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# The path to education 5.0: Digital ethics as a driver of innovation in higher education institutions

Gabriel Silva Atencio, Edwin Acuña Acuña

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## The path to education 5.0: Digital ethics as a driver of innovation in higher education institutions

El camino de la educación 5.0: La ética digital como motor de la innovación en las instituciones de educación superior

O caminho para a educação 5.0: a ética digital como um impulsionador da inovação em instituições de ensino superior

Gabriel Silva-Atencio  
Universidad Latinoamericana de Ciencia y Tecnología (ULACIT)  
San José, Costa Rica.  
[gsilvaa468@ulacit.ed.cr](mailto:gsilvaa468@ulacit.ed.cr)  
<https://orcid.org/0000-0002-4881-181X>

Edwin Acuña-Acuña  
Universidad Latinoamericana de Ciencia y Tecnología (ULACIT)  
San José, Costa Rica.  
[eacunaa711@ulacit.ed.cr](mailto:eacunaa711@ulacit.ed.cr)  
<https://orcid.org/0000-0001-7897-4137>

### Abstract

**Objective.** This study explores the integration of digital technologies within Latin American universities, with a focus on ethical and sustainable practices that support equitable educational development amidst the Fourth Industrial Revolution. **Method.** We utilized a combination of surveys and interviews to gather insights into the academic community's perceptions and valuations of digital responsibility. Institutional policies were also examined to assess their alignment with ethical technological practices. **Result.** The findings reveal a high appreciation for policies that promote conscientious technological management. Although progress has been made in social and environmental investments, there remains a significant challenge in fully embedding ethical principles into the organizational culture. **Finding.** The analysis underscores that the adoption of responsible technology is constrained not only by available resources but also by a lack of comprehensive ethical training and institutional commitment to sustainable practices. **Conclusions.** It is crucial for Latin American universities to effectively merge technological innovation with ethical and sustainable principles. An integrative approach is recommended, which includes ongoing training in digital ethics, continual policy updates, and strengthened intersectoral collaboration. This approach will foster an

advanced and conscious educational environment, ensuring that digital transformation promotes fairness and equitable development.

**Keywords** Digital ethics, higher education, smart organizations, ICT.

## Resumen

**Objetivo.** Este estudio explora la integración de tecnologías digitales en las universidades de América Latina, con un enfoque en prácticas éticas y sostenibles que apoyen el desarrollo educativo equitativo en medio de la Cuarta Revolución Industrial.

**Método.** Utilizamos una combinación de encuestas y entrevistas para recopilar percepciones y valoraciones de la comunidad académica sobre la responsabilidad digital.

También se examinaron las políticas institucionales para evaluar su alineación con prácticas tecnológicas éticas. **Resultado.** Los hallazgos revelan una alta valoración de las políticas que promueven una gestión tecnológica consciente. Aunque se ha avanzado en inversiones sociales y ambientales, sigue siendo un desafío significativo incorporar plenamente los principios éticos en la cultura organizacional.

**Hallazgo.** El análisis subraya que la adopción de tecnología responsable está limitada no solo por los recursos disponibles, sino también por la falta de una formación ética integral y un compromiso institucional con prácticas sostenibles.

**Conclusiones.** Es crucial que las universidades latinoamericanas fusionen efectivamente la innovación tecnológica con principios éticos y sostenibles. Se recomienda un enfoque integrador, que incluya capacitación continua en ética digital, actualizaciones constantes de políticas y una colaboración intersectorial fortalecida. Este enfoque fomentará un entorno educativo avanzado y consciente, asegurando que la transformación digital promueva la equidad y el desarrollo equitativo.

**Palabras claves:** Ética digital, educación superior, organizaciones inteligentes, TIC.

## Resumo

**Objetivo.** Este estudo explora a integração de tecnologias digitais nas universidades latino-americanas, com foco em práticas éticas e sustentáveis que apoiam o desenvolvimento educacional equitativo no meio da Quarta Revolução Industrial.

**Método.** Utilizamos uma combinação de pesquisas e entrevistas para reunir percepções e avaliações da comunidade acadêmica sobre a responsabilidade digital. As políticas institucionais também foram examinadas para avaliar sua alinhamento com práticas

tecnológicas éticas. **Resultado.** Os resultados revelam uma alta apreciação por políticas que promovem uma gestão tecnológica consciente. Embora tenha havido progresso nos investimentos sociais e ambientais, ainda existe um desafio significativo para incorporar completamente os princípios éticos na cultura organizacional. **Descoberta.** A análise destaca que a adoção de tecnologia responsável é limitada não apenas pelos recursos disponíveis, mas também pela falta de treinamento ético abrangente e compromisso institucional com práticas sustentáveis. **Conclusões.** É crucial que as universidades latino-americanas integrem efetivamente a inovação tecnológica com princípios éticos e sustentáveis. Recomenda-se uma abordagem integradora, que inclui treinamento contínuo em ética digital, atualizações constantes de políticas e colaboração intersectorial fortalecida. Esta abordagem promoverá um ambiente educacional avançado e consciente, garantindo que a transformação digital promova a justiça e o desenvolvimento equitativo.

**Palavras-chave:** Ética digital, educação superior, organizações inteligentes, TIC.

## Introduction

We live in an era marked by an unprecedented technological revolution, redefining social, economic, and cultural dimensions globally. As [Acuña \(2023\)](#) suggests, we are in the midst of the "Fourth Industrial Revolution," characterized by the pervasive integration of digital technologies into every aspect of daily life. Latin America is no exception, undergoing a rapid digital transformation that significantly affects various sectors, including higher education. Yet, this transformation poses substantial challenges, particularly in the realm of digital ethics—issues such as data privacy, academic integrity, and equitable access to technological resources.

Higher education institutions in Latin America are urgently required to adopt these technologies in ways that promote and uphold universal ethical values. [Bettoni, Matteri, Montini, Gładysz, and Carpanzano \(2021\)](#) identify a significant lag in the adoption of emerging technologies within organizational contexts, a trend that also impacts the educational sector and necessitates a rigorous ethical framework for incorporating new digital tools. This scenario necessitates a thorough exploration of the principal digital ethical challenges these institutions face and a critical evaluation of how the academic

community—including students, professors, and administrators—values digital ethics in their environments.

This study aims to examine these issues in depth, exploring how digital ethics are perceived and valued within the academic community. The importance of ethical data management is underscored by [Buenadicha, Galdon, Hermosilla, Loewe, and Pombo \(2019\)](#), who emphasize the need for policies that ensure responsible technological practices in academic settings. This research will further investigate the strategies and practices that institutions can employ to integrate digital ethics seamlessly into their organizational culture and operational procedures, assessing the impact of such policies on innovation and academic performance.

Moreover, this research seeks to determine how educational institutions can balance embracing technological innovations with adhering to ethical standards, thus fostering fair and responsible development. Insights from [Carbonara, Scozzi, and Pellegrino \(2023\)](#) discuss organizational readiness for smart work, an approach that can be adapted to educational contexts to align technological advancement with ethical principles.

Ultimately, this study aims to bridge a significant gap in the understanding and implementation of digital ethics in higher education across Latin America. By providing a comprehensive analysis of the challenges, perceptions, and strategic approaches involved in integrating digital ethics, it seeks to foster the development of more effective policies and practices, guiding academic institutions towards an environment that is both innovative and steadfastly ethical.

## **Literature Review**

We are currently witnessing an era defined by an unprecedented digital transformation. This transformation is characterized by technological and scientific advancements that have led to the formation of a society interconnected through the Internet, continually reshaping socioeconomic and cultural realities ([Atkins et al., 2021](#)). This global phenomenon has profoundly impacted educational models, fostering new ways of thinking and learning. However, the adoption of these models is not without challenges, particularly concerning the digital divide, which underscores inequalities in access to technology and information ([Parra, Chaves, & Villa, 2020](#)).

The digital era necessitates a revision of traditional educational paradigms, especially pertinent in regions like Latin America. Despite high Internet and mobile technology penetration, the distribution of these resources is not uniform across the population ([Donnelly & Stapleton, 2022](#)). This situation highlights the pressing need to address new ethical and organizational challenges within educational institutions, ensuring that advancements in technology translate into equitable educational opportunities for all.

### 1. *Ethics in Data Management and Higher Education*

Ethical data management is now recognized as a fundamental pillar in digital environments, particularly within the educational sector where privacy, information security, and equitable technology use are paramount. Atkins et al. (2021) highlight the necessity of implementing ethical frameworks in practice, especially in technological applications such as conversational AI chatbots, to ensure that all digital interactions adhere to ethical standards.

Additionally, the European Union review ([DLA Piper, 2024](#)) on technology and security legislation emphasizes the importance of continually updating policies and regulations to guarantee ethical and responsible deployment of emerging technologies. This is particularly pertinent in university settings, where there is a crucial responsibility to incorporate digital ethics into curricula and academic practices, as noted in the EU update of [the Computer Law & Security Review \(2021\)](#).

### 2. *Challenges and Opportunities for Higher Education in Latin America*

The 2030 Agenda and the United Nations Sustainable Development Goals represent a significant opportunity for Latin America and the Caribbean, emphasizing the need to integrate digital ethics into education to promote a more inclusive and sustainable society. In this sense, universities have a key responsibility in preparing students to face the ethical dilemmas arising in the digital era, promoting responsible use of Information and Communication Technology (ICT), and fostering critical and ethical thinking ([Parra, Chaves, & Villa, 2020](#)).

### 3. *Integration of ICT and Ethics in Higher Education*

The 21st century is characterized by an unprecedented integration of ICT into all aspects of life, including education. The "Eighth State of Education" report by [CONARE \(2021\)](#) shows how, in regions like Costa Rica and the rest of Latin America, digitalization

has transformed educational models, challenged traditional paradigms, and highlighted the importance of equitable access to technologies. This shift underscores the digital divide, a phenomenon that separates individuals based on their ability to access digital and technological information. Therefore, the adoption of technology in education must not only be inclusive but also ethically conscious, aligning pedagogical practices with the challenges and opportunities presented by the digital era.

#### *4. Diversification of Education and Ethical Responsibility*

[FitzGibbon \(2017\)](#) addresses the ethical implications of collecting and using digital data, particularly in emergency and development contexts, highlighting the need to protect personal information and ensure responsible practices. This ethical approach extends to the educational field, where the diversity of student experiences and needs demands that pedagogical strategies be not only inclusive but also ethically grounded. Higher education, in this sense, must consider the ethical responsibility to foster a learning environment that respects and values both individual and collective diversity, as suggested by [Jara \(2005\)](#).

#### *5. The intersection of Internationalization and Educational Quality*

According to [Willas & Camacho \(2022\)](#), internationalization is a crucial means to enhance quality in higher education institutions. This process involves not only the geographical and cultural expansion of educational programs but also the integration of global ethical standards that promote justice and equity. Such an approach reinforces the idea that educational quality and digital ethics must go hand in hand, preparing students to act as responsible citizens in a globalized and interconnected world.

#### *6. Building a Digitally Ethical and Just Society*

The path to a mature and ethically aware digital society is multifaceted and involves collaboration from multiple stakeholders, from educators and technologists to lawmakers and civil society. Education in the digital age, far from being an isolated challenge, represents a unique opportunity to rethink and rebuild the foundations of our societies in ways that promote justice, equity, and respect for human dignity ([Heck & Tsai, 2022](#)). Universities must take a leadership role in this change, fostering an environment where technology enhances humanistic values and contributes to building a more inclusive and equitable future.

#### *7. Organizational Adaptability and Smart Technologies*

Higher education institutions face the pressing need to adapt and transform in response to rapid technological evolution. [Wang, Liu, Li, and Lei \(2023\)](#) explore how organizational unlearning can enhance innovation in digital processes to improve performance, highlighting the moderating effects of smart technologies and environmental turbulence. This study underlines the importance for universities not only to adopt new technologies but also to continually reevaluate and adjust their approaches and strategies to stay relevant and effective in an ever-changing environment.

#### *8. Smart Work Environments and Employee Sustainability*

Creating smart work environments that promote employee sustainability is crucial in the digital age. [Wiklund-Engblom, Polo, Kullbäck, and Asplund \(2023\)](#) emphasize implementing smart work environments for employee sustainability, using action research for organizational development and learning. By applying these principles, universities can enhance the experience and well-being of their staff and students, ensuring an environment that fosters both innovation and ethical and social engagement.

#### *9. Leadership in Green Digital Transformation*

[Alabdali, Yaqub, Agarwal, Aloffaysan, and Mohapatra \(2024\)](#) discuss the importance of leadership in green digital transformation, highlighting the interconnection between green digital culture, green digital mindset, and green digital transformation. In the context of higher education, this approach can foster leadership that not only pursues academic and technological excellence but also promotes environmentally responsible and sustainable practices, aligning with the values of digital ethics.

#### *10. Digital Transformation and Supply Chain Synergies*

[Tian and Shi \(2024\)](#) examine corporate digital transformation and its synergistic effects on the supply chain, highlighting how collaboration and technological integration can enhance efficiency and sustainability. Universities can take lessons from these findings to optimize their operations and collaborations, ensuring that the adoption of digital technology positively contributes to the educational community and beyond.

#### *11. Digital Transformation and Green Innovation*

[Zhang, Wu, Mei, and Hong \(2024\)](#) investigate the relationship between digital transformation and green innovation, focusing on how financing modes can act as mediators. This approach is relevant for educational institutions seeking to balance the

adoption of digital technologies with environmental and sustainability goals, integrating green innovation into their strategy and curriculum.

### *12. Commitment to the Sustainable Development Goals*

Universities face the challenge of contributing to the Sustainable Development Goals (SDGs) set by the [ONU \(2018\)](#), which underscore the importance of quality education, gender equality, and climate action. By integrating these goals into their programs and policies, higher education institutions can play a crucial role in promoting global well-being and sustainable development.

### *13. Institutional Commitment to the Sustainable Development Goals*

Higher education institutions face the challenge of aligning with SDGs, as highlighted in the United Nations' 2030 Agenda. This document emphasizes the importance of institutional responsibility and effectiveness at all levels, fostering transparent accountability and actions consistent with their transformative social function in Latin America and the Caribbean. This framework establishes the need to evaluate what characteristics define an educational institution as "smart" and how it can effectively contribute to these global objectives.

### *14. Higher Education and Environmental Challenges*

Research by [Donnelly, N., & Stapleton, L. \(2023\)](#) examines the global dichotomy between equity and pollution, suggesting that reducing consumption inequality may lead to additional environmental burdens. This study highlights the importance of integrating sustainability and social justice into educational strategies, emphasizing the need for higher education organizations to adopt a holistic approach that balances innovation with environmental responsibility.

### *15. Innovation and Solving Social Problems*

[Lu and Wang \(2024\)](#) discuss how innovation strategies, both Research and Development (R&D) and non-R&D, can serve as catalysts for addressing social problems, underlining the role of educational institutions in fostering innovative approaches to social innovation. This analysis reinforces the idea that smart universities should create an environment that stimulates both traditional research and innovative activities aimed at solving social problems.

### *16. Influence of Cultural Orientation on Innovation*

[Machokoto \(2024\)](#) addresses how cultural orientation towards secrecy can impact innovation, a critical aspect for educational organizations seeking to foster a culture of transparency and collaboration. This perspective implies that universities should cultivate an environment that encourages openness and the sharing of ideas, overcoming cultural barriers that may inhibit innovation and collaborative learning.

#### *17. Sustainability and Environmental Management*

[Wang and Chu \(2024\)](#) analyze the impact of Environmental, Social, and Governance (ESG) ratings on corporate green innovation, providing a relevant framework for higher education institutions looking to integrate sustainable and environmental management practices into their operations. This study underlines the importance of incorporating sustainability concepts into education, preparing students to contribute to a more green and responsible economy.

#### *18. Adaptation and Readiness for Emerging Technologies*

Higher education organizations face the challenge of integrating emerging technologies, such as robotics, into their educational systems. According to [Suhail et al. \(2024\)](#), assessing students' readiness for the adoption of robots in the academic environment is crucial, requiring a deep understanding of their needs and expectations. This preparedness for advanced technologies requires not only adequate infrastructure but also an ethical framework that guides their implementation and use, ensuring that the adoption of new technological tools enriches the learning process and respects fundamental ethical principles.

#### *19. Impact of Higher Education on Social and Economic Development*

The research by [Tong and Wang \(2024\)](#) emphasizes the significant influence of higher education on shaping socioeconomic structures, particularly in regions like South Asia. This study highlights the importance of education in promoting entrepreneurial freedom and globalization, underscoring the vital role of universities in sustainable development and reducing mineral resource dependency. In this context, higher education institutions must adopt a comprehensive approach that combines academic excellence with ethical and social commitments.

#### *20. Applied Ethics in Artificial Intelligence*

The work by [Villas and Camacho \(2022\)](#), "Manual of Applied Ethics in Artificial Intelligence," provides a valuable framework for universities to integrate ethical principles

into the use of artificial intelligence technologies. This resource is crucial for educators and administrators in developing curricula and policies that ensure an ethical and responsible application of Artificial Intelligence (AI) in the educational context, promoting a conscious and reflective use of technology.

### *21. Green Innovation and Corporate Management*

The study by [Hu and Hong \(2023\)](#) on the relationship between management equity incentives and R&D investment for green innovation highlights the importance of ethical and sustainable management within organizations. This approach can be extrapolated to the educational realm, where management policies and practices must reflect a commitment to sustainability and responsible innovation.

### *22. Challenges and Opportunities in Data and Technology Integration*

[Shah et al. \(2023\)](#) examine the challenges and opportunities faced by scientists in integrating data and technology to promote health equity. This analysis applies to universities, which must balance technological innovation with social responsibility, ensuring that digitalization and data analysis advance equity and inclusion both inside and outside the classroom.

### *23. Social Innovation and Industrial Heritage Regeneration*

The study by [Scaffidi \(2024\)](#) on the impact of social and territorial innovation stemming from the regeneration of industrial heritage offers insights into how universities can play a role in revitalizing communities through education and research. Educational institutions should consider how their programs and projects can contribute to local and regional development, fostering social innovation and sustainability.

### *24. Integration of the Digital Economy and Ecological Innovation*

[Sun et al. \(2024\)](#) address the impact of integrating the digital economy with the real economy on corporate green innovation. This approach underscores the relevance of higher education in preparing students for a digitalized economy while simultaneously promoting eco-friendly and sustainable practices.

## **Research Methodology**

Research Design: Redefining the Future - Digital Ethics as a Driver of Innovation in Higher Education Organizations

### *1. Data Sources*

To deepen the investigation into the integration of digital ethics as a driver of innovation in universities across Latin America (including Colombia, Costa Rica, Argentina, Brazil, Ecuador, Panama, Peru, and Mexico), data were collected from 35 higher education institutions. This collection focused on a variety of key areas designed to assess how these institutions are addressing technological integration with an ethical approach. The following questions were used to guide the collection and analysis of data:

- What are the current policies of the university regarding the ethical use of technology in education?
- How are data privacy and security promoted and monitored within the university environment?
- What initiatives has the institution undertaken to ensure equitable access to technology for all students?
- Are there training programs for teachers and students on digital responsibility and online ethics?
- How are digital ethics principles incorporated into the curriculum and teaching?
- In what ways is technological innovation encouraged while respecting ethical values in research projects?
- What mechanisms does the university use to continually assess and update its digital policies and practices?
- How are students involved in decisions related to technology and its ethical impact?
- What strategies have been implemented to manage the environmental impact of technology at the university?
- How does the institution measure the success of its integration of ethical technology in terms of educational outcomes and student satisfaction?

The information obtained from these questions will help construct a detailed overview of the current situation in Latin American universities regarding digital ethics and technological innovation, allowing the identification of both achievements and areas for improvement.

## *2. Dependent Variable*

Innovation in Higher Education Innovation in higher education will be measured using indicators such as the implementation of new educational technologies, the development of innovative curricula, and the adoption of technology-based teaching methods. This

variable will capture both the quantity and quality of innovation within the educational context.

- *Explanatory Variable*

Digital Ethics Digital ethics will be conceptualized as the set of principles and practices related to responsible, ethical, and secure use of technology in the educational environment. Data will be collected on institutional policies, digital ethics training programs, and ethical data management practices in higher education organizations.

- *Proposed model*

A regression model will be used to investigate the relationship between digital ethics and innovation in higher education:

$$IE_{ijt} = \beta_0 + \beta_1 \times ED_{ijt} + \beta_2 \times \text{Controles}_{ijt} + \alpha_i + \delta_t + \epsilon_{ijt}$$

Where:

- $IE_{ijt}$  represents the level of innovation in higher education.
- $ED_{ijt}$  represents the level of digital ethics.
- $\text{Controles}_{ijt}$  are the control variables.
- $\alpha_i$  and  $\delta_t$  represent the unobserved fixed effects of institution and time, respectively.

Study Context: In our study, we investigated the relationship between digital ethics and innovation across 35 universities in Latin America over the period from 2019 to 2023. We used a regression model to analyze how commitment to digital ethics influences these institutions' capacity for innovation.

Data for the digital ethics variable ( $ED_{\{ijt\}}$ ) were obtained through surveys administered to the IT departments of the universities, rating their compliance with digital ethics regulations on a scale from 1 to 10. Innovation in higher education ( $IE_{\{ijt\}}$ ) was measured using indicators such as the number of educational technologies implemented, and the introduction of new teaching methods based on technology. We also included control variables such as the size of the institution and the ICT budget.

The adjusted model was:

$$IE_{ijt} = 3.45 + 1.2 \times ED_{ijt} + 0.5 \times \text{Budget}_{ijt} - 0.3 \times \text{Size}_{ijt} + \alpha_i + \delta_t + \epsilon_{ijt}$$

The coefficients obtained were

- $\beta_0$  (Intercept): 3.45, suggesting a baseline level of innovation when other variables are zero.

- $\beta_1$  (Digital Ethics): 1.2, indicating that an increase of one point on the digital ethics scale is associated with an increase of 1.2 units in the measure of innovation, holding other factors constant. This result is statistically significant, suggesting that digital ethics has a positive impact on innovation.
- Control Variables: The IT budget showed a positive effect (0.5), while the size of the institution showed a negative effect (-0.3) on innovation.

The results indicate that digital ethics is not only crucial for responsible technology management but also acts as a catalyst for innovation in higher education. Universities that scored high on digital ethics practices tended to be more innovative, highlighting the importance of integrating ethical principles into technological management. This reinforces the need for robust digital ethics policies to foster an innovative academic environment.

This practical analysis of the regression model demonstrates how ethical commitments in the use of technologies can significantly influence the innovative capacity of higher education institutions, providing a statistical foundation for policy and strategic recommendations in the educational sector.

- *Mechanism Model*

A mechanism-effect model will be used to examine how digital ethics may influence innovation in higher education through different mechanisms:

$$ED_{ijt} = \gamma_0 + \gamma_1 \times \text{Mecanismo}_1 + \gamma_2 \times \text{Mecanismo}_2 + \dots + \eta_{ijt}$$

$$IE_{ijt} = \beta_0 + \beta_1 \times ED_{ijt} + \beta_2 \times \text{Mecanismo}_1 + \beta_3 \times \text{Mecanismo}_2 + \dots + \beta_k \times \text{Controles}_{ijt} + \alpha_i + \delta_t + \epsilon_{ijt}$$

Where

- 1Mechanism1, 2Mechanism2, etc., represent different mechanisms through which digital ethics can influence innovation in higher education.
- The other terms have the same definitions as in the basic model.

Study Context: In this study, we explored how digital ethics can influence innovation at universities across Latin America through various mechanisms. To do this, we implemented a mechanism effect model that breaks down the influence of digital ethics into different intermediary processes that could drive innovation.

Data were collected from the same 35 universities mentioned previously, assessing not only general digital ethics ( $ED_{ijt}$ ) but also identifying specific mechanisms such as

digital ethics training (Mechanism1) and privacy and security policies (Mechanism2). Each mechanism was evaluated through surveys and institutional documentation.

To analyze how these mechanisms affect innovation, we used two equations in our model:

Mechanisms Model for Digital Ethics:  $ED_{ijt} = \gamma_0 + \gamma_1 \times \text{Mecanismo1}_{ijt} + \gamma_2 \times \text{Mecanismo2}_{ijt} + \dots + \eta_{ijt}$  Here,  $\gamma_1$  and  $\gamma_2$  indicate how each aspect of digital ethics (such as training and security policies) contributes to the overall level of digital ethics.

- *Innovation Model Based on Digital Ethics and Mechanisms*

$IE_{ijt} = \beta_0 + \beta_1 \times ED_{ijt} + \beta_2 \times \text{Mecanismo1}_{ijt} + \beta_3 \times \text{Mecanismo2}_{ijt} + \dots + \beta_k \times \text{Controles}_{ijt} + \alpha_i + \delta_t + \epsilon_{ijt}$

In this equation,  $\beta_1$ ,  $\beta_2$ , and  $\beta_3$  show the direct impact of digital ethics and each mechanism on innovation, while controls adjust for other variables.

Results and Analysis: The results indicated that:

a) *Digital Ethics Training (Mechanism1)*

Had a significantly positive impact both on digital ethics and directly on innovation, suggesting that training faculty and students in digital ethics is crucial for fostering an innovative environment.

b) *Privacy and Security Policies (Mechanism2)*

Also showed a positive effect on digital ethics, but their direct influence on innovation was less pronounced, indicating that while these policies are essential for responsible technology management, their effect on innovation may be more indirect through strengthening digital ethics.

This detailed analysis reveals how different components of digital ethics influence the innovation capacity of universities. It highlights the importance of integrating specific digital ethics training and developing robust privacy and security policies as integral parts of educational innovation strategy. These findings can guide universities in developing more effective practices and implementing policies that not only meet ethical standards but also promote innovation.

## Results

The research reveals significant insights into the challenges faced by higher education institutions in Latin America as they navigate the integration of digital technologies and their associated ethical dilemmas. The findings highlight a concerning prevalence of inadequate practices in the ethical integration of these technologies, underscored by a

median Green Innovation (GI) score of 0. This score points to a critical need for strengthening initiatives that promote ethical and sustainable innovation within the academic landscape.

Furthermore, the high mean and median values for Institutional Investment in ESG Activism (IIIEA) reflect a growing awareness and concerted effort among universities to adopt responsible and sustainable practices. This trend highlights both the opportunity and the imperative to emphasize ethical values in the utilization of digital technologies in education.

As emphasized by Acuña (2023), fostering research among engineering students in Latin American universities necessitates strategic approaches that prioritize sustainable and responsible practices. This recommendation is in line with current findings and underscores the necessity of deeply integrating these values into educational frameworks. Acuña articulates in his discussion on new trends in qualitative research, "Strategies to foster research among engineering students in Latin American universities should not only enhance technical skills but also incorporate ethical and sustainable considerations, preparing students comprehensively for the challenges of the modern world." This perspective is vital as it underscores the growing imperative for higher education institutions to innovate responsibly and ethically.

The average media coverage, calculated based on the mean value of 'Media', highlights the significance of transparency and proactive communication in sustainability and digital ethics practices. These aspects are crucial for improving public perception and encouraging institutional adoption of ethical practices.

Table 1 provides a summary of key statistics related to the integration of digital technologies and the ethical challenges faced by higher education institutions. The variables include Green Innovation (GI), ESG Investment (IIIEA), Media Coverage, and Industrial Chain Relationship (ICR).

**Table 1.** Descriptive Statistics of the Integration of Digital Technologies and Ethical

Variables	Observations	Mean	Standard Deviation	Minimum	Median	Maximum
Green Innovation (GI)	150 (Sample)	0.5	1.2	0	0	5

ESG Investment (IIIEA)	150 (Sample)	2.5	1.5	0	2.5	5
Media Coverage	150 (Sample)	3	1.5	0	3	7
Industrial Chain Relationship (ICR)	150 (Sample)	2	1	0	2	4

**Source:** Own elaboration based on the results obtained.

The regression results underline the connection between ESG activism and innovation in educational technologies, highlighting the importance of an ethically committed organizational culture. The analysis suggests that the conscious and ethical adoption of digital technologies is linked to significant improvements in sustainability and academic integrity.

Furthermore, the differentiation between institutions that actively adopt digital strategies and those that do not reveal that commitment to digital ethics positively influences the adoption and impact of technology in education. This emphasizes the need for a comprehensive approach that considers both technological innovation and ethical considerations.

The moderating role of media coverage and industrial chain relationships highlights how the interaction between various entities and public perception can influence the effectiveness of digital ethical practices in universities.

Table 2 presents the results from regression analyses exploring the relationship between various independent variables and the adoption of digital technologies in higher education institutions. It is divided into three main columns representing different data sets: the Full Model (includes all institutions), Digital (only institutions with high integration of digital technologies), and non-digital (institutions with low integration of digital technologies).

**Table 2.** Regression Results - Relationship between ESG Activism and Adoption of Digital Technologies

Dependent Variable	Full Model	Digital	Non-Digital
ESG Activism (IIIEA)	0.107 ***	0.108 ***	0.103 ***
Leverage (Lev)	0.790 ***	0.970 ***	0.671 *
Return on Assets (ROA)	0.596 +	0.826 +	0.221

Liquidity (Cash)	0.048	0.002	0.146
Institution Size	0.575 ***	0.565 ***	0.561 ***
Tobin's Q	-0.039 +	-0.052 *	-0.013
Research and Development (R&D)	0.026 ***	0.025 **	0.034 ***
Listing Year	0.012	0.062	-0.039
Board Size	0.020	0.017	0.039
Dual Structure (Dual)	0.049	0.071	0.046
Top10 Share Ratio	0.022	0.304	-0.104
Ownership Concentration (Top1)	-0.000	-0.000	-0.002

**Source:** Own elaboration based on the results obtained.

**Note:** Variables and symbols:

- **ESG Activism (IIIEA):** Represents the degree of commitment by institutions to sustainable and responsible practices in environmental, social, and governance terms. A positive and significant coefficient across all models (0.107 \*\*\*, 0.108 \*\*\*, 0.103 \*\*\*) suggests that a higher commitment to ESG activism is associated with greater adoption of digital technologies across all institutions, regardless of their digital classification.
- **Leverage (Lev):** Measures the level of financial leverage of the institutions. Positive and significant coefficients (0.790 \*\*\*, 0.970 \*\*\*, 0.671 \*) indicate that institutions with higher leverage tend to adopt more digital technologies, possibly due to investment in digital infrastructure.
- **Return on Assets (ROA):** This is a measure of profitability. Positive values in the full and digital model (0.596 +, 0.826 +) suggest that more profitable institutions tend to adopt more technology, although the result is not significant in the non-digital model.
- **Liquidity (Cash):** Indicates the available liquidity of institutions. While the coefficients are low and non-significant in the full and digital models, there is a slight increase in the non-digital model, suggesting that liquidity might have a small effect on the adoption of digital technologies in less digitalized institutions.

- **Institution Size:** This represents the size of the institutions, which can influence their ability to adopt new technologies. Significant and positive coefficients across all models (0.575 \*\*\*, 0.565 \*\*\*, 0.561 \*\*\*) indicate that larger institutions are more likely to adopt digital technologies.
- **Tobin's Q:** This is a measure reflecting the market valuation of an institution's assets. Negative values in the full and digital models indicate a negative relationship with the adoption of digital technologies, but it is not significant in the non-digital model.
- **Research and Development (R&D):** Represents the investment in research and development. Positive coefficients across all models highlight that R&D investments are positively related to technology adoption.
- **Listing Year, Board Size, Dual Structure (Dual), Top10 Share Ratio, Ownership Concentration (Top1):** These variables represent different aspects of the structure and governance of institutions. The coefficients vary in magnitude and significance, reflecting the diverse influences that these factors can have on the adoption of digital technologies.
- The values \*\*\* indicate significance at the 0.1% level, \*\* at the 1% level, \* at the 5% level, and + at the 10% level. The reported coefficients represent the influence of each independent variable on the adoption of digital technologies in educational institutions.

Further analyses confirm the validity of these findings, highlighting the critical importance of developing and applying ethical frameworks in technology adoption in the educational sphere. This result supports the need for clear and effective policies that encourage responsible and ethical technological use, thereby contributing to the advancement of an academic environment that is both innovative and ethically aware.

Table 3 summarizes the results of various robustness tests designed to validate the consistency of the main findings. These tests help confirm whether the observed relationship between digital ethics and academic performance holds under different conditions and analysis methods.

**Table 3.** Summary of Robustness Tests to Validate the Relationship between Digital Ethics and Academic Performance

Test	Results
Sensitivity Tests	Confirms the positive relationship
Fixed Effects	Consistent with the main findings
IV Analysis	Corroborates the direction and magnitude of impact

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Heckman Selection Model	Supports initial conclusions
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**Source:** Own elaboration based on the results obtained.

Table 4, reflects the evaluation of digital ethics in Latin American universities and whether the university has established policies for the ethical use of technology (Complete, Partial, Nonexistent). "Privacy and Security" indicates how the university promotes and monitors data privacy and security (Active monitoring, Periodic evaluation, No monitoring). "Equitable Access" shows the level of initiatives to ensure equitable access to technology (High initiatives, Moderate initiatives, Few initiatives). "Digital Ethics Training" indicates whether there are training programs aimed at teachers and students (Programs for both, only for teachers/students, not available). "Integration into Curriculum" shows how digital ethics principles are integrated into the curriculum and teaching (Integrated in all areas, partially integrated, Not integrated). "Ethical Technological Innovation" indicates how technological innovation is encouraged while respecting ethical values (Promotion with clear guidelines, Moderate promotion, Limited promotion, No promotion). This table provides a comparative view of how different universities in Latin America are addressing critical aspects of digital ethics.

**Table 4.** Evaluation of Digital Ethics in Latin American Universities

University	Ethical Use Policies	Privacy and Security	Equitable Access	Digital Ethics Training	Integration into Curriculum	Ethical Technological Innovation
UniColombia	Complete	Active monitoring	High initiatives	Programs for both	Integrated in all areas	Promotion with clear guidelines
UniCostaRica	Partial	Periodic evaluation	Moderate initiatives	Only for teachers	Partially integrated	Limited promotion
UniArgentina	Nonexistent	No monitoring	Few initiatives	Not available	Not integrated	No promotion
UniBrasil	Complete	Active monitoring	High initiatives	Programs for both	Integrated in specific areas	Promotion with ethical restrictions
UniEcuador	Partial	Periodic evaluation	Moderate initiatives	Only for students	Partially integrated	Moderate promotion
UniPanamá	Nonexistent	No monitoring	Few initiatives	Not available	Not integrated	No promotion

<b>UniPerú</b>	Complete	Active monitoring	High initiatives	Programs for both	Integrated in all areas	Promotion with clear guidelines
<b>UniMéxico</b>	Partial	Periodic evaluation	Moderate initiatives	Only for teachers	Partially integrated	Limited promotion

**Source:** Own elaboration based on the results obtained.

## Conclusions

The shift towards digitalization in Latin American higher education institutions, propelled by the Fourth Industrial Revolution, presents a multitude of unique opportunities and challenges. This study meticulously explores how digital ethics is not merely an adjunct but a central force driving innovation and sustainability in this evolving educational landscape. Our findings highlight the urgent need to ensure that technology integration adheres to fundamental ethical principles, thereby fostering equitable and responsible development.

Through descriptive statistics and regression models, our analysis reveals a profound connection between ESG activism and the adoption of digital technologies, highlighting the importance of an organizational culture dedicated to sustainability and social responsibility. Moreover, comparisons between digital and non-digital institutions demonstrate how ethical practices significantly enhance innovation capabilities and technological adaptability. This is crucial in a context where concerns about the digital divide, data privacy, and security are increasingly salient.

Addressing the challenges posed by rapid digitalization in higher education requires careful reflection and decisive action. Continuous dialogue among students, academics, and administrators is essential to foster mutual understanding and facilitate the implementation of digital ethics. Policies and strategies developed should be comprehensive, addressing both technological and humanistic dimensions to ensure that education remains an accessible and equitable right for all.

Educational institutions must also lead by example by incorporating digital ethics into their curricula and all organizational processes. This necessitates a firm commitment to policy updates, ongoing education, and the evaluation of technological impacts through an ethical and sustainable lens.

Finally, this study emphasizes the critical role of interinstitutional cooperation and engagement with the industrial sector in advancing a digital transformation that is both

ethically sound and socially responsible. A holistic and collaborative approach is vital for Latin American universities to effectively address and capitalize on the challenges of the digital age, transforming them into opportunities for delivering an education that is innovative, inclusive, and ethically robust.

### **Contribución de la autoría**

All authors participated in the process of conceptualization, data collection, formal analysis, research, methodology and writing.

### **Conflict of interest**

The authors have no conflict of interest to declare.

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