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Assessing digital transformation maturity in higher education institutions: a correlational analysis by actors and dimensions

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This study evaluated the maturity of Digital Transformation (DT) in a Higher Education Institution (HEI), analyzing how teachers, students, administrators and managers perceive various dimensions of DT, including Sociocultural, Teaching-Learning, Digital Governance, Research-Innovation, Academic Management, Administrative Management, Institutional Image-Marketing and University Extension. A quantitative approach was used, applying four structured surveys validated by experts to 338 participants from a HEI, which were processed by applying Spearman's correlation analysis. It was found that digital maturity varies significantly according to the actor and the dimension considered. For teachers, Digital Governance shows strong links with University Extension and Research, suggesting that digitalization enhances both social projection and academic collaboration. Students perceive the importance of Institutional Image-Marketing in creating a positive presence of the institution. As for administrative staff, administrative management is strongly related to Institutional Image, reflecting the impact of internal efficiency on public perception. Managers, on the other hand, emphasize the role of University Extension in strengthening institutional prestige. The study concludes that DT in HEIs is multifactorial and recommends adopting customized digital maturity strategies that respond to the needs of each actor, thus facilitating an effective and sustainable digital transformation.

KEYWORDS

digital transformation, digital education, maturity levels, correlational analysis, higher education institutions

1 Introduction

Digital Transformation (DT) has emerged as an essential element in Higher Education Institutions (HEIs), driving significant changes in management, teaching and the relationship with society. As digital technologies become more integrated into educational operations and processes, the degree of maturity of DT varies significantly among HEIs, and is related to the perception of each actor and their participation in this process (Bravo et al., 2021; Santally et al., 2020).

Digital maturity in HEIs refers to the level at which an institution has adopted and integrated the use of digital technologies in its academic, administrative and strategic processes in a sustainable and effective manner. This includes not only the implementation of technologies, but also the capacity to adapt to technological changes, the formation of digital competencies in its stakeholders and the creation of an environment that promotes continuous

innovation, starting from teaching—learning to administrative management and digital governance (Limani et al., 2019; Salas-Pilco et al., 2022; Santally et al., 2020; Smith et al., 2022).

DT in HEIs goes beyond the digitization of resources and services, it also encompasses the creation of learning environments, making them more flexible and personalized, the implementation of advanced tools for academic and administrative management, and the development of research and innovation through the use of advanced technologies such as cyber-physical systems and cloud services (Gürdür Broo et al., 2021; Poletaikin et al., 2021; Santally et al., 2020). Due to these advances, HEIs can promise quality education, promote their research capacity and adapt to the requirements of a progressively more digital world.

HEIs must face problems such as resistance to change, lack of digital competencies among their stakeholders and inequality in access to technology, especially among students from less favored socioeconomic backgrounds (Coral and Bernuy, 2022). In addition, the incorporation of digital technologies in education and management requires a profound restructuring of processes as well as an organizational culture that supports technological adoption and effective leadership in this process (Nguyen-Anh et al., 2023; Zakharov et al., 2022).

DT becomes important because the actors involved have their own perception; thus, teachers perceive DT as an opportunity to innovate in pedagogical practices and thus improve the quality of learning, provided that they receive adequate support and training to develop their digital competencies (Rodríguez, 2022). On the other hand, students value DT for its ability to provide a more personalized and flexible education. Aligned with labor demands that are increasingly digital (Akhmetshin et al., 2021). In the case of managers and administrators, they perceive DT as a core tool for improving operational efficiency and strategic decision making in the institution (Aditya et al., 2021b).

DT in HEIs is manifested in different dimensions, each one decisive in the success of the process. The Sociocultural dimension (D1) includes the integration of digital technologies in the organizational culture, being essential its acceptance to avoid the resistance that may be evidenced due to the lack of digital competences among teachers and students (Yan, 2022; Zabolotska et al., 2021). The Teaching-Learning dimension (D2) is essential, because it involves digital tools in the pedagogical transformation, thus improving accessibility and allowing the personalization of learning, increasing the satisfaction of the particular needs of each student (Koinova-Zoellner et al., 2022; Laufer et al., 2021).

The Academic Management dimension (D3) focuses on the digitalization of educational processes, improving operational efficiency and information transparency (Maier and von der Linden, 2021). The Administrative Management dimension (D4) involves the digitization of processes such as enrollment and financial management, resulting in improved efficiency and better decisions on more accurate data (Ozturk and Kocak, 2021). Regarding the Research and Innovation dimension (D5), DT boosts interdisciplinary collaboration, improves project management, as well as the dissemination of results, favoring innovation in HEIs (Anisimova and Efremova, 2022; Camargo et al., 2021).

Likewise, the digital government dimension (D6) allows for more transparent and efficient governance, these characteristics being decisive for maintaining competitiveness in a globalized world (Hashim et al., 2021). Institutional image and marketing (D7) is also affected by DT, where an effective digital presence is key to attract students and collaborators, reinforcing the institutional image (Nunez Valdes et al., 2021). Finally, the university extension dimension (D8) makes use of digital technologies to strengthen the link between HEIs and society, expanding their social impact and facilitating the transfer of knowledge (Aditya et al., 2021a).

The findings of Santally et al. (2020) have significant implications for policies in HEIs, especially in the design of teacher training programs to strengthen digital competencies, as well as in the improvement of technological infrastructure in accordance with student needs.

Monteiro and Leite (2021) emphasize that improving digital literacy among teachers is essential to ensure a pedagogically appropriate use of technology, enhancing the educational experience. In addition, this result can be valuable for managers who seek to overcome barriers in the effective implementation of DT, with strategies based on accurate diagnoses of digital maturity, which would result in the improvement of both academic and administrative outcomes (Rof et al., 2020; Vitchenko and Shcherbakov, 2022).

Identifying the key dimensions of DT allows HEIs to focus on the application of technologies and methodologies that facilitate learning that is more personalized and adaptable to the changing needs of the global educational environment (Alenezi, 2021). Likewise, it is of utmost importance to promote a culture of data-driven decision making by integrating digital tools that analyze large volumes of information regarding academic performance and operational efficiency, which would improve the ability of institutions to adapt quickly to emerging challenges (Demchenko et al., 2021).

Despite the progress made, the implementation of DT in HEIs faces considerable challenges, such as resistance to change on the part of stakeholders, lack of digital competencies, unequal access to technology and the need to allocate financial resources. In addition, significant investment in technology and the management of cultural change are indispensable, which represent significant challenges for institutions (Poletaikin et al., 2021). Overcoming these obstacles is paramount for HEIs to not only survive, but to maintain growth in today's digital environment.

The present study aims to assess the maturity of Digital Transformation in a Higher Education Institution, performing a correlational analysis between dimensions for each actor, to understand how each of them perceives and is affected, as well as to identify the barriers and key enablers of this transformation process.

The research question is: How does the maturity of Digital Transformation correlate in the various dimensions of a higher education institution and how does this perception vary among the different actors involved (teachers, students, administrators and managers)?

2 Related jobs

Digital maturity in HEI is a growing area of research. In this field, several researches have analyzed various aspects of DT. The following is a review of the most relevant works, related to the present research study.

2.1 Digital maturity models in IES

Different researchers have proposed models to understand and evaluate digital maturity in HEIs. Bravo et al. (2021) present a model of sustainable DT where they stress the importance of aligning technological capabilities with institutional strategies. This holistic approach is important to ensure that universities can successfully adapt to emerging digital demands. Similarly, Santally et al. (2020) highlights the need for a continuous process of improvement in online teaching and learning, arguing that flexibility and innovation are of vital importance to achieve a high level of digital maturity.

Limani et al. (2019) explore the readiness of HEIs for DT, highlighting the importance of a robust technology infrastructure and staff training. These elements are critical for educational institutions to meet the challenges of DT effectively.

2.2 Digital maturity assessment indicators

The assessment of digital maturity requires indicator systems that allow HEIs to monitor their progress and make informed decisions. Poletaikin et al. (2021) develop a set of indicators to assess digital maturity in HEIs. Providing a robust methodology for monitoring digital evolution and ensuring that institutions can identify and address critical areas for their development.

Also, Zakharov et al. (2022) consider information literacy and digital competence as fundamental pillars of digital maturity, highlighting the need for universities to focus their efforts on digital education so as not to be left behind in technological adoption.

2.3 Implementation challenges and strategies

The action of DT in HEIs faces several challenges. Coral and Bernuy (2022) discuss the difficulties faced by students from disadvantaged socioeconomic backgrounds in accessing the necessary technological tools, which is reflected in their academic performance and motivation. Nguyen-Anh et al. (2023) and Zakharov et al. (2022) indicate that resistance to change and lack of digital competencies among academic and administrative staff are significant barriers to the effective adoption of digital technologies.

To meet these challenges, Vitchenko and Shcherbakov (2022) highlight the need for a well-structured implementation strategy based on an accurate diagnosis of digital maturity, which should include process re-engineering, ongoing staff training and the development of effective leadership to support DT in an integrated manner.

2.4 Integration of emerging technologies and leadership

The integration of outbound technologies and strong institutional leadership are essential to progress in the digital maturity of HEIs. According to Criollo-C et al. (2023) stress the importance of adopting emerging technologies to advance in digital maturity, while Alenezi et al. (2023) emphasize the need for institutional leadership to understand and support DL in order to ensure its success. Niță and Guțu (2023) highlight that effective leadership is a determining factor in digital maturity, enabling institutions to remain competitive in a globalized environment.

Despite significant advances in the understanding of digital maturity in HEIs, there are still considerable gaps such as the need for more research on how the different perceptions and roles of actors within HEIs influence the adoption and success of DT. In addition, there is a need for studies that explore in depth the relationship between the dimensions of digital maturity and outcomes, both academic and administrative.

3 Methodology

3.1 Research design

This research adopts a quantitative correlational design, aimed at assessing digital maturity in a HEI through an analysis by key actors and specific dimensions of DT. This approach allows us to explore the relationships between the perceptions of the different stakeholders: teachers, students, managers and administrators and the various dimensions of DT: Academic Management, Administrative Management, Sociocultural, Teaching – Learning, Research – Innovation, Digital Governance, Institutional Image – Marketing (MKT) and University Extension.

3.2 Population and sample

The study population is composed of all key stakeholders within an HEI: teachers, students, managers and administrators. A representative sample was selected from each group, using stratified sampling to ensure the proportional inclusion of all stakeholders, thus avoiding biases derived from over- or under-representation of any key stakeholder, as shown in Table 1. The total sample was 338 participants, distributed as follows: 36 teachers, 253 students, 23 managers, and 26 administrative staff. This stratified sampling guarantees the representativeness of the opinions and perceptions of each group in the analysis.

3.3 Data collection instrument

Four structured surveys were designed as the main data collection instrument, one for each stakeholder, based on a methodological theoretical model to measure the level of DT maturity in HEIs, which were previously validated by experts in the area of digital transformation and higher education.

The surveys contain items distributed in eight key dimensions of DT. (D1) Sociocultural, covers the adaptation of the educational community to new forms of digital interaction and collaboration, (D2) Teaching-Learning, refers to the implementation of pedagogical methodologies supported by digital technologies, (D3) Academic Management, involves the digitization of processes related to academic planning and monitoring, (D4) Administrative Management, covers the automation and optimization of administrative processes through the use of digital technologies,

TABLE 1 Sociodemographic data of the sample.

Variable	Value	Student		Teacher		Manager		Administrative	
		n	Frequency (%)	*n*	Frequency (%)	*n*	Frequency (%)	*n*	Frequency (%)
Age range	Up to 20	42	16.6	0	0	0	0	0	0.00
	21–25	178	70.36	0	0	0	0	0	0.00
	26–30	31	12.25	0	0	0	0	0	0.00
	31–35	2	0.79	0	0	0	0	5	19.23
	36–40	0	0	4	11.11	1	4.35	8	30.77
	41–45	0	0	10	27.78	5	21.74	5	19.23
	46–50	0	0	22	61.11	17	73.91	8	30.77
	Over 50	0	0	0	0	0	0	0	0.00
Gender	Male	187	73.91	30	83.33	16	69.57	8	30.77
	Female	66	26.09	6	16.67	7	30.43	18	69.23
Area of origin	Urbana	176	69.57	31	86.11	23	100.00	26	100.00
	Rural	77	30.43	5	13.89	0	0.00	0	0.00
Total		253		36		23		26	

TABLE 2 Distribution of questions by dimension according to actor.

Dimension	Student	Teacher	Administrative	Manager
Socio-Cultural	11	10	10	14
Teaching-Learning	17	16	0	4
Academic Management	5	7	7	11
Administrative Management	2	2	9	10
Research-Innovation	13	13	4	8
Digital Government	6	6	9	11
Institutional Image-Mkt	4	5	5	11
University Extension	3	2	2	10
Total	61	61	46	79

(D5) Research-Innovation, is the use of digital tools to enhance research and development of innovations, (D6) Digital Government, focuses on transparency, efficiency and participation through the implementation of digital platforms, (D7) Institutional Image-MKT, refers to the construction of a modern and competitive image of the institution in the digital environment and (D8) University Extension, involves the use of digital platforms for interaction with the community and its environment. Table 2 shows the number of questions for each dimension and actor.

Each item was formulated using a five-point Likert scale, ranging from "strongly disagree" to "strongly agree," to capture participants' perceptions of digital maturity at their institution.

3.4 Procedure

The survey was administered online, using a secure platform that guarantees the confidentiality and anonymity of the responses. An e-mail invitation was sent to selected participants, along with an explanation of the purpose of the study and instructions for completing the survey. The data collection period was spread over 3 weeks, ensuring an adequate response rate for analysis.

3.5 Data analysis

The data collected were analyzed using descriptive and correlational statistical techniques. Initially, normality and homogeneity of variance tests were determined for each item in order to determine the appropriate statistical test. Subsequently, Spearman's correlation coefficient was used to examine the relationships between the different dimensions of DT and between stakeholder groups. This correlational analysis made it possible to identify the dimensions with the greatest impact on digital maturity and how this perception varies among teachers, students, managers and administrators.

Spearman's correlation coefficients (rho), ranging from −1 to 1, represent:

- 1: Perfect positive correlation, which means that both dimensions increase or decrease together.

- 0: No correlation, indicating that the dimensions are not related.
- −1: Perfect negative correlation, indicating that when one-dimension increases, the other decreases proportionally.

The results of the analysis were presented in tables and graphs to facilitate the interpretation of the findings, and were discussed taking into account the existing literature and the theoretical framework of the study. This methodological approach provides a solid basis for understanding the dynamics of DT in HEIs and for developing recommendations aimed at improving digital maturity in HEIs.

4 Results

The analysis of the data collected provided a comprehensive view of digital maturity in HEIs. The results present the correlation of the different dimensions for each actor involved.

4.1 Results for the teaching actor

4.1.1 Statistical assumptions

Regarding the normality test, to determine whether the teacher's responses to the 61 questions (Q1-P61) conformed to a normal distribution, the Shapiro–Wilk test was used.

This statistical test showed that most of the variables analyzed presented *p*-values less than 0.05, where the lowest *p*-value is 1.22523e-08 corresponding to P6 (question 6) and the highest *p*-value is 0.01201 corresponding to P61 (question 61), which implies rejecting the null hypothesis of normality. Consequently, the data do not follow a normal distribution, suggesting the application of nonparametric statistical tests in the subsequent analysis.

Regarding the homogeneity of variances, to determine whether the teacher's answers to the 61 questions (P1-P61) have homogeneity of variances, Levene's test was used, with the result, Levene's statistic: 2.22 and *p*-value: 3.25 × 10–7.

The *p*-value obtained is less than the 0.05 significance level, which leads us to reject the hypothesis of homogeneity of variances. This lack of homogeneity, known as heteroscedasticity, implies that the variances of the variables are not constant. Consequently, it is necessary to use non-parametric statistical tests to analyze the correlation between the variables.

4.1.2 Correlation analysis

Spearman's statistical test was performed by pairs of dimensions and the results were presented, as shown in Figure 1, where the heat map of the correlation matrix between all the dimensions for the teaching actor of the TD model in HEIs can be seen, showing that the Digital Government dimension presents the strongest correlations with other dimensions, highlighting its link with University Extension

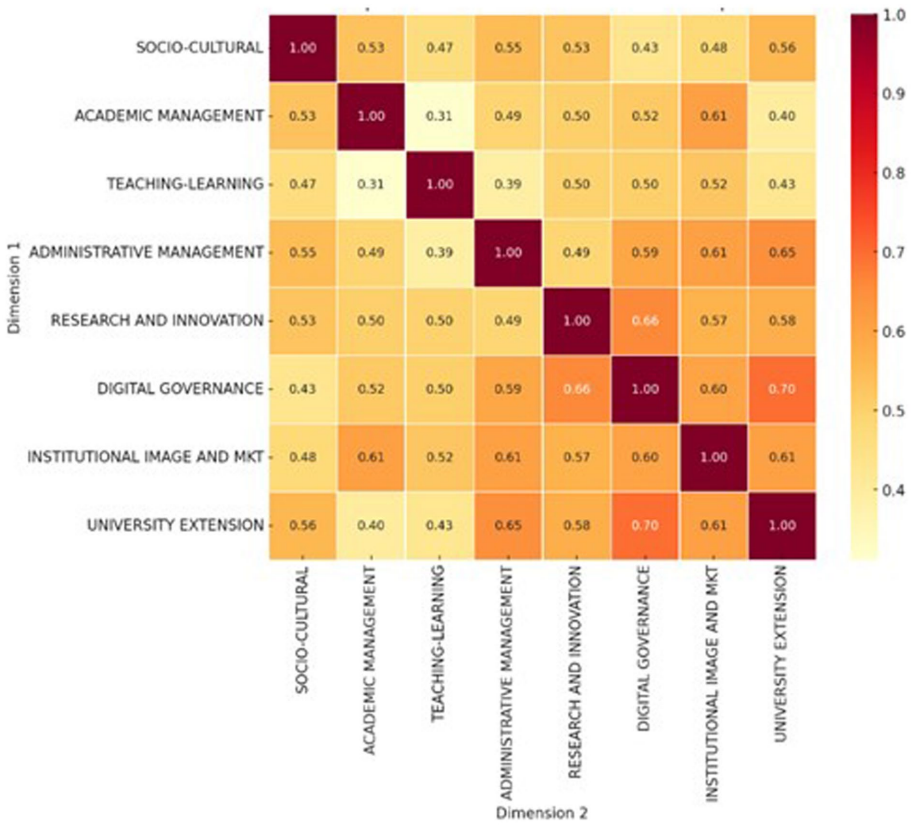

FIGURE 1
Heat map of the dimensions for the teaching actor. The heat map shows the correlation matrix between the dimensions of the TD model in IES. Each cell represents the Pearson correlation coefficient, whose value ranges from –1 to 1. The colors indicate the magnitude of the correlation: darker shades represent stronger correlations, while lighter shades indicate weaker correlations.

(0.70), Research-Innovation (0.66) and Institutional Image-MKT (0.60). In contrast, Teaching-Learning shows weaker correlations, especially with Academic Management (0.31), Administrative Management (0.39), and University Extension (0.43). These results suggest that, from the faculty member's view, Digital Governance is a central axis linking several functions within the faculty administration for DT, while Teaching-Learning might be less integrated with other dimensions for DT. This observation provides an opportunity to create and strengthen digital strategies that can directly support teaching and learning, ensuring that technological transformation directly benefits education.

When the correlations between the different dimensions were analyzed, higher correlations indicate that these dimensions tend to change together, i.e., if one of them changes, it is likely that the other will also change; conversely, low correlations indicate that there is no clear relationship between them.

Table 3 presents the results of the Spearman correlation analysis, showing the pairs of dimensions that have a strong relationship (rho > = 0.6). The strong correlation observed between the pairs of dimensions in the table highlight the integrated nature of DT and its impact on higher education.

The following is a detailed interpretation of the pairs of dimensions and their respective correlation coefficients, which have obtained a higher score as shown in Table 3.

4.1.3 Digital government and university extension

Teachers perceive a strong correlation between Digital Government and University Extension (rho = 0.70), this relationship indicates that digital tools can enhance interaction with society and optimize the management of extension initiatives. The implementation of digital technologies could encourage greater involvement of teachers in university outreach activities, strengthening the university's social commitment. DT plays the role of a catalyst to broaden the scope and effectiveness of outreach programs, helping HEIs to improve their role in society.

4.1.4 Research-innovation and digital government

Regarding Research and Innovation and Digital Governance (rho = 0.66), teachers recognize that efficient digital governance promotes the advancement of research and innovation, since digital infrastructure facilitates access to technological resources, fosters collaboration among researchers and improves data management, allowing higher quality research to be carried out on a larger scale, driving innovation within the institution.

4.1.5 Administrative management and university extension

The correlation between Administrative Management and University Extension (rho = 0.65) is fundamental from the faculty member's perspective, to optimize the organization and implementation of extension programs, since the digitalization of administrative processes not only facilitates the management of resources, but also optimizes the planning and execution of extension activities. A clear example is the use of technological platforms to coordinate volunteer activities and manage continuing education programs.

4.1.6 Administrative management and institutional image-MKT

Teachers perceive that good administrative management supported by digital technologies improves institutional image (rho = 0.61). Efficient administrative management supported by digital technologies such as ERP (Enterprise Resource Planning) systems and internal communication platforms improves both operational efficiency and institutional image. This operational efficiency streamlines administrative processes, which in turn projects professionalism and competitiveness, helping to strengthen the institution's prestige.

4.1.7 Institutional image-MKT and university extension

The correlation between Institutional Image-MKT with University Extension (rho = 0.61) from the teaching perspective, indicates that the effective dissemination of extension activities and programs through marketing strategies improves the institutional image of the University, presenting it as an institution dedicated to social progress, contributing to the positive perception of the university in the community and potential new students.

4.1.8 Academic management and institutional image-MKT

For teachers, there is a strong correlation between Academic Management and Institutional Image-MKT (rho = 0.61). This link suggests that advances in academic management through the use of digital technologies, such as the adoption of online learning platforms and efficient academic management systems, not only improves educational quality and teaching, but also projects an image of innovation and institutional commitment, aligning with existing literature on the influence of academic management on the institutional image of an HEI.

TABLE 3 Pairs of dimensions with strong correlation of the teacher actor.

Dimension 1	Dimension 2	Spearman correlation
Digital Government	University Extension	0.70
Research-Innovation	Digital Government	0.66
Administrative Management	University Extension	0.65
Administrative Management	Institutional Image-MKT	0.61
Institutional Image-MKT	University Extension	0.61
Academic Management	Institutional Image-MKT	0.61
Digital Government	Institutional Image-MKT	0.60

4.1.9 Digital government and institutional image-MKT

On the other hand, the correlation observed between Digital Government and Institutional Image-MKT (rho = 0.60) indicate that teachers associate a technologically advanced administration with greater transparency and institutional effectiveness, improving the perception of the institution toward the community, for example, the use of digital tools enhances marketing campaigns, strengthening the image of the university as a leader in innovation.

4.2 Results for the student actor

4.2.1 Statistical assumptions

For the normality test, the Shapiro–Wilk test was used to determine whether the students' responses to the 61 questions conformed to a normal distribution. The *p*-values obtained for each question were extremely low, ranging from a minimum value of 1.61×10^{-20} (Question 3) to a maximum value of 3.26×10^{-11} (Question 7). These results indicate that, with a high level of confidence, we can reject the hypothesis that the responses follow a normal distribution. Therefore, none of the questions meet this statistical assumption and indicate that the sample is not normally distributed.

Levene's test was conducted to assess the homogeneity of variances in the students' responses to the 61 questions. The results (statistic = 3.770581, $p = 6.38\times10^{-21}$) indicate that the variances are significantly different among the questions, since the *p*-value is much less than 0.05, thus rejecting the hypothesis of homogeneity of variances.

4.2.2 Correlation analysis

Since the statistical assumptions (normality test and homogeneity of variance) were not met, the Spearman statistical test by pairs of dimensions was applied, the results of which are shown in Figure 2, where the heat map of the correlation matrix between all the dimensions for the student actor of the TD model in HEIs is shown.

It is visualized that there are two dimensions with high values, the first one is Research-Innovation that has values higher than 0.6 in six dimensions, particularly with Digital Government (0.75), University Extension (0.71) and Teaching-Learning (0.66) and the second one is Digital Government that has values higher than 0.6 for six dimensions, especially with Research-Innovation (0.75), University Extension (0.73) and Institutional Image-MKT (0.69). On the other hand, the Sociocultural dimension has the lowest correlations, its relationship with Institutional Image-MKT (0.44), Administrative Management (0.46) and University Extension (0.48) being particularly low.

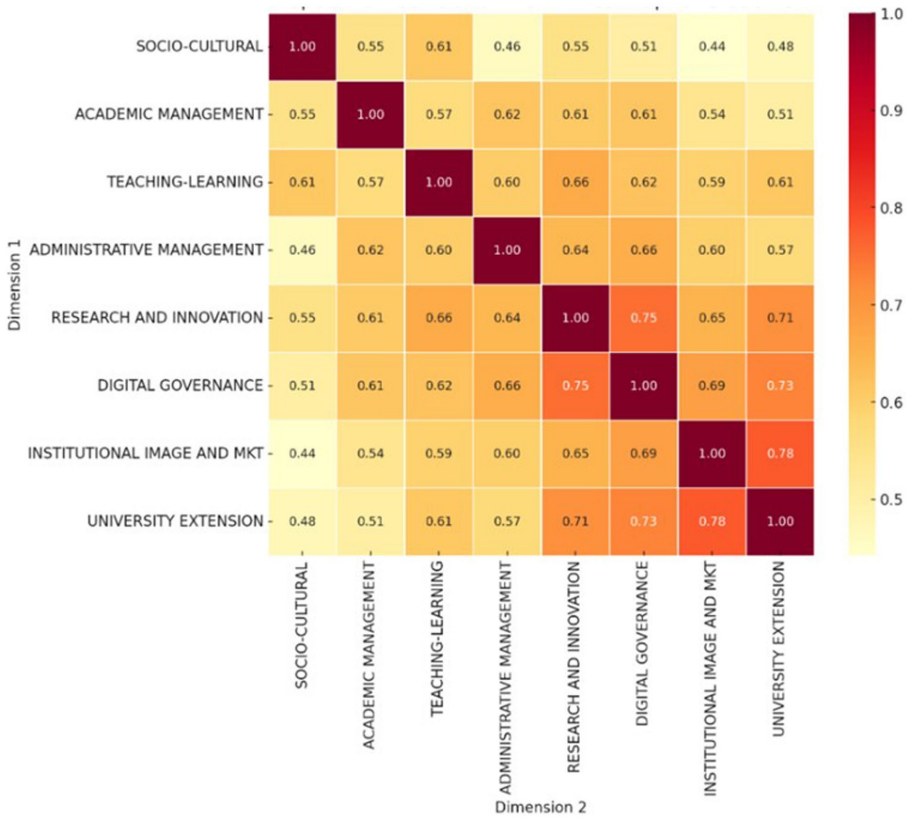

FIGURE 2
Heat map of the dimensions for the student actor. The heat map shows the correlation matrix between the dimensions of the TD model in IES. Each cell represents the Pearson correlation coefficient, whose value ranges from –1 to 1. The colors indicate the magnitude of the correlation: darker shades represent stronger correlations, while lighter shades indicate weaker correlations.

The role of Research-Innovation and Digital Governance in institutional management is highlighted, especially in relation to University Extension. These dimensions act as catalysts to expand the institution's reach and influence. However, the Sociocultural dimension presents less impact on administrative operations, suggesting opportunities to strengthen its integration and alignment with the institution's overall strategy.

Table 4 shows the pairs of dimensions that have a Spearman's rho coefficient greater than 0.6. The strong correlation observed between the pairs of dimensions in the table highlight the integrated nature of TD and its impact on higher education for the student actor.

Next, the pairs of dimensions with a Spearman correlation greater than 0.7 will be analyzed, as shown in Table 4.

4.2.3 Institutional image-MKT and university extension

The correlation between Institutional Image-MKT with University Extension (rho = 0.78) indicates that students perceive a relationship between extension programs and the university's reputation, since community, cultural and social aid activities tend to strengthen the university's image. These programs act as advertising campaigns, increasing institutional visibility. This suggests that students appreciate the university's involvement with its society, which generates a positive opinion toward the institution.

4.2.4 Research-innovation and digital government

The correlation between the areas of Research-Innovation and Digital Government (rho = 0.75), according to student perception, reveals that the implementation of digital technologies is related to improvement in research and innovation. Students associate an efficient digital government with greater opportunities and resources for innovative projects, access to information and tools that facilitate the research process. In this context, the importance for students of fostering a technological environment for scientific development is highlighted.

4.2.5 Digital governance and university extension

The statistical analysis shows a strong correlation between Digital Governance and University Extension (rho = 0.73) suggesting that the implementation of digital administration methods is closely linked to an increase in student collaboration in programs that connect the university with its environment. Digital technologies improve the availability of information and resources, making processes more efficient, which, in turn, leads to greater student interest in the outreach programs offered by the university.

4.2.6 Research-innovation and university extension

The correlation analysis between Research-Innovation and University Extension (rho = 0.71) reveals that students perceive a strong relationship between these aspects, since, for them, universities that prioritize research tend to have stronger extension programs. This linkage could be due to the interaction between the creation of new knowledge and its implementation in society. Institutions that excel in research generate a flow of knowledge that can be channeled into extension projects. In this way, the generation of knowledge is converted into concrete benefits for the community, establishing a positive circle.

4.3 Results for the administrative actor

4.3.1 Statistical assumptions

For the normality test, the Shapiro–Wilk normality test was performed for each question from Q1 to Q46. The results per question showed that the p-values obtained ranged from the lower value of 9.28×10^{-8} (Q3) to the value 0.0408 (Q26).

The results suggest that none of the questions follow a normal distribution, since the p-values are less than the typical threshold of 0.05 rejecting the null hypothesis of normality.

The homogeneity of variances test was performed using Levene's test to evaluate the homogeneity of variances between the different

TABLE 4 Pairs of dimensions with strong correlation of the student actor.

Dimension 1	Dimension 2	Spearman correlation
Institutional Image-MKT	University Extension	0.78
Research-Innovation	Digital Government	0.75
Digital Government	University Extension	0.73
Research-Innovation	University Extension	0.71
Digital Government	Institutional Image-MKT	0.69
Teaching-Learning	Research-Innovation	0.66
Administrative Management	Digital Government	0.66
Research-Innovation	Institutional Image-MKT	0.65
Administrative Management	Research-Innovation	0.64
Teaching-Learning	Digital Government	0.62
Academic Management	Administrative Management	0.62
Academic Management	Digital Government	0.61
Teaching-Learning	University Extension	0.61
Socio-Cultural	Teaching-Learning	0.61
Academic Management	Research-Innovation	0.61

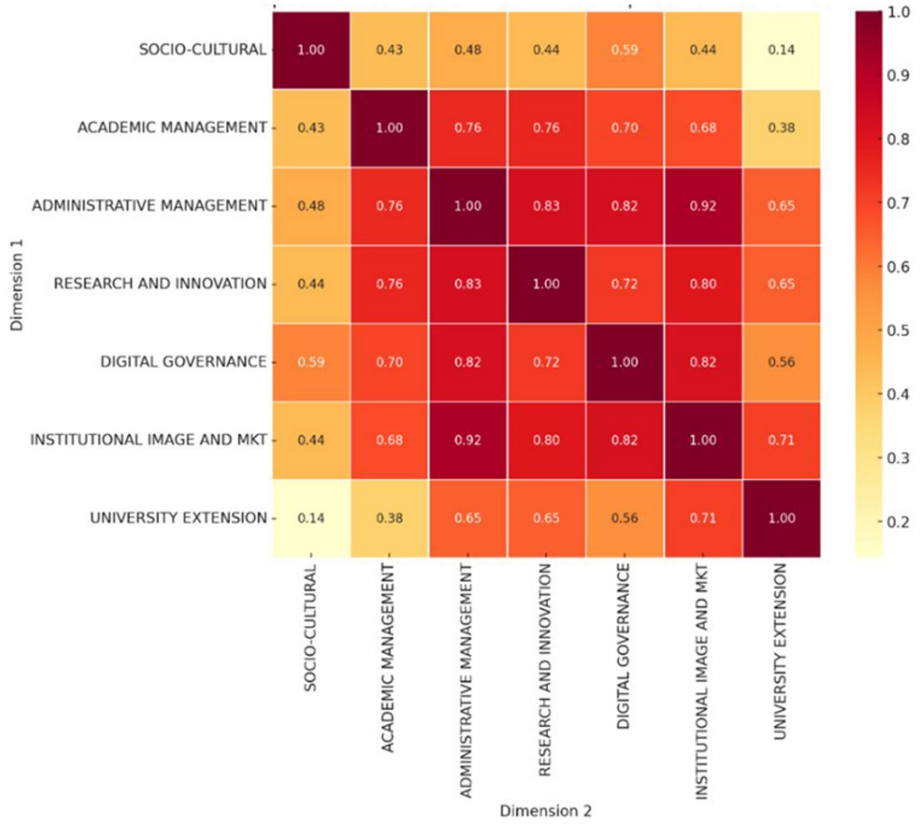

FIGURE 3
Heat map of the dimensions for the administrative actor. The heat map shows the correlation matrix between the dimensions of the TD model in IES. Each cell represents the Pearson correlation coefficient, whose value ranges from −1 to 1. The colors indicate the magnitude of the correlation: darker shades represent stronger correlations, while lighter shades indicate weaker correlations.

dimensions of the administrative actor. This test yielded a statistic of 1.737 and a p-value of 0.00208. This indicates that, at the typical significance level of 0.05, there is sufficient evidence to reject the null hypothesis of equality of variances among the questions. This suggests that the variances are not homogeneous among the questions analyzed.

4.3.2 Correlation analysis

Spearman's statistical test was performed for pairs of dimensions and the results are presented in Figure 3, which shows the heat map of the correlation matrix between all the dimensions for the administrative actor of the TD model in HEIs. The first, the Administrative Management dimension has very high correlations with the other dimensions, standing out especially with Institutional Image-MKT (0.92), with Research-Innovation (0.83) and Digital Government (0.82). The second is the Institutional Image-MKT dimension, which has very high correlations with Administrative Management (0.92), with Digital Government (0.82) and Research-Innovation (0.80). On the other hand, the Sociocultural dimension shows the lowest correlations, being especially notable its low correlation with University Extension (0.14) and Academic Management (0.43).

It is evident that Administrative Management and the Institutional Image-MKT dimension not only reflects the identity of the institution, but is also intertwined with the other dimensions. In contrast, the sociocultural aspects, although important for the overall environment and identity of the institution, play a less critical role in directly influencing the other dimensions, which could be an area of interest for more effective integration strategies.

It is worth mentioning that the Teaching-Learning dimension does not apply to the administrative actor.

The results of the pairs of dimensions with a Spearman's rho coefficient greater than 0.6 indicate a strong correlation, as shown in Table 5.

Next, the pairs of dimensions with a Spearman correlation higher than 0.8 will be analyzed to allow a deeper insight into the relationship between this pair of dimensions.

4.3.3 Administrative management and institutional image-MKT

The analysis reveals a correlation between the dimensions of Administrative Management and Institutional Image-MKT (rho 0.92), which indicates that, for administrators, the effectiveness of administrative management is linked to how an institution is perceived. It may also be influenced by the fact that administrators see administrative management as a priority. Investing in technology to improve administrative management influences institutional reputation, which corroborates that the adoption of technological tools in administrative management makes it possible to identify opportunities, reduce costs and increase the satisfaction of users and clients, which, in turn, improves the institutional image.

TABLE 5 Pairs of strongly correlated dimensions of the administrative actor.

Dimension 1	Dimension 2	Spearman correlation
Administrative Management	Institutional Image-MKT	0.92
Administrative Management	Research-Innovation	0.83
Administrative Management	Digital Government	0.82
Digital Government	Institutional Image-MKT	0.82
Research-Innovation	Institutional Image-MKT	0.80
Academic Management	Research-Innovation	0.76
Academic Management	Administrative Management	0.76
Research-Innovation	Digital Government	0.72
Institutional Image-MKT	University Extension	0.71
Academic Management	Digital Government	0.70
Academic Management	Institutional Image-MKT	0.68

4.3.4 Administrative management and research-innovation

The correlation value between Research-Innovation and Administrative Management (rho = 0.83), evidences that, from the perspective of the administrative staff, a solid connection between a well-organized administrative management and the promotion of research activities within the University, through the allocation of resources and the promotion of cooperation among scientists. Efficient management is a driver of innovation, as it streamlines procedures and enhances research projects in university institutions.

4.3.5 Administrative management and digital government

The analysis shows a strong correlation between Administrative Management and Digital Government implementation (rho = 0.82), which supports the idea that effective management is fundamental to effectively implement digital technologies. Good administration facilitates the move toward a digital governance model by improving internal procedures and promoting an organizational environment that welcomes innovation. This interaction between administration and digitization appears to be an important element in updating and improving organizational services.

4.3.6 Digital government and institutional image-MKT

The correlation analysis between Digital Government and Institutional Image-MKT shows a significant coefficient (rho = 0.82), indicating that the effectiveness of digital government influences the institutional image and enhances marketing strategies. The implementation of digital technologies in university management optimizes processes, increases transparency and facilitates communication, which results in the positive perception of the institution. Likewise, they could favor personalized marketing campaigns that strengthen the positioning of the university in the market.

4.3.7 Research-innovation and institutional image-MKT

The correlation value between Research-Innovation and Institutional Image-MKT shows a significant coefficient (rho = 0.80), which indicates that for the administrative staff, a university institution with high achievements in research and innovation is perceived as a prestigious university, this could be due to the fact that research and innovation are fundamental for the creation of new knowledge and the development of answers to social challenges, promoting technological progress which strengthens the positioning of the university.

4.4 Results for the management actor

4.4.1 Statistical assumptions

To determine whether the responses to the 79 questions of the Managerial actor followed a normal distribution, the Shapiro–Wilk test was used. The results per question showed that the values obtained are within a range between 2.81×10^{-8} (Q3) to 0.0926 (Q13). Although some questions (Q13, Q64, Q57, Q26, Q55, and Q51) presented p-values slightly higher than 0.05, the vast majority of questions (72) had much lower p-values, indicating a clear deviation from normality.

To determine whether the variances of the different dimensions of the managerial actor were equal, Levene's test was applied. The results obtained (statistic = 0.02314, $p = 0.6355$) do not allow us to reject the null hypothesis of equality of variances. This indicates that the variability of the data is similar in all dimensions. Although this assumption is met, the decision to use nonparametric tests is justified by the lack of normality in most of the data, which makes these tests more robust.

4.4.2 Correlation analysis

Spearman's statistical test was performed by pairs of dimensions and the results are presented in Figure 4, which shows the heat map of the correlation matrix between all the dimensions for the management actor of the TD model in HEIs, in which an important aspect is the strong correlation between the University Extension dimension and the other dimensions, with four correlations greater than 0.6, highlighting the relationship with Institutional Image-MKT with a coefficient of 0.83 and Digital Government, with a coefficient of 0.69. On the other hand, the Teaching-Learning dimension can inform about the perspective of the managers regarding where

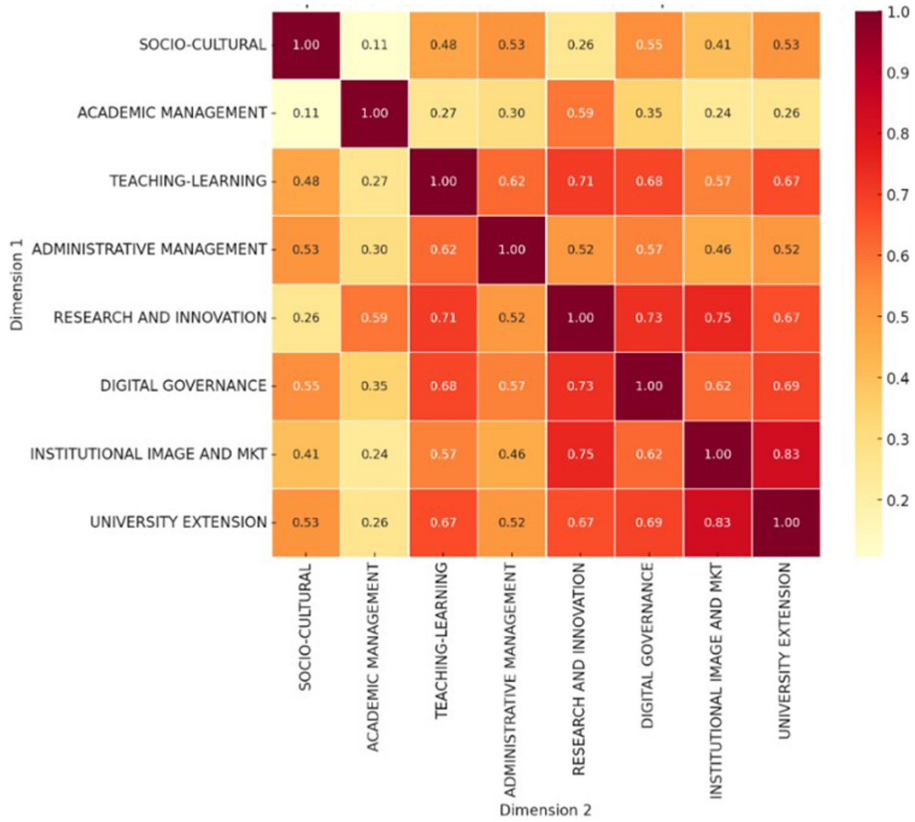

FIGURE 4
Heat map of the dimensions for the management actor. The heat map shows the correlation matrix between the dimensions of the TD model in IES. Each cell represents the Pearson correlation coefficient, whose value ranges from −1 to 1. The colors indicate the magnitude of the correlation: darker shades represent stronger correlations, while lighter shades indicate weaker correlations.

TABLE 6 Pairs of dimensions with strong correlation of the management actor.

Dimension 1	Dimension 2	Spearman correlation
University Extension	Institutional Image-MKT	0.83
Research-Innovation	Institutional Image-MKT	0.75
Research-Innovation	Digital Government	0.73
Research-Innovation	Academic Management	0.71
Digital Government	University Extension	0.69
Digital Government	Academic Management	0.68
Academic Management	University Extension	0.67
Research-Innovation	University Extension	0.67
Digital Government	Institutional Image-MKT	0.62
Administrative Management	Academic Management	0.62

development and intervention efforts should be focused to maximize the impact on the digital maturity of the institution.

Table 6 shows the analysis of pairs of dimensions that have a Spearman's rho coefficient greater than 0.6, indicating a strong correlation, which allows a better understanding of their interaction in the context studied.

Next, the analysis of those dimensions with a Spearman's correlation higher than 0.7, shown in Table 6, will be discussed in more detail.

4.4.3 University extension and institutional image-MKT

The correlation between University Extension and Institutional Image-MKT (rho = 0.83) indicates that from the manager's perspective, university extension programs have a strong impact on the external perception of the University, since they strengthen the connection with the community which results in an image of social responsibility and commitment, important aspects to attract new students and establish collaborations with

other institutions, consolidating the presence of the university in its community.

4.4.4 Research-innovation and institutional image-MKT

The results show a close relationship between Research-Innovation and Institutional Image-MKT (rho = 0.75), which indicates that, from the managers' point of view, achievements in research and innovation help to improve the positioning of the university, since quality research generates new knowledge and innovative technologies. This approach highlights that the university should not only stand out in the quality of teaching, but also in research, improving its visibility at the local and national level, and allowing it to differentiate itself from other higher education institutions.

4.4.5 Research-innovation and digital government

The relationship between Research-Innovation and Digital Governance (rho = 0.73), suggests that managers perceive digitalization as a key tool to foster research. By facilitating project management and improving efficiency, digital governance enables the university to develop more agile innovative initiatives. Concrete examples of this relationship are the use of online project management platforms that allow research teams to plan and track their projects collaboratively, the use of digital repositories where research data, scientific publications and other academic resources are stored and shared, and the use of online collaboration tools that allow research teams to communicate and coordinate in real time, regardless of their geographic location.

4.4.6 Research-innovation and academic management

The results show a close relationship between Research-Innovation and Academic Management (rho = 0.71), suggesting that, from the managers' point of view, effective academic management is critical to the success of research initiatives. By ensuring adequate resource allocation and a clear alignment between academic objectives and the innovation vision, academic management creates an environment conducive to the generation of new knowledge and development of innovative solutions. In Peru, for example, professors at state universities who have the status of research professors have a reduced academic load. Such a case can facilitate a greater production of quality research, fostered by good academic management.

4.5 Comprehensive analysis

By examining the most significant correlations between the key dimensions for each actor (teachers, administrative, students and managers), a clear view was obtained of how digital maturity is perceived from different roles in an HEI. This analysis allows universities to identify critical areas where technology can generate greater impact and, at the same time, point out specific dimensions that could be lagging behind. In this way, key barriers and enablers in the DT process can be recognized.

There is a clear consensus on the importance of Digital Governance, Research-Innovation and University Extension as important dimensions in the development of HEIs. Each dimension interacts synergistically with the others, creating a picture of digital maturity that should be seen as a complex and multidimensional phenomenon.

The multidimensional approach justifies the importance of adopting a comprehensive DT strategy, since it should not only seek to implement digital technologies but also develop plans to ensure that these tools enhance research, improve administration and collaborate in outreach activities, linking the university with its community to project an image of innovation and social responsibility.

Figure 5 shows a correlation network of the five pairs of dimensions with the greatest impact per stakeholder, where the red lines represent administrative actor, blue lines represent managers, green lines represent teachers and orange lines represent students.

The Digital Governance dimension is a central dimension for all stakeholders, in the case of teachers, they see Digital Governance as a tool to optimize Extension activities (rho = 0.70) and to enhance Research (rho = 0.66). Students, for their part, recognize the importance of Digital Government in improving Research (rho = 0.75), University Extension (rho = 0.73) and Institutional Image (rho = 0.69). For administrative actor, Digital Government is a platform that makes Administrative Management efficient (rho = 0.82) and improves Institutional Image (rho = 0.82). And for managers, it is an argument to improve Research-Innovation (rho = 0.73) and University Extension (rho = 0.69).

The influence of Digital Government is evidenced in its ability to enhance Research-Innovation and to promote and manage university Extension activities according to the opinion of teachers, students and managers, which in turn will have an impact over time on the improvement of the Institutional Image-MKT as stated by students and administrators.

The Research-Innovation dimension is another strategic driver that correlates with different nuances: Teachers and administrators perceive that the use of digital technology (rho = 0.66) and a solid administrative management (rho = 0.83) are very important to improve research. For students, it is achieved through digital technology (rho = 0.75) and for managers it is important for institutional projection (rho = 0.75) and through good academic management (rho = 0.71). This reflects that research is achieved through a digital governance infrastructure and efficient administrative management, enhancing institutional prestige, fostering an academic environment conducive to the generation of new knowledge, strengthening the educational quality and visibility of the university.

The correlation between the dimension University Extension and Institutional Image-MKT is another important axis, for students (rho = 0.78) and managers (rho = 0.83), the relationship between these dimensions is evidenced by strengthening extension programs, which allows the university to fulfill its social commitment, fundamental to improve its positioning and attractiveness in society. This highlights that the external perception of the institution is strongly influenced by its outreach to the community through outreach activities.

The relationship between the Administrative Management dimension and the Institutional Image-MKT dimension is a significant factor for the administrative staff with an extremely high correlation value (rho = 0.92) suggesting that from their perspective the improvement in administrative processes brings as an immediate effect the operational optimization and competitiveness of the University.

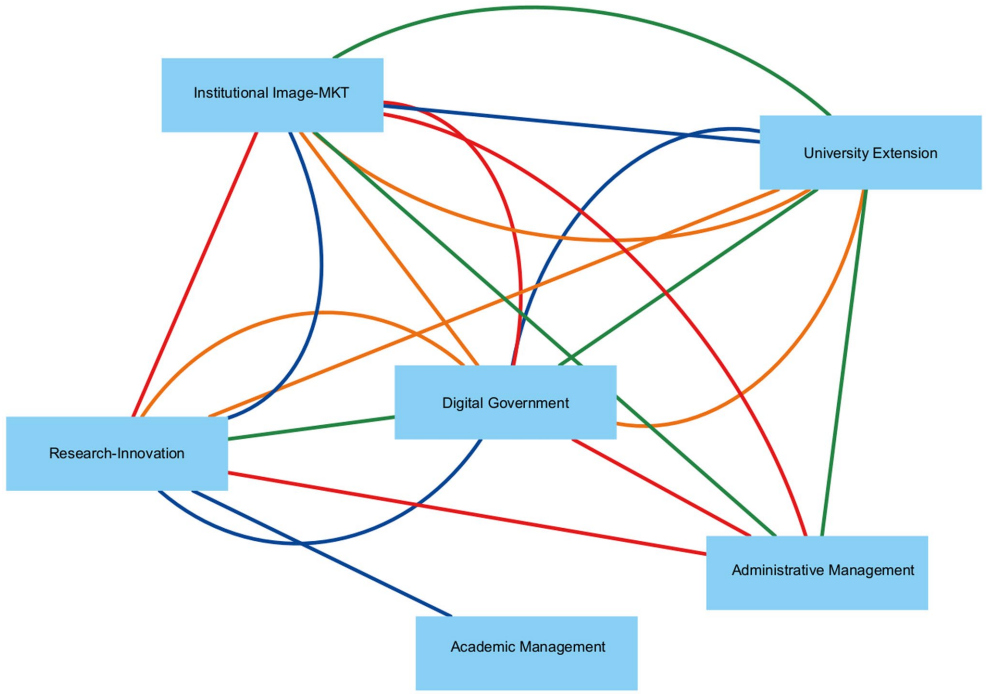

FIGURE 5
Correlation network of the most relevant dimensions according to actor.

The design of personalized strategies for digital maturity will promote a segmented approach that prioritizes platforms, technologies that reinforce University Extension, Research-Innovation and Institutional Image-MKT to support teachers, students, managers and administrators and thus achieve greater technological adoption and better effectiveness for each actor.

Likewise, this research identifies several obstacles and key enablers in the DT of HEIs. Obstacles can impede effective technological maturity, and this research has identified as the main obstacle the lack of alignment between Academic Management and Administrative Management, which prevents the optimization of processes and generates operational inefficiencies, increasing costs and limiting the responsiveness of the institution to the demands of the academic community. In addition, if the areas of University Extension and Institutional Image are not adequately prioritized, these areas may be left behind, affecting the perception of society.

On the other hand, the facilitators include a strong correlation between Research-Innovation and Digital Governance, which highlights the importance of having technological infrastructure that drives innovation. HEIs that optimize their digital governance systems can improve their research capacity and competitiveness.

This research is valuable as it allows HEIs to prioritize their investments in specific dimensions, designing customized digital maturity strategies that consider the needs of each stakeholder, to promote an effective and segmented approach fostering effectiveness in the implementation of digital solutions. This will result in an improvement of internal processes, enhance their innovative capacity and project a solid institutional image, providing a framework for strategic DT planning in line with the specific needs of each stakeholder.

5 Discussion of results

The results obtained in the present research provide insight into digital maturity in HEIs and its relationship with key dimensions. Comparing these findings with previous studies, an important alignment is observed in certain aspects while others reveal new perspectives to be taken into account.

First, the strong correlation observed between the dimensions of Digital Governance and University Extension for teachers (rho = 0.70) and students (rho = 0.73) suggests that the implementation of digital technologies in HEIs improves the operational efficiency and planning of extension activities by strengthening the connection between university and community, being a finding aligned with the research of Limani et al. (2019) who highlight that a robust digital government is fundamental for universities to face the challenges of their context.

The strong correlation between Research-Innovation and Digital Governance was also a recurring finding with values (rho = 0.66) for teachers and (rho = 0.75) for students. This highlights that digitalization not only facilitates Administrative Management, but also plays a key role in strengthening research. Studies such as those (Poletaikin et al., 2021) reinforce this idea, arguing that an efficient digital environment is crucial to boost research by allowing better access to technological resources, collaboration between researchers and data management, in addition, Criollo-C et al. (2023) suggest that strong digital governance is a vital for research and innovation. The ability of universities to implement digital research platforms facilitates both innovation and knowledge transfer to society, consolidating their role as generators of progress.

A particularly high correlation was observed between Administrative Management and Institutional Image (rho = 0.92 among

administrative staff and rho = 0.61 among managers), which reflects that the external perception of the university is strongly influenced by the efficiency of its administrative processes, which is consistent with what was pointed out by Ozturk and Kocak (2021) who indicate that the adoption of advanced enterprise resource planning systems and other management technologies not only optimizes internal processes, but also contributes to projecting an image of transparency and management, aspects that are increasingly valued in the educational environment. Bravo et al. (2021) emphasize the importance of alignment between technological capabilities and institutional strategies to project an image of professionalism and competitiveness. The incorporation of digital technologies in administrative management not only optimizes internal processes, but also strengthens the institutional image of the university, improving its positioning in the academic and social environment.

Another significant link identified was between Institutional Image-MKT with University Extension (rho = 0.78) among students and (rho = 0.83) among managers. This result highlights the importance of outreach activities as a key strategy to improve the perception of the university. Research such as that of Zakharov et al. (2022) emphasize that an institution's image is closely linked to its participation in community initiatives and outreach programs and Aditya et al. (2021a), who suggest that university outreach activities not only benefit the community but also reinforce its image and strengthen its social commitment and allow it to attract new students, thus reinforcing its prestige.

Finally, the correlation between Research-Innovation and Institutional Image was also significant with values of rho = 0.80 for administrators and rho = 0.75 for managers. These results suggest that universities that excel in research and innovation tend to be perceived as more prestigious and competitive, which coincides with the findings of studies such as those by Coral and Bernuy (2022), who highlight the importance of research to improve institutional positioning in the educational sphere and Vitchenko and Shcherbakov (2022), who underline the interdependence between research excellence and institutional image. By producing new knowledge and innovative technologies, universities not only generate academic value, but also strengthen their image in the eyes of society and their environment.

In the comparative analysis with global studies on digital maturity in universities, it was found that in Bulgaria, Croatia, Vietnam and Bosnia and Herzegovina have mainly highlighted dimensions such as ICT Culture, ICT Infrastructure, Leadership and Planning. Doneva et al. (2019) and Mabić et al. (2022) obtained average scores of 3.59/5, highlighting digital infrastructure and culture, while technology transfer was the weakest dimension. Đurek et al. (2018) emphasized the relevance of leadership and planning in Croatian universities, with ICT Infrastructure as the second key dimension. Ngoc et al. (2025), evaluating universities in Hanoi, found that the dimension planning, leadership and management scored the highest, while Technology transfer and social service was the lowest dimension.

In contrast, our study focuses on the relationships between key dimensions, identifying Digital Governance as the most influential factor. Significant correlations were found between University Extension and Institutional Image-MKT ($r = 0.83$ for managers), as well as between Administrative Management and Institutional Image-MKT ($r = 0.92$ for administrators), evidencing the relevance of Digital Governance in institutional perception. In addition, Digital Governance showed strong links with University Extension ($r = 0.73$, students) and Research-Innovation ($r = 0.75$, students), suggesting that digital transformation should not only focus on infrastructure and planning, but also on its impact on institutional image and social bonding.

However, the adoption of technology in HEIs faces various structural and cultural barriers that limit its effective implementation. Structural barriers include the lack of advanced technological infrastructure, budgetary restrictions and regulatory rigidity, which hinder digitization. On the other hand, cultural barriers include resistance to change on the part of teaching and administrative staff, the generation gap in the use of technologies, and the lack of a culture of innovation in teaching and research. These barriers can affect TD, influencing institutional efficiency and external perception. To overcome them, a combination of continuous training policies, flexibility of regulations and promotion of an adaptive digital culture is required. Therefore, the results of this study confirm and extend the findings of previous research, underscoring the importance of an integrated digital strategy that considers the interrelationships between various dimensions to achieve a high level of digital maturity in HEIs. It also highlights the need to overcome structural and cultural barriers to achieve effective and sustainable TD. These findings have important implications for the formulation of policies and strategies in universities, especially regarding the integration of digital technologies in all aspects of institutional management.

5.1 Limitations

Despite the relevant findings, this research has some limitations that should be considered. First, the study was conducted in a single HEI which may limit the generalization of the results to other institutions with different contexts, however, it allowed for a deeper analysis, minimizing the influence of external variables and providing a clearer understanding of specific institutional dynamics. In addition, although multiple stakeholders were included, the perceptions of other key groups such as graduates or the external community were not considered, which could have enriched the analysis. Another limitation is that the analysis focused on the correlation between dimensions, which, although useful for identifying relationships, does not allow establishing causality.

5.2 Future work

For future research, it would be valuable to extend the study to a larger number of HEIs both nationally and internationally, to examine how the dynamics of digital maturity vary in different educational contexts. In addition, including other stakeholders such as alumni and the community could provide a more holistic view of how DT impacts all levels.

Also, it would be interesting to use mixed methodologies that combine quantitative analyses with qualitative case studies to further understand the processes underlying the observed correlations.

Finally, it would be beneficial to further investigate the causal relationships between the dimensions of digital maturity through structural equation modeling to identify which factors are truly determinant in the evolution of digital transformation in HEIs.

6 Conclusion

The present study achieved the objective of evaluating the maturity of digital transformation in an HEI by performing a correlational analysis by dimension of each actor: faculty, student, administrative and managerial. The fact that results were obtained indicating significant variations in digital maturity according to the actor and the dimension analyzed shows that the correlational analysis was effective in identifying differences in the perception of each actor within the institution, i.e., digital maturity in HEIs is not a homogeneous phenomenon, but varies significantly according to the actor and the dimension analyzed.

The research identifies that digital maturity in HEIs is articulated synergistically among several key dimensions, with digital government, research-innovation and university outreach being the most influential. The participating stakeholders agree that the implementation of digital technologies not only improves internal administrative management processes, but also strengthens the university's relationship with the community and strengthens research and innovation. These results provide valuable information for HEI managers, suggesting that investment in digital infrastructure and governance can generate positive effects in multiple institutional areas.

Teachers and students perceive a significant correlation between digital governance and university outreach, which shows that digitalization favors the planning and execution of outreach activities. Likewise, the relationship between Research-Innovation and Digital Governance is key, confirming that a strong technological infrastructure facilitates access to resources, promotes academic collaboration and improves data management, boosting the production of knowledge. These results highlight the need for universities to develop strategic plans that integrate TD into their extension and research policies, ensuring a sustainable and inclusive technological evolution.

The administrative actor emphasizes administrative management in the improvement of the institutional image with a high correlation between these dimensions. This reflects that efficiency in administrative processes not only improves internal operations, but also projects an image of efficiency, contributing to the positioning of the institution in the academic and social environment. From a strategic perspective, this suggests that digitalization should not be seen simply as a technological update, but as an important factor in institutional identity and competitiveness, so HEIs should promote continuous training programs for administrators to improve their technological competencies.

Managers highlight the importance of University Extension to improve the image of the university, which coincides with the students' vision. University extension programs are perceived as strategic tools to reinforce the university's social commitment and improve its prestige. This aspect reinforces the idea that TD policies in HEIs should explicitly incorporate university outreach initiatives in the subjects of academic programs, taking advantage of digital tools to strengthen social engagement and institutional reputation.

However, despite the benefits identified, DT in HEIs faces cultural barriers that include resistance to change, lack of digital skills and the perception of digitization as a threat. At the structural level, budgetary limitations, infrastructure deficiencies and the scarce integration of digital tools in institutional processes stand out; to overcome them, it is important to implement awareness strategies, training and sustainable investment policies that facilitate an effective adoption of technology.

Finally, digital maturity is conceived as a complex and multifactorial phenomenon, where digital technologies not only influence operational efficiency, but also strengthen the institutional image and social impact of the university. Therefore, it is essential that HEIs adopt a holistic approach to TD, ensuring that technological development is aligned with academic, administrative and social objectives. The study highlights the importance of designing comprehensive digital strategies that consider the interrelationships between different dimensions to achieve an effective and sustainable digital transformation.

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 the Ethics Committee of the Pedro Ruiz Gallo National University. 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-J: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. GM-N: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. NG: Conceptualization, Data curation, Investigation, Methodology, Writing – review & editing. CV: Conceptualization, Data curation, Investigation, Methodology, Writing – review & editing. RA: Conceptualization, Methodology, Visualization, Writing – review & editing. JA: Conceptualization, Methodology, Validation, Writing – review & editing. OS: Conceptualization, Methodology, Supervision, 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.

Generative AI statement

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