Digital Transformation and Teacher Competencies in Higher Education: A Post-pandemic Analysis

Karolina González, Universidad Militar Nueva Granada, Colombia

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Abstract
The COVID-19 pandemic accelerated the integration of Learning and Knowledge Technologies (TAC) in higher education in Colombia, following directives from the Ministry of National Education (MEN) that mandated the virtualization of academic activities. This study examines the impact of this situation on the digital competencies of educators across five key areas. A qualitative approach was employed, utilizing virtual ethnography and hermeneutic methodology to interpret data collected through online questionnaires. The data was analyzed using Nvivo software to identify patterns and trends in teachers' media literacy. The findings indicate a general improvement in the digital competencies of educators between 2019 and 2022. The area of informational literacy showed stability with a trend towards high competence levels. In the realm of digital communication and interaction, there was a notable increase in the use of digital tools for collaboration. Content creation also saw an enhancement, particularly in the application of intellectual property rights and usage licenses. Additionally, there was a heightened awareness and application of information security measures. Problem-solving emerged as an area of growth, with educators developing skills to address unexpected challenges in digital environments. The pandemic significantly advanced educators' digital competencies, facilitating better adaptation to TAC. This progress included greater technological integration in higher education, overcoming generational and geographical barriers, and promoting content creation and digital interaction.

Keywords: Digital Transformation, Teacher Competencies, Higher Education, Media Literacy

Introduction

The incorporation of Information and Communication Technologies (ICT), particularly social web tools, has brought about significant changes in teaching practice. These technologies have radically transformed how teachers access and use information, leading to a redefinition of their roles and functions. Access to a wide range of digital resources, communication platforms, and collaborative tools has facilitated research and continuous professional development, enabling teachers to stay up to date with the latest trends and advancements in their areas of expertise.

Moreover, knowledge management has been transformed as ICT has facilitated the creation, storage, and dissemination of educational content in different ways. Teachers can now collaborate with colleagues from various parts of the world, share resources and experiences, and participate in online communities of practice. This global connectivity has fostered a culture of knowledge exchange that transcends geographical and cultural barriers.

On the other hand, educational innovation has taken on a new dimension with the possibility of integrating emerging technologies into the teaching-learning process. Social web tools allow for the creation of more interactive and participatory learning environments, where students are not mere recipients of information but active participants in knowledge construction. This transformation requires teachers to acquire new competencies and skills, including digital literacy, the ability to assess and select appropriate technological resources, and the skill to design learning experiences that effectively integrate these technologies.

In this context, there is a need for an education professional who goes beyond the mere transmission of content and adopts a pedagogy centred on the formulation of questions. This approach, which places special emphasis on students' ability to create and innovate, seeks to foster critical and reflective thinking. Teachers must be able to guide students in exploring open-ended questions and complex problems, promoting a culture of curiosity and inquiry both inside and outside the classroom (Reig, 2012). This new pedagogy implies a paradigm shift, where the teacher's role evolves from being a source of knowledge to a facilitator of learning, supporting students in their process of discovery and the creation of new knowledge.

Authors such as González, Rincón, and Contreras (2013) describe the profound transformation faced by teachers in blended learning contexts (b-learning), to the point where they become "prosumer teachers," a term denoting the ability to produce and consume knowledge unilaterally. This transformation reflects a change in the traditional role of the teacher, who now must adapt to an environment where technology and digital media play a central role in the educational process. The figure of the "prosumer teacher" is key in this new scenario, as educators are not only expected to generate educational content but also to actively participate in its consumption and critical evaluation, promoting more dynamic and interactive learning.

In this regard, there is a highlighted need to develop advanced digital competencies, which include not only technical skills but also a critical understanding of media and the ability to integrate them effectively into teaching. Media literacy, or "new literacy," thus becomes an essential component of teacher training, especially in higher education. This concept encompasses teachers' ability to use, analyse, and critically evaluate digital tools, and to teach students to do the same (Buckingham, 2003).

Based on this premise, this study proposes to identify and hierarchically classify the digital competencies of teachers related to media literacy in higher education in Colombia, in the context of the COVID-19 pandemic. The global health crisis has accelerated the adoption of digital technologies in education, highlighting the importance of teachers being prepared to face the challenges this entails. The pandemic has acted as a catalyst for change, forcing educational institutions to reassess their pedagogical approaches and teachers to quickly adapt to new teaching and learning methods (Hodges et al., 2020).

Higher Education and Digital Transformation in Colombia

Since 13 March 2020, the Colombian Ministry of National Education (MEN) mandated that all educational institutions carry out their academic activities virtually. This included Directive 04/2020, which allowed higher education programmes with qualified registration in face-to-face mode to operate virtually. In May 2020, it was established that education in Colombia would continue virtually until August 2022. These measures required Higher Education Institutions (HEIs) to quickly transform their face-to-face educational offerings into virtual environments, ensuring the continuity of academic activities in a new normal.

The adaptation process included not only the implementation of technologies for virtual teaching but also the restructuring of academic administration and resource management, which was fundamental in addressing the financial and operational challenges posed by the pandemic. Many institutions managed to maintain or even increase their enrolments, partly thanks to the flexibility of digital formats and the ability to offer programmes to a broader audience, including access to additional funding for students. This allowed for financial sustainability and avoided significant tuition increases, thus providing stability during uncertain times (McKinsey & Company, 2020).

In the global context, digital transformation in higher education was not only a response to the public health crisis but also an opportunity to renew and improve academic practices, driving innovation and collaboration through digital platforms. Thus, HEIs have begun integrating these new dynamics into their educational mission, linking financial and academic objectives to strengthen their offerings and ensure a return on the institutional mission. This comprehensive approach has allowed many institutions not only to survive the crisis but also to lay the foundations for sustainable growth and development in the long term.

Media Literacy

Media literacy, or new literacy, refers to the ability to understand, critically evaluate, and use media and the information presented through them. It involves developing skills to analyse and comprehend media messages in various formats, such as television, radio, the internet, social networks, newspapers, and magazines, among others, as well as competencies for using digital tools. This form of literacy goes beyond simple reading and writing, encompassing proficiency in using and interpreting media in everyday life.

Some key aspects of media literacy include the ability to identify and understand how media are produced, who controls them, and how they influence society and culture. Furthermore, the skill to assess the truthfulness, accuracy, and credibility of the information presented is crucial, recognising the ideological, political, or commercial biases that may influence the way news and information are presented (Kellner & Share, 2007). This critical evaluation is

essential in a world where misinformation and fake news can significantly impact public opinions and individual decisions.

Moreover, media literacy focuses not only on the passive reception of information but also advocates for the production and exchange of one's own media content in an informed and ethical manner. This includes the competence to use technological tools and digital platforms ethically and responsibly. In this context, the concept of socionomy is introduced, which refers to individuals' ability to create, share, and collaborate in media content creation, leveraging the opportunities that digital technologies offer for active participation in society (Reig, 2012b). This approach empowers individuals not only as critical consumers of media but also as responsible creators who contribute to public discourse.

Moreover, the need for a process of technological literacy extends not only to teachers but also to students and other members of the educational community. This is essential before teachers can fully adopt the stance of prosumers. According to Buckingham (2003), media literacy in the digital age includes the ability to understand and use a variety of media, which is essential for effective participation in modern society.

For centuries, literacy has focused on the ability to read and write, but today, with most information emerging through a network of media technologies, the ability to read and understand various types of media has become an essential 21st-century skill. Digital competencies, therefore, involve the ability to access, analyse, evaluate, and engage with media. This skill set is vital not only for effective communication but also for developing critical thinking, understanding how media messages influence culture and society, and identifying persuasion techniques and informational biases.

Concept of Digital Competence for Teachers

Digital competence for teachers, according to various perspectives, goes beyond operational and technical skills. It includes the ability to manage information, communicate in social environments, and use the internet for learning. Additionally, it relates to the development of critical thinking, creativity, and innovation. Digital competence is not limited to decoding and encoding information but encompasses a set of knowledge, skills, and attitudes necessary to be functional and effective in a digital environment.

Digital competence for teachers, as part of media literacy, has been defined and conceptualised in various ways by different authors and organisations. The 2006 European recommendation defines digital competence as "the critical and secure use of information society technologies for work, leisure, and communication. This competence is based on basic ICT skills, such as using computers to retrieve, evaluate, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the internet" (Recommendation 2006/962/EC of the European Parliament and of the Council of 18 December 2006). This definition underlines the importance of technical and operational skills as an essential part of digital competence.

Table 1 presents the foundational areas for the development of teachers' digital competences and the specific competences (at the level of indicators) in each development area. This study uses these sources to measure and classify the levels of teachers' training.

Table 1: Areas for the Development of Teachers' Digital Competences

Area	Competencies
Information and Media Literacy	• Navigates the internet to locate information and digital educational resources. • Presents needs, selects information, and the appropriate digital resource to meet them. • Knows the usage licences that allow the reuse or dissemination of online resources. • Evaluates the quality of educational resources found on the internet. • Knows how to save and tag files, content, and information. • Knows how to retrieve and manage saved or lost information and content.
Communication and Collaboration	• Interacts seamlessly (synchronously and asynchronously) through various applications. • Selects the appropriate digital interaction medium according to the recipients of the communication. • Participates in social networks and online communities. • Utilises intermediate aspects of online services (e.g., electronic offices, educational management systems, etc.) for their work. • Creates educational products in collaboration with other teachers and students online. • Develops a protocol for online communication. • Knows how to create their digital identity and track their digital footprint. • Manages data generated in various accounts and digital channels.
Digital Content Creation	• Produces digital content in different formats using online applications. • Promotes content production among students. • Knows and uses repositories and/or libraries of online resources and materials. • Modifies and adapts resources from other users to meet students' needs. • Knows the basic differences between open and proprietary licences and how they affect digital content. • Develops activities related to respecting copyright. • Makes modifications to educational programming applications concerning computational thinking.
Safety	• Updates knowledge about digital threats to devices. • Manages technology protection measures appropriately. • Knows how to protect their privacy and that of others online. • Understands how data is collected and used. • Develops activities related to the digital protection of personal data. • Understands the health risks associated with technology use (from ergonomic aspects to technology addiction). • Makes decisions about the purchase and disposal of technologies.
Problem Solving	• Solves technical problems with devices and digital environments common in academic work. • Assesses the digital services offered to resolve technological problems. • Uses digital technologies to create products and participate in projects, dynamically adapting the media. • Explores emerging digital technologies to stay updated and address gaps in digital competence.

Research Methodology

Considering the complexity of analyzing the educational phenomenon and the impact of social media and research in higher education, this proposal will adopt a qualitative approach (Sautu et al., 2005; Valles, 2001), supported by virtual ethnography (Hine, 2004) to establish social trends and data from documentary interpretation and category analysis that allow for an in-depth understanding of the study object (prosumer teachers). This methodology considers various sources or primary documents in line with the object of study. In terms of processing emergent data from general and substantive theory, constant comparison will be employed, which confers greater reliability and relevance to the results, enabling a solid foundation for data analysis carried out with the software Nvivo.

The qualitative approach is suitable for this research due to the inherent complexity of the educational phenomenon and the implications of social media and research in higher education. This approach allows for an in-depth and detailed exploration of the phenomena studied, in this case, the transformation of teachers into "prosumer teachers" and their relationship with media literacy. The choice of virtual ethnography as a specific method is pertinent given the digital context in which current educational processes develop, facilitating the observation and analysis of teachers' interactions and practices in digital environments.

Data Collection Techniques

A questionnaire was developed on a virtual platform as a data collection technique aligned with the principles of the qualitative approach, providing an effective means to explore and understand the complex realities of digital competencies and media literacy in the educational field. This technique allowed for capturing the depth and diversity of teaching experiences, offering a solid foundation for qualitative analysis and interpretation.

The questionnaire was designed without specific hypotheses, which is characteristic of the qualitative approach that seeks to understand and explore phenomena in depth. This technique allows for gathering information on how teachers perceive and experience their digital competencies, providing a rich and detailed view of their practices and experiences.

The use of a virtual platform to distribute the questionnaire facilitates access to a wide population of teachers, which is essential in a context where geographical distance and time availability may be limiting factors. Furthermore, collecting data in a standardized format simplifies comparative analysis, allowing for the contrast and correlation of the data obtained with other studies or different participant groups.

Similarly, the online questionnaire enabled the rapid collection of data, which was useful in requiring a swift response to contextual changes, such as those caused by the COVID-19 pandemic in teaching practices. The immediacy in collecting and processing information facilitated analysis and decision-making based on current and relevant data.

Results and Discussion

A total of 69 teacher-researchers from various higher education institutions in Colombia were characterized, who are registered in the National Education Ministry's Misión de Sabios database. The levels of education were classified as follows: Postdoctoral 8, Doctorate 22, Specialization 3, Master's 33, Undergraduate 3.

The distribution of teaching modalities among the participants is as follows: 69% of teachers work in face-to-face settings, 26.1% work in virtual or distance education without in-person components, and 18.8% engage in blended or mixed modalities, combining in-person instruction with the use of ICT in the classroom. This distribution reflects the diversity of educational approaches adopted by institutions, addressing the specific needs and circumstances of each context.

The skills for developing digital competencies among teachers have emerged from various sources of knowledge. As shown in Figure 1b, autonomous learning through trial and error and deduction, along with training courses offered by educational institutions, are the main ways teachers have strengthened their digital competencies. This finding highlights the importance of self-directed learning and continuous training to adapt to technological and pedagogical changes. The ability of teachers to learn autonomously and apply new technologies in their educational practice is essential to stay current and provide relevant and effective learning experiences.

For each of the estimated areas, specific teaching competencies have been identified and generated. In the applied questionnaire, the digital skills of teachers were compared before the COVID-19 pandemic (2019) with those acquired afterward (2022). According to Table 1, areas of competencies were defined for classification and comparison, allowing a detailed view of strengths and areas for improvement. Additionally, Table 2 presents the measurement levels for each competency, providing a quantitative framework for assessing progress and skill acquisition.

The results indicate a significant increase in teachers' digital competencies, particularly in areas related to the use of technological tools for teaching and managing virtual learning environments. This suggests that the pandemic has acted as a catalyst for the adoption of educational technologies, prompting rapid adaptation and the development of new skills. This adaptation process has been crucial not only for ensuring educational continuity during the health crisis but also for preparing teachers to face the challenges of 21st-century education.

Table 2: Classification Levels of Teaching Competencies

High	Develops the competency autonomously, can even share and teach related knowledge, can generate complex elements and analyze them deeply and with expertise.
Medium	Feels comfortable with the statement, demonstrates skill in the mentioned field, can account for their knowledge in this area.
Low	Considers that the proposed statement does not describe their knowledge, does not understand some terms or actions presented, knows the terms but does not apply them in their work.

Area 1 – Information and Informational Literacy

The area of Information and Informational Literacy focuses on teachers' ability to identify, locate, obtain, store, organize, and analyze digital information, data, and content, evaluating its usefulness and relevance for educational tasks. This domain is essential in an increasingly

digital academic environment, where effectively managing information is crucial for success in teaching and pedagogical innovation.

When comparing the results obtained before and after the pandemic, two main trends can be observed in this area. First, regarding the recovery and management of information, data storage and labeling, evaluation of educational resources, and use of licenses, a significant improvement has been noted among teachers who initially had a low level of competency. These teachers have progressed to a medium level, indicating a notable acquisition of skills and advancement in handling tools and techniques for effective information management. This progress is crucial for ensuring that educational resources are relevant and useful for the teaching process.

Second, in terms of navigating and selecting information to address specific educational needs, considerable improvement has been observed. Teachers have shown progress by moving from a low to a medium level in their ability to search for and utilize appropriate resources. This change reflects increased skill in conducting effective information searches and using the resources found efficiently. The elimination of cases where teachers did not manage these competencies adequately highlights progress in informational literacy, contributing to higher-quality teaching and better resolution of educational problems.

These results, represented in Figure 1, underscore the importance of continuous training and institutional support in developing digital competencies. The transition from a low to a medium level in these skills not only indicates individual progress for teachers but also an overall improvement in the educational system's ability to adapt to the demands of a digital environment. Training and professional development are crucial for equipping teachers with the necessary tools to effectively manage information and maximize the potential of digital resources in the classroom.

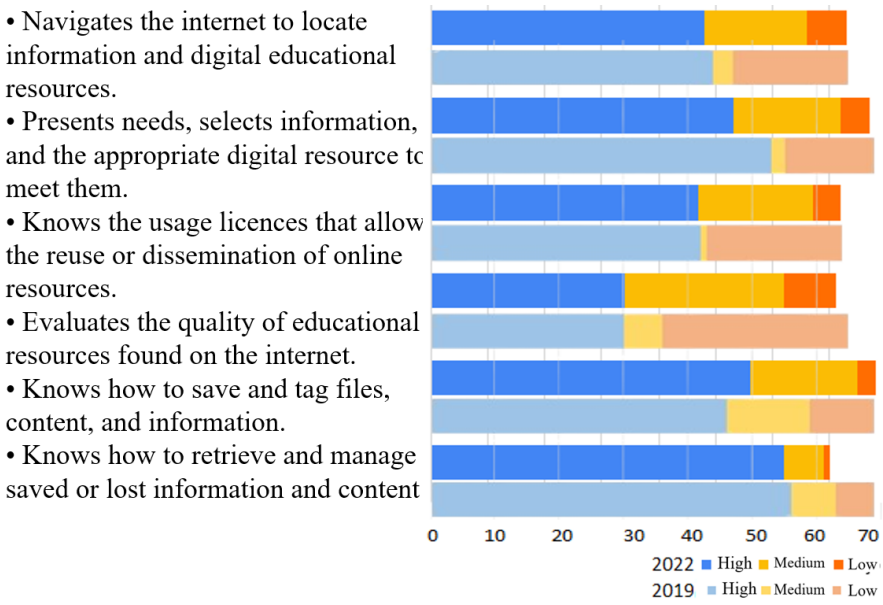

Figure 1: Comparison of Competencies in Area 1: 2019–2022

Area 2 – Communication and Interaction

In the area of Communication and Interaction, teachers have shown significant progress in their ability to use digital environments for communication, share resources through online tools, connect and collaborate with others, interact in communities and networks, and develop intercultural awareness. This area is crucial in the digital age, where the ability to communicate and collaborate effectively in virtual environments has become essential.

Among the most notable achievements at a high level is active participation in social networks and online communities. Teachers have demonstrated effective use of these platforms to foster academic collaboration, both in interactions with colleagues and in academic support for students. The integration of these skills into virtual platforms and the collaboration between teachers and students reflect an advanced use of available digital tools. This type of participation not only improves communication but also enriches the teaching and learning process through the exchange of ideas and resources.

Additionally, there has been notable progress in competencies that were initially at a low level but have advanced to a medium level. These include the ability to develop online communication protocols and manage one's virtual identity. Developing communication protocols helps establish clear and effective norms for interacting in digital environments, while proper management of virtual identity allows teachers to present a professional and coherent image in their online interactions. These advancements indicate an improvement in how teachers manage their communication and presence in the digital environment.

The achievements in the area of Communication and Interaction demonstrate significant advancement in teachers' digital skills. Effective participation in social networks and online communities, along with improvements in developing communication protocols and managing virtual identity, indicate robust development in the competence to communicate and collaborate in digital environments. These advancements contribute to a more dynamic and collaborative learning environment, adapted to the demands of modern education.

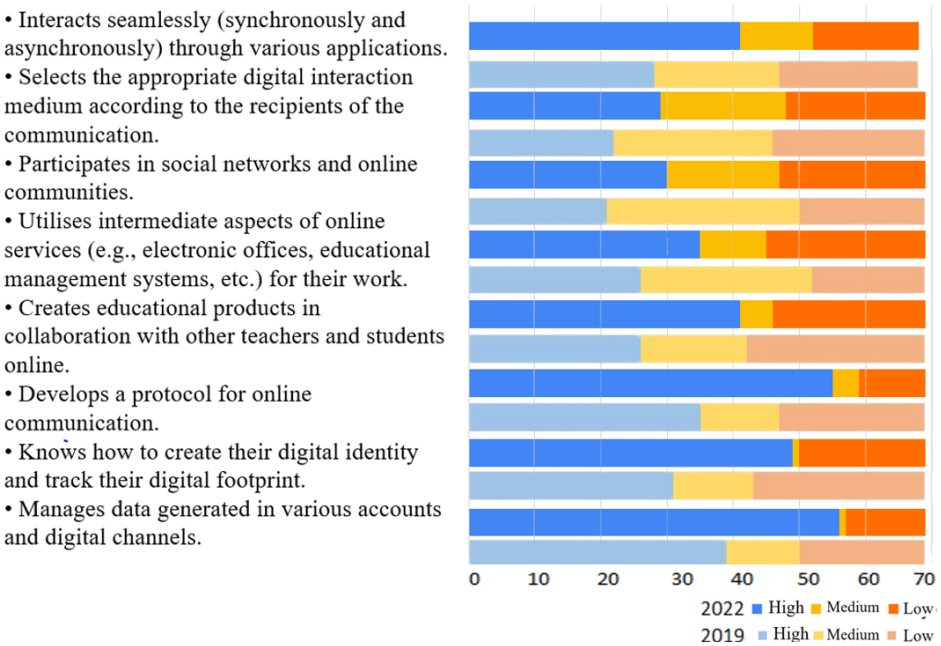

Figure 3: Comparison of Competencies Area 2: 2019–2022

Area 3 – Content Creation

In the Content Creation area, crucial skills are addressed, including the creation and editing of digital content, the integration and reworking of previous knowledge and content, the production of artistic and multimedia materials, and programming. Additionally, the proper application of intellectual property rights and usage licenses is essential.

A notable aspect in this area is the mastery of open licenses and their impact on digital content. Educators with advanced competencies in this area have demonstrated a deep understanding of how licenses affect digital content. These experts in open license management maintain a high level in this competency, with minimal growth compared to other competencies. This indicates that raising the level in this specific skill requires specialized and ongoing knowledge due to its complexity and the need for a detailed understanding of the legal and practical implications of usage licenses.

On the other hand, there has been general growth in competencies related to digital content creation, with most skills at medium and high levels. Competencies showing significant progress include the use of applications for content development and the utilization of online repositories. The ability to use these tools and resources is crucial for the effective creation and editing of digital materials. The trend indicates that, while there is an increase in the mastery of these skills, some cases still exhibit low levels, particularly in more advanced areas of multimedia content creation and computer programming.

In conclusion, the content creation area has shown notable progress in most competencies, with significant advancement in the use of applications and digital resources. However, mastery of open licenses remains a challenge that requires deeper specialization. These results underscore the need for additional training in specific aspects of digital content creation to achieve a higher and more efficient level of competence in all aspects of digital content management.

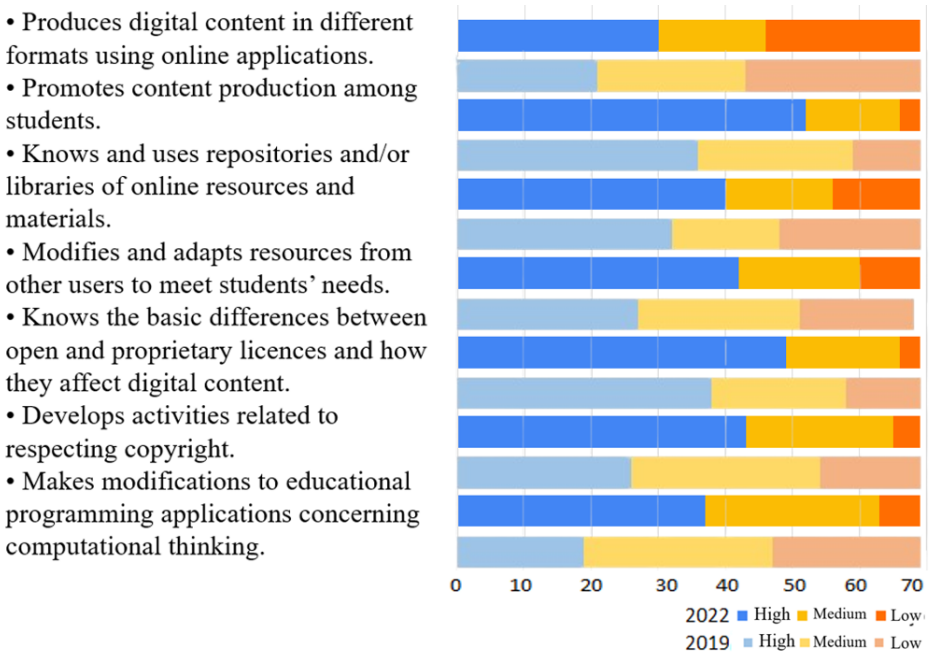

Figure 3: Comparison of Competencies Area 3: 2019–2022

Area 4 – Security

In the Security area, which covers the protection of information and personal data, digital identity security, digital content protection, and the responsible and safe use of technologies, significant progress in competency development has been observed.

All components of this area have shown a consistent improvement in levels. Specifically, the low level of competency has steadily decreased across all evaluated aspects, while the medium level has seen a notable increase. This suggests a greater awareness and application of security measures by educators, reflecting an evolution in managing digital security. The attention that was previously limited to digital security has increased, becoming a crucial aspect in preparing and executing teaching activities.

Overall, these changes demonstrate that digital security has gained greater relevance in the educational context. The decrease in the low level and the increase in the medium level indicate that educators are paying more attention to the protection of their data, their digital identity, and the content they manage. Figure 5 illustrates these advancements, highlighting how the focus on security has become an integral part of teaching practice, adapting to the demands and challenges of an increasingly complex digital environment.

In summary, the security area has shown positive development in the competency of handling information and digital identity securely. Although advanced levels remain an area for improvement, progress at the intermediate level is a clear indicator of the growing importance educators place on digital security in their professional practice.

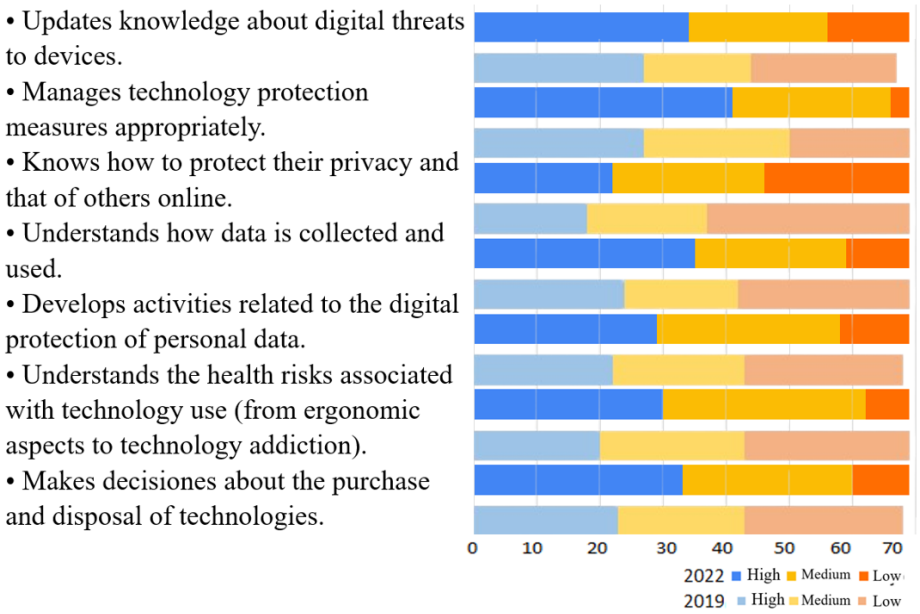

Figure 4: Comparison of Competencies Area 4: 2019–2022

Area 5 – Problem Solving

In the Problem Solving area, the focus is on evaluating educators' ability to identify the need for digital resources, make informed decisions about the most appropriate digital tools, solve conceptual problems using digital means, use technology creatively, address technical issues, and update their own competencies as well as those of others.

The results show significant development in the ability to explore digital technologies and use them to create dynamic projects. This competency has received notable emphasis, reflecting considerable progress in the creative application of digital tools to develop innovative projects in the educational field. The ability to explore and apply new technologies is crucial for addressing emerging challenges and maximizing the resources available in the digital environment.

The increase in the medium level reflects an ongoing effort by educators to improve their problem-solving skills using digital technologies. Additional training and practice in these competencies have enabled educators to more effectively face technological challenges and resolve issues more efficiently.

Figure 6 illustrates these advancements, highlighting how, despite the fact that higher levels of competency have not changed dramatically, training and development in the Problem Solving area have led to a general improvement in educators' ability to use digital technologies effectively and creatively. This progress underscores the importance of continuing training and support in the use of digital tools for problem-solving and staying updated in the field of educational technology.

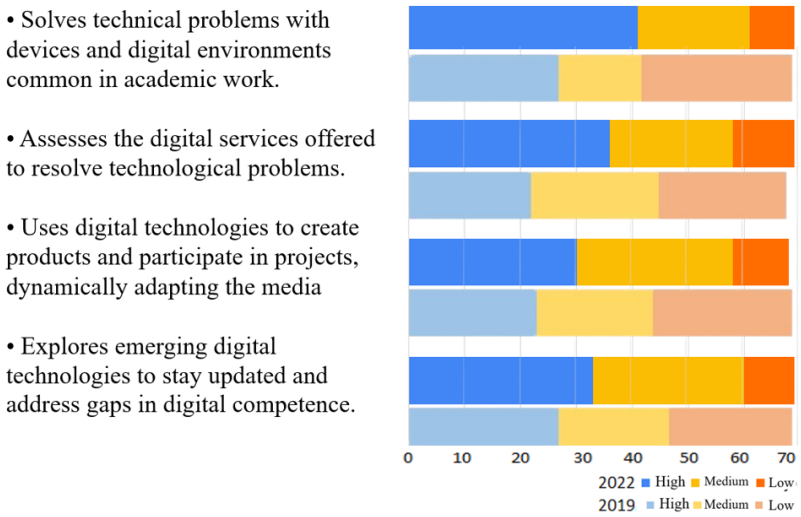

Figure 5: Comparison of Competencies Area 5: 2019–2022

Conclusion

In the context of the COVID-19 pandemic, the Ministry of National Education (MEN), through directive 04/2020, allowed academic programs in higher education with qualified registration in face-to-face modality to conduct their activities in virtual format. This situation significantly accelerated the integration of Learning and Knowledge Technologies (TAC) into academic programs.

Since 2022, notable advances have been observed in the use and appropriation of TAC. Teachers and students have been key elements in this transformation process. Motivated and driven by the need to adapt to the new reality imposed by the pandemic, educators have overcome barriers related to skills, generational differences, and technological knowledge. Meanwhile, students, with their expertise, self-development capacity, and enthusiasm for new

teaching modalities (virtual and b-learning), have significantly contributed to the success of this change, creating a new digital learning ecosystem.

The results obtained in this study confirm that self-training and adaptation to the context have been essential for the evolution in the use of TAC. Five areas of digital teaching competencies were analyzed, which, interrelated and harmonized during the pandemic, have revealed new opportunities for training both students and educators and institutions. This process has demonstrated the importance of flexibility and resilience in higher education, highlighting the potential of TAC to transform educational practices and improve the quality of learning in virtual contexts.

In summary, during the pandemic period (2019-2022), there was a noticeable increase in the level of performance in digital competencies. Educators expanded their knowledge, overcame generational gaps in technology use, and took the opportunity to integrate TAC into their educational practices with favorable results. This context allowed for the implementation of rapid and effective training paths, such as the mentoring program at some universities, and encouraged students to overcome the fear of the absence of face-to-face classes, fostering self-awareness and virtual collaboration. Additionally, spatial and distance barriers were overcome, and educators actively engaged in the creation and development of content and knowledge.

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Contact email: karolina.gonzalez@unimilitar.edu.co