

**글로벌 관점에서 본 대학 경영 효율성:  
프로그램 다각화, 국제화 및 국가 교육 성과를 중심으로**  
**Quantitative Exploration of Operational Efficiency with  
Business Program Diversification, Internationalization,  
and National Education Performance\***

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International rankings, a key management metric, significantly influence how universities allocate resources. This drive to improve higher education quality is especially critical for developing countries with limited resources. For these institutions, systematic resource management is essential to boost efficiency and overcome unique challenges. This study aims to identify benchmark strategies. These strategies will help institutions adopt best practices from leading “frontier institutions” to enhance operational efficiency. We propose a three-stage program efficiency model. This model uses a data envelopment analysis approach. It specifically focuses on program diversification, internationalization, and social contributions. We assessed management practices across 18 countries to determine their efficiencies and identify areas for improvement. Our analysis derived stage-specific efficiency levels and strategic benchmarking orders for inefficient countries. This study highlights the critical role of resource management and performance evaluation in making universities more competitive. Academically, this research contributes to the construction of an analytical model. Practically, it advances the understanding of managerial efficiency in higher education.

Keyword: business school, program management, performance management, efficiency, diversification, internalization, education quality, data envelopment analysis

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## 1. Introduction

Several changes to the management model in higher education have materialized from recent issues related to decreasing birth rates, increasing technological adoption, growing attention to non-credential-seeking learning experiences, and intensifying international competition (McKinsey and Company, 2022; Yue and Choi, 2025). Universities are in demand for the following features: high levels of scientific researchers, production of new technologies, job securement of graduates, sustained enrolment of students, financial stability, and contribution to global sustainable development goals (Cattaneo et al., 2019; Hou et al., 2020). These factors have led to call to redesign the management model for improved higher education quality based on comparative or benchmarking analyses across countries or institutions (Hou et al., 2020; Yan et al., 2023). Such analyses are expected to provide benefits by offering insights and significant reference value for the development of higher education globally, particularly in countries with universities that aspire to global standards and have limited resources (Guo et al., 2023).

Notable studies provide insights into the outcomes (performance management) of higher education and the inputs (key internal and external resources) needed for competitive

advantage. For example, diversification and competition have received ongoing attention owing to increasing competition among institutions (Teixeira et al., 2013). Hart and Rodgers (2023) revealed that higher education's competitive advantage can be viewed from the perspectives of human capital (i.e. leadership capabilities, faculty, and students), structural capital (i.e. brand image), and relational capital (i.e. reputation). Similarly, Otto et al. (2021) highlighted the importance of internationalization in encouraging universities to adopt a business model that encompasses both opportunities and challenges related to resource use and mission fulfilment. Rahnema (2020) also emphasized the recent changes in quality culture in higher education institutions contingent on quality assurance activities. These outcome-oriented perspectives are posited to provide guidelines for higher education to achieve a higher level of education quality, outcomes, and community impacts.

From an input-oriented perspective of higher education, various studies have underscored the importance of resources. Competition for students has been ignited by the need for financial sustainability (Cattaneo et al., 2019). Zhou et al. (2024) emphasized the importance of intellectual resources in assessing the performance of the education, science, and technology industries in 31 Chinese provinces from 2010 to 2019 in the context of rapid innovation-driven economic growth. Fadda et

al. (2022) utilized performance-oriented funding adoption as an input to understand its effect on performance in Italian institutions. Their findings highlighted the vital role of external factors, such as financial resources provided by the government. Finally, resource allocation for accreditation is often regarded as a commitment to high assurance of learning and educational excellence (Ito et al., 2024). Various types of accreditations (e.g. Association to Advance Collegiate Schools of Business [AACSB]) are considered to have a significant impact on internationalization, student mobility, and education quality.

These studies collectively provide pertinent information on both outcome- and input-oriented perspectives for managing overall performance. However, from the perspective of practitioners, two main research gaps remain. The first gap refers to the lack of clarity in incorporating program-, university-, and national-level perspectives into the evaluation of inputs and outputs for comprehensive efficiency planning in the context of limited resources. The second gap concerns the limited understanding of the processes involved in developing a benchmark strategy considering various resources and performance outputs.

This study aims to identify benchmark strategies by which institutions can adopt best practices from leading institutions to improve their operational efficiency. This research is aligned with the ongoing efforts to understand

adopting management 'best practices' for a desirable level of outcome in higher education management (Marconi and Ritzen, 2015; Scur et al., 2021); as well as a resurgence of research interest in understanding the connection between a university's performance contingent on management conditions and resource allocation, including investment in administrative support for programs and student management (Agasisti et al., 2024; McCormack et al., 2014). Specifically, this study presents a three-stage program efficiency model for measuring and comparing the efficiency of institutions with respect to program diversification, university internationalization, and social contribution to the quality of national education. The model demonstrates the process for assessing management activities and formulating recommendations for inefficient management regarding the directions of change needed to improve efficiency, based on business programs, universities, and national performance measures in 18 countries.

The findings underscore the importance of efficient resource management and performance evaluation, especially for universities seeking to improve their global standing and compete in a resource-constrained environment. This study has both academic and managerial implications. It contributes to the literature by incorporating diversification, internalization, and national performance perspectives into an efficiency management framework for ed-

educational resources. Furthermore, the results can be used to aid university management evaluate their key activities and implement action plans for continuous improvement.

## II. Literature Review

### 2.1 Improvement planning for higher education institutions with limited resources

According to recent observations of the modern education industry, it is challenging to simultaneously secure resources and develop education programs and higher education services. For example, various studies have underscored the importance of resources and strategic allocation to improve planning for higher education quality (Hart and Rodgers, 2023; Marquardt and Harima, 2024; Shi et al., 2024; Zhou et al., 2022).

Many universities, particularly those in developing countries, struggle with limited resource acquisition and allocation, while simultaneously being pressured to demonstrate program performance. Despite concerns related to the unintended consequences of performance funding policies (Umbricht et al., 2017), resource constraints are worsening. For example, reduced government funding in southern Europe has forced underfunded universities to compete more aggressively for

students as a revenue source (Cattaneo et al., 2019). For example, Fadda et al. (2022) raised concerns related to potentially misleading competitive allocative mechanisms in resource allocation for universities in Italy. Resource constraints are expected to have a large impact on developing countries, as resource-dependent countries perform worse than resource-abundant countries in measures of human and intellectual capital (Lashitew et al., 2021).

With increasing technological adoption and international mobility, the required range of institution resources now relates to financial resources as well as human, structural, technological, and even social capital. The stakeholders involved in securing human and social capital (e.g. leadership) are regarded as sources of competitive advantage (Mahdi et al., 2019). Higher education institutions depend on faculties and research structure to deliver their research and teaching missions (Langrafe et al., 2020). In addition, technological resources and social capital are transitioning from a conditional to necessary resource for improved performance. The inclusion of technological improvement is vital, as it provides a significant source of competitive advantage for programs and institutions (Marulanda-Grisales and Vera-Acevedo, 2023). In the recent work of Wang et al. (2022), psychological resources (i.e. career adaptability) significantly affected students facing challenges

〈Table 1〉 Multi-level performance evaluation in higher education management

Classification	Approach	Context	Research approach	Reference
<b>Program level</b>				
Employability	Employability (Graduate Tracer Study)	A state university in the Philippines	Cross-sectional retrospective survey	(Albina and Sumagaysay, 2020)
	Graduate employability	510 business graduates from three Australian universities	Group comparison: regression analysis	(Jackson and Bridgstock, 2021)
Student flow	Graduates' employability	University graduates of sub-Saharan Africa	Narrative literature review	(Mgaiwa, 2021)
	Flow of students	University competition for students	Spatial interaction approach	(Cattaneo et al., 2019)
	Student dropout and churn	Eight cohorts of first-year students in Italian universities (2010-2018)	Multi-level logistic models	(Usala et al., 2024)
<b>University level</b>				
Operational Performance	University performance	58 public universities in Italy	Multivariate quantitative analysis	(Fadda et al., 2022)
	Overall performance in learning and teaching	German universities	Case study	(Leiber et al., 2018)
Performance	University mission achievement	73 public universities in Germany	Three-stage, mathematical analysis	(Otto et al., 2021)
	Research performance	Heads of research institutions at universities in Indonesia	Survey questionnaire	(Hermanu et al., 2024)
Quality	Research performance	37 public Australian universities	Data envelopment analysis	(Szuwarzyński, 2019)
	Quality assurance	Quality managers' perceptions of effectiveness	Mixed-method perspective: ordinary least squares regression model	(Seyfried and Pohlenz, 2018)
	Quality education	Educational institutes of Indonesia	Structural equation modelling analysis	(Budiharso and Tarman, 2020)
Sustainability	University performance (teaching quality, employment outcome)	UK teaching excellence framework	Network data envelopment analysis model	(Lee and Johnes, 2024)
	Sustainability practices in university	500+ universities included in ranking systems	Regression analysis	(Atici et al., 2021)
<b>National level</b>				
Competitiveness	Competitiveness	80 articles on higher education competition	Systematic review	(Hart and Rodgers, 2023)
Performance	Environmental and economic performance	UK higher education institutions	Slacks-based measure model	(Lee and Johnes, 2024)
	Research performance-based ranking	Local universities in 266 NUTS 2 European regions	Fuzzy-set qualitative comparative analysis	(Garcia-Alvarez-Coque et al., 2021)
Quality	World university ranking	Italy and Belgium universities	Semantic alignment of data concepts	(Poelmans et al., 2024)
	University quality	Panel data from top universities in global rankings	Staggered difference-in-differences model	(Guo et al., 2023)

related to social, cultural, and psychological adaptation in cross-cultural contexts.

Despite the ongoing academic emphasis on the importance of resource allocation, there remains a lack of clarity in incorporating program-, university-, and national-level perspectives into understanding the integration of inputs and outputs for comprehensive improvement planning in the context of limited resources. To complement the ongoing academic efforts to identify the key drivers of higher education performance, this study aims to provide a means of incorporating performance from different levels of interest. This approach is inspired by the recent work of Lee and Johnes (2024), who emphasized the importance of universities' role as principal operators of education services.

A wide range of performance levels is observed when universities or programs are viewed as a service medium, as Table 1 summarizes. The limited understanding of program improvement planning with distinct performance goals motivates an investigation using a stage-specific evaluation process. These studies collectively show how educational performance delivers multiple outputs, thus highlighting the need for a process of inclusion. This need could be addressed through a systematic approach to identify and evaluate frontier universities for stage-specific improvement strategies.

## 2.2 Diversification, internationalization, and educational sustainability for higher education

Despite the increasing number of studies related to improvement efforts toward higher performance in higher education, a strategic approach to benchmarking planning has yet to be fully incorporated. An interdisciplinary approach to viewing higher education from a mixed approach of operations management and benchmarking perspective could resolve the gap between education performance management and available support tools.

One such strategic framework that addresses the gap is provided by AACSB. AACSB sets accreditation standards to ensure high-quality business education worldwide, emphasizing excellence, innovation, and societal impact through three pillars: strategic management and innovation, learner success and thought leadership, and engagement and societal impact. These pillars are operationalized via nine standards that guide program diversification, internationalization, and sustainability practices. For instance:

- Program diversification is supported by curriculum management and assurance of learning (Standard 4 - 6), fostering innovation through competency-driven education models (AACSB, 2021).
- Internationalization for strategic goals aligns with AACSB's 2025 focus on student mobility and global training to cul-

tivate culturally competent business leaders (Jean-Philippe Ammeux et al., 2021).

- Long-term sustainable impacts are embedded in standards requiring alignment with societal needs (e.g., environmental responsibility, equity) and partnerships with industry to address global challenges (AACSB Thought Leadership, 2022).

To that end, this study focuses on (i) program diversification, (ii) internationalization for strategic goals, and (iii) long-term impacts on the educational landscape for sustainable development. These thematic goals draw from AACSB's emphasis on mission-driven adaptability, global engagement, and alignment with the UN Sustainable Development Goals (SDGs).

Program diversification can be viewed as operating and offering various curricula to appeal to the needs of a wider, heterogeneous student population, which in turns contributes to securing program competitiveness (Hart and Rodgers, 2023; Teixeira et al., 2013). The role of institutions is no longer limited to research activities, but to diversifying learning curricula and campus infrastructure (Atici et al., 2021). Diversification has been of primary interest in both industrial economics and management, but it has its own set of challenges related to resource allocation, global trends, and higher education policies (Chankseliani and McCowan, 2021).

For example, program-level diversification must be initiated with a suitable level of financial support. However, universities often struggle to initiate or diversify because of limited resources. Specifically, financial funding has gained attention as a key input that can fulfil development goals related to innovation and sustainable development (Chankseliani and McCowan, 2021; Garcia-Alvarez-Coque et al., 2021; Lashitew et al., 2021). Financial funding, both internal and external, is commonly viewed as a critical tangible investment at the program or department levels. It is collectively considered an essential investment aimed at enhancing program operations and improving the overall program or department efficiency. By strategically allocating these resources, programs can foster innovation, support infrastructure development, and drive academic and research excellence, ultimately strengthening their local and global competitive positions. This is well aligned with the resource-based view, which provides a basis for understanding how managers utilize organizational resources to gain and maintain competitive advantage; tangible resources, such as program investment provide unique opportunities that are key to diversifying existing programs (Cattaneo et al., 2019; D'Oria et al., 2021; El-Ouahi, 2024; Zahra, 2021).

University internationalization can be described as the university's strategic focus on internationalization abroad utilizing a media plat-

form to highlight the global standard of transparency and information related to global ranking and employment rates for institutions, students, and government (Poelmans et al., 2024). For example, such information provides benefits for individuals to make informative decisions for choosing a university but also for identifying collaborative partners or recruitment decisions for researchers and employers (Szuwarzyński, 2019). While various researchers have raised concerns about the potential manipulation and gaming of rankings (De Wit and Altbach, 2021; Johnes, 2018), the platform can be used to understand the generic framework of the international campus environment and opportunities for studying, working, researching, and even volunteering (Kethüda, 2023). Moreover, the platform impacts the economic market, such as the employment rate. Universities that regard themselves as accountable are expected to focus on how their graduates can impact the labour market with acquired skills and knowledge instead of merely emphasizing the graduation rate (Mgaiwa, 2021).

Prior to strategic planning, making decisions related to advancing international image, and fostering international mobility, it is first necessary to understand the level of program competitiveness (i.e. program diversification) (Garcia-Alvarez-Coque et al., 2021). In other words, universities can strategically plan only when they secure operations and com-

petitiveness for diversified programs and learning opportunities. Ito et al. (2024) noted that the balance between AACSB compliance and innovative teaching provides strategic insights for business schools and universities aiming to meet accreditations, which then can enable positive impact on the overall education quality. For example, in the case of Japan, AACSB accreditation has positively influenced teaching as well as encouraging active learning with a positive impact on education quality, enabling access to learning in a global environment (Ito et al., 2024). Universities can also utilize the anticipated impact of accreditation efforts to communicate accountability. This is well aligned with ongoing higher education efforts to operate regional campuses (Glass and Cruz, 2023; Kethüda, 2023). Program operation through accreditation, including the management of faculty and programs, can ultimately help schools achieve global recognition of their teaching methods, content, curriculum, research, and practical engagements as educational hubs (De Wit and Altbach, 2021; Ito et al., 2024; Lipura and Collins, 2020)

The national education system is commonly evaluated as a social outcome measure of universities at the national level and has been a meaningful measure of quality and opportunity for learners (De Wit and Altbach, 2021; Guo et al., 2023; Hou et al., 2020). Numerous research streams have attempted to identify

how to improve the national education system; studies have also analysed education sustainable development (ESD) and sustainable development goals (SDG) promoted by UNESCO and the UN, respectively (Lee and Kuzhabekova, 2019). ESD ‘allows every human being to acquire the knowledge, skills, attitudes and values necessary to shape a sustainable future’ (UNESCO, 2012). These efforts align with the need for collective efforts for sustainable development. This study posits that, as universities work toward establishing sustainability education, the degree of university performance provides a meaningful representation of national education quality. Quality and opportunity are expected to quantitatively address the level of the public education system, specialization expertise, high-school completion rates, and government expenditure on education, among others (Ashour and Fatima, 2016; Lee and Johnes, 2024; Shephard, 2017). While these measures pose limitations in the comprehensive representation of national-level education quality, they are deemed appropriate as a starting point for including national-level education measures in the research scope.

This study focuses on university performance as a national competency to improve the education system. The performance of universities often has direct or indirect impacts on a country’s educational system. In line with ESD, universities are expected to have a

national-level impact on the overall education system. In summary, quantitative exploration through the efficiency measure of program inputs (as operation) and outputs (as performance) can support institutions’ program management strategies.

### III. Research Methodology

#### 3.1 Data envelopment analysis

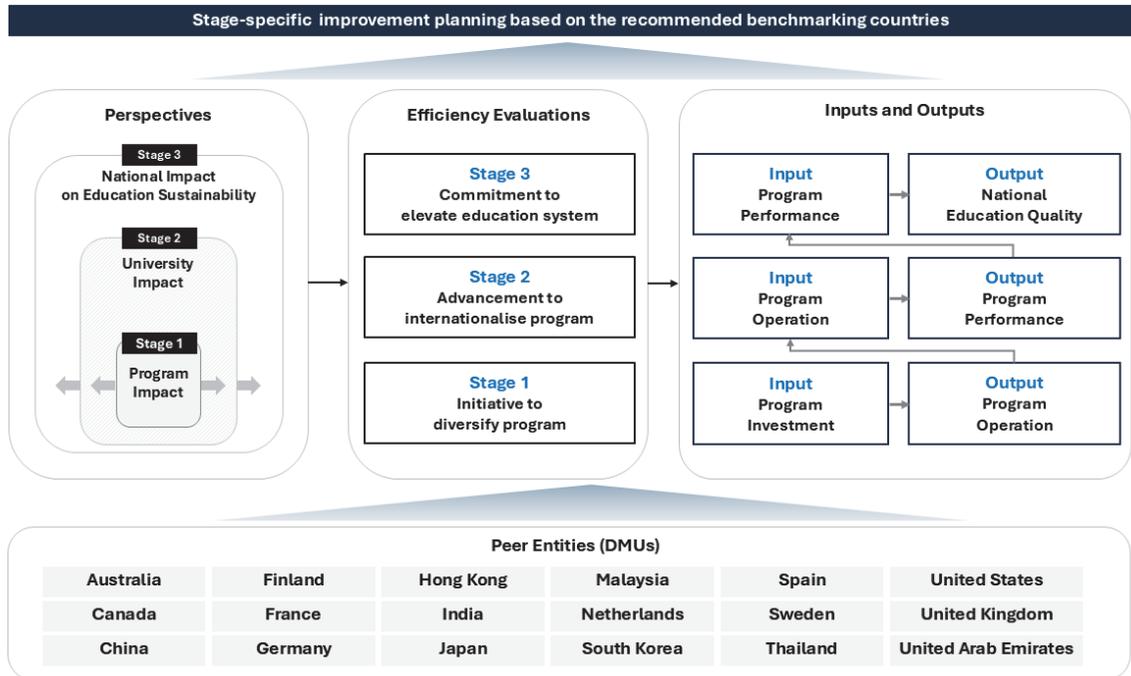
DEA provides various benefits for various services and industries, such as education, science and technology, artificial intelligence, and healthcare, by quantitatively analysing their operational systems to make operational decisions aimed at improving efficiency (Antunes *et al.*, 2022; Park, 2021; Park and Ko, 2024; Shi *et al.*, 2024; Zhou *et al.*, 2022). DEA is a linear programming method that empirically quantifies the relative efficiency of peer entities, also known as decision-making units (DMUs) (Banker *et al.*, 1984). Various education studies have used DEA to evaluate institutions from the perspectives of performance and strategic management (Lee and Johnes, 2022; Otto *et al.*, 2021; Wolszczak-Derlacz, 2017; Zhou *et al.*, 2022).

One of the most important issues in the DEA approach is dividing efficiency features into sub-stages so that each stage can explain

the direct input-output relationships. The stages need to be structured in such a way that they not only explain the efficiency levels within the respective stages but also provide interrelationships between the consecutive stages. This study adopts the DEA approach to identify baseline planning in benchmarking recommendations in a global market while incorporating program, university, and national levels of operational efficiency measures. A three-stage framework is thus proposed, as shown in Figure 1, which outlines the efficiency evaluation process.

The framework aims to identify, sequen-

tially, the efficiency in program diversification, internationalization, and contribution to sustainable development of the education system. It is noted that the efficiency levels are studied according to an expanding perspective of education performance. In Stage 1 (Program Impact), it first identifies the efficiency levels of education programs within each of the universities. Stage 2 (University Impact) advances them to international programs, while Stage 3 (National Impact) considers their impact on the national education system for sustainability. These perspectives would help educational organizations under-



(Figure 1) Three-stage model of the efficiency evaluation process

stand their roles and responsibilities in fostering the education system nationwide.

### 3.2 Description of stages, indicators, and suggested measures

This section explains the inputs, outputs, and interrelationships of each stage.

For Stage 1, this study posits that based on program financial resources, the operational opportunity for diversification of program innovation will differ based on the resource-based view. That is, program's initiative to diversify program is reflected based on the notion that: degree of the internal and external investments (input) affects the degree of program's opportunity and resource advantage in innovating and diversifying the program (output). This aligns with prior research indicating that financial investments in higher education directly impact student outcomes, including employability and retention (Albina and Sumagaysay, 2020; Jackson and Bridgstock, 2021; Mgaiwa, 2021). Moreover, competition for students and institutional efforts to reduce dropout rates further highlight the importance of resource allocation in ensuring program sustainability and long-term success (Cattaneo et al., 2019; Usala et al., 2024). For input, this study utilizes internal program funding or investment, which reflects the financial perspective of operation budgets and expenditures spent on the management

of representative universities for a DMU. For output, program operation is utilized based on the "operational perspective of the necessary human resources and programs that contribute to overall business program operations, which is further discussed in Stage 2.

For Stage 2, based on the impact of program-level performance on university-level outcomes, this study posits that business school operations and accreditation participation have meaningful impacts on program and university performance. The number of faculty members and programs reflects a university's capacity for internationalization by influencing curriculum diversity, research collaborations, and student exchange opportunities (Poelmans et al., 2024; Szuwarzyński, 2019). Prior studies have demonstrated that international program expansion is often driven by faculty engagement in global research networks and program offerings designed to attract diverse student populations (Ito et al., 2024). In other words, a university's advancement to internationalize program is reflected based on the following: the degree of program operations in terms of faculties and programs (input) affects the degree of program performance in students placements and university ranking (output). Program operation (the output variable from Stage 1) was incorporated as an input variable. This measure consisted of the number of faculty members and programs offered at the program level. Program performance was used

as the output variable. Program performance contains the 'Performance outcome measure perspective of business programs and overall university'. Program performance is further discussed in Stage 3.

For Stage 3, based on the overall effect of program- and university-level performance on national-level outcomes, this study posits that national education quality is driven by university performance. Prior research highlights that higher education competitiveness is closely tied to institutional performance, with global rankings and student employability shaping national educational standing (Hart and Rodgers, 2023). Additionally, university quality, as measured by world rankings, plays a vital role in strengthening national education systems and broader socio-economic outcomes (Guo et al., 2023; Poelmans et al., 2024). In this framework, national education quality is assessed through university performance indicators, where student placements and institutional rankings (inputs) directly influence national education quality outcomes (outputs). For the input, university performance (output from Stage 2) incorporated the variables. University performance based on The Times Higher Education—World University Rankings (THE-WUR) ranks universities based on five indicators: teaching, research, citations, industry income, and international outlook (Poelmans et al., 2024). The Times Higher Education (THE) ranking assesses universities

according to their scientific findings, elements of the internationalization of teaching and research, and subjective assessments, including employers' opinions (Szuwarzyński, 2019). To this end, both ranking and employment rate are incorporated into the underlying metrics for university-level performance, and national education quality incorporates the performance of national systems related to educational quality and opportunity.

### 3.3 Data collection

While the abovementioned indicators for the input and output variables are not exhaustive, they provide a starting point for future studies on a three-stage efficiency model that can serve the needs of program managers and policymakers (Table 2).

The DMUs investigated for data collection and analysis included G20 and non-G20 members. This was done to ensure that both large- and smaller-economy countries were addressed. The G20 countries were Australia, Canada, China (Mainland), France, Germany, India, Japan, South Korea, the United Kingdom (UK), and the United States (US). Non-G20 countries include Finland, Hong Kong SAR, Malaysia, the Netherlands, Spain, Sweden, Thailand, and the United Arab Emirates (UAE).

Data collection was focused on an initial illustration of potential data that could be utilized (Table 3). Program investment takes

measures based on (i) operating budget information provided by the AACSB, (ii) performance information by Times Higher Education (THE), and (iii) an increase in the operation budget utilizes simulated value. Program operation is evaluated using (i) the average number of full-time faculty members and (ii) the average number of programs from the AACSB. Program performance utilizes university rankings, and the employment rate is obtained from the THE ranking site. Although opinions on the reliability of public university rankings vary, the benefits are notable. Rankings based on composite indicators (CIs) are useful for benchmarking institutional performance and guiding policymakers in setting priorities (Szuwarzyński, 2019). Lastly, the national education quality indicator provided by CEOWORLD was used; it includes 16 indicators falling into the quality and opportunity index that pertains to institutional output by research, adult literacy rates, and collegiate-level school completion rates. The abovementioned indicators are not comprehensive but are valued, as they enable an initial approach in capturing the context of the national-level perspective of education impact.

Given the relatively short data collection period from 2022 to 2024, this study acknowledges the potential limitations in capturing long-term impacts. However, prior research suggests that financial investments in program diversification and innovation can yield

measurable short-term outcomes, particularly when strategically allocated to enhance operations and institutional performance (Cattaneo *et al.*, 2019; D'Oria *et al.*, 2021). While long-term effects may continue to unfold beyond this timeframe, studies indicate that initial improvements in program efficiency and competitiveness often emerge within one to two years, highlighting the dynamic nature of resource utilization in higher education (El-Ouahi, 2024; Zahra, 2021).

Independent t-tests comparing G20 ( $n=10$ ) and Non-G20 ( $n=8$ ) business departments revealed no significant differences in operating budget ( $X_1$ ), education spending ( $X_2$ ), number of faculties ( $M_1$ ), or program offerings ( $M_2$ ) ( $p > 0.05$ ). However, university rankings ( $Y_1$ ) showed a marginal trend ( $p = 0.072$ ), with Non-G20 institutions scoring higher, potentially due to specialized program focus or lower competition. Conversely, employment rates ( $Y_2$ ) exhibited no significant gap ( $p = 0.245$ ), suggesting comparable graduate outcomes despite disparities in rankings. These results imply that Non-G20 institutions may prioritize niche program quality (reflected in rankings) over resource allocation, while maintaining comparable employment outcomes. Small sample sizes and outliers (e.g., Thailand's high ranking score) limit generalizability. Future studies should incorporate non-parametric tests to account for structural disparities in resource utilization.

〈Table 2〉 Summary of input and output variables used for three-stage DEA model

Indicators	Scope	Measures (Variables)	Data period	Inclusion period
Program Investment	Financial perspective of operation budgets and expenditures that are spent on managing business schools as well as rate of expenditure spent on education	<ul style="list-style-type: none"> <li>Operating budget in business department (<math>X_1</math>)</li> <li>Spending on education out of total expenditure (<math>X_2</math>)</li> </ul>	2022	Stage 1
Program Operation	Operational perspective of necessary human resources and programs that contribute to overall business program operations	<ul style="list-style-type: none"> <li>Average number of full-time faculties of business in business department (<math>M_1</math>)</li> <li>Average number of programs in business department (<math>M_2</math>)</li> </ul>	2023	Stage 1, 2
University Performance	Performance related to international ranking of university and employment rate	<ul style="list-style-type: none"> <li>Average ranking placements of universities (<math>Y_1</math>)</li> <li>Average employment rate of universities (<math>Y_2</math>)</li> </ul>	2024	Stage 2, 3
National Education Quality	Societal outcome measure perspective of universities at the national level	<ul style="list-style-type: none"> <li>Education quality index (<math>Z_1</math>)</li> <li>Education opportunity index (<math>Z_2</math>)</li> </ul>	2024	Stage 3

Source: AACSB, THE, Ranking, CEO world

〈Table 3〉 Descriptive statistics of higher education institutions in 18 countries

	Measures	Mean	SD	Minimum	Maximum
$X_1$	Operating budget (USD/GDP per capita)	1386.9062	1641.5009	170.9510	6819.7471
$X_2$	Spending on education out of total expenditure (%)	0.1219	0.0302	0.0743	0.2015
$M_1$	Number of faculty	101.5549	48.7939	40.0000	214.0000
$M_2$	Number of programs	16.5654	10.9220	3.5000	44.5882
$Y_1$	Ranking placements of universities $Y_1 (1 - Y_1 / \text{Max}(Y_1) + 0.001)$	0.7833	0.2537	0.0001	0.9950
$Y_2$	Employment rate (%)	0.9534	0.0255	0.8786	0.9911
$Z_1$	Education quality index	64.5389	8.0540	50.3000	78.2000
$Z_2$	Education opportunity index	56.8111	9.7071	43.5100	69.7900

## IV. Results and Analysis

### 4.1 Efficiency measures of DMUs by stages

The DEA results for Stages 1 - 3 are listed in Table 4. The Charnes, Cooper, and Rhodes

model with a constant return to scale (CRS) is used to analyse the output-oriented model and obtain the efficiency score using pyDEA. The adopted model is beneficial in assuming that a proportional change in inputs leads to a proportional change in outputs and in quantifying a measure of overall efficiency (Salas-

Velasco, 2020). Further benefits and assumptions related to the DEA model can be found in a recent systematic literature review (Ahmad and Nana Khurizan, 2024).

The analysis aligns with the hierarchical structure of the three-stage framework: Stage 1 (Program Investment - Program Operations) : Evaluates how financial inputs, operating budget ( $X_1$ ) and education spending ratio ( $X_2$ ) translate into operational outputs, full-time faculty count ( $M_1$ ) and program offerings ( $M_2$ ). Stage 2 (Program Operations - University

Performance) : Measures how operational inputs ( $M_1, M_2$ ) drive institutional outcomes, university rankings ( $Y_1$ ) and employment rates ( $Y_2$ ). Stage 3 (University Performance - National Education Quality) : Assesses how institutional performance ( $Y_1, Y_2$ ) contributes to societal outcomes, education quality ( $Z_1$ ) and opportunity indices ( $Z_2$ ).

Based on the Stage 1 DEA analysis, 3 of the 18 countries (the Netherlands, Sweden, and the UK) received an efficiency score of 1. Based on Stage 2 DEA analysis, 3 of the 18

〈Table 4〉 Efficiency value of business schools by country (output-oriented CRS)

Decision-making unit		Stage 1 Initiative to diversify	Stage 2 Advancement to internationalization	Stage 3 Commitment to education quality
Australia	(AUS)	0.8820	0.2663	0.9635
Canada	(CAN)	0.6992	0.5157	0.9181
China	(CHN)	0.6449	0.4110	0.6513
Finland	(FIN)	0.8874	0.4574	0.9597
France	(FRA)	0.8421	0.3304	0.9808
Germany	(GER)	0.5676	0.6039	0.8964
Hong Kong SAR	(HKG)	0.5262	0.3588	0.7409
India	(IND)	0.2408	0.5736	0.9325
Japan	(JPN)	0.5028	1	0.8981
Malaysia	(MYS)	0.6802	0.3639	0.7623
Netherlands	(NLD)	1	0.2474	0.9588
South Korea	(KOR)	0.5459	0.7433	0.8541
Spain	(ESP)	0.6015	0.4040	0.8462
Sweden	(SWE)	1	0.3574	1
Thailand	(THA)	0.2784	0.7251	1
United Arab Emirates	(UAE)	0.9367	1	0.9301
United Kingdom	(UK)	1	0.2957	1
United States	(USA)	0.8576	1	0.9777

NOTE: Stage 1: (Input, I) Program investment, (Output, O) Program operation; Stage 2: (I) Program operation, (O) University performance; Stage 3: (I) University performance, (O) National education quality.

〈Table 5〉 Stage-specific benchmark peers for decision-making units

Decision-making unit	Stage 1 Initiative to diversify		Stage 2 Advancement to internationalization		Stage 3 Commitment to education quality	
	Peer	Lambda	Peer	Lambda	Peer	Lambda
Australia (AUS)	UK	0.850	USA	2.073	UK	0.329
	NLD	0.154	JPN	1.666	SWE	0.703
	SWE	0.199				
Canada (CAN)	UK	0.430	USA	1.180	UK	0.939
	NLD	0.008	JPN	0.716	THA	0.048
	SWE	0.453				
China (CHN)	NLD	0.953	JPN	2.644	UK	0.976
					THA	0.017
Finland (FIN)	UK	0.004	JPN	1.152	UK	0.727
	NLD	0.063	UAE	0.940	THA	0.237
	SWE	0.702				
France (FRA)	UK	0.207	USA	0.441	UK	0.414
	NLD	0.595	JPN	2.669	SWE	0.578
Germany (GER)	UK	0.432	USA	0.838	UK	0.947
	NLD	0.214	JPN	0.820	THA	0.065
	SWE	0.146				
Hong Kong SAR (HKG)	UK	0.865	USA	1.457	UK	0.940
	NLD	0.467	JPN	1.305	THA	0.061
India (IND)	NLD	1.329	UAE	1.713	UK	0.443
					THA	0.535
Japan (JPN)	NLD	0.167	JPN	1.000	UK	0.879
	SWE	0.413			THA	0.134
Malaysia (MYS)	SWE	1.344	UAE	2.729	UK	0.555
					THA	0.437
Netherlands (NLD)	NLD	1.000	JPN	4.314	UK	0.209
					SWE	0.829
South Korea (KOR)	SWE	0.898	USA	0.025	UK	0.894
			JPN	1.340	THA	0.119
Spain (ESP)	UK	0.411	JPN	1.432	UK	0.708
	NLD	0.414	UAE	0.804	THA	0.203
Sweden (SWE)	SWE	1.000	USA	0.393	SWE	1.000
			JPN	2.348		
Thailand (THA)	UK	0.507	UAE	1.408	THA	1.000
	NLD	0.561				
United Arab Emirates (UAE)	SWE	0.358	UAE	1.000	UK	0.614
					THA	0.387
United Kingdom (UK)	UK	1.000	USA	3.286	UK	1.000
			JPN	0.070		
United States (USA)	UK	0.272	USA	1.000	UK	1.007
	SWE	0.103				

countries (Japan, the UAE, and the US) received an efficiency score of 1. Based on the Stage 3 DEA analysis, 3 of the 18 countries (Sweden, Thailand, and the UK) received efficiency score of 1. Overall, no single country achieved an efficiency score of 1 across Stages 1 - 3. Sweden and the UK achieved efficiency scores of 1 in both Stages 1 and 2.

#### 4.2 Peer selection based on stage-specific efficiency measures

Following the procedure for identifying stage-specific inefficient countries, the inefficient countries can be benchmarked against a combination of efficient countries, as Table 5 shows. Two observations can be made from the analysis results. First, inefficient countries have a quantified order of efficient countries they can consider for the benchmarking strategy. Second, some countries have a single country as a peer for benchmarking.

Peer selection supports hierarchical improvement across the three-stage DEA model. Stage 1 peers guide optimal resource allocation, Stage 2 peers inform operational strategies, and Stage 3 peers exemplify systemic impact, ensuring that improvements in resource utilization cascade into operational efficiency and national outcomes. This tiered benchmarking creates a cohesive roadmap for cross-stage management plannings.

In Stage 1, Australia, Canada, Finland, and

Germany have three peer countries for benchmarking, while the other countries were assigned one or two peer countries. In Stage 2, the peer groups are limited to one or two countries. Similarly, in Stage 3, most countries are assigned two peer countries for benchmarking. Interestingly, some countries have only one benchmark country. For example, in Stage 1, China has the Netherlands as its benchmark, while Malaysia and South Korea have Sweden as their sole benchmark. Stage 2 includes five countries with a single benchmark (excluding countries with an efficiency value of 1). Stage 3 also shows that the US and UK are the only peer countries available for benchmarking recommendations.

Overall, this information provides valuable supplementary information for countries seeking improvement. Inefficient countries seek to improve and design strategic plans for stage-specific performance goals by identifying which specific inefficient countries should be benchmarked.

## V. Discussion

This section discusses the notable activities and policies of frontier countries to provide a pivotal basis for countries seeking to improve at the level of a specific stage.

### 5.1 Diversification-focused program management strategy

In Stage 1 (initiative to diversify), the Netherlands, Sweden, and the UK are considered as benchmarks. These countries should be benchmarked for their program investments, such as operational budget and government spending on education out of total expenditure.

Despite ongoing pressure for research and budget cuts, various countries have continuously emphasized the importance of program diversification. For example, initiatives in the Netherlands encourage universities to focus on research and educational strengths through program specialization and institutional collaboration (de Boer, 2019). Sweden is widely acknowledged for its program offerings focused on digitalization and environmental sustainability (Laterza et al., 2020). Moreover, several Swedish institutions offer programmes that enable academic and professional students to continue lifelong learning opportunities. In the case of the UK, the government has been focusing on research funding (i.e. Research Excellence Framework), encouraging differentiation in academic programs to strengthen the alignment between university programs and industry needs (Basso and Di Tollo, 2022; Jensen et al., 2022; Pinar and Unlu, 2020). Overall, financial resources, including internal budgets and government policies, spark di-

versification efforts in curriculum, program, and learning outcomes.

### 5.2 Internationalization-focused program management

In Stage 2 (advancement to internationalize programs), Japan, the UAE, and the US are highlighted as frontiers.

Japan has implemented two main initiatives, the Top Global University Project and the Go Global Japan Project (Chen and Huang, 2023; Rose and McKinley, 2018). These initiatives primarily aimed to expand global exposure and attract international students to Japan (Rose and McKinley, 2018). Japan has also incorporated English-language programmes while expanding its international partnerships through English-medium instruction (Ota, 2018). The UAE is another active example of internationalizing programs and institutions. The UAE established a global hub for higher education (Vardhan, 2015). The government has supported infrastructure and globally recognized academic programs by enabling branch campuses of international universities in Dubai and Abu Dhabi (Mahani and Molki, 2011). The US is continuously regarded as a promising destination for international students, as shown by its various visa programs and initiatives that enable global student mobility (Jacobs, 2022). Ongoing government support for international research collabo-

ration plays a meaningful role in attracting international students to universities (Alsharari, 2018). In summary, through the competitive management of program- and university-level performance, institutions can benefit from international recognition and exposure, which in turn provide cyclic benefits for operational resources.

### 5.3 National education system-focused program management

In Stage 3 (advancement to improve the national education system), Sweden, Thailand, and the UK are the leading countries in the frontier analysis. Sweden is a leading country in promoting equitable access to quality education with a focus on inclusivity and accessibility.

Key initiatives, such as the Higher Education Act, emphasize equal access to education for students with diverse geographic, social, and economic backgrounds (Argento et al., 2020). Moreover, the Swedish Smart City initiative highlights the importance of teacher training for the overall quality of educational arrangements (Brorström et al., 2018; Klett and Wang, 2014). In the UK, various reforms have been implemented (i.e. standards in teacher education, curriculum reforms, and adult education programs) to ensure high-quality learning outcomes (Department for Education, 2022). Overall, the overall operation and performance

of higher education can synergistically provide a meaningful impact on national-level education quality. Through the channel of higher education institutions, national-level initiatives provide a commitment to culturing high-quality education while addressing socio-economic and regional disparities.

## VI. Conclusion and future studies

This study primarily aimed to identify benchmark strategies for countries using a three-stage program efficiency model based on a case study of business schools in 18 countries, considering diversification, internationalization, and quality management perspectives. A three-stage DEA was used to assess efficiency by evaluating inputs and outputs. The analysis results revealed which countries are efficient and identified efficient countries for benchmarking.

This study is theoretically unique in that it proposes a three-stage DEA framework for analysing efficiency in managing education systems. The model adopts an expanding perspective in the education environment, thus allowing researchers to observe how to structure a sequential affecting situation with DEA. Moreover, the data collection process over 18 countries could be applied to other international comparative studies. The research re-

sults may also be beneficial to practitioners in identifying leading management countries for possible benchmarking. When managing with limited resources, benchmarking strategy is often critical for immediate responses. This study provides a benchmarking strategy for inefficient countries to efficiently maximize their output without increasing inputs. These findings offer an alternative approach to efficient benchmarking with limited resources. It is noted that the results obtained here are based on a one-year lag time. Considering the long-term influence in the following stage, the performance efficiency in a given year might be accumulated through numerous years up to that point. The cumulative impact on educational efficiency must be a meaningful research topic to be resolved in the near future.

Future studies investigating national-level benchmarking planning for higher education should address the following limitations. First, because of the diversified views of higher education institution performance, this study relies heavily on cross-referencing (i.e. multiple global ranking systems). Aligned with ongoing efforts to address discrepancies in the criteria used by different ranking platforms, the proposed model should be improved and updated to appropriately resolve the challenges in making direct comparisons between institutions and potential inconsistencies in the assessment. Second, the information provided by each system or institution is not free

from potential self-reported bias when managing the complexity of institutional performance. The 18 countries investigated here were chosen from both G20 and non-G20 nations. The impact of global classification schemes on management efficiency in education should be further studied in the future. Third, data constraints limit longitudinal analysis beyond the investigated period. Future research could explore extended time horizons to capture delayed impacts more comprehensively. Finally, the proposed model could benefit by including a comprehensive input from a broader network of stakeholders, including industry professionals, alumni, and current students. Specifically, insights related to the practical outcomes of educational programs, such as employability, industry relevance, and student satisfaction, could offer a more holistic evaluation and plan for institutional performance.

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