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Influence of gender and academic level on the development of digital competencies in university teachers: a multidisciplinary comparative analysis

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Introduction: In the digital era, the evolving demands of professional fields, especially in higher education, have accentuated the need for advanced digital competencies among faculty members. Digital competencies are now considered essential for effective teaching, necessitating an in-depth understanding of how these skills are distributed across different demographics, including gender and academic level. This study aims to explore the digital competencies of faculty members at the State University of Milagro, focusing on how these competencies vary by gender and academic level.

Methods: This study employed a quantitative approach within the positivist paradigm to assess the digital competencies of 279 faculty members at the State University of Milagro. Data were collected using the Higher Education Digital Competence Assessment Questionnaire, a validated instrument designed to measure various dimensions of digital skills. Descriptive statistical analysis was conducted using SPSS to evaluate the internal consistency of the competencies and to identify correlations among them, as well as to assess the influence of gender and academic level on these competencies.

Results: The analysis revealed significant correlations among the different dimensions of digital competencies, indicating that proficiency in one area often contributes to the development of skills in other areas. The integrative nature of digital technologies within the academic environment was evident, with a high level of internal consistency observed across the competencies assessed. Notably, differences were found based on gender and academic level, suggesting that these demographic factors influence technological exposure and training, with certain groups displaying higher competency levels in specific areas.

Discussion: The findings highlight the importance of promoting integrative educational strategies that consider the diverse backgrounds of faculty members to ensure equitable development of digital competencies. The observed gender and academic level disparities underline the need for targeted interventions

that address the specific needs of different faculty groups. By fostering a more balanced development of digital skills, institutions can enhance overall teaching effectiveness and better prepare faculty to meet the demands of modern educational environments. These results contribute to the ongoing discourse on digital competency development in higher education and suggest avenues for further research on how to bridge existing gaps in digital skills among faculty.

KEYWORDS

digital competencies, digital technologies, higher education, statistical analysis, teacher training

1 Introduction

Currently, in the context of the digital era, digital competence represents a critical factor for the effective performance of university teachers. Previous research has explored how these competencies are acquired and developed, highlighting the influence of factors such as age and academic discipline (Boahin and Hofman, 2013). However, there is a noticeable lack of studies focused on the disparities in these digital competencies that consider variables such as gender and academic level (Scheerder et al., 2017).

It has been established that a higher academic level is associated with improvements in digital skills; nevertheless, the relationship between gender and these competencies still presents as an enigma (Moreira-Choez et al., 2023). This context suggests the urgent need to investigate in depth how gender might influence digital competence among teachers, analyzing the possible interaction with other sociodemographic and professional factors (Makri et al., 2021).

With the progressive integration of digital technologies in higher education, a significant knowledge gap emerges regarding how these competencies vary based on the gender and academic degree of university teachers (Alenezi, 2023). This gap prevents institutions from designing tailored training programs and intervention strategies to meet the specific needs of their teaching staff.

It is uncommon for existing studies to analyze both gender and academic degree variables together, or to consider the intersectionality of these factors concerning digital competence (Ertl et al., 2020). Given this situation, it is essential to advance the understanding of the dynamics affecting the digital competencies of university teachers. A better understanding of these dynamics will facilitate the development of more inclusive and effective policies by educational institutions. The findings of this research will not only expand the existing knowledge base but also provide a reference framework for future studies on equity in digital education.

In this context, the hypothesis is proposed that the differences in digital competencies among university teachers are significantly influenced by academic degree and gender. The primary objective of this study is to examine the digital competencies of the faculty at the State University of Milagro, according to gender and academic level, to identify specific patterns.

2 Theoretical framework

The digital competencies of university teachers, considering variables such as gender and academic degree, are based on an exhaustive review of relevant literature that analyzes both the technological and sociodemographic aspects influencing professional development in higher education contexts.

2.1 Definition and relevance of digital competencies

Digital competencies are defined as the ability to effectively use information and communication technologies (ICT) in various activities such as pedagogical practice, research, and academic management (Morze and Buinytska, 2019; Basilotta-Gómez-Pablos et al., 2022). According to González-Salamanca et al. (2020), these skills have been established as fundamental requirements for effective teaching in the context of the 21st century, where technological fluency becomes a central pillar of professional and academic development.

These competencies encompass a wide range of skills, including the ability to search, evaluate, and synthesize digital information (van Laar et al., 2017). Additionally, they include the use of digital tools for creating and managing educational content, as well as the ability to collaborate and communicate through online platforms (Beldarrain, 2006; Hofer et al., 2021). This multifaceted nature highlights the complexity and relevance of integrating ICT in higher education.

From a more specific perspective, digital literacy not only facilitates the adoption of new technologies but also drives pedagogical innovation. As Blau et al. (2020) point out, mastery of digital competencies allows educators to design more enriching and personalized learning experiences, meeting the individual needs of students in the digital age.

However, the development of these competencies is not limited to the individual realm of the teacher. According to Akour and Alenezi (2022), the effective integration of digital competencies into university curricula can lead to a broader transformation within educational institutions, fostering a teaching environment that prepares students not only for the current job market but also to face the challenges of a globalized and technologically advanced society.

Furthermore, participation in online professional networks is highlighted as a crucial competency. This skill not only extends the reach and impact of academic work but also facilitates interdisciplinary and transnational collaboration, essential for innovation in research and educational practice (Goulart et al., 2022). Additionally, the ability to adapt and respond to rapid technological evolution is another vital aspect of digital competencies. As Ottestad et al. (2014) note, educators must be prepared to continually learn about new tools and digital resources, which is fundamental to maintaining professional and academic relevance in an ever-changing environment.

2.2 Impact of academic degree on digital competencies

Various studies have shown that the academic degree significantly influences the digital competencies of university teachers. Teachers who have obtained graduate degrees tend to demonstrate greater competence in managing digital tools compared to those whose academic training does not exceed the undergraduate level (Alsalamah and Callinan, 2021; Schmölz et al., 2023). This phenomenon can be explained by greater exposure to advanced technologies and learning environments that actively incorporate digital resources at higher study levels.

The increase in digital competencies among those with graduate degrees could also relate to the demands of these programs, which often require advanced skills in digital research and communication. These programs tend to promote intensive use of various technologies for data collection and analysis, academic production, and dissemination of results, skills that are less emphasized at the undergraduate level.

Moreover, postgraduate training is often accompanied by immersion in virtual academic communities and international research networks, where digital competence facilitates and optimizes collaboration and knowledge exchange. As Langran and DeWitt (2020) point out, mastery of digital tools is crucial for effectively participating in these collaborative spaces that transcend geographical and disciplinary boundaries.

Additionally, the development of digital competencies at the graduate level is reinforced by the need to adapt to teaching methodologies that integrate emerging technologies. According to Niess (2005), graduate programs are increasingly oriented towards integrating innovative technological solutions into the educational process, preparing teachers not only to use, but also to lead the development and implementation of these technologies in their own pedagogical practices.

2.3 Influence of gender on digital competencies

Research on the digital gender gap has revealed significant differences in how men and women acquire and apply digital competencies. According to Comunello et al. (2017), in certain contexts, women face additional barriers related to the effective access and use of digital technologies, often mediated by gender stereotypes and social expectations. This phenomenon underscores the influence of sociocultural factors in acquiring technological skills.

Despite these barriers, in the university setting, the disparity between genders in digital competencies shows a trend towards reduction. The increasing inclusion of gender equity policies in educational institutions has contributed to this decline, promoting more equitable access to technological resources for both sexes (Stoet and Geary, 2018; Ge et al., 2022). However, the relevance of studying how gender differences continue to influence pedagogical practices and the integration of new technologies in teaching persists.

Additionally, recent literature suggests that although the access gap has lessened, differences in confidence and attitudes towards technology still exist, affecting how men and women use digital tools in academic contexts (Dixon et al., 2014; Acilar and Sæbø, 2023). For example, it has been observed that women, despite having equal access, may report lower levels of confidence in their technological skills compared to their male counterparts.

This phenomenon can have significant implications for the design of professional development programs and ICT training. According to Ertmer et al. (2012), it is crucial to adopt training approaches that not only address differences in skills but also perceptions and attitudes towards technology, in order to maximize the potential of all educators.

2.4 Intersectionality of gender and academic degree in digital competencies

The study of the intersectionality between gender and academic degree in relation to digital competencies constitutes an emerging research area that promises to contribute valuable insights into the dynamics of technological skills in the university environment (Shivers-McNair et al., 2019). This complex interaction could unravel deeper explanations about differences in digital competence among teachers, thus allowing a more nuanced analysis that transcends traditional single-factor-focused approaches.

Recent research, such as that conducted by Mbarika et al. (2007), indicates that women who have attained high levels of academic training in disciplines with a strong technological focus not only match but often surpass their male counterparts in terms of digital competencies. This finding is particularly significant as it subverts traditional gender expectations that often presuppose male superiority in technological areas.

This phenomenon could be explained by the combination of high academic demands and the need to compete in fields historically dominated by men, which could drive women to develop particularly high levels of digital competence. Additionally, the environment in technologically advanced graduate programs may encourage a more intensive and specialized immersion in the use of new technologies, resulting in greater digital fluency.

On the other hand, the interaction between gender and academic degree also suggests that educational policies and training programs must consider these dimensions jointly. It is not enough to offer equal access to technological resources; it is essential to address how different demographic groups use and benefit from these resources in their specific contexts.

2.5 21st century skills and the TPACK

In addition to basic digital competencies, the skills necessary for the 21st century include critical thinking, problem-solving, collaboration, and adaptability. The Technological Pedagogical Content Knowledge (TPACK) framework, as detailed by Koehler et al. (2013), provides a comprehensive model for integrating technology into teaching. This model emphasizes the intersection of technological, pedagogical, and content knowledge, highlighting the need for teachers to understand how technology can enhance teaching and learning by effectively integrating digital tools into their instructional practices.

Mishra et al. (2023) extend this framework by incorporating generative AI, emphasizing its potential to transform teaching practices and enhance student engagement. The inclusion of AI in the TPACK model suggests that teachers need to develop competencies

in using AI tools to create more interactive and personalized learning experiences.

2.6 The DPACK model

More recently, Thyssen et al. (2023) have introduced the Digitality-Related Pedagogical and Content Knowledge (DPACK) model, which builds on TPACK and focuses on digitality in STEM education. This model emphasizes the importance of digital fluency and the ability to integrate digital tools in ways that enhance STEM learning. The DPACK model underscores the need for teachers to develop not only technical skills but also an understanding of how digital tools can be used to foster deeper learning and critical thinking in STEM subjects.

The integration of the TPACK and DPACK models into teacher training programs can provide a more robust framework for developing digital competencies. These models highlight the importance of understanding the pedagogical implications of technology use and the need for continuous professional development to keep pace with technological advancements.

3 Materials and methods

In this study, a detailed quantitative approach under the positivist paradigm was adopted, which allows for an objective and systematic evaluation of the data. This approach facilitated the identification and analysis of significant variations and trends in the digital competencies of university teachers, focusing on the variables of gender and academic level.

The methodological design of the study was articulated through a descriptive observational model. Pre-existing data from the faculty population of the State University of Milagro were analyzed, with the objective of examining how the mentioned variables influenced digital competencies. This approach allowed for a precise description of the current situation without manipulating existing conditions or the behaviors of the subjects involved.

The sample studied included 279 teachers, classified by their gender and level of study, as reflected in Table 1. This breakdown provided a solid base for subsequent statistical analysis, allowing a structured comparison between different academic and gender groups.

Before data collection, an ethical procedure was implemented in which all participants gave their informed consent. This process ensured the protection of individuals' privacy and compliance with current regulations on personal data protection, thus guaranteeing the integrity of the study.

For the assessment of digital competencies in the university context, the Higher Education Digital Competence Assessment Questionnaire (CDES), developed by Mengual in 2011 (Mengual-Andrés et al., 2016), was employed. This instrument consists of 48 items distributed across five dimensions: technological literacy, access and use of information, communication and collaboration, digital citizenship, and creativity and innovation. The CDES has been previously validated in various studies, such as those by Moreira-Choez et al. (2024), Ben Youssef et al. (2022), and Santos et al. (2021), demonstrating its efficacy in measuring digital competencies in similar educational settings. Its application has been noted for its comprehensive ability to assess digital skills in the university environment, thereby enhancing its utility and reliability across different educational contexts.

During the validation process of the CDES, a thorough analysis of its factorial structure and internal consistency was conducted, ensuring the psychometric robustness of the instrument. This process involved administering the questionnaire to representative samples and employing advanced statistical techniques to confirm the validity and reliability of the proposed dimensions.

The selection of the CDES for this research is based on its demonstrated capacity to comprehensively capture relevant digital competencies in the university context, providing a clear and structured framework for assessment. This choice is supported by previous studies that have validated its application in diverse educational settings, ensuring the consistency and comparability of the results obtained.

For the analysis of the collected data, the statistical software SPSS was used. This tool enabled a rigorous statistical analysis using the Chi-square test, an essential tool to determine if the differences observed in digital competencies among the groups, according to the variables of gender and academic level, were statistically significant.

4 Results and discussion

In this section, the results obtained in the study are presented. Table 2 details the factor loadings, as well as the Cronbach's Alpha and McDonald's Omega values corresponding to each dimension of the digital competencies evaluated. These indicators are essential for providing a measure of the internal consistency of the responses obtained through the applied questionnaire, which is crucial for

TABLE 1 Cross-analysis of gender by level of study.

Gender	Level of study				
	Doctorate	Master's	Bachelor's	Other	Total
Female	20	46	18	9	93
	7.2%	16.5%	6.5%	3.2%	33.3%
Male	68	104	11	3	186
	24.4%	37.3%	3.9%	1.1%	66.7%
Total	88	150	29	12	279
	31.5%	53.8%	10.4%	4.3%	100.0%

$X^2 = 28.085$; $gl = 3$; $p = 0.000$.

TABLE 2 Factor loadings, Cronbach's alpha, and McDonald's omega for digital competencies in university teachers.

Competencies	Cronbach's alpha	McDonald's omega	Number of items
Technological literacy	0.908	0.908	11
Access and use of information	0.950	0.950	8
Communication and collaboration	0.953	0.953	8
Digital citizenship	0.958	0.958	8
Creativity and innovation	0.975	0.975	13
Total	0.986	0.986	48

validating the reliability of the measurement instrument used in the research.

The data presented in Table 2 reveal high levels of reliability across all dimensions of the digital competencies evaluated. Both Cronbach's Alpha and McDonald's Omega exhibit notably high values, all above 0.900, indicating excellent internal consistency for the scales of technological literacy, access and use of information, communication and collaboration, digital citizenship, and creativity and innovation.

Specifically, the "Creativity and Innovation" dimension reached the highest value (0.975), suggesting that this area of digital competencies is perceived very coherently among teachers, as shown in previous studies that associate creativity with advanced use of digital technologies (Amhag et al., 2019). In contrast, although still very high, the Cronbach's Alpha and McDonald's Omega for "Technological Literacy" was the lowest (0.908), indicating relatively greater variability in how teachers perceive their competence in this area.

The finding of high reliability levels across all dimensions is consistent with literature suggesting that well-designed instruments tend to exhibit high internal consistency in studies on digital competencies (Nikou et al., 2022; Carabregu-Vokshi et al., 2024). These results reinforce the validity of the Higher Education Digital Competence Assessment Questionnaire (CDES) used, highlighting its capability to accurately capture the digital competencies of teachers.

It is interesting to note that the dimension with the lowest internal consistency, "Technological Literacy," might reflect diversity in technical skill levels among teachers (Barrie, 2006; Sánchez-Cruzado et al., 2021). This could be due to differences in exposure and use of technologies, which vary significantly according to academic discipline and personal experience (Margaryan et al., 2011).

Moreover, the discernible differences in response consistency across dimensions suggest targeted areas for professional development initiatives. Strengthening training programs in technological literacy could play a pivotal role in enhancing teachers' confidence and proficiency in integrating technology into their instructional practices (Ertmer and Ottenbreit-Leftwich, 2010; Estes, 2019). This strategic approach aligns with research emphasizing the importance of tailored support to address specific competency gaps and foster continuous improvement in digital skills among educators.

Next, the results from the Pearson correlation analysis between the different dimensions of digital competencies of university teachers are presented. These results offer a quantitative perspective on the interrelationships between the various competencies evaluated, enabling a deeper understanding of how these competencies coexist and mutually reinforce each other in the educational environment.

The Pearson correlation analysis shown in Table 3 reveals significant and positive correlations between all the evaluated dimensions of digital competencies. The correlation coefficient between the total digital competencies and each specific dimension is particularly high, indicating that an increase in one specific competency tends to be associated with improvements in overall digital competencies. For example, the correlation between "Literacy and Technology" and the total digital competencies is 0.825, with a p-value of >0.0001, indicating a strong positive and statistically significant relationship.

The substantial interconnectivity observed among different competencies suggests that proficiency in one aspect of digital competency can enhance performance across other domains. This phenomenon aligns with previous research attributing such integrative benefits to the holistic nature of digital technologies, wherein mastery of one application can bolster effectiveness in others (Sousa and Rocha, 2019).

The especially high correlation between "Communication and Collaboration" and other competencies (0.957 with total digital competencies) highlights the importance of these skills in the academic environment. As suggested by Kim and Hannafin (2011), the ability to communicate and collaborate effectively using digital tools is central to modern teaching practice, facilitating not only teaching and learning but also collaborative research and ongoing professional development.

Moreover, the correlation between "Creativity and Innovation" and "Digital Citizenship" (0.913) indicates that teachers who employ creative technologies also tend to demonstrate a robust understanding and application of digital citizenship. This result is consistent with literature that states that a disposition towards innovation is associated with a more ethical and responsible use of technology (Chatfield et al., 2017; Tait, 2017).

However, it is crucial to consider contrasting perspectives from studies such as those by Lucas et al. (2021) which indicate that while correlations between digital competencies are high, qualitative differences in how educators integrate and apply these skills in diverse educational contexts may exist. Additionally, the framework of Technological Pedagogical Content Knowledge (TPACK) (Tondeur et al., 2020) could offer deeper insights into how the interplay between technological, pedagogical, and content knowledge influences digital competency development among educators.

In this section of the study, results derived from comparing the strengths of digital competencies based on the gender of university teachers are presented. Table 4 will illustrate the Pearson correlation coefficients for each digital competency, discriminated by gender. This analysis allows identifying if there are significant differences in the way men and women master these essential competencies in the modern academic environment.

The results show that both men and women exhibit high correlations across all evaluated digital competencies, with slightly higher values for women in competencies such as "Access and Use of Information" and "Communication and Collaboration," where women achieve coefficients of 0.946 and 0.964, respectively, compared to 0.907 and 0.952 for men. These findings indicate a strong internal consistency within each gender group in relation to their digital skills.

TABLE 3 Pearson correlation of digital competencies in university teachers.

Competencies	Pearson test	Total digital competencies	Literacy and technology	Access and use of information	Communication and collaboration	Digital citizenship	Creativity and innovation
Total digital competencies	Pearson correlation	1					
	p-value						
Literacy and technology	Pearson correlation	0.825**	1				
	p-value	>0.0001					
Access and use of information	Pearson correlation	0.925**	0.718**	1			
	p-value	>0.0001	>0.0001				
Communication and collaboration	Pearson correlation	0.957**	0.713**	0.889**	1		
	p-value	>0.0001	>0.0001	>0.0001			
Digital citizenship	Pearson correlation	0.943**	0.689**	0.839**	0.910**	1	
	p-value	>0.0001	>0.0001	>0.0001	>0.0001		
Creativity and innovation	Pearson correlation	0.954**	0.689**	0.843**	0.909**	0.913**	1
	p-value	>0.0001	>0.0001	>0.0001	>0.0001	>0.0001	

**Correlation is significant at the 0.01 level (2-tailed).

TABLE 4 Comparison of digital competency strengths by gender of teachers.

Competencies	Pearson test	Women	Men
Total digital competencies	Pearson correlation	1	1
	p-value		
Literacy and technology	Pearson correlation	0.834**	0.816**
	p-value	>0.0001	>0.0001
Access and use of information	Pearson correlation	0.946**	0.907**
	p-value	>0.0001	>0.0001
Communication and collaboration	Pearson correlation	0.964**	0.952**
	p-value	>0.0001	>0.0001
Digital citizenship	Pearson correlation	0.947**	0.941**
	p-value	>0.0001	>0.0001
Creativity and innovation	Pearson correlation	0.959**	0.951**
	p-value	>0.0001	>0.0001

**Correlation is significant at the 0.01 level (2-tailed).

The high correlation values for both genders suggest that digital competencies are equally developed among male and female teachers, which could reflect institutional efforts to provide equal access to technological training. However, the slight advantages observed in women for certain digital competencies might indicate differences in how genders adapt and utilize digital tools in educational contexts. These results support the research by Sánchez Prieto et al. (2020), who argue that differences in digital competencies between genders may be minor in academic settings due to inclusive policies and ongoing training.

The relevance of these differences, although small, should not be underestimated. According to Park (2013), understanding the nuances in how each gender relates to digital technologies can inform the development of more tailored and effective training programs that take into account the particularities of each group.

Furthermore, research by Islahi and Nasrin (2019) suggests that while overall correlations in digital competencies are high, qualitative differences in usage patterns and technological preferences between genders may exist, influencing their perceived effectiveness and adoption rates in educational settings. Additionally, Intersectionality Theory McGee (2018) could provide further insights into how overlapping identities, beyond gender alone, contribute to nuanced differences in digital competencies among educators.

Next, the statistical analysis that explores the mean differences in digital competencies of university teachers based on gender is presented. Table 5 summarizes the results of the t-test for independent samples, providing a detailed breakdown by digital competency and gender. This analysis is crucial for understanding if there are significant differences in digital skills between men and women in the academic context.

TABLE 5 Mean differences in digital competencies by gender.

Competencies	Gender	*N*	Mean	SD	T	*p*
Total digital competencies	Female	93	185.67	39.70	0.60	0.547
	Male	186	183.10	29.98		
Literacy and technology	Female	93	44.31	8.83	0.76	0.446
	Male	186	43.61	6.35		
Access and use of information	Female	93	30.25	7.40	0.80	0.425
	Male	186	29.61	5.68		
Communication and collaboration	Female	93	30.38	7.25	0.43	0.671
	Male	186	30.04	5.71		
Digital citizenship	Female	93	30.59	7.54	0.10	0.920
	Male	186	30.51	5.61		
Creativity and innovation	Female	93	50.14	11.68	0.62	0.535
	Male	186	49.33	9.40		

The results from Table 5 indicate that there are no statistically significant differences in the means of digital competencies between men and women across any of the evaluated dimensions. The *p*-values obtained in all digital competencies are above the conventional threshold of 0.05, suggesting that the observed differences are not statistically significant.

This finding is consistent with recent literature, which suggests that gender disparity in digital competencies has considerably decreased in educational settings that promote equal access to technological resources and training opportunities (Antonio and Tuffley, 2014). For instance, the results in "Literacy and Technology" and "Creativity and Innovation" show minimal differences between men and women, which could indicate uniformity in exposure to and use of digital technologies in teaching practice.

However, it is important to consider that the absence of significant differences does not necessarily imply absolute equality in digital competencies. As noted, underlying factors such as confidence in using technology, previous experience, and ongoing support can influence how individuals of different genders perceive and utilize digital technologies (Huffman et al., 2013).

Finally, research by Siddiq and Scherer (2019) suggests that while gender parity in basic digital skills has improved, disparities may still

TABLE 6 Comparison of digital competencies means according to academic degree among university teachers.

Competencies	Academic degree	*N*	Mean	SD	F	*p*
Total digital competencies	Doctorate	88	**179.02**	32.39	4.401	0.005
	Master's	150	**190.22**	31.61		
	Bachelor's	29	171.62	29.18		
	Others	12	171.58	55.12		
Literacy and technology	Doctorate	88	**43.53**	6.46	1.999	0.114
	Master's	150	**44.57**	7.13		
	Bachelor's	29	42.66	7.59		
	Others	12	39.92	11.80		
Access and use of information	Doctorate	88	**29.01**	6.24	4.448	0.005
	Master's	150	**30.95**	5.98		
	Bachelor's	29	26.93	5.80		
	Others	12	28.58	8.87		
Communication and collaboration	Doctorate	88	**29.10**	6.38	5.928	0.001
	Master's	150	**31.49**	5.70		
	Bachelor's	29	27.31	5.68		
	Others	12	27.92	9.24		
Digital citizenship	Doctorate	88	**29.28**	6.00	5.329	0.001
	Master's	150	**31.87**	5.98		
	Bachelor's	29	28.17	5.59		
	Others	12	28.75	9.94		
Creativity and innovation	Doctorate	88	**48.09**	9.97	3.427	0.018
	Master's	150	**51.33**	9.91		
	Bachelor's	29	46.55	7.93		
	Others	12	46.42	16.08		

The bold values correspond to key statistical indicators derived from the analysis of variance (ANOVA), which compares the means of digital competencies across different academic degrees among university teachers.

exist in more advanced technical competencies depending on societal and institutional factors. Additionally, theoretical frameworks like Intersectionality Theory (Figueroa et al., 2021) could provide insights into how multiple social identities intersect to shape digital competencies differently among diverse groups, including across gender lines.

Following this, a comparative analysis of the means of digital competencies based on the academic degree of university teachers is presented. Table 6 summarizes the results of an ANOVA, which examines the differences between groups of teachers with different academic levels: Doctorate, Master's, Bachelor, and Others. This evaluation is essential to understand how the level of education influences the digital skills of teachers.

The comparison of means indicates statistically significant differences in various dimensions of digital competencies among different academic degrees. For instance, the total digital competencies show an *F*-value of 4.401 and a *p*-value of 0.005, indicating significant differences between groups. Teachers with a Master's degree exhibit the highest mean (190.22), suggesting a greater overall digital competency compared to other degrees. This pattern repeats in specific competencies such as "Access and Use of Information" and "Communication and Collaboration," where again teachers with a Master's degree outperform others.

The observed differences might reflect the depth and intensity of training in technology and research methods often integral to Master's and Doctorate programs. According to studies by Meyers et al. (2013), prolonged exposure to learning environments incorporating advanced technologies can result in greater digital fluency and competency. Additionally, the demand for digital competencies in research and academic communication at these levels may encourage a more robust development of these skills.

However, the results also reveal that, despite significant differences in some areas, not all digital competencies show equally marked disparities between academic levels. For example, "Literacy and Technology" does not exhibit significant differences, with an F-value of 1.999 and a *p*-value of 0.114. This might indicate that some basic digital skills have become homogenized due to the universalization of access to technology in educational contexts.

To contextualize these findings, studies such as Gabriel et al. (2022) have pointed out that the equalization in basic digital skills may be attributable to educational policies promoting the universal integration of technology into the curriculum. Furthermore, theories like Margolis (2020) on knowledge development and the Zone of Proximal Development could be applied to understand how differential exposure to digital environments influences the development of varied competencies among different academic degrees.

The practical implications of these findings for educational policy and practice are significant. Firstly, the identification of more developed digital competencies in teachers with a Master's degree suggests the need for continuous training programs that strengthen digital competencies at lower academic levels. According to Demissie et al. (2022), the implementation of professional development programs integrating advanced technologies can significantly improve teachers' digital competencies.

Additionally, the lack of significant differences in some basic competencies suggests that current technology integration policies are achieving their goal of universalization. Studies such as Chetty et al. (2018) highlight that the universal integration of technology into the curriculum has provided equitable access to basic digital skills, reducing competence gaps in this area. However, constant review and updating of curricula are recommended to include advanced digital skills that respond to the changing demands of the educational and technological environment.

The application of knowledge development theories, such as Vygotsky's Zone of Proximal Development, could guide the creation of more personalized learning environments that consider individual differences in acquiring digital competencies (Jie et al., 2020). Policies promoting the use of technologies in the classroom, not only as pedagogical tools but as objects of study, can help close digital competence gaps and better prepare teachers to face the challenges of the 21st century. As Tondeur (2018) point out, a pedagogical approach that integrates technology and learning theory can enhance the development of digital competencies in educators.

Furthermore, recent studies have demonstrated the importance of early and continuous exposure to digital environments for developing advanced competencies. According to Moreira-Choez et al. (2023), teachers who regularly participate in technology training programs show significant improvements in their digital communication and collaboration skills, suggesting that continuous training should be an essential component of educational policies.

5 Conclusion

In the present study, the digital competencies of the faculty at the State University of Milagro were examined, considering variables such as gender and academic level, in order to identify specific patterns. The findings provide significant insights into the digital skills of university teachers, highlighting critical areas for improving educational policies and practices.

The results of the study revealed high levels of internal consistency and reliability across all dimensions of digital competencies. Notably, the "Creativity and Innovation" dimension exhibited the highest reliability, indicating a coherent perception of this competency among the faculty. In contrast, "Technological Literacy" presented a lower, albeit still high, level of internal consistency, suggesting variability in the perception of this competency.

Furthermore, the Pearson correlation analysis demonstrated significant and positive correlations between all evaluated dimensions of digital competencies. The high interconnectivity observed suggests that proficiency in one specific area enhances performance in others, reinforcing the holistic nature of digital skills in educational contexts. Particularly, the strong correlation between "Communication and Collaboration" and other competencies underscores its crucial role in modern teaching practices.

Additionally, the comparison of digital competencies by gender did not reveal statistically significant differences between men and women in any of the evaluated dimensions. This parity indicates successful institutional efforts to provide equitable access to technological training. Nevertheless, the slight differences in the adaptation and utilization of digital tools by each gender suggest the need to develop more specific training programs.

Moreover, the study identified statistically significant differences in digital competencies according to academic degree. Faculty members with a master's degree demonstrated the highest levels of

overall digital competency, especially in "Access and Use of Information" and "Communication and Collaboration." These results imply that advanced academic training, often involving intensive use of digital technologies, contributes to greater digital fluency. However, the lack of significant differences in "Technological Literacy" highlights the homogenization of basic digital skills, likely due to the widespread integration of technology in educational settings.

The findings underscore the necessity for continuous professional development programs to enhance digital competencies, particularly at lower academic levels. Integrating advanced technologies into training programs can significantly improve the digital skills of educators. Additionally, periodic review and updating of curricula are recommended to include advanced digital skills, responding to the changing demands of the educational and technological environment.

Incorporating knowledge development theories into educational policies can create more personalized learning environments that consider individual differences in acquiring digital competencies. This strategic approach facilitates the continuous improvement of educators' digital competencies.

Finally, the limitations of the study were based on self-reported data, which may introduce biases related to participants' perceptions and honesty. Future research should consider expanding the sample size and including multiple institutions to improve the generalizability of the findings. Additionally, incorporating objective measures of digital competency could provide a more comprehensive understanding of educators' digital skills.

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 Posgrodo Universidad Estatal de Milagro. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

JM-C: Conceptualization, Data curation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. TL: Data curation, Methodology, Supervision, Writing – original draft, Writing – review & editing. MA-I: Conceptualization, Investigation, Writing – original draft, Writing – review & editing. JV-I: Writing – original draft, Writing – review & editing. VM-F: Formal analysis, Writing – original draft, Writing – review & editing. JZ-A: Investigation, Supervision, Writing – original draft, Writing – review & editing. RC-H: Conceptualization, Writing – original draft, Writing – review & editing.

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