior formation. Prioritize natural lighting and ventilation: Make full use of natural light in classrooms and offices. When the light is sufficient, do not turn on the lights; open windows for ventilation in the morning and evening when the temperature is suitable. Energy consumption disclosure and assessment: Aggregate energy consumption data to the specific departments and individual dormitories, and strengthen supervision and inspection through an information system.

(4) Optimize building orientation and ventilation: Utilize BIM wind environment simulation to optimize the building orientation, spacing, and shape, and construct a continuous ventilation corridor to guide natural wind through the building complex, reducing the frequency of air conditioning use. Climate-adaptive spaces: Incorporate traditional architectural elements such as cold alleys, courtyards, and arcade-style buildings into the design. Improve summer ventilation by optimizing wind pressure differences. Implement green building standards: Promote the implementation of green standards above the second level for new buildings, and prioritize the adoption of ultra-low energy consumption technologies for existing buildings.

4. Conclusion

This study selected three public research universities in Malaysia: University of Malaya (UM), University of Technology Malaysia (UTM), and University of Malaysia (UKM), and selected appropriate participants for surveys and interviews. Corresponding questionnaires were designed to conduct field research. By integrating data from multiple sources and exploring the influencing factors of university campus power resource utilization through paired comparisons before and after the intervention, this study enriched the theoretical framework and provided practical guidance for Malaysian higher education leaders in formulating future-oriented sustainable development strategies. For university administrators, this study offers data-based strategies to optimize campus power management.

This study acknowledges the following limitations:

(1) Self-report bias: Survey and interview data may be affected by social expectation bias, and participants may overestimate sustainable behaviors. This problem will be partially alleviated by cross-verifying self-reported data with objective readings from smart meters.

(2) Sample representativeness: Although the survey used stratified random sampling, the purposeful selection of interview participants and the research being limited to three specific universities limited the diversity of the collected viewpoints.

(3) Universality: The study focused on three public research universities in Malaysia, so the research results may not be generalized to private universities, technical colleges, or small regional institutions with different infrastructure and governance structures.

(4) Intervention compliance: The effectiveness of comparisons before and after the intervention depends on the consistent implementation of the intervention measures at each site. Differences in the implementation methods of the intervention in different campuses may introduce confounding factors.

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