“Fostering achievement of sustainable development goals through green culture and digital transformation: Empirical evidence from an Indonesian education human resources university”

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FOSTERING ACHIEVEMENT OF SUSTAINABLE DEVELOPMENT GOALS THROUGH GREEN CULTURE AND DIGITAL TRANSFORMATION: EMPIRICAL EVIDENCE FROM AN INDONESIAN EDUCATION HUMAN RESOURCES UNIVERSITY

Abstract

Amidst global calls for sustainable transformation, higher education institutions are urged to align their operations with the Sustainable Development Goals (SDGs). This study investigates how green university culture and digital transformation contribute to SDG achievement within Indonesian education human resources universities (IEHRUs), focusing on financial, environmental, and human development outcomes. Utilizing a quantitative approach, a survey was conducted with 435 students from State University of Surabaya, a leading IEHRU. Data were analyzed using partial least squares structural equation modeling (PLS-SEM) with SmartPLS 4. The results reveal that green university culture significantly influences financial growth ($\beta = 0.427$, $t = 5.662$, $p < 0.001$), environmental quality growth ($\beta = 0.510$, $t = 7.564$, $p < 0.001$), and human development growth ($\beta = 0.430$, $t = 7.123$, $p < 0.001$). Similarly, digital transformation has significant positive effects on financial growth ($\beta = 0.313$, $t = 4.294$, $p < 0.001$), environmental quality growth ($\beta = 0.203$, $t = 2.713$, $p = 0.007$), and human development growth ($\beta = 0.313$, $t = 5.447$, $p < 0.001$). These three dimensions, in turn, significantly enhance SDG performance at the university level ($R^2 = 0.610$). The study underscores the strategic role of green values and digital innovation in university sustainability. It offers empirical insights for educational policymakers to embed sustainability across institutional governance, pedagogy, and operations, particularly in teacher-training institutions poised to catalyze wider societal change.

Keywords digital transformation, environmental quality, financial growth, green university culture, human development, SDGs, sustainability

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INTRODUCTION

Sustainable Development Goals (SDGs), introduced in 1987 by the Brundtland Report, have gained urgency amid global social and environmental challenges. The 2030 Agenda and its 17 SDGs, adopted by 193 UN member states, serve as a global framework for a just and sustainable future. Universities play a vital role through education, research, and community engagement, supporting goals like quality education and climate action. Although direct involvement is still limited, more institutions are joining SDG networks and initiatives such as the THE SDGs Impact Rankings, fostering collaboration and transformation (E. Price et al., 2024). Their active participation is crucial to achieving the SDGs.

Multiple factors, including organizational structure (Franco et al., 2019), technology (Angelaki et al., 2024), intellectual property (Griebeler et al., 2022), HR management (Prior et al., 2024), knowledge sharing (Aras et al., 2022), and organizational culture (Walker, 2022), significantly influence universities' efforts to achieve the SDGs. In response to global challenges like climate change and energy crises, sustainability and operational excellence have become key priorities (Serafini et al., 2022). Implementing green governance enhances reputation and stakeholder trust. Meanwhile, digitalization, driven by technologies such as AI and big data, is transforming universities and supporting long-term sustainability (Palos-Sánchez et al., 2023).

While many universities are actively promoting green culture and adopting digital transformation, the possibility of quantifying their role in fostering Sustainable Development Goals (SDGs) through these initiatives remains underexplored. This is essential for making strategic decisions that align higher education institutions with the achievement of the Sustainable Development Goals (SDGs).

1. LITERATURE REVIEW AND HYPOTHESES

Higher education plays a strategic role in achieving the Sustainable Development Goals (SDGs) through its primary functions in education, research, and community service. The university is increasingly integrating sustainability values in its curriculum, research, and institutional governance to support social and environmental transformation (Price et al., 2021). However, the implementation of the SDGs still faces challenges such as limited resources, low awareness among the academic community, and structural barriers (McCowan, 2023). Collaborative efforts and the adoption of innovations, such as digital transformation and green culture, are crucial to strengthen the university's contribution to this global agenda.

Indonesia is strongly committed to achieving the UN's Sustainable Development Goals (SDGs), with over 3,000 universities playing a key role. The Indonesian education human resources university (IEHRU), or LPTK, is central to this effort, preparing future teachers and education personnel to integrate sustainability into education. As agents of change, teachers shape environmentally conscious and inclusive future generations. Through SDG-relevant curricula, educational research, and reflective teaching practices, LPTKs link primary and secondary education with national SDG goals. Currently, only 78 official IEHRUs are designated by the Ministry of Higher Education.

The internal performance of universities in achieving the SDGs is influenced by several strategic factors. Governance and organizational culture, especially when aligned with sustainability, are primary drivers (Roos et al., 2023). Effective strategic planning enhances accountability and social orientation (Mattos et al., 2023), while financial support and research capacity contribute to institutional resilience (Pereira et al., 2025). Practices that integrate social, environmental, and economic sustainability, alongside top management commitment, are also vital (Govindaraju et al., 2019). Furthermore, TQM, innovation, internationalization, and a sustainability-embedded curriculum support the achievement of SDGs (Texeira-Quiros et al., 2022). However, most research centers on institutions in developed countries, with limited focus on teacher-training universities in developing nations like Indonesia. There is also a research gap regarding the combined influence of sustainability culture and digital transformation. This study addresses these gaps by exploring their integrative role in advancing sustainable universities.

This study is grounded in the triple bottom line (TBL) theory by Elkington (1994), which promotes sustainability through three interconnected dimensions: People, Planet, and Profit (Elkington, 1997). The People pillar focuses on social equity, human resource development, and welfare; the Planet pillar emphasizes environmental stewardship and resource efficiency; and the Profit pillar ensures financial viability. In the context of higher education, TBL encourages institutions to strike a balance between financial growth and environmental and social responsibilities. A green university culture and digital transformation reflect a commitment to the People and Planet pillars while also supporting long-term profitability. These elements collectively enhance institutional performance and contribute

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to the achievement of the Sustainable Development Goals (SDGs). Integrating TBL principles into university strategy aligns sustainability with core operations, ensuring that ecological, social, and financial values are not separated but work together to create a lasting impact.

Green culture is a set of values, beliefs, and organizational practices that prioritize environmental sustainability and foster a harmonious relationship between humans and nature (Wang et al., 2014). This culture is formed through the implementation of green operations that are in line with green values and symbols to achieve the organization's sustainability goals (Maheshwari et al., 2024). In university design, this concept translates into green university culture, which is the integration of sustainability values into education, research, campus operations, and community service (Seilkhan et al., 2024). The implementation of green culture at the university encompasses green campus initiatives, sustainable curriculum development, green technology research, and community engagement (Binani et al., 2024). Its main goal is to generate knowledge and innovation that supports global sustainable development (Liyanage, 2022).

Recent empirical evidence shows that green culture and green university culture have a significant impact on improving financial performance, environmental quality, and human development. From a financial perspective, an organization's environment-based culture and green innovation can mediate the relationship between green human resource management (GHRM) practices and the company's financial performance (Altassan, 2024; Fang et al., 2022). This is reinforced by the finding that green technology transformation in Chinese companies significantly improves financial performance (Bai et al., 2024). However, this impact is sectoral, where green initiatives in U.S. companies are showing mixed results (Li et al., 2017). In the context of environmental quality, green culture has been proven to improve environmental performance through the mediating role of green innovation and GHRM (Altassan, 2024). In the university environment, initiatives such as green cultural festivals and smart campus projects increase environmental awareness as well as a tangible contribution to sustainability (Al-Dmour, 2023). Regarding human development, the culture of the green university plays a role in integrating the value of sustainability into the curriculum, increasing student awareness and participation (Yuan et al., 2013). Students who engage in green activities tend to have a higher sense of social responsibility and environmental leadership (Chen & Zhou, 2024). The human development index (HDI) has a direct relationship with environmental sustainability, where green innovation is an important mediating factor (Ghouse et al., 2025).

Digital transformation in higher education is a comprehensive change in the way higher education institutions manage the process of learning, research, and administration through the use of digital technology. The initiative aims to improve operational efficiency, expand access to education, and support sustainable development goals (Suárez et al., 2021). The use of technology such as artificial intelligence, online learning, and gamification allows for the creation of more adaptive, inclusive, and student-centered learning methods (Kuzmina-Merlino, 2024). A robust digital infrastructure also encourages innovation in the curriculum and strengthens cross-institutional collaboration (Rodríguez-Abitia & Bribiesca-Correa, 2021).

Recent empirical evidence shows that the digital transformation of universities has a significant impact on financial performance, environmental quality, and human development. In terms of financial performance, the integration of digital systems, such as biometric grids, in university financial management has been proven to improve efficiency, security, and resource allocation, thereby enhancing institutional innovation capacity (De Jesus Wong-Galvez & Libaque-Saenz, 2023; Xie, 2024). Operational efficiency is also increased through the digitization of education management, saving up to 30% of time in administrative processes (Yang, 2024). In terms of environmental quality, digitalization contributes to waste management, pollution prevention, and the sustainable use of resources (Truong, 2022). Although direct evidence from the higher education sector is limited, studies in the manufacturing sector indicate that digital transformation enhances economic performance while reducing environmental impact (Tian & Zhou, 2024), a trend that could potentially be applied to universities. Meanwhile,

in terms of human development, digital transformation strengthens human resource management through strategic planning, leadership, and skills development (Khatir et al., 2024). The result is a 25% increase in student satisfaction, and the quality of education improves by up to 20% (Yang, 2024). The university has also begun to align the curriculum with the needs of Industry 4.0 through the improvement of digital skills for lecturers and students (Mahere, 2024).

Financial growth, environmental quality, and human development are key determinants in achieving the Sustainable Development Goals (SDGs) at the university level. Financial development drives economic growth and supports financing for sustainable development, although its impact on the environment can vary depending on the country's context (Daly et al., 2022). Financial institutions play a role in ensuring access to and efficiency in financing that impacts climate change mitigation (Annor et al., 2023). On the other hand, improving environmental quality through the adoption of renewable energy and climate technologies has been proven to lower the ecological footprint and strengthen the pillars of sustainability (Yin et al., 2025). However, the relationship between financial growth and environmental quality remains complex and contextual. Meanwhile, human development through education and capabilities is a crucial foundation for encouraging the adoption of clean technology and energy efficiency (Oben et al., 2024). Universities have a strategic role in producing superior human resources, promoting a culture of sustainability, and building an inclusive education system (Diaz-Vega et al., 2023). The synergy between these three aspects will strengthen the university's contribution to the overall achievement of the SDGs.

Various empirical studies show that financial growth, environmental quality growth, and human development growth have a significant influence on the achievement of the Sustainable Development Goals (SDGs) across sectors. A study of ASEAN and West African countries found that the financial growth of universities strengthens economic growth, which in turn provides resources for the education sector (AbdulKareem et al., 2024; Adeel-Farooq et al., 2020). This two-way relationship is also evident in the context of BRICS countries, underscoring the importance of financial stability and efficiency in supporting sustainable performance (Tekin Turhan et al., 2023). On the other hand, improving the quality of the environment is an important factor in supporting a healthy learning ecosystem. Studies show that innovations related to the environment, energy efficiency, and the role of green finance can improve the quality of education by creating a sustainable climate (Crespo et al., 2017; Suklun & Bengü, 2024). Additionally, eco-friendly behavior and energy conservation promote the quality of sustainable university institutions (Altassan, 2023). Education increases labor productivity and human capital accumulation, as well as strengthens institutional capacity in achieving the SDGs (Vien & Galik, 2024).

Based on the literature review, this study aims to empirically investigate the impact of green university culture and digital transformation on universities' achievement of the Sustainable Development Goals (SDGs) through their influence on financial growth, environmental quality, and human development.

Figure 1 presents the conceptual framework, based on institutional theory and relevant literature regarding sustainable university development. As a result, the following hypotheses are put forward:

H1: Green university culture has a significant impact on financial growth.

H2: Green university culture has a significant effect on environmental quality growth.

H3: Green university culture has a significant effect on human development growth.

H4: Digital transformation has a significant impact on financial growth.

H5: Digital transformation has a significant impact on environmental quality growth.

H6: Green university culture has a significant effect on human development growth.

H7: Financial growth has a significant impact on the university's Sustainable Development Goals (SDGs) performance.

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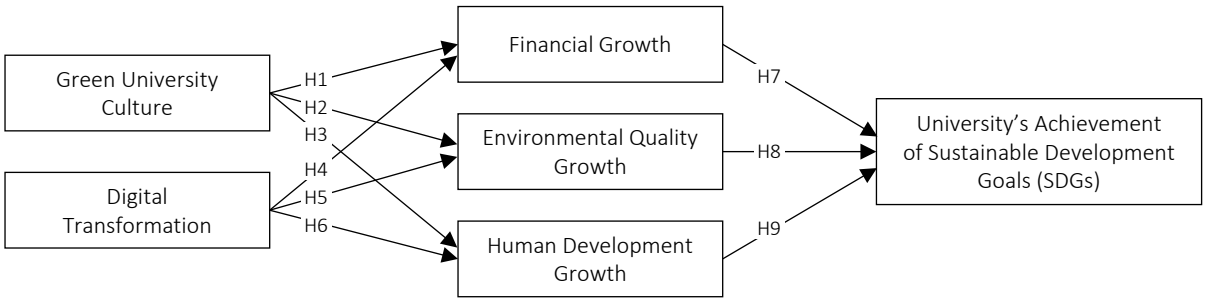

Figure 1. Proposed research model

H8: Environmental quality growth has a significant impact on the university's Sustainable Development Goals (SDGs) performance.

H9: Human development growth has a significant impact on the university's Sustainable Development Goals (SDGs) performance.

2. METHOD

This study employs a quantitative survey method, targeting students as key respondents due to their role as change agents and direct users of green culture and digital transformation on campus. The analysis was conducted at the State University of Surabaya (UNESA), which was selected as a representative of Indonesian education human resources universities (IEHRU) due to its international reputation. UNESA is ranked 601+ globally and 501–600 in education in the THE Interdisciplinary Science Rankings 2025 (Times Higher Education, 2025). It also ranked 601–800 globally and 15th nationally in the THE Impact Rankings 2025, highlighting contributions to SDG-5 on gender equality (Times Higher Education, 2025). Additionally, UNESA is placed 171st globally and 25th nationally in UI GreenMetric 2024 for campus sustainability (UI GreenMetric, 2024).

This study operationalized variables based on indicators validated through previous literature studies. Each indicator of the variable (Appendix A) was measured using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), to quantitatively capture student perceptions. There are seven main variables in this study. Green university culture is measured through nine indicators that reflect policies, curriculum, facilities, and participation in sustainability (Al-Dmour, 2023; Atici et al., 2021; Wang et al., 2014). Digital transformation encompasses eight indicators that assess the impact of digital strategy, infrastructure, and technology on campus services (De Jesus Wong-Galvez & Libaque-Saenz, 2023; Zhou et al., 2024). Financial growth is measured through seven indicators regarding budget efficiency, financial independence, and its impact on university performance (Liu, 2022; Mandanici & Pace, 2016; Zhou et al., 2024). Environmental quality growth has seven indicators that evaluate green initiatives, energy, and waste management (Beuron et al., 2020; de Andrade Guerra et al., 2018; Yadegaridehkordi & Nilashi, 2022). Human development growth encompasses eight indicators, including graduation rates, quality of education, human resource development, and industry partnerships (Barra & Zotti, 2017; Marques et al., 2018; Walker, 2022). Finally, the SDG university performance consists of ten indicators that measure the integration, commitment, and collaboration of universities in realizing the Sustainable Development Goals (SDGs) (Liu, 2020; Mahere, 2024; Tašaković & Büyükdağlı, 2024).

The population in this study includes 61,235 active students at the State University of Surabaya in 2023. Purposive sampling was used with criteria: (1) undergraduate (S1) students in at least semester 4, and (2) Master's (S2) and Doctoral (S3) students in at least semester 2. The minimum sample size was determined using Hair et al. (2017), recommending 5 times the number of indicators. With 49 indicators, a minimum of 245 respondents is required. Additionally, G*Power 3.1 analysis (Faul et al., 2009) with an effect size of 0.05, alpha of 0.05, and power of 0.95 suggests a minimum of 402 participants.

Data collection is carried out directly by independent enumerators who have been trained beforehand. They visited students who met the sample criteria at various faculties of the State University of Surabaya and handed out printed questionnaires for completion. This process lasts for two months, from February to March 2025. During the data collection process, the ethical aspects of the research were upheld, including providing respondents with information about the study's purpose, ensuring confidentiality of their identities, and obtaining their consent for voluntary participation. The respondent had the right to refuse or terminate participation at any time without any consequences.

This study involved 435 respondents who met the inclusion criteria, with detailed characteristics in Table 1. Based on gender, the majority of respondents were female, at 317 (72.87%), while males accounted for 118 (27.13%). In terms of age, most participants fell within the 18–20 year range (41.61%), followed by 21–30 (33.33%), and those under 18 (25.06%). Based on the education cluster under the IEHRU of the State University of Surabaya, most respondents came from the social and political sciences education cluster (19.31%), followed by philosophy and educational administration (16.78%), and vocational education (14.25%). Meanwhile, respondents from the technology and engineering education cluster constituted the least (5.29%). Judging from the level of education, the majority were 287 students of the Bachelor's (S1) program (65.98%), followed by Master's (S2) as many as 96 people (22.07%), and Doctoral (S3) as many as 52 people (11.95%).

Table 1. Respondent characteristics

Characteristics	Sum	Percentage
Gender		
Male	118	27.13%
Female	317	72.87%
Age		
< 18 years old	109	25.06%
18–20 years old	181	41.61%
21–30 years old	145	33.33%
IEHRU Education Group		
Philosophy and Educational Administration	73	16.78%
Language and Literature Education	24	5.52%
Economics and Business Education	50	11.49%
Social and Political Science Education	84	19.31%
Technology and Technical Education	23	5.29%
Mathematics and Natural Sciences Education	36	8.28%
Art and Design Education	31	7.13%
Sports and Health Education	52	11.95%
Vocational Education	62	14.25%
Education Level		
Bachelor	287	65.98%
Master	96	22.07%
Doctoral/Ph.D.	52	11.95%

The data analysis was carried out using the partial least squares structural equation modeling (PLS-SEM) approach with the help of SmartPLS software version 4. PLS-SEM was chosen because it is capable of handling complex models with many latent indicators and variables, and is suitable for data with non-normal distributions and moderate sample sizes (Becker et al., 2023). This technique is used to test the validity and reliability of constructs and relationships between variables and to measure the direct and indirect influence between variables in the model. The test is carried out through the analysis of the outer model (measurement) and inner model (structural) in stages (Hair et al., 2019).

3. RESULTS

The first step in the SEM-PLS method is to evaluate the outer or measurement model to ensure that indicators accurately represent the constructs (Hair et al., 2019). This involves testing convergent validity, discriminant validity, and reliability. Indicators must have a loading factor above 0.70, and those with a loading factor below 0.4 should be removed (Hair et al., 2019). AVE values should be at least 0.50 to confirm convergent validity, while Cronbach's Alpha and Composite Reliability should exceed 0.70 and 0.60, respectively. Multicollinearity is tested using the Variance Inflation Factor (VIF), with a threshold of 5 (Kock, 2017). Table 2 shows that all indicators have loading factors above 0.70 and AVE values above 0.50, indicating good convergent validity. Furthermore, all constructs demonstrate strong reliability with CA and CR values above the required thresholds. VIF values are also within acceptable limits, indicating no multicollinearity issues.

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Table 2. Convergent validity, reliability, and outer VIF testing

Variable	Factor Loading	AVE	CA	CR	VIF
Green University Culture					
GUC1	0.795	0.585	0.911	0.927	2.320
GUC2	0.769				2.158
GUC3	0.772				2.060
GUC4	0.799				2.803
GUC5	0.726				2.163
GUC6	0.723				2.790
GUC7	0.747				2.132
GUC8	0.766				2.022
GUC9	0.780				2.196
Digital Transformation					
DT1	0.823	0.659	0.914	0.931	2.571
DT2	0.788				2.363
DT3	0.782				2.440
DT4	0.850				2.302
DT5	0.797				2.176
DT6	0.849				2.112
DT7	0.792				2.710
Financial Growth					
FG1	0.769	0.696	0.927	0.941	2.203
FG2	0.841				3.116
FG3	0.846				3.267
FG4	0.798				2.177
FG5	0.863				2.181
FG6	0.863				2.114
FG7	0.856				2.258
Environmental Quality Growth					
EQG1	0.762	0.659	0.913	0.931	1.882
EQG2	0.805				1.882
EQG3	0.843				2.044
EQG4	0.808				2.129
EQG5	0.832				2.187
EQG6	0.823				2.058
EQG7	0.805				1.720
Human Development Growth					
HDG1	0.760	0.626	0.913	0.930	1.935
HDG2	0.745				1.957
HDG3	0.722				2.608
HDG4	0.753				3.376
HDG5	0.832				2.999
HDG6	0.881				3.105
HDG7	0.851				3.046
HDG8	0.855				3.073
University's Sustainable Development Goals (SDGs) Performance					
SDGs1	0.845	0.703	0.953	0.960	2.902
SDGs2	0.840				2.520
SDGs3	0.827				3.292
SDGs4	0.796				3.040
SDGs5	0.861				3.122
SDGs6	0.837				3.057
SDGs7	0.849				3.010
SDGs8	0.850				3.109
SDGs9	0.840				2.475
SDGs10	0.841				3.019

Testing of discriminant validity in SEM-PLS can be performed using the heterotrait-monotrait ratio (HTMT) approach. HTMT evaluates the extent to which a construct is completely different from other constructs in the model. A good HTMT value should be below 0.85, which indicates that the construct has adequate discrimination against other constructs. The results of the discriminant validity test using the heterotrait-monotrait ratio (HTMT) value in Table 3 show that all values between construct pairs are below the threshold of 0.85 (Roemer et al., 2021). The highest HTMT value was recorded at 0.798 between green university culture (GUC) and digital transformation (DT), which is still within reasonable limits. This indicates that each construct in the model has clear differences and that there is no conceptual overlap.

After the measurement model (outer model) test is completed and meets the criteria for validity and reliability, the next step in SEM-PLS is to analyze the inner or structural model. This stage aims to test the relationships between latent constructs in the model. Evaluation is carried out through a bootstrapping procedure, which is a resampling technique to estimate the significance of the path (path coefficient) (Streukens & Leroi-Werelds, 2016). Figure 2 is the output of the PLS-SEM bootstrapping analysis.

In the hypotheses testing, the acceptance criteria were based on a *t*-statistic value of > 1.96 and a *p*-value of < 0.05, which showed that the relationship between variables was statistically significant at a confidence level of 95% (Hair et al., 2018). In addition, *R*-squared analysis is used to evaluate the predictive power of the model. The *R*-squared value indicates how much the independent variable explains the dependent variable in the model. An *R*-squared value close to 1 indicates high predictive strength, while a value close to 0 indicates predictive weakness (Hair et al., 2020).

Table 4 shows that all relationships between constructs are statistically significant, with a *t*-test value of > 1.96 and a *p*-value of < 0.05. Green university culture (GUC) has a positive and significant effect on financial growth (H1: $\beta = 0.427$), environmental quality growth (H2: $\beta = 0.510$), and human development growth (H3: $\beta = 0.430$), which shows that green culture in universities plays an impor-

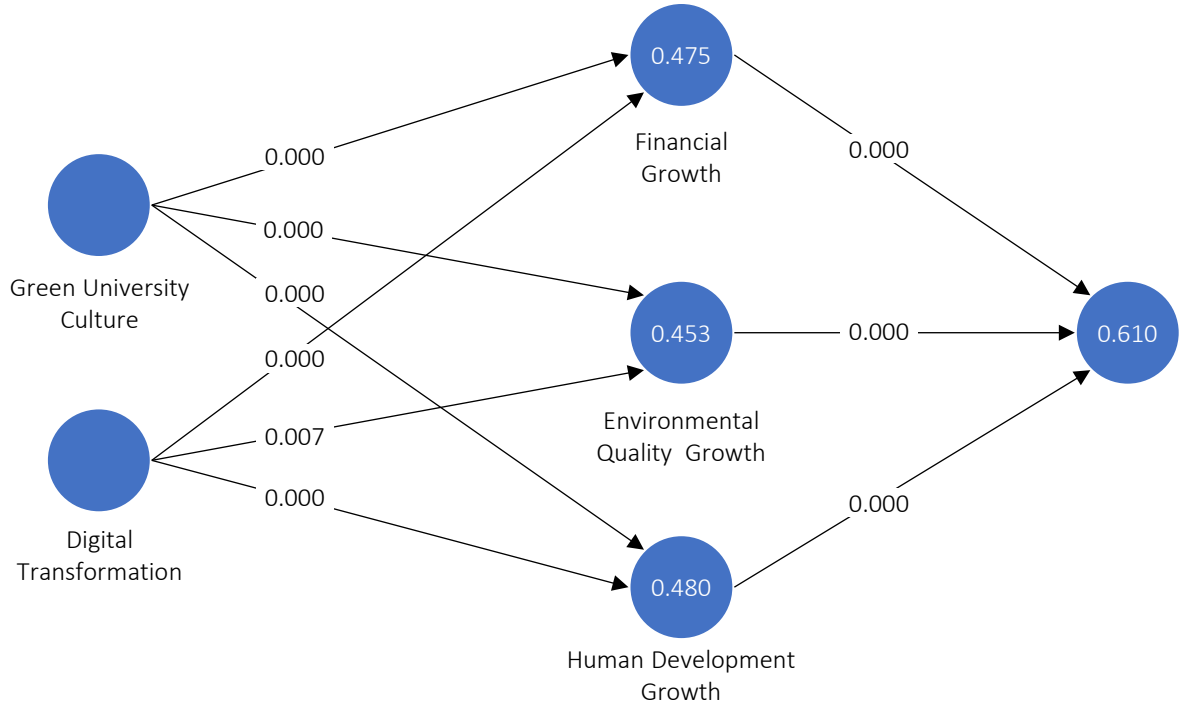

Figure 2. Bootstrapping output

Table 3. HTMT results

Construct	DT	EGQ	FG	GUC	HDG	SDGs
Digital Transformation (DT)						
Environmental Quality Growth (EGQ)	0.628					
Financial Growth (FG)	0.676	0.781				
Green University Culture (GUC)	0.798	0.721	0.710			
Human Development Growth (HDG)	0.684	0.700	0.712	0.711		
University SDG Performance (SDGs)	0.649	0.744	0.729	0.702	0.733	

tant role in driving growth in various aspects. Digital transformation also had a significant positive influence on these three variables (H4–H6), with the highest coefficient in human development growth (β = 0.313). Furthermore, the three growth variables contributed significantly to the university's SDG performance (H7–H9), with an *R*-squared of 0.610, indicating that the model was able to explain 61% of the variation. Meanwhile, the *R*-squared values for FG, EGQ, and HDG were 0.475, 0.453, and 0.480, respectively, indicating a moderate level of predictive ability for the model. Overall, the structural model shows strong inter-construct relationships that are relevant to the achievement of sustainable development goals in the university environment.

Table 4. Hypothesis and R-squared testing

Hypothesis	Path Coefficient	t-test	p-value	Decision	R-Squared
H1: Green University Culture → Financial Growth	0.427	5.662	0.000	Accepted	0.475
H2: Green University Culture → Environmental Quality Growth	0.510	7.564	0.000	Accepted	0.453
H3: Green University Culture → Human Development Growth	0.430	7.123	0.000	Accepted	0.480
H4: Digital Transformation → Financial Growth	0.313	4.294	0.000	Accepted	0.475
H5: Digital Transformation → Environmental Quality Growth	0.203	2.713	0.007	Accepted	0.453
H6: Digital Transformation → Human Development Growth	0.313	5.447	0.000	Accepted	0.480
H7: Financial Growth → University SDG performance	0.248	4.570	0.000	Accepted	0.610
H8: Environmental Quality Growth → University SDG performance	0.309	5.019	0.000	Accepted	0.610
H9: Human Development Growth → University SDG performance	0.325	6.125	0.000	Accepted	0.610

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4. DISCUSSION

This study was developed in response to the demands of global urgency in realizing the Sustainable Development Goals (SDGs) through the transformation of higher education institutions. The university, as a center for science development and character building, is expected to be able to internalize green culture and utilize digital transformation in all its academic and operational activities. The findings show a significant impact of green university culture on financial growth. Previous studies have also demonstrated that a green university culture has a significant influence on financial performance and human development, mediated by green innovation and GHRM (Altassan, 2024; Fang et al., 2022; Chen & Zhou, 2024; Ghouse et al., 2025). The acceptance of this hypothesis opens up a new discourse on the role of sustainability culture in the economic strategy of higher education institutions. Green culture is not only a symbol of ethical commitment to the environment, but also an innovative institutional economic strategy. Practices such as energy efficiency, waste management, and green infrastructure development can lower long-term operational costs while enhancing the university's reputation on a national and global scale. This reputation, in turn, opens up funding opportunities and international cooperation and attracts the interest of students and social investors who care about the environment. Theoretically, these results expand the understanding that sustainability is not only an environmental domain but also a strategic instrument in university financial governance. As a teacher-producing institution, IEHRU has a dual role: an agent of educational change and a pioneer of sustainability. Prospective teachers who have gone through the sustainability-based higher education process will have an impact of expanding the principles of sustainability in the education process and supporting sustainability at the primary and secondary education levels. Currently, there are quite a few schools that develop energy efficiency, sustainability of educational operations, and green school initiatives driven by teachers.

Green university culture also has a significant impact on the growth of environmental quality. The findings of this study align with Altassan (2024), Fang et al. (2022), and Al-Dmour (2023), who affirm the role of campus green culture in enhancing environmental performance through green innovation and civic engagement. The significant impact affirms the university's strategic role as a catalyst for a sustainable environmental ecosystem. Green culture in the campus environment encourages collective behavior change, not only at the institutional policy level but also at the individual level, i.e., students, lecturers, and staff. The implementation of programs such as green curriculum, carbon emission reduction, the use of renewable energy, and campus greening offers systemic effects that go beyond the physical boundaries of the university. This creates a living lab where the campus environment becomes a prototype of sustainable environmental management. Furthermore, green culture fosters long-term ecological awareness within the academic community, which then extends to the broader community through service- and solution-based research. For IEHRU or its ilk, green culture not only has an impact on operational cost efficiency but also becomes an integrated pedagogical instrument in the learning process and character formation of prospective teachers. IEHRU, which adopts sustainability principles, is able to create an attractive academic environment for donors, international partners, and government agencies that support environmentally sound education. Structurally, this strengthens IEHRU's position in the national education ecosystem as a pioneer of green transformation in the education sector. Culturally, the green culture embedded in the campus can be a model of ecological values that are replicated by graduates when teaching and managing schools.

It was further found that green university culture has a significant impact on human development growth and these results support previous findings that green culture in higher education strengthens the value of sustainability and forms environmental leadership and student social responsibility (Yuan et al., 2013; Chen & Zhou, 2024; Ghouse et al., 2025). Green culture in universities not only facilitates environmental awareness but also hones students' critical, collaborative, and ethical competencies as part of green human capital. Through a curriculum that focuses on sustainability issues, problem-based learning projects, and engagement in social-environmental activities, individuals experience a holistic transformation: mental, intel-

lectual, and emotional. Furthermore, this culture fosters the values of ecological empathy, environmentally sound leadership, and 21st-century skills needed in the era of the green economy. In addition, in the context of IEHRU or a university that produces prospective teachers, students who are exposed to sustainability values tend to bring that passion into the learning process in schools, creating a multiplier effect in the development of environmentally conscious human resources. Teacher training colleges play a crucial role in shaping agents of change at the grassroots level. Green culture internalized in the campus environment not only improves ecological literacy but also fosters the character of environmentally conscious transformative leadership. IEHRU's active involvement in the green campus provides students with empirical experiences that enrich the social, ethical, and leadership competencies of prospective teachers. Thus, green university culture is an important foundation for holistic human development at IEHRU, which is not only cognitively intelligent but also ecologically and socially wise.

Digital transformation has a significant positive impact on financial growth. These findings are in line with previous studies that showed increased financial efficiency and innovation through digital systems such as biometric grids (De Jesus Wong-Galvez & Libaque-Saenz, 2023; Xie, 2024) and administrative efficiency of up to 30% (Yang, 2024). The findings reflect the significant potential of digitalization in supporting budget efficiency and institutional sustainability. The digitization of academic and managerial processes allows for cost efficiency, reduced paper use, and optimization of human resources. Digital transformation is not just a modernization of technology, but also a redefinition of data-driven education, administration, and service processes. In the design of educational institutions such as IEHRU, the integration of online learning platforms, academic information systems, and cloud-based management allows for operational cost efficiency, increased access to education, and resource optimization. This not only reduces the long-term fiscal burden but also opens up new revenue opportunities through certification programs, online courses, and edutech cooperation. Additionally, a robust digital ecosystem fosters the digital literacy of prospective teachers, which is essential in preparing them for the era of technology-based education.

Furthermore, digital transformation has a significant positive influence on growth in environmental quality. This is in line with the findings of Truong (2022) that digitalization supports waste management and resource efficiency, and is supported by Tian and Zhou (2024), who show a similar impact in the manufacturing sector on the environment. As an institution tasked with producing prospective teachers, IEHRU has great potential to use digital technology to support the quality of the campus environment. Digital transformation enables more efficient management of resources, such as reduced paper use through digital-based learning systems, better energy management with IoT-based solutions, and reduced carbon emissions with the implementation of environmentally friendly technologies. By utilizing technology in campus operations, the university can reduce its negative impact on the environment while providing students with concrete examples of the importance of using technology in creating sustainability solutions. Furthermore, for IEHRU, the application of digital technology in the curriculum can introduce prospective teachers to the principles of environment-based education, enriching their pedagogical competence in integrating sustainability in the teaching and learning process.

Ultimately, digital transformation is also found to impact human development and growth. These findings are in line with studies by Khatir et al. (2024) and Mahere (2024), which show that digitalization accelerates the improvement of skills and strategic leadership, supporting the readiness of human resources in the Industry 4.0 era. These findings mark a paradigm shift: universities are no longer just educational institutions, but digital ecosystems that support the development of 21st-century human resource competencies, such as digital literacy, virtual collaboration, and adaptability. Digital transformation expands access to learning resources, encourages inclusivity, and creates a more holistic learning experience. The impact is felt not only by students but also by lecturers and education staff, who are encouraged to increase their digital capacity. For IEHRU or teacher training colleges, the application of technology in education allows for the development of more interactive, adaptive, and data-driven learning, which directly improves the quality of teaching and interpersonal skills of prospective teach-

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ers. Digitalization also opens up opportunities for aspiring teachers to access a wide range of global training platforms and resources, enriching their knowledge in current topics and innovative teaching methodologies. In addition, the use of technology encourages the development of 21st-century skills, such as critical, creative, and collaborative skills, which are critical in equipping prospective teachers with the ability to meet the educational challenges of the future.

Finally, financial growth, environmental quality growth, and human development growth have a significant positive effect on the achievement of the university's SDGs. The acceptance of the three hypotheses aligns with previous findings, which demonstrate that financial growth, environmental quality, and human development mutually support one another in facilitating the achievement of the university's SDGs synergistically (AbdulKareem et al., 2024; Vien & Galik, 2024). This shows that the university's success in realizing the goals of sustainable development requires an integrative approach. For IEHRU as an institution that produces prospective teachers, achieving the SDGs means not only carrying out environmentally friendly activities and implementing social programs, but also instilling sustainable values in all institutional dimensions. Financial growth provides the foundation for sustainable investments, such as green infrastructure development, digital technology education, and sustainable training programs for lecturers and students. Meanwhile, the improved quality of the environment creates a healthy, conducive learning ecosystem and becomes a living laboratory for students to understand sustainability practices in real terms. Furthermore, the development of human resources, both in terms of educators and students, is the center of the transformation of sustainability culture. Without financial support, human and environmental development will not be optimal. Without conscious and skilled humans, environmental and financial strategies will be stagnant. Therefore, the integration of the three is inevitable to make IEHRU the driving force of the SDG performance in the national and global education system.

CONCLUSION

This study aims to investigate the contribution of green university culture and digital transformation to the achievement of the Sustainable Development Goals (SDGs) by educational personnel training universities (IEHRU), through financial growth, environmental quality growth, and human development growth. The analysis revealed that a green university culture and digital transformation have a positive impact on all three aspects of growth: financial, environmental, and human development. Furthermore, these three growth indicators have a significant impact on achieving the SDGs in universities. Statistically, the model is able to explain more than 60% of the variation in the achievement of the university's SDGs, signaling substantial and practically relevant predictive power.

These findings make a real contribution to university management and higher education stakeholders. First, the implementation of green culture must be improved systemically through campus policies, continuous curriculum integration, and strengthening the participation of the academic community in environmental activities. Second, digital transformation needs to be seen as a managerial and pedagogical strategy, not just technological modernization. Investment in digital infrastructure, human resource training, and integration of academic and administrative information systems is key to continuous efficiency and innovation.

For IEHRU, as a teacher training institution, the strategic implications are enormous. Students who are exposed to the value of sustainability and digitalization during higher education will bring that vision into the teaching process in schools. This creates a multiplier effect in the dissemination of SDGs values to primary and secondary education levels, strengthening IEHRU's role as a national transformation agent in sustainable development.

This study has limitations, including the use of quantitative methods based on student perceptions that do not include the perspectives of lecturers, campus management, and external stakeholders. In addition, the research focus is limited to one IEHRU institution, which limits the generalizability of the results, and has not explored the long-term impact of digitalization and green culture on learning quality. Further research is recommended using a mixed-methods approach, incorporating in-depth interviews and case studies to provide contextual understanding. Comparisons between IEHRU and countries and the use of longitudinal metrics can enrich the literature on the impact of sustainability strategies in higher education.

AUTHOR CONTRIBUTIONS

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APPENDIX A

Table A1. Indicators

Variable	Indicators
Green University Culture	The university has a clear and structured policy in support of a green culture. The curriculum at the university has integrated the concepts of sustainability and the environment in various disciplines. The university supports and facilitates research focused on sustainability and environmental issues. The university implements an efficient energy management system and uses renewable energy sources. Waste management programs, such as recycling and waste reduction, are effectively implemented on campus. The campus has enough green space and is well managed to support the balance of the ecosystem. The university builds and renovates buildings with the principle of environmentally friendly buildings in mind. Students and staff are actively involved in sustainability initiatives held by the university. The university collaborates with local communities and international institutions to improve sustainability practices.
Digital Transformation	The university has a clear digital strategy that is integrated with the vision and goals of the institution. The university has provided adequate information technology infrastructure to support digital learning and administration. The use of technologies such as artificial intelligence (AI), big data, and the Internet of Things (IoT) has been adopted in the academic and operational management of universities. Digitalization has increased efficiency and effectiveness in university administration and management processes. Lecturers and education staff have sufficient digital skills to support the university's digital transformation. Digital culture has been embedded in the campus environment, characterized by collaboration and technology-based innovation in various academic and administrative aspects. Digital transformation has contributed to improving the quality of academic services and student satisfaction. The implementation of digital technology has had a positive impact on the university's performance in scientific research and publication.
Financial Growth	The university's financial performance is consistently greater than its operating costs. The university exhibits a high degree of financial autonomy, which allows it to operate without relying on heavy external funding. The process of implementing the university budget is efficient and meets the goals of the university that have been set. The allocation of financial resources at the university is carried out efficiently, prioritizing key projects and essential needs. The financial investments made by the university have brought a significant improvement in its international rankings. Increased funding in the university's research and innovation activities has had a positive impact on its financial growth. The university's performance funding program has contributed significantly to the university's financial stability and growth.
Environmental Quality Growth	The university has reduced CO2 emissions per student/lecturer in recent years. The amount of waste generated per student on campus can be effectively minimized. Energy consumption on campus is regularly monitored and optimized for efficiency. The university has a well-structured waste management and recycling system that is effectively implemented. The university has implemented green building initiatives, such as energy-efficient facilities. Environmental education programs are well supported and widely promoted within the university. The university's environmental performance is regularly evaluated using recognized sustainability ratings and benchmarks.
Human Development Growth	The graduation rate at this university has increased significantly in recent years. The enrollment rate of our study program continues to increase sharply. The student-lecturer ratio positively influences the quality of education at this university. The income of lecturers at this university competes with the regional average. The university supports career development through ongoing training and effective teamwork. The development of human resources at this university has made a positive contribution to the development of the local economy. Partnerships between universities and local industries are effective in advancing human resource development. The university ensures the continuous development of its human resources through progressive models and policies.

Table A1 (cont.). Indicators

Variable	Indicators
University's Sustainable Development Goals (SDGs) Performance	Universities integrate the concept of sustainable development in academic policies and programs to support the SDGs. The university actively promotes and funds key SDGs initiatives, such as health, climate action, and social equity. The university has implemented sustainable infrastructure practices, including energy-efficient buildings, waste management systems, and water conservation methods. The university engages with local communities and stakeholders to promote awareness and collaboration on SDGs-related projects. The university encourages the adoption of green campus initiatives, such as the use of renewable energy, waste recycling, and sustainable transportation. The university's leadership demonstrates a strong commitment to the SDGs by setting strategic goals that are in line with the principles of sustainable development. The university fosters environmental awareness and responsibility among students through sustainability awareness programs and activities. The university works closely with other institutions, government bodies, and the private sector to advance the SDGs. The university regularly monitors, evaluates, and reports on its progress toward the SDGs using clear performance indicators. The university actively works to ensure equal access to education, promote social inclusion, and equality in line with the SDGs.

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