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EDITED BY
Zeeshan Ahmad,
Chinese Academy of Sciences (CAS), China

REVIEWED BY
Hamad Raza,
Government College University, Faisalabad, Pakistan
Teresa Nogueiro,
University of Evora, Portugal

*CORRESPONDENCE
Jessie Bravo
✉ jbravo@unprg.edu.pe

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Transforming document management for environmental sustainability: the mediating effect of pro-environmental culture and service satisfaction in higher education institutions

Jessie Bravo[1]*, Carlos Valdivia[1], Roger Alarcón[1], Nilton Germán[1], Oscar Serquén[1], Janet Aquino[1], Marco Agustín Arbulú Ballesteros[2] and Laurita Guevara[3]

[1]Digital Transformation Research Group, Pedro Ruiz Gallo National University, Lambayeque, Peru, [2]Institute for Research in Science and Technology, Cesar Vallejo University, Trujillo, Peru, [3]Academic Program of Computer Engineering and Informatics, Pedro Ruiz Gallo National University, Lambayeque, Peru

This research investigates the factors influencing environmental sustainability in a Peruvian higher education institution (HEI), using Structural Equation Modeling (SEM) with SmartPLS. The methodology included data collection through questionnaires administered to students, alumni, and professors, followed by SEM analysis to assess the relationships between technological support (TS), document management (DM), open government (OG), pro-environmental organizational culture (POC), service satisfaction (SS), and environmental sustainability (ES). The findings emphasize that technological infrastructure significantly enhances document management, which in turn boosts service satisfaction and promotes a pro-environmental organizational culture. The pro-environmental organizational culture emerges as the most powerful mediator, significantly impacting environmental sustainability. Although service satisfaction also contributes positively, its effect is less pronounced. Furthermore, transparency and open access to information improve document management, albeit with a lesser impact. Sociodemographic variables such as gender and academic program within the institution influence the relationship between the examined variables, suggesting that these characteristics can affect the perception and effectiveness of sustainability practices. This study provides a robust foundation for designing effective strategies to promote environmental sustainability in higher education institutions and would contribute to the fulfillment of the SDGs.

KEYWORDS

document management, environmental sustainability, pro-environmental organizational culture, higher education institution, service satisfaction, SEM

1 Introduction

Documents are the most crucial assets of any organization; therefore, understanding how to properly maintain a paper trail can significantly impact the efficiency of its management (Reyes et al., 2023), conversely, document management represents a major issue for higher education institutions. According to Regla and Marquez (2020) extensive storage spaces, filing cabinets, and necessary security measures are required, Sheela Rani et al. (2023) indicate that

records, time, and energy are lost, and resources are squandered, with the main challenge being the upkeep of records and the failure to meet deadlines for obtaining information. In most higher education institutions (HEIs), there are no academic document management systems (DMS) nor are the necessary technologies for their development identified (Hüller et al., 2022). Added to this, other issues of document management (DM) include the quality of managerial staff, the significance of the work, the funding, and the information, which directly affect the administration of archives and documents overall (Sun, 2022).

Moreover, the continuous enhancement of education with various approaches and reforms has led to a substantial number of educational policies, programs, and research reports, which also increases the processing and information load for HEIs, also, traditional methods of classification and manual filing are ineffective and vulnerable to the loss of documentation and inefficiency in DM processes (Zhang et al., 2024), Additionally, many offices use a hierarchy of folders on computers to organize documents and the use of labels to sort them, which is currently not an efficient process due to the vast amount of documentation generated (Watanabe et al., 2024). Similarly, when it comes to collecting information managed traditionally, it becomes an isolated process due to the lack of communication between different types of stored data and even incomplete documentation (Korro et al., 2024). HEIs also face the maintenance of their documents and records, where records, time, and resources are lost, not meeting the search for documents (Sheela Rani et al., 2023).

Industrial advancement has led to economic progress and societal well-being, but the impact of industrial complexes has altered the environment, causing environmental effects and climate changes (Barragán-Ocaña et al., 2024). The growing awareness of environmental challenges, resource scarcity, and the urgent need to address climate change necessitate paradigm shifts in product and service design (Lyu et al., 2024). Increasingly, companies are seeking to enhance their operational performance and paying more attention to sustainability issues, leading to practices that improve sustainability performance and, specifically, environmental impacts (Fiorello et al., 2023). Companies are even beginning to discuss a "green paradigm," seeking the integration of Industry 4.0 technologies and management model principles that enhance precision, customization, competitiveness, and environmental sustainability (Costa et al., 2024), This fosters green product innovation as a key strategic issue in companies.

In universities, energy usage is a critical issue, as the aim is to balance growing operational demands with ES (Laporte et al., 2024). Additionally, it must be considered that HEIs have a significant impact on the society and environment in which they operate, influencing various fields of development, including ES, and contributing with their social role in the education of future generations (Usta et al., 2024). However, many HEIs place significant emphasis on integrating ES at a strategic level, but generally lack policies that incorporate it into operational aspects (Christou et al., 2024).

Nevertheless, the environmental implications remain relatively unknown, and there is no substantial literature addressing the elements of this research. Therefore, this article offers an analysis of DM in HEIs, evaluating the level of organizational culture and service satisfaction present as a mediating effect on environmental sustainability. This will identify the needs for "paperless" management, the use of digital environments, and enhancing operational efficiency by adopting new digital practices framed in Digital Transformation (DT), understood as the process by which HEIs integrate digital technology to all its areas, which will allow cultural and operational changes that are better adapted to the changing needs of users, thus improving the perception of its benefits by users.

The aim of this research is to use Structural Equation Modeling (SEM) to assess the mediation of organizational culture and service satisfaction between document management and environmental sustainability, whose findings will define environmental strategies and policies in HEIs.

The significance of this study lies in its potential to generate valuable knowledge that enables HEIs to foster a cultural change that promotes the commitment and active involvement of various stakeholders, raising awareness of ES, developing pro-environmental policies, and incorporating them into curricular experiences. This is supported by efficient DM based on effective strategies that reduce the environmental footprint, aligned with sustainability principles, under a "paperless" approach, using digital environments and optimizing operational processes. This will lead to tangible benefits such as reduced paper usage, savings in natural resources, and contributing to the education of professionals and citizens aware of the importance of environmental preservation.

2 Theoretical framework

2.1 Document management in organizations

DM and archiving are critical responsibilities in any organization, as they must ensure the access, upkeep, preservation, and oversight of pertinent information. The ISO 30300 standard offers a framework that sets forth guidelines for the enhancement of DMS in organizations (Manzanelli, 2023). Similarly, in DM, best practices need to be established for the creation and maintenance of information and documentation, which enables decision-making, activities, and operations within the organization, easing its use in business procedures and at every level of the organization (Alonso, 2020).

In the context of HEIs, Hüller et al. (2022) observe that these institutions retain vital academic and administrative data that must be safeguarded. However, many of them still lack the required technology to implement effective DM. According to Mulchan and Wang (2024) digital transformation is progressing rapidly, with the widespread presence of digital technologies and technology-driven innovations transforming organizational processes, where one of the principal initiatives is to enhance record and document management to boost productivity.

In a study by Simwaka et al. (2023) at universities in Malawi, a survey uncovered the presence of document records such as minutes, grades, theses, political documents, and reports, but there was an absence of management of such documentation due to, among other factors, a lack of management policies, limited financing, and information technology infrastructure. On the other hand, Henriksen (2023) examined the impact of user-focused digitalization on record management in the public sector in Norway. Through interviews, it was discovered that municipalities lack resources and technologies and do not engage their users, despite their professionals attempts to assist them. Likewise, according to Mosweu and Bwalya (2023),

government entities frequently implement automated record management systems without a clear governance structure to support automation.

2.2 The role of technological support in document management efficiency

Over the past decades, the role of technological support (TS) has been a significant concern in research. The acceptance and application of innovations in information systems (IS) and information technology (IT) have been evaluated through theoretical frameworks examining their acceptance (Dwivedi et al., 2019). Among these frameworks, the Unified Theory of Acceptance and Use of Technology (UTAUT) stands out, proposing that actual technology utilization is driven by behavioral intention. This theory suggests that technology adoption hinges on performance expectations, effort expectations, social influence, and facilitating conditions, with individual perceptions of technology being crucial for enhancing job performance (Marikyan and Papagiannidis, 2023).

Recent advancements in technologies are affecting document and record management worldwide. Key elements of the Fourth Industrial Revolution, such as blockchain technology and artificial intelligence (AI), are shaping how digital records are administered within organizations (Ngoepe et al., 2024). In Tsabedze (2024) study, viewpoints and readiness of professionals for records and archives management were assessed through a survey, revealing insufficient experience and budget constraints for acquiring technology. Therefore, improved funding and AI integration into DM are suggested.

In the context of HEIs, this swift technological progress has introduced innovative methods for safeguarding crucial student data (Dongre et al., 2024). Similarly, Reyes et al. (2023) identify documents as the most valuable assets in a university, so maintaining paper trails greatly impacts DM efficiency. Consequently, technological platforms and IT systems have been developed to organize and centralize their files.

Various studies, such as those by Ayaz and Yanartaş (2020), have examined UTAUT, concluding that technological support is essential for the acceptance and effective use of systems, positively affecting document management. Additionally, Alghobiri et al. (2022) demonstrated that advanced technologies in HEIs, such as optimization with graph-based document clustering algorithms and distance functions, enhance document retrieval. Sidhimantra et al. (2024) indicate that repository system development improves academic document management and supports accreditation processes in HEIs. Karpenko et al. (2020) note that these systems also contribute to the effectiveness of academic workload distribution, and (Chen et al., 2022) assert that the adoption of technologies like blockchain enhances the security and efficiency of the entire DM process.

The reviewed studies provide consistent evidence of the positive effect of technological support on DM. Although various approaches and technologies are utilized, all studies conclude that technological support is fundamental for the automation, security, and accessibility of DM, directly impacting efficiency in HEIs.

Finally, the role of technological support represents an opportunity to boost the efficiency of DM processes. Therefore, the following hypothesis is proposed:

> *Hypothesis* 1: Technological support has a significant impact on effective document management in HEIs.

2.3 Impact of efficient document management on user satisfaction in HEIs

As Alonso (2020) highlights, DM establishes best practices for the generation and maintenance of information and records, facilitating appropriate decision-making. According to Gamido et al. (2023), the procedure of an electronic DMS starts with the transformation of paper documents into digital files with standardized formats, enabling effective document organization and encouraging the reduction of paper waste in document reproduction. It also enhances user access to essential documents distributed in real-time, with simple searches and retrieval of necessary records.

According to Alade (2023), one sector that has seen rapid expansion in recent years is document management, regarded as essential in the organizational work environment. For this reason, a web-based electronic DMS was developed, which, when utilized, achieved a 96.60% satisfaction rate among participants, concluding that it enhances user satisfaction, boosts productivity, and ensures data efficiency in a timely manner.

In Peru, according to Ramirez et al. (2023), public institutions have a substandard service in DM. To tackle this, robotic process automation (RPA) technology was implemented, reducing the processing time of procedures, preventing citizen dissatisfaction, and improving their experience.

DT is acknowledged as a phenomenon that has drastically changed how organizations function. The emergence of digital technologies in the public sector presents multiple possibilities, where user satisfaction is deemed one of the most critical conditions for effective DT implementation (Kitsios and Ioannou, 2024). DMS are a necessity in the organizational work environment and specifically in HEIs because they facilitate access to documents in shortened times (Alade, 2023) and must have secure and interoperable management of crucial and legal documents (Siva Rama Rao et al., 2023), both for university faculty with documentation related to their academic duties (educational, methodological, scientific, and organizational) (Pleskach et al., 2023), and for general document procedures. Therefore, this service satisfaction regarding digital document management could generate positive user attitudes toward sustainable practices, facilitating their adoption and maintenance.

Based on the reviewed literature, the following hypothesis is proposed:

> *Hypothesis* 2: Efficient document management positively influences service satisfaction in HEIs.

2.4 User satisfaction as a driving factor for environmental sustainability in HEIs

User satisfaction as a driving force for environmental sustainability in HEIs is based on the notion that when the services provided meet user expectations, users develop affirmative behaviors and attitudes toward the institution, which results in greater commitments to sustainable practices.

In the study by Mansoor and Hussain (2024) on the impact of knowledge-based leadership on service quality in HEIs, it was shown that effective and user-centered management can significantly influence service quality, which in turn promotes a more sustainable environment conducive to pro-environmental practices. Similarly, Rolo et al. (2024), concerning service quality in HEIs in Portugal and Angola, emphasize the importance of adjusting service quality strategies to local needs and expectations. In the context of environmental sustainability, this suggests that HEIs should consider user specifics to implement sustainable practices perceived positively. Likewise, Kidido et al. (2024), on the management and sustainability of event facilities in HEIs in Ghana, also discovered that user perception of facility management can affect their satisfaction and, consequently, their support for sustainable resource practices.

The research by Bao et al. (2024) on the assessment of sustainable service quality in HEIs emphasizes the importance of considering the varied opinions and expectations of users in the decision-making process. HEIs can design and adjust their services to better meet user needs, incorporating sustainable practices that are valued by the educational community. On the other hand, Alshamsi et al. (2024) examine the factors driving the sustainability of blockchain technology in higher education, underscoring that its implementation largely depends on user acceptance and satisfaction, concluding that well-received technology can contribute to more sustainable practices in HEIs.

As stated by Ozdemir et al. (2020), measuring sustainable service quality on university campuses includes dimensions such as waste management, energy efficiency, and community participation, highlighting a holistic approach to campus sustainability. Santos et al. (2020) explore the influence of social responsibility on service quality and student satisfaction in higher education, concluding that when universities implement socially responsible practices, such as volunteer programs and environmental sustainability, they tend to have more satisfied and committed students.

These studies underscore that service satisfaction in HEIs is closely linked to environmental sustainability. By focusing on user satisfaction, positive cycles are created where satisfaction and sustainability reinforce each other. Therefore, the following hypothesis is proposed:

> *Hypothesis* 3**:** Service satisfaction has a positive impact on environmental sustainability in HEIs.

2.5 Promoting a pro-environmental organizational culture through efficient document management

According to Nanayakkara and Wilkinson (2021), organizational culture (OC) theory is one of the most influential in the workplace because if an organization does not maintain a suitable culture to support its activities, it could adversely impact its procedures and overall performance. Additionally, Sindakis et al. (2024), the adoption and transfer of culture are achieved through the sharing of knowledge within and between areas, departments, and units of large organizations. Additionally, as Schlegel et al. (2023) emphasize in the context of DT, having a data-based OC is a crucial factor in data analysis capabilities, innovation, and competitive advantages for companies.

Based on the study by Souza and Aganette (2022), digital preservation and efficient DM are closely associated with POC, arguing that implementing efficient document management practices can positively impact organizational culture, promoting sustainable and pro-environmental practices. Similarly, Netshakhuma (2022) demonstrated that using the SharePoint platform as a DMS in a university not only enhances administrative efficiency but also supports the development of a sustainability-oriented OC.

The reviewed studies provide evidence that efficient DM can be a key driver in fostering an organizational culture dedicated to environmental sustainability in HEIs, therefore proposing the following hypothesis:

> *Hypothesis* 4: Efficient document management promotes a pro-environmental organizational culture in HEIs.

2.6 Influence of pro-environmental organizational culture on achieving sustainability in HEIs

Various studies have indicated that an organizational culture that fosters pro-environmental values and behaviors can significantly affect the environmental sustainability of HEIs. Kalsoom and Hasan (2022) stress that a POC can transform educational and administrative practices in HEIs. Additionally, Dieguez (2023) underscores the importance of leadership as part of the organizational culture in the sustainability of higher education, promoting educational transformation and enhancing the entrepreneurial and innovative spirit necessary to implement sustainable practices in HEIs.

As proposed by Khan and Terason (2022) fostering pro-environmental behaviors through a green organizational culture can encourage sustainable attitudes among the employees of an institution. Barros et al. (2020) illustrate in a Brazilian university that an organizational culture centered on sustainability leads to the development of sustainable practices and greater environmental awareness. Moreover, Žalėnienė and Pereira (2021) suggest that global integration allows universities with this pro-environmental culture to serve as global models that incorporate sustainability into all facets of university life.

According to Fuchs et al. (2023), an organizational culture dedicated to sustainability is crucial for the success of Sustainable Development Goals (SDG) initiatives in Latin American universities. Marques et al. (2023) contend that an organizational culture that values sustainability can facilitate cooperation between universities and businesses, promoting a positive impact on environmental sustainability.

These theories and studies provide insights into organizational culture and its role in advancing environmental sustainability in HEIs; therefore, the following hypothesis is proposed:

> *Hypothesis* 5: A pro-environmental organizational culture positively influences environmental sustainability in HEIs.

2.7 Open government and transparency as enablers of effective document management

Digital technologies have a recognized potential to create more efficient, trustworthy, and innovative public institutions (Aguerre

and Bonina, 2024). Government open data are crucial drivers of DT in the public sector, as they allow for insight into how strategies are formulated, executed, and assessed for their ongoing success, aiming to encourage users to engage with and make use of these essential resources (Begany and Gil-Garcia, 2024). However, it is necessary to have governance structures that support the integration of technologies across various platforms and adapt to an increasingly digital society (Zwitter, 2024). This facilitates the development and interpretation of data visualizations that simplify information access, enhance comprehension, and bolster information literacy (Barcellos et al., 2024), this term has gained significant relevance in the digital era, marked by the abundance of information and the rapid evolution of information and communication technologies.

A study in Spain, one of the most decentralized nations globally (Curto-Rodríguez et al., 2024), discovered that open government has a favorable outlook and a promising future despite challenges such as resistance to change. Pasillas-Banda et al. (2024) in Mexico observed that there are advancements in governance through open government with the application of technologies in diverse media, emphasizing citizen engagement. Similarly, in Chilean municipalities (Hernández-Bonivento and Moller, 2024) state transparency is being promoted by involving citizens in public affairs and encouraging public accountability, which leads to insights on social and political participation, poverty levels, and information dissemination.

According to Saptarini et al. (2024), a result of the pandemic, particularly in online education, was the necessity for paperless document management, which offers benefits such as cost reduction, time efficiency, decreased physical storage needs, and access to documents anytime and anywhere. However, resistance to change, lack of technical expertise, and investment costs could hinder its implementation.

As part of the DT, Gelashvili and Pappel (2021) argue that a key component of e-governance is paperless management, which streamlines data exchange and digitized workflows, allowing for secure document recording, traceability, and immutable archiving for future access. Additionally, it is essential to complement these practices with DM policies based on technologies, tailored to each HEI's conditions, regulatory framework, and the readiness of its experts (Jiménez et al., 2022). Payment for services in DMS processes should also be considered (Glavev, 2023). However, as Ioannou et al. (2022) point out, the effectiveness of these e-government initiatives faces hurdles due to insufficient specialized knowledge, limited funding, and weak political initiatives and decisions, often resulting in flawed designs that merely transfer existing bureaucracy into the digital sphere. In Peru, the Digital Government law regulation (Decreto Supremo No 029-2021-PCM, 2021) seeks to promote the integration of digital technologies in public services, encompassing digital identity, interoperability, security, and digital architecture. Nevertheless, in practice, its application is very limited, considering that many HEIs do not even use digital signatures or have proposed automation of the processes involved in DM.

These findings underscore the significance of open government and transparency as fundamental contributions to document management, leading to the following proposal:

> *Hypothesis* 6: Open government and transparency have a substantial impact on effective document management in HEIs.

2.8 Document management as a catalyst for environmental sustainability in higher education institutions

Environmental sustainability (ES) is presently a crucial element for both economic progress and human well-being. Environmental deterioration is alarming, leading nations and global organizations to conduct conferences and agreements (Luo and Sun, 2024). It should be acknowledged that the environmental crisis is the outcome of industrial, economic, and social development, which has adversely affected the planet's ecosystem (Cóndor-Salvatierra et al., 2022). Similarly, the evolution and utilization of information and communication technologies (ICT) have brought growing prosperity and accessible information globally. Nevertheless, this advancement has not been devoid of notable environmental costs that jeopardize environmental sustainability, such as electronic waste that contaminates soil and water, releasing hazardous substances that endanger human health and biodiversity. As Tkachenko and Denisova (2022) propose, the intricate connection between digitalization, sustainability, and profitability has not garnered much focus from the academic community; however, it represents significant research domains on its own.

HEIs not only prepare professionals and future leaders but also need to heighten awareness about environmental preservation and directly influence communities to adopt sustainable practices (Karalam and Mathew, 2023). Furthermore, there is increasing concern about involving HEIs in an international effort to assume a more fitting role as champions of sustainable development (Pereira de Morais et al., 2024). This necessitates beginning with curricular incorporation of environmental sustainability viewpoints, as many countries' educational systems are limited by rigid disciplinary frameworks and do not encourage transdisciplinary perspectives, which could address environmental concerns and the need for their protection. This is supported by Vidrevich and Pervukhina (2023), who highlight the significance of embedding environmental sustainability into HEI curricula and the necessity for educators to adopt teaching methods aligned with these integrative principles. Moreover, the United Nations Sustainable Development Goals (SDGs) have prompted substantial shifts in environmental education, making it vital to reform educational research and classroom methodologies (Guevara-Herrero et al., 2023), to cultivate critical individuals and professionals with initiatives aimed at fostering a more sustainable, inclusive, and resilient world.

As Dongre et al. (2024) suggest, universities manage vital student data that must be safeguarded and protected. Consequently, they should adopt innovative strategies as a crucial step toward a sustainable future, where digitalization will play an essential role in necessary technological transformations. From the viewpoint of Alnafrah and Mouselli (2021) HEIs in low-income nations tend to be delicate and responsive to the political and economic climates in which they operate, influencing the costs of obtaining and certifying credentials for students. Hence, a hybrid national platform based on blockchain was proposed to consolidate academic record management, advancing sustainable development.

Therefore, based on the examined documentary approaches, the following hypothesis is proposed:

> *Hypothesis* 7: Effective document management contributes to environmental sustainability in HEIs.

The following mediator hypotheses are also defined:

> *Hypothesis* 8: Service satisfaction will mediate the connection between effective document management and environmental sustainability in HEIs, acting as a catalyst that amplifies the positive effect of document management on environmental sustainability.

> *Hypothesis* 9: Pro-environmental organizational culture will mediate the link between effective document management and environmental sustainability in HEIs, facilitating and enhancing the beneficial impact of document management on environmental sustainability.

Next, in Figure 1, a conceptual framework is presented as a graphic design, which offers a visual understanding of the variables and their theoretical basis, as well as the hypothesis proposal where the variables involved are related. This conceptual framework allows an easy interpretation of the SEM model that will be applied, allowing an understanding of each variable in the structure of the study, without the need to have a technical background in this type of analysis.

3 Materials and methods

The investigation used a quantitative method and applied a non-experimental design. This method involved creating survey tools through an exhaustive review of existing literature, including scholarly articles and regulations.

Considering this, a questionnaire was created and administered to users of document management, such as students, alumni, and faculty members. The questionnaire aimed to assess the effectiveness of document management toward environmental sustainability within the context of a pro-environmental organizational culture and service satisfaction.

3.1 Participants

The study was applied to a population of 2,000 individuals, considering a sample of 247 participants, distributed among students, graduates and teachers of a Peruvian HEI. The inclusion criteria were higher education students, appointed teachers and graduates of the last 3 years.

A non-probabilistic convenience sampling was applied, considering only one faculty in the study, with participation being voluntary through informed consent.

The justification for the sampling method lies exclusively in the constraints of resources and time. By applying this type of sampling, our sample is diverse within the area of study, thus ensuring reliable outcomes. The applied method provided us with an initial approach to generate valuable insights on the effectiveness of document management among the different actors of the institution.

The participants come from five professional schools at a public university, offering a rich and varied depiction of the educational community. More than half belong to the Computer Engineering and Informatics program, highlighting a strong interest in how

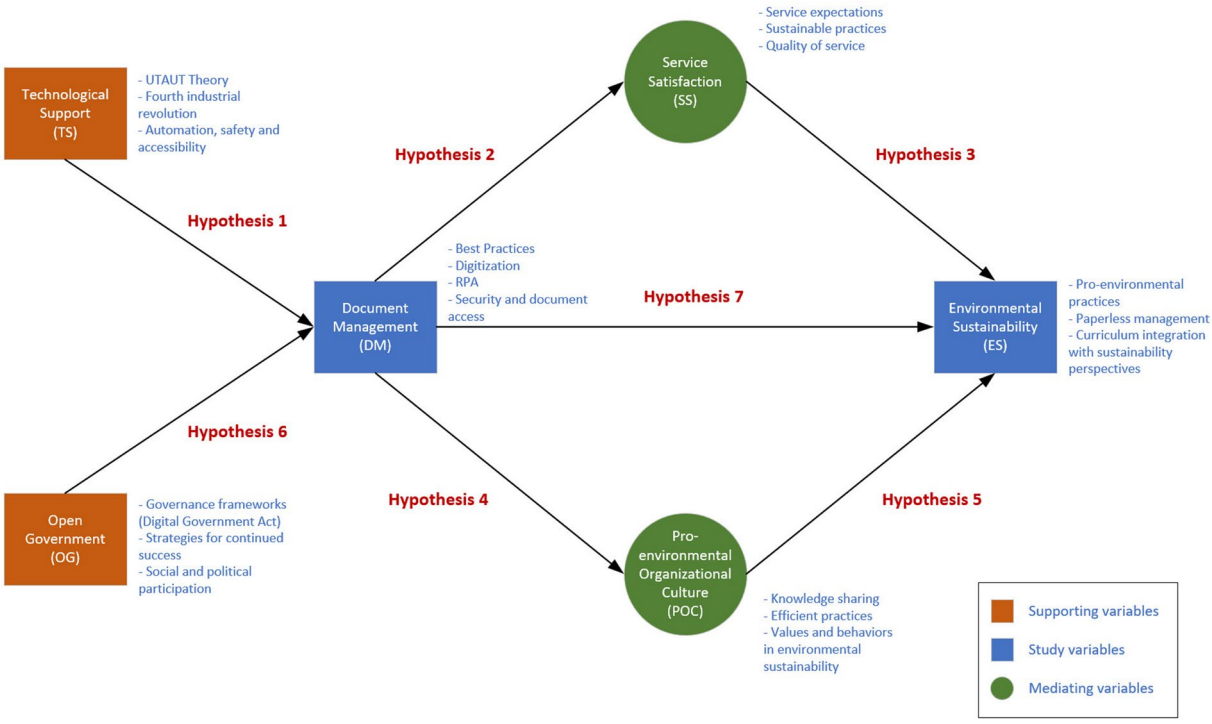

FIGURE 1
Conceptual framework of the study.

technologies can support environmental sustainability. Although fewer in number, students from Statistics, Electronic Engineering, Mathematics, and Physics also contribute valuable perspectives and are directly related to the population in each school.

Regarding roles, 51.4% are students, 34.8% are alumni, and 13.8% are faculty members. This indicates that most participants are still in their educational process or have recently completed their studies, thus providing current opinions on DM and sustainability. The age range of the participants shows that almost half (46.2%) are between 23 and 30 years old, something expected in a university setting. However, there is also a notable representation of people of different ages, which enriches the intergenerational perspective of the study. In terms of gender, the majority of participants are men (78.1%) compared to 21.9% women. This difference suggests possible trends in enrollment in certain programs or specific roles within the institution, which is important to consider when interpreting the results.

The way participants obtain information about the status of their administrative procedures reflects a preference for multiple communication channels. Most prefer email (28.7%) and face-to-face interaction (20.6%), although some combine both methods (15.4%) or use information systems and applications like WhatsApp to a lesser extent. This variety emphasizes the need to offer flexible communication tailored to individual preferences. Table 1 presents the sociodemographic data of the surveyed sample.

Finally, it is indicated that all participants in the study possess experience and expertise in the document management process within the institution.

3.2 Instruments

Based on the identification of theoretical constructs and literature review, the instrument was created, comprising 27 items using a 5-option Likert scale, where 1 means not satisfied or not fulfilled, and 5 means completely satisfied or its fulfillment is total and adequate.

For the instrument, six variables were established: **service satisfaction** with four items where the service and attention are rated, as well as the average response time and the level of staff training are assessed; **document management** with five items focused on dissemination mechanisms, clarity of procedures, support, and advice (Jiménez et al., 2022; Zambrano Plúa et al., 2021); **technological support** with three items covering the level of automation and the tracking of procedures (Kholiya et al., 2021; Monarcha-Matlak, 2021); **open government and transparency** with three items oriented to the awareness of the transparency portal and the data published on it (Vidrevich and Pervukhina, 2023); **pro-environmental organizational culture** with eight items oriented toward training, policies, initiatives, programs, and participation in activities (Ioannou et al., 2022) and finally, **environmental sustainability** with five items addressing environmental aspects and their sustainability (Gestión Documental y Sostenibilidad: Reduciendo el Impacto Ambiental, 2023).

The survey was consolidated into an online form for its application, adding sociodemographic questions such as age range, gender, academic program, role, and how they know the status of their procedure. Additionally, three open-ended questions were added for subsequent analysis.

3.3 Validation of instruments

A pilot test was conducted with a small group of 10 participants to ensure the clarity and validity of the questions. Based on the feedback received, minor adjustments were made to the questionnaires.

Cronbach's alpha coefficient and composite reliability with values above 0.7 were used (Table 2). Additionally, the square root of the average variance extracted (AVE) was applied for each of the variables, ensuring that their values are not higher than the correlations among all variables with values above 0.5.

3.4 Reliability and validity analysis of the evaluated variables

In this study, variables such as service satisfaction, document management, technological support, open government and transparency, as well as pro-environmental organizational culture and environmental sustainability were evaluated. Below is an analysis of the reliability and validity of these factors, aiming to provide a clear and accessible overview. To begin, service satisfaction (SS) was assessed through questions about the overall service rating, the attention received, response time, and the level of staff training. The results indicate that the questions used were very consistent with each other, reflecting a high Cronbach's alpha value (0.939). Furthermore, it is observed that perceptions of these facets are strongly interrelated, suggesting that SS is being effectively measured. Regarding document management (DM), aspects such as the effectiveness of procedure dissemination, clarity of instructions, staff support, information accessibility, and data privacy were analyzed. A high internal consistency was also found (Cronbach's alpha of 0.915), meaning the questions align well to measure DM. However, a question on data privacy had a slightly lower correlation with the rest, suggesting that this question could be refined to ensure it measures the same as the others. Technological support (TS) focused on process automation, information security, and procedure tracking. The results show that the questions were consistent and reliable (Cronbach's alpha of 0.879), indicating that participants view these elements as interconnected aspects of TS. This underscores the importance of technology in the efficient management of procedures. The open government and transparency (OG) variable was evaluated through questions about awareness and updates of the transparency portal, as well as deadline compliance. Again, the responses showed high consistency (Cronbach's alpha of 0.886), indicating that these questions well capture the perception of transparency in the university. Regarding pro-environmental organizational culture (POC), the questions covered topics from sustainability training to the perception of organizational values and participation in environmental activities. This variable showed excellent consistency (Cronbach's alpha of 0.937), although a question about sustainability as a core value had a lower correlation. This suggests that while most questions are well-aligned, some could be adjusted to improve the set's cohesion. Finally, environmental sustainability (ES) was evaluated through questions about investment in sustainable technologies, the use of renewable inputs, the promotion of sustainability in curricula, and sustainable printing practices. The responses also showed high consistency (Cronbach's alpha of 0.923), reinforcing the validity of the questions to measure ES in the university. The variables evaluated in this study

TABLE 1 Sociodemographic profile of the sample (n = 247).

Sociodemographic	Category	Frequency	%
Academic program	Statistics	47	19.00%
	Physical	8	3.20%
	Electronic Engineering	37	15.00%
	Computer and Informatics Engineering	127	51.40%
	Math	28	11.30%
Role	teacher	34	13.80%
	Graduate	86	34.80%
	Student	127	51.40%
Age range to which they belong	Up to 19	28	11.30%
	20–22	37	15.00%
	23–30	114	46.20%
	31–40	26	10.50%
	41–55	12	4.90%
	46–50	7	2.80%
	Over 50	23	9.30%
Gender	Female	54	21.90%
	Male	193	78.10%
How do you know about the status of your procedures? (You can select more than one option)	By mail	71	28.70%
	In person	51	20.60%
	By mail, in person	38	15.40%
	Computer system	14	5.70%
	By mail, By WhatsApp	12	4.90%
	By mail, Computer System	11	4.50%
	By WhatsApp	11	4.50%
	By mail, in person, computer system	10	4.00%
	Statistics	29	11.70%

present high reliability and validity. This means that the questions used are consistent and well capture the perceptions and attitudes of the participants.

3.5 Data collection and analysis method

Information was gathered through an online survey administered to various participants. The study was conducted between April and May 2024, spanning 5 weeks. An online questionnaire was distributed containing nine sections: the first included information about the survey and informed consent; the second section contained general user details; sections 3 to 8 corresponded to the six variables analyzed; and finally, section 9 included open-ended questions. A total of 247 responses were collected from participants.

3.6 Quantitative analysis

Descriptive statistics were used to summarize the survey results. Structural Equation Modeling (SEM) (Ávila and Moreno, 2018; Escobedo et al., 2016) was utilized to examine the relationships among pro-environmental organizational culture, service satisfaction, the effectiveness of document management, and environmental sustainability. SEM allowed for the concurrent evaluation of multiple dependent and independent relationships, measuring both observable and latent variables (Romero-Sánchez and Barrios, 2023).

The SEM approach overcomes the limitations of traditional methods such as those of Baron & Kenny and Andrew Hayes by integrating mediation and moderation analyses into a unified model, which facilitates the evaluation of direct, indirect and conditional effects in a robust manner. This approach was key to our study to capture the complex interactions between the dimensions analyzed and provide more generalizable results.

The software SmartPLS-v4 educational version (Ávila and Moreno, 2018) was used to assess the theoretical model based on partial least squares (PLS) methods using structural equation models.

3.7 Structural equation modeling (SEM)

SEM is suitable for this research due to its ability to model intricate relationships between latent and observable variables, providing a more detailed and precise understanding of the interactions between

TABLE 2 Results of the instrument quality tests evaluated by each of the model variables.

Variables	Item code	Average	DE	Factor loading	Cronbach's alpha	Composite reliability	Average Variance Extracted (AVE)
Service satisfaction	SATSER1	3.00	1.17	0.933	0.939	0.939	0.845
	SATSER2	3.10	1.20	0.921			
	SATSER3	2.55	1.29	0.909			
	SATSER4	2.99	1.14	0.913			
Document management	GESTDOC1	2.89	1.16	0.903	0.915	0.923	0.749
	GESTDOC2	3.06	1.12	0.891			
	GESTDOC3	3.01	1.11	0.898			
	GESTDOC4	2.83	1.19	0.880			
	GESTDOC5	3.59	1.19	0.746			
Technological support	SOPTEC1	2.87	1.10	0.917	0.879	0.881	0.806
	SOPTEC2	3.23	1.07	0.869			
	SOPTEC3	2.86	1.18	0.907			
Open government and transparency	GOBTRANS1	3.09	1.15	0.897	0.886	0.888	0.814
	GOBTRANS2	3.04	1.08	0.918			
	GOBTRANS3	2.72	1.22	0.891			
Pro-environmental organizational culture	COPROA1	2.79	1.19	0.912	0.937	0.96	0.755
	COPROA2	2.92	1.12	0.919			
	COPROA3	2.75	1.23	0.917			
	COPROA4	2.88	1.20	0.927			
	COPROA5	2.82	1.15	0.931			
	COPROA6	2.83	1.12	0.935			
	COPROA7	3.74	1.19	0.409			
Environmental sustainability	SOSTAMB1	3.07	1.16	0.834	0.923	0.936	0.767
	SOSTAMB2	2.88	1.11	0.917			
	SOSTAMB3	2.75	1.16	0.930			
	SOSTAMB4	2.79	1.14	0.925			
	SOSTAMB5	3.13	1.15	0.761			

pro-environmental organizational culture, service satisfaction, document management, and environmental sustainability. Relevant observable indicators were included based on the survey responses.

4 Results

The assessment of the variables examined in this study offers an in-depth perspective on how participants perceive various aspects of their experience at the institution, as illustrated in Table 3. The results concerning service satisfaction indicate that 38.06% of the participants evaluate the service as high, 35.22% as moderate, and 26.72% as low. While the majority hold a positive view of the service, it is evident that a quarter of the respondents believe there are areas that require improvement. This may highlight problems at certain times or in specific areas of attention.

Regarding DM, 50.61% of the participants view it as high-quality, indicating that most perceive the document processes as effective. However, the average and low evaluations (31.98 and 17.41%, respectively) suggest that some individuals encounter difficulties, potentially due to issues with accessibility or insufficient clarity in procedures. TS also reveals notable outcomes. 39.27% of respondents assess it positively, while 38.06% rate it as average, and 22.67% consider it poor. This implies that, although many find the technological support satisfactory, a substantial number of users experience technical issues impacting their experience. For the OG variable, 36.84% of participants rate it as high, 40.08% as average and 23.08% as low. This shows that, while transparency initiatives are recognized, there is a need to enhance accessibility and update information to build greater trust among users. The POC gets a high rating of 42.51%, average of 37.25%, and low of 20.24%. This indicates that the majority of participants acknowledge the institution's dedication to environmental sustainability. Nevertheless, one-fifth of the respondents believe that the pro-environmental policies could be more effective or better communicated. Lastly, regarding ES, 38.06% of participants rate it as high, 39.68% as average, and 22.27%

TABLE 3 Scale of the evaluated variables.

Variables		High	Average	Low
Service satisfaction (SS)	*n*	94	87	66
	%	38.06%	35.22%	26.72%
Document management (DM)	*n*	125	79	43
	%	50.61%	31.98%	17.41%
Technological Support (TS)	*n*	97	94	56
	%	39.27%	38.06%	22.67%
Open government and transparency (OG)	*n*	91	99	57
	%	36.84%	40.08%	23.08%
Pro-Environmental Organizational Culture (POC)	*n*	15	92	5
	%	42.51%	37.25%	20.24%
Environmental Sustainability (ES)	*n*	94	98	55
	%	38.06%	39.68%	22.27%

as low. The closeness of high and average ratings suggests a generally positive perception but also highlights areas where the execution of sustainable practices and their communication to the university community could be improved. Overall, these findings offer a thorough view of the current state of participant experience and perception at the institution. The variables of DM and POC stand out as strengths, which is promising for sustainability and administrative efficiency initiatives. However, the variables of SS and TS present clear opportunities for enhancement, suggesting that addressing these areas could significantly improve the overall perception of the institution. The interaction between these variables provides crucial insights into the study, emphasizing how advancements in one area can positively affect others. For example, enhancing technological support and clarity in document management can boost service satisfaction. Conversely, greater transparency and a solid organizational culture can reinforce participants' trust and commitment to sustainable practices. Thus, the study not only identifies specific areas for enhancement but also underscores the importance of a comprehensive strategy that considers how these factors interconnect to create a more positive and effective educational and administrative experience.

4.1 Proposed research model

In the current landscape of HEIs, ES has emerged as a domain of growing interest and importance. Incorporating sustainable practices not only demonstrates a commitment to environmental conservation but can also improve operational efficiency and institutional standing. This study suggests a framework to assess the factors affecting environmental sustainability within a HEIs, utilizing SEM. It will explore how various factors, such as technological support, document management, open government and transparency, as well as pro-environmental organizational culture, influence environmental sustainability. Furthermore, two crucial mediators are incorporated in this model: service satisfaction and pro-environmental organizational culture. It is posited that effective document management, supported by solid technological support and open government and transparency, can greatly improve service satisfaction, which in turn might enhance efforts toward increased environmental sustainability. Moreover, a POC is viewed as a pivotal driver in this process, fostering values and practices that advance environmental sustainability. The framework will also include sociodemographic factors such as gender, academic program, age, and role within the institution as moderators, to better understand individual variations in the perception and impact of these practices. These moderators will help reveal how personal traits and specific roles within the institution can affect the connections between the examined variables.

The diagram of the conceptual model shown in Figure 2 illustrates these associations and offers a visual basis for the analysis. This comprehensive approach aims not only to identify the direct connections between the mentioned variables but also to investigate how demographic traits and specific roles might moderate these connections. Through this study, it is anticipated to contribute to the development of more effective and adaptive strategies that reinforce HEIs' dedication to environmental sustainability and offer a more holistic and detailed understanding of the factors driving environmental sustainability in the academic context.

4.2 Summary of direct hypotheses

The examination of the proposed model unveils significant insights into how different variables impact ES in a HEI. Several direct hypotheses were tested, with their relationships and significance providing a thorough view of these factors, as presented in Table 4.

Firstly, TS demonstrates having a crucial impact on DM. With a path value of 0.699 and a *p*-value of 0.000, this correlation is clearly positive and significant. This suggests that enhancing technological infrastructure not only facilitates document management but also boosts operational efficiency. This finding highlights the importance of investing in technology to improve administrative procedures. Document management, in turn, has a notable effect on service satisfaction, as indicated by a path value of 0.857 and a *p*-value of 0.000. This positive and significant link underscores that effective document management is crucial to ensure users are content with administrative services. Clearly, efficient document handling not only results in smoother operations but also in greater user satisfaction. When examining the link between service satisfaction and

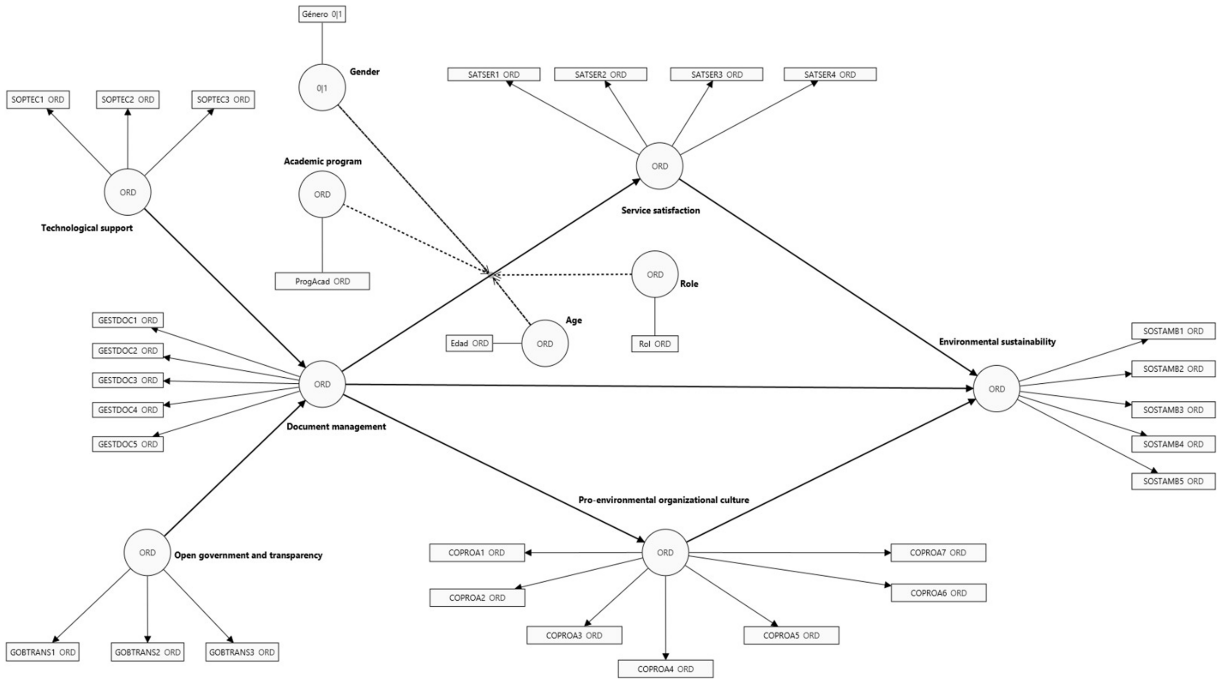

FIGURE 2
Diagram of the proposed research model.

TABLE 4 Hypotheses proposed.

Hypothesis statement	*p*-value	Path value	Condition	Interpretation
Technological Support → Document Management	0.000	0.699	Accepted	The relationship is positive and significant
Document Management → Service Satisfaction	0.000	0.857	Accepted	The relationship is positive and significant
Service Satisfaction → Environmental Sustainability	0.030	0.185	Accepted	The relationship is positive and significant but weak
Document Management → Pro-Environmental Organizational Culture	0.000	0.701	Accepted	The relationship is positive and significant
Pro-Environmental Organizational Culture → Environmental Sustainability	0.000	0.726	Accepted	The relationship is positive and significant
Open Government and Transparency → Document Management	0.000	0.219	Accepted	The relationship is positive and significant but weak
Document Management → Environmental Sustainability	0.217	0.103	Rejected	The relationship is not significant

environmental sustainability, a positive and significant, albeit relatively weak, connection is observed with a path value of 0.185 and a *p*-value of 0.030. This indicates that, although service satisfaction contributes to environmental sustainability, its impact is not as strong as other factors. Nevertheless, this result suggests that improving user satisfaction may have beneficial effects on sustainability practices, though indirectly. On the other hand, DM also shows a significant association with POC, with a path value of 0.701 and a *p*-value of 0.000. This positive correlation underscores how well-organized document management can cultivate an organizational culture that values and promotes environmental sustainability. It is evident that clear and accessible document processes not only facilitate daily tasks but also reinforce pro-environmental principles within the organization. Additionally, POC has a strong effect on SS, with a path value of 0.726 and a *p*-value of 0.000. This result emphasizes the importance of an organizational culture dedicated to sustainability for achieving positive environmental outcomes. Promoting sustainable values and practices within the institution is crucial for the success of environmental initiatives. The association between open government and document management is also positive and significant, though weaker, with a path value of 0.219 and a *p*-value of 0.000. This suggests that transparency and open access to information contribute to

TABLE 5 Moderation analysis.

Hypothesis Statement	*p*-value	Path value	Condition	Interpretation
Gender moderates the relationship between Document Management and Service Satisfaction	0.012	0.172	Accepted	The relationship is significant
The academic program moderates the relationship between Document Management and Service Satisfaction	0.019	0.059	Accepted	The relationship is significant
Age moderates the relationship between Document Management and Service Satisfaction	0.427	−0.025	Rejected	The relationship is not significant
The role moderates the relationship between Document Management and Service Satisfaction	0.207	0.040	Rejected	The relationship is not significant

TABLE 6 Mediation analysis.

Hypothesis statement	Type	*p*-value	Path value	Condition	Interpretation
Document Management → Pro-Environmental Organizational Culture → Environmental Sustainability	Mediator	0.000	0.509	Accepted	Mediation is positive and significant
Document Management → Service Satisfaction → Environmental Sustainability	Mediator	0.030	0.159	Accepted	Mediation is positive and significant but weak

enhanced document management, although its effect is not as strong as other factors. Nonetheless, fostering transparent practices remains essential for improving administrative efficiency. Finally, the hypothesis linking DM directly to ES was not supported, with a path value of 0.103 and a *p*-value of 0.217. This indicates that document management, on its own, does not have a significant direct impact on environmental sustainability. Its influence is likely mediated through other variables, such as service satisfaction and pro-environmental organizational culture. In summary, the results from the direct hypothesis analysis underscore the importance of technological support, document management, and a pro-environmental organizational culture as key factors in driving environmental sustainability. Although service satisfaction also plays a relevant role, its effect is more subtle.

4.3 Moderation analysis

This study examines the influence of various demographic and academic factors on the relationship between DM and SS in higher education environments providing new insights to enhance ES through customized document management practices, detailed in Table 5.

The results indicate that gender has a notable impact on the mentioned relationship ($p = 0.012$, Path = 0.172), suggesting differences in service satisfaction perceptions between men and women. This finding highlights the need to develop inclusive DM strategies that foster both environmental sustainability and fairness in service satisfaction. Additionally, the academic program was identified as a significant moderator ($p = 0.019$, Path = 0.059), emphasizing the importance of tailoring DM practices to the specific context of each program to enhance service satisfaction. This outcome underscores the need for a customized approach in DM initiatives for various academic settings. In contrast, neither age ($p = 0.427$, Path = −0.025) nor role ($p = 0.207$, Path = 0.040) demonstrated significant moderation in the studied relationship. This indicates that DM practices can be uniformly implemented in these areas without compromising their effectiveness.

Finally, this study provides empirical evidence on the importance of considering gender and academic program when designing DM strategies in universities, with the goal of advancing environmental sustainability and service satisfaction. The absence of significant moderation by age and role offers a practical perspective for the consistent application of these practices in certain domains. These results establish a solid foundation for future research and practices in sustainable DM, tailored to the specific needs of diverse groups within the university environment.

4.4 Mediation analysis

The mediation analysis in the model, as detailed in Table 6, assists in understanding how certain variables affect environmental sustainability through key mediators in the HEI under examination.

Below are the findings of the mediation hypotheses, explaining how document management, pro-environmental organizational culture, and service satisfaction interact to affect environmental sustainability. Initially, it was found that DM influences environmental sustainability through pro-environmental organizational culture. With a Path value of 0.509 and a *p*-value of 0.000, this mediation is positive and significant. This means that effective DM can enhance pro-environmental organizational culture, which in turn greatly increases environmental sustainability. In this case, the mediation is complete, highlighting the importance of pro-environmental

organizational culture as a key channel for achieving sustainability through efficient DM. This finding underscores that cultivating a culture that values sustainability is crucial for maximizing improvements in DM. The practical implication is that universities should not only focus on enhancing DM but also on developing an organizational culture that supports and fosters sustainability.

Conversely, it was found that service satisfaction also mediates the relationship between document management and environmental sustainability. With a path value of 0.159 and a *p*-value of 0.030, this mediation is positive and significant, albeit weaker. This indicates that effective DM can increase service satisfaction, which in turn contributes to environmental sustainability. Although this mediation is also complete, the impact is less pronounced, suggesting that service satisfaction plays a role in sustainability but not as strongly as pro-environmental organizational culture. This finding highlights that while service satisfaction is important, additional complementary efforts are required to achieve a notable change in sustainability. Practically, this means that HEIs should work to enhance service satisfaction as it can positively impact their sustainability initiatives, but they should complement these efforts with other more direct actions toward sustainability.

These findings are essential for understanding how intermediate variables can amplify the effects of DM practices on environmental sustainability. POC emerges as a very important mediator, suggesting that initiatives to improve sustainability should focus on building and strengthening a culture that values and promotes environmental sustainability. On the other hand, service satisfaction, while less influential, also contributes positively, indicating that improving the service experience can have beneficial effects on sustainability practices. The mediation analysis shows that both POC and service satisfaction are key mediators in the relationship between document management and environmental sustainability. However, pro-environmental organizational culture has a much stronger and more significant impact. This provides a solid basis for designing effective strategies in HEIs, highlighting the importance of the complete mediations identified in this study.

4.5 R^2 analysis

The R^2 analysis offers a clear understanding of how much of the variability in certain critical areas can be explained by the studied factors, detailed in Table 7. At the research location, four main variables were investigated: pro-environmental organizational culture, document management, service satisfaction, and environmental sustainability.

For the POC, the outcomes show that 49.2% of the variability in this domain can be accounted for by the model, with an adjusted R^2 of 0.490. This implies that nearly half of the changes in pro-environmental organizational culture within the institution are due to factors such as DM, technological support, and transparency. These insights underscore the significance of these components in fostering a culture that values and endorses environmental sustainability. In the case of DM, it was found that 77.7% of the variability can be explained by the elements of the model, with an adjusted R^2 of 0.775. This indicates that enhancing technological support and transparency has a substantial impact on the efficacy of document management. These findings highlight the importance of these areas for efficient administrative operations and suggest that investments in technology and transparent practices are essential. SS was also examined, revealing that 73.4% of the variability can be explained by the model, with an adjusted R^2 of 0.733. This implies that document management and pro-environmental organizational culture have a significant impact on how users perceive the quality of the service. Enhancing these aspects is crucial to increasing user satisfaction with the services provided by the institution. Lastly, for ES, it was found that 78.1% of the variability can be explained by the model, with an adjusted R^2 of 0.771. These results emphasize the necessity for integrated approaches that consider multiple factors to promote sustainable practices. In summary, the R^2 and adjusted R^2 values illustrate that the studied factors adequately explain the key areas of interest. The results suggest that improving document management, fostering a pro-environmental culture, and increasing service satisfaction are vital to driving environmental sustainability.

TABLE 7 R^2 analysis.

Variables	R squared	R-squared-adjusted
Pro-environmental organizational culture	0.492	0.490
Document management	0.777	0.775
Service satisfaction	0.734	0.733
Environmental sustainability	0.781	0.771

TABLE 8 Summary of fit indices.

	Saturated model	Estimated model
SRMR	0.053	0.063
d_ULS	1.381	1.401
d_G	0.897	0.945
Chi-square	1,009.338	1,017.348
NFI	0.948	0.929

4.6 Model fit: summary of fit indices

The evaluation of the fit indices offers an assessment of how well the proposed model aligns with the observed data at the study site, with the outcomes displayed in Table 8.

The following are the findings and interpretations of the main fit indices for the saturated model and the estimated model. The value of SRMR (Standardized Root Mean Square Residual) is an indicator that measures the discrepancy between the observed and predicted correlations by the model. In the saturated model, the SRMR is 0.053, while in the estimated model it is 0.063. These values indicate a good fit, as they are below the commonly accepted threshold of 0.08. This suggests that the discrepancies between the observed and predicted correlations are small, implying that the estimated model adequately represents the data. The d_ULS (Unweighted Least Squares Discrepancy) index in the saturated model is 1.381 and in the estimated model is 1.401. These values are quite close to each other, indicating that the fit of the estimated model is similar to that of the saturated model. Although there is no specific threshold for d_ULS,

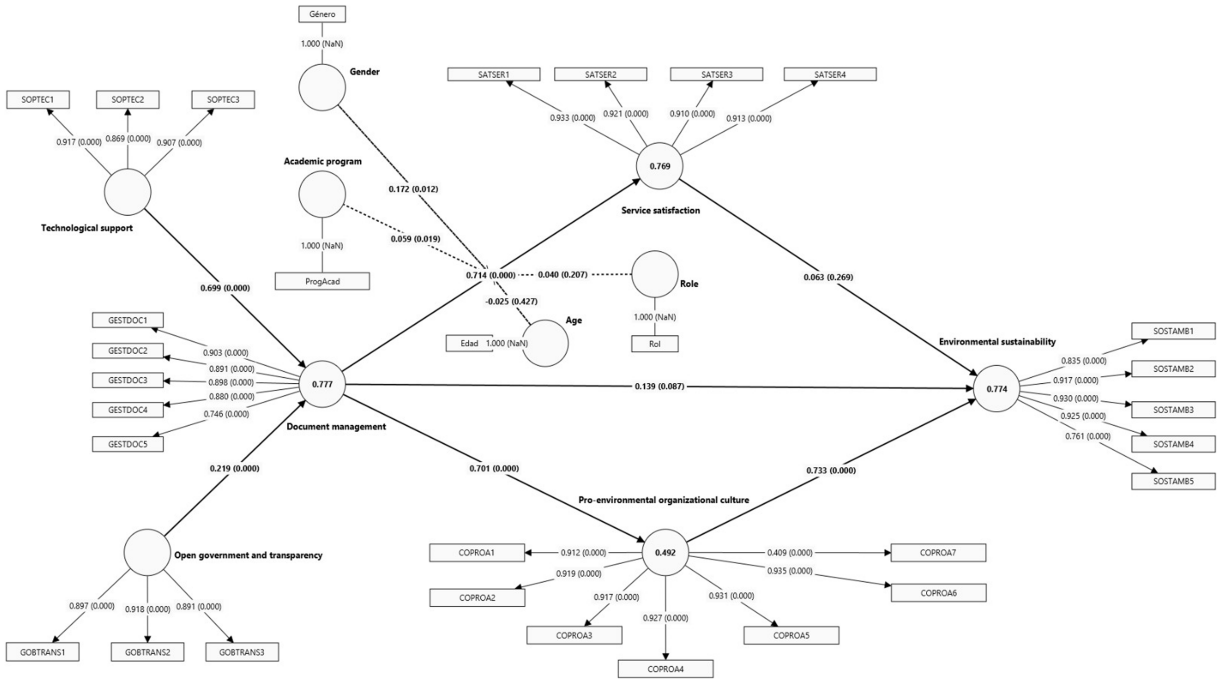

FIGURE 3
Solved research model.

lower values are preferable and these results suggest that the model has a good fit. The value of d_G (Geodesic Discrepancy) shows values of 0.897 for the saturated model and 0.945 for the estimated model. These close values also suggest a good fit of the estimated model compared to the saturated model. As with d_ULS, lower values indicate a better fit. The Chi-square value is 1,009.338 for the saturated model and 1,017.348 for the estimated model. The Chi-square measures the discrepancy between the observed data and the expected data by the model; lower values indicate a better fit. Although both values are relatively high, the small difference between them suggests that the estimated model does not differ much from the saturated model in terms of fit. The value of NFI (Normed Fit Index) is 0.948 for the saturated model and 0.929 for the estimated model. NFI values close to 1 indicate a good fit. Both values are high, suggesting that the estimated model has a reasonably good fit, although slightly inferior to the saturated model. Finally, the analyzed fit indices show that the estimated model has a good fit with the observed data. The values of SRMR, d_ULS, and d_G indicate that the discrepancies between the observed data and the predicted data by the model are small. Although the Chi-square values are high, the small difference between the saturated and estimated models suggests that the fit is adequate. Finally, the NFI value close to 0.93 supports the quality of the fit of the estimated model. These results suggest that the estimated model is a reasonably accurate representation of the relationships between the variables in the studied context.

4.7 Solved research model

The research model (see Figure 3) generated with the values: *p*-value, path coefficients and factor loadings between the constructs (direct, mediators and moderators) is presented below.

5 Discussion

The primary aim of the study was to evaluate the mediation of pro-environmental organizational culture and service satisfaction between document management and environmental sustainability. The SEM showed very satisfactory fit indices. Moreover, the R^2 values demonstrated that 49.2% of the variability in this area can be explained by the model, with an adjusted R^2 of 0.490. For document management, 77.7% of the variability can be explained by the model factors, with an adjusted R^2 of 0.775. Concerning service satisfaction, the analysis indicated that 73.4% of the variability can be explained by the model, with an adjusted R^2 of 0.733. Finally, for environmental sustainability, it was found that 78.1% of the variability can be explained by the model, with an adjusted R^2 of 0.771.

Regarding hypothesis 1, TS shows having a pivotal influence on document management. With a path value of 0.699 and a *p*-value of 0.000, this relationship is evidently positive and significant. In another context, Dwivedi et al. (2019) indicate that the role of technological support is a significant concern in research, where the acceptance and use of innovations in information systems (IS) and information technology (IT) were examined using theoretical models that investigate their acceptance; the Unified Theory of Acceptance and Use of Technology (UTAUT) stands out and suggests that the actual use of technology is determined by behavioral intention. It points out that technology adoption depends on performance and effort expectancy, social influence, and facilitating conditions, and individuals' perceptions of technology are crucial for enhancing job performance (Marikyan and Papagiannidis, 2023). Therefore, this hypothesis is validated, and although our research does not examine the acceptance theory, the findings suggest that technology use influences document management.

Concerning the second hypothesis, the outcomes of the relationship between open government and document management are also positive and significant, although weaker, with a path value of 0.219 and a *p*-value of 0.000. This suggests that transparency and open access to information contribute to better document management. As Aguerre and Bonina (2024), mention, digital technologies have recognized potential to build more efficient, credible, and innovative public institutions. Additionally, Aguerre and Bonina (2024), indicate that open government data are important agents of the DT of the public sector, allowing us to understand how strategies are designed, implemented, and evaluated for their continuous success, with the goal of engaging users and utilizing these vital resources (Begany and Gil-Garcia, 2024). It is necessary to have governance frameworks that allow the integration of technologies into different platforms and the adaptation to an increasingly digital society (Zwitter, 2024), constructing and interpreting data visualizations that simplify access to information, enhancing interpretation and strengthening information literacy (Barcellos et al., 2024). Therefore, these aspects suggest and confirm the importance of the relationship between OG as a catalyst for providing data for adequate document management.

Concerning the third research hypothesis, the outcomes show that DM has a notable impact on service satisfaction, with a path value of 0.857 and a *p*-value of 0.000. This evidences a positive and significant relationship, confirming that efficient document management is essential to ensure users are satisfied with administrative services. On the other hand, Alade (2023), indicates that an area that has experienced rapid growth in recent years is document management, a necessity in the work environment of an organization, concluding that it improves user satisfaction, increases productivity, and ensures data efficiency in a timely manner. Therefore, the results obtained in our hypothesis closely relate to what was indicated. In Peru, according to Ramirez et al. (2023), public institutions have a deficient document management service, so they implemented the automation technology to reduce the time for processing procedures and avoid citizen dissatisfaction, improving their experience. Thus, our hypothesis is significant to avoid such problems in organizations.

In the fourth hypothesis, the outcomes demonstrated that POC has a strong influence on environmental sustainability, with a path value of 0.726 and a *p*-value of 0.000. According to Nanayakkara and Wilkinson (2021), the theory of organizational culture is one of the most powerful in the workplace and could impact its processes and overall company performance. Sindakis et al. (2024) mention that the adoption and transfer of culture is achieved through knowledge exchange within and between areas. As Schlegel et al. (2023) point out in the context of DT, having an organizational culture based on data is an important factor in data analysis capabilities, innovation, and competitive advantages of companies. This allows us to infer that innovation and competitive advantage in companies are factors that contribute to environmental sustainability. According to the study by Souza and Aganette (2022), digital preservation and efficient document management are closely related to pro-environmental organizational culture. Consequently, this would generate digital use of documents, avoiding physical archives, which reaffirms the results obtained in our research. Similarly, Netshakhuma (2022) demonstrated that using the SharePoint platform as a document management system supports the development of a sustainability-oriented organizational culture. The reviewed studies provide evidence that efficient document management can be the key driver for fostering a culture committed to environmental sustainability in HEIs. Therefore, based on the results, our hypothesis is accepted, as confronting it with various authors confirms this strong relationship between the two constructs.

The fifth hypothesis, examining the direct relationship between document management and environmental sustainability, was not accepted, as it yielded a path value of 0.103 and a *p*-value of 0.217. This indicates that document management alone does not have a significant direct impact on environmental sustainability, suggesting that its influence may be indirect and mediated by other variables, such as service satisfaction and pro-environmental organizational culture.

The sixth hypothesis shows a positive and significant connection, although relatively weak, with a path value of 0.185 and a *p*-value of 0.030. The impact of service satisfaction on environmental sustainability is not very strong. Mansoor and Hussain (2024) demonstrated that effective and user-centered management can significantly influence service quality, which in turn fosters a more sustainable environment inclined toward pro-environmental practices. Consequently, this indirect fostering is represented by the weak result in the relationship between these variables. Likewise, Rolo et al. (2024), regarding service quality in HEIs in Portugal and Angola, highlight the importance of adapting service quality strategies to local needs and expectations. In the context of environmental sustainability, this implies that HEIs should consider user particularities to implement sustainable practices that are positively perceived. Nonetheless, this finding suggests that improving user satisfaction can have beneficial effects on sustainability practices, albeit indirectly.

The seventh hypothesis, relating document management directly to environmental sustainability, was not accepted, with a path value of 0.103 and a *p*-value of 0.217. This evidences that document management alone does not have a significant direct impact on environmental sustainability. In conclusion, the outcomes of the direct hypothesis analysis highlight the importance of technological support, document management, and pro-environmental organizational culture as key factors for driving environmental sustainability.

5.1 Theoretical and practical implications

In terms of theoretical implications, this study contributes to the field of environmental sustainability in HEIs by exploring how document management, mediated by pro-environmental organizational culture and service satisfaction, contributes to sustainable practices. By incorporating these factors as mediators, the study provides a conceptual framework that evidences the influence of cultural and internal satisfaction dimensions on the effectiveness of environmental initiatives. Thus, the findings suggest that sustainability in HEIs depends not only on operational actions, but also on a committed institutional culture and the satisfaction of the organization's members. These results can serve as a reference for future research seeking to understand the relationship between organizational culture, service satisfaction and sustainability in different contexts and sectors. Furthermore, the application of the SEM model proves effective in analyzing these interrelationships, which reinforces the potential of this analytical tool in sustainability and management studies in educational settings.

And in reference to the practical implications, the findings highlight the need to implement sustainable strategies in document management within HEIs, promoting the digitization of documents, a greater reduction in the use of paper and the adoption of standards and practices that favor sustainability. The digitization and proper management of digital files not only improves the efficiency of document processes, but also significantly reduces the environmental impact of the institution. Additionally, the results indicate the importance of fostering a pro-environmental culture at all levels of the organization. To this end, it is essential to implement awareness and training programs, suggesting that courses should have content on environmental care and the implications of the carbon footprint, to strengthen the collective commitment to sustainability, ensuring that the university community actively participates in environmental initiatives and that these values are part of the institutional mission. Finally, the SEM analysis suggests that HEIs could develop environmental policies based on the principles of sustainability and document management, integrating a long-term environmental strategy that consolidates them as models of sustainability within the community, thus inspiring other organizations and promoting a significant transformation toward sustainability.

Aligned with the SDGs, the TD of document management in HEIs not only optimizes internal processes, but also contributes directly to quality and accessible education, in line with SDG 4, where the digitization of documents and institutional resources reduces physical barriers and facilitates more inclusive learning, allowing teachers, students and graduates to access relevant information regardless of their location. In the area of sustainable communities, established in SDG 11, HEIs can lead the change by adopting pro-environmental practices, strengthening the role of institutions as models of sustainability in society, inspiring both students and local organizations to adopt a culture of responsible consumption and practices aimed at greater community resilience and sustainable development.

On the other hand, the shift toward digitized document management allows IES to significantly reduce its consumption of paper and other resources, complying with the SDG 12 principles on responsible production and consumption. At the same time, these proactive digitization practices help to reduce the institutional carbon footprint, in line with SDG 13 on climate action, where, by reducing the physical storage and waste derived from printed documents, it contributes to mitigate climate change, reinforcing the role of higher education not only as a knowledge educator, but also as an actor committed to climate action and environmental preservation.

5.2 Limitations and future studies

Nevertheless, the study presents certain constraints. Firstly, the specific geographical and cultural context of a single university restricts the generalization of the findings to other institutions or regions with different cultural and geographical backgrounds. Moreover, although the model encompasses several key factors, there are other potentially significant variables that were not considered in this study, such as the availability of financial resources and the commitment of top management.

For future research, it is recommended to expand the scope of the study to other faculties within the same university or to other HEIs, both nationally and internationally, to validate the generalization of the findings obtained. Additionally, it would be advantageous to include other pertinent variables that might impact environmental sustainability, such as financial resources, senior management commitment, and specific institutional policies on sustainability, which would enrich understanding in this field. Complementing quantitative analyses with qualitative studies would deepen the comprehension of the perceptions and experiences of university community members regarding sustainability practices.

6 Conclusion

In the context of HEIs, environmental sustainability has become a crucial pillar for institutional growth. This research has offered a more profound understanding of the factors affecting ES within a Peruvian HEI, using the Structural Equation Modeling (SEM) methodology through SmartPLS.

The analysis disclosed that technological infrastructure has a notable and favorable impact on document management, emphasizing the importance of investing in technology to streamline administrative operations and enable effective document management, as stated by Alade (2023), the web-based electronic DMS, obtained a 96.60% satisfaction of respondents. Consequently, efficiency in document management translates into higher service satisfaction and promotes a pro-environmental organizational culture, key elements for enhancing user experience and supporting sustainable practices within the institution. The pro-environmental organizational culture emerged as the strongest mediator, significantly influencing environmental sustainability, Barros et al. (2020) shows that in a Brazilian university introduced an electronic information system with the aim of virtualizing administrative processes (until then paper-based), resulting in savings of 57.5% in printed paper. Advancing an organizational culture dedicated to sustainability is vital to achieving favorable environmental results (valor path 0.726). Although service satisfaction also has a positive effect on environmental sustainability, its influence is less substantial (valor path 0.185) compared to other elements. Nonetheless, improving user experience is advantageous for sustainable practices. Transparency and open access to information, open government factors, aid in better document management, although their effect is not as marked (valor path 0.219) as other influences.

Additionally, sociodemographic factors such as gender and academic program within the institution moderate the relationship between the examined variables, indicating that these attributes can affect the perception and efficacy of sustainability practices.

Finally, designing and evaluating specific interventions based on the findings of the study, aimed at improving document management, technological support and pro-environmental organizational culture, would promote greater environmental sustainability in HEIs and contribute to the fulfillment of the SDGs. These interventions would not only improve the efficiency and accessibility of educational processes in line with SDG 4, but would also strengthen the role of universities as agents of change in their communities, aligning with SDG 11. Furthermore, by reducing paper consumption and promoting sustainable practices, these initiatives would be in line with SDG 12 and 13, reducing the institutional carbon footprint and contributing to global efforts against climate change.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors without undue reservation.

Ethics statement

The studies involving humans were approved by Ethics Committee 2024-IIICyT-ITCA. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

JB: Conceptualization, Funding acquisition, Investigation, Project administration, Supervision, Validation, Writing – original draft, Writing – review & editing. CV: Conceptualization, Formal analysis, Investigation, Resources, Validation, Writing – original draft, Writing – review & editing. RA: Formal analysis, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. NG: Conceptualization, Data curation, Validation, Visualization, Writing – original draft, Writing – review & editing. OS: Data curation, Formal analysis, Investigation, Resources, Software, Writing – original draft, Writing – review & editing. JA: Formal analysis, Investigation, Resources, Visualization, Writing – original draft, Writing – review & editing. MA: Conceptualization, Data curation, Formal analysis, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. LG: Data curation, Formal analysis, Resources, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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