

DIGITAL TEACHING COMPETENCIES IN SABANA DE OCCIDENTE: THE INFLUENCE OF THE UNESCO FRAMEWORK ON DIGITAL EDUCATIONAL PRACTICE

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ABSTRACT

The incorporation of Artificial Intelligence (AI) in education demands a redefinition of teaching competencies. Basic digital skills are no longer sufficient: teachers must be able to understand and apply tools with pedagogical, ethical, and evaluative implications. The UNESCO AI Competency Framework for Teachers serves as both a regulatory and training reference that guides the responsible and professional integration of AI. This paper aims to analyse how teachers' familiarity with the UNESCO AI Competency Framework influences their level of performance in digital practice within educational processes. The study adopts a quantitative, descriptive, and correlational design. A total of 145 teachers participated, responding to a five-point Likert scale instrument. Results show that 93.8% of teachers demonstrate at least an intermediate level of digital competence, while 40% display a high level of proficiency in the use of AI. Nevertheless, gaps remain, especially those linked to access and technological infrastructure in rural contexts. In conclusion, it is necessary to strengthen continuous and contextualised training, ensuring digital equity and pedagogical sustainability.

KEYWORDS: Digital Teaching Competencies, Educational Artificial Intelligence, Rural Digital Divide, Continuous Training.

1. INTRODUCTION

Education, like many other areas of society, is being transformed by Artificial Intelligence (AI) and the innovations derived from digitalisation across diverse sectors (Goenechea & Valero-Franco, 2024). This transformation is driven by the significant advances that AI has brought to multiple fields, optimising processes, improving decision-making, facilitating information management, and providing solutions to complex problems through machine learning and advanced reasoning (Cárdenas-Rodríguez & Suárez-Monzón, 2024). In the educational context, these capabilities open new possibilities to personalise learning, support teaching, and strengthen pedagogical decision-making based on data, thus fostering a structural evolution in educational practices (Ocaña et al., 2019).

The progressive incorporation of AI-based tools, such as virtual assistants, intelligent tutoring systems, and adaptive learning platforms, is significantly transforming educational environments (Chiu, 2024). The influence of AI in education has marked a turning point in how teaching is conceived and implemented, demanding new forms of professional training and continuous updating for educators (Falloon, 2020). In other words, educational transformation driven by AI has created an urgent need to strengthen teachers' digital competencies, ensuring that they are prepared to integrate these technologies effectively into their pedagogical practices.

In this constantly evolving digital context, the role of the teacher is no longer limited to transmitting content but has shifted to becoming a facilitator of learning, guiding students in the critical and creative use of emerging technologies (Chiu, 2021). This entails not only mastering digital tools but also fostering competencies such as critical thinking, autonomous learning, and problem-solving (Chaudhry & Kazim, 2022). In an educational scenario where AI is gaining increasing prominence, it is essential that teachers keep pace with technological developments and continuously adapt to the new challenges and opportunities that emerge in the teaching-learning process (Seo et al., 2021; Scherer et al., 2023).

In response to these challenges, UNESCO (2025) has developed the AI Competency Framework for Teachers, a tool that defines the knowledge, skills, and attitudes that educators must master in the digital era. This framework recognises that teacher professional development in AI cannot be addressed as an isolated technical process, but must be articulated with a comprehensive vision of

educational practice and grounded in the fundamental principles of inclusion, equity, social justice, and sustainable development.

Despite the growing potential of AI to transform educational processes, many teachers still lack the skills and confidence necessary to integrate these technologies effectively in the classroom (Falloon, 2020). Advances in AI have opened innovative possibilities to personalise teaching, diversify pedagogical resources, and optimise administrative tasks; however, these opportunities are not yet being fully realised in practice (Hwang et al., 2020). One of the reasons for this gap is that, in many cases, teacher training is not aligned with the real and fast-paced dynamics of the contemporary digital world (Sancho-Gil et al., 2017).

Even though international organisations have made efforts to promote the development of AI competencies, the reality is that in several countries these guidelines have not yet been coherently integrated into national education policies (UNESCO, 2022). The lack of specific AI training programmes for teachers, limited investment in technological infrastructure, and the scarcity of contextualised local research are factors that hinder an equitable and effective implementation of AI in schools (Guanga et al., 2024; Rivas, 2025).

In the Colombian context, particularly in the region of Sabana de Occidente—which includes municipalities such as Funza, Mosquera, Madrid, and Facatativá—the challenges associated with integrating AI into education take on an even more complex dimension. Although various institutional and governmental initiatives have been promoted to strengthen digital education, significant gaps remain in areas such as connectivity, access to technological devices, continuous teacher training, and pedagogical support (Sánchez & Aldana, 2025). These limitations not only affect the effective incorporation of AI into teaching practices but also highlight the need to adopt a contextualised, territorial, and situated approach to teacher professional development.

Considering educational dynamics means recognising the real conditions of pedagogical practice, the impact of educational policies, and the strategic role of AI in improving education. This approach makes it possible to generate evidence on technological appropriation, digital performance, and the pedagogical incorporation of AI in rural and subregional contexts, particularly in Sabana de Occidente. Ultimately, it contributes to the design of teacher training programmes, the strengthening of leadership in innovation, and the consolidation of a digital culture that is ethical, equitable, and inclusive.

2. THEORETICAL FRAMEWORK

2.1. *Perspective on Digital and Teaching Competencies in Rural Contexts*

At present, the strengthening of teachers' digital competencies has become a decisive factor in educational quality, particularly in contexts of growing digitalisation and technological advances such as artificial intelligence (Tituaña et al., 2025). Several studies have shown that mastering digital tools, in addition to improving pedagogical management, also broadens opportunities for inclusion, innovation, and curricular adaptation (Domínguez-González et al., 2025; Ochoa et al., 2024). Thus, teacher professional development in digital competencies must be understood as a dynamic, contextualised, and sustained process, conditioned by factors such as access to ICT training and the geographical and sociocultural characteristics of the educational environment. This highlights the need to update the teacher profile in this area, with the European Framework for the Digital Competence of Educators (DigCompEdu) serving as a good practice to support this effort (Caena & Redecker, 2019).

Digital teaching competencies have been widely addressed through international frameworks such as DigCompEdu (Redecker & Punie, 2017), which proposes six key dimensions ranging from professional engagement to facilitating student learning. Complementarily, the TPACK model (Mishra & Koehler, 2006) emphasises the need to integrate technological, pedagogical, and disciplinary knowledge into teaching practice. These conceptual structures have provided the basis for evaluating and guiding professional development at different educational levels, highlighting the importance of comprehensive digital competence that goes beyond the instrumental use of technology and instead focuses on its critical, pedagogical, and ethical application (Michel & Pierrot, 2024; Fernández & Aquino, 2024).

In Latin America, specific challenges persist. According to Ochoa et al. (2024), an analysis revealed low levels of digital competence among in-service teachers, particularly in rural settings where technological infrastructure is limited and training opportunities are scarce. This situation underscores the urgent need to adapt teacher training to the emerging demands of the 21st century, such as the responsible use of AI and the protection of digital rights. Within this framework, continuous ICT training emerges as a central component to reduce performance gaps and ensure more equitable education (OECD, 2023; El-Hamamsy et al., 2023).

Along these lines, Ramírez and Bernal (2023) argue that ongoing training enables teachers to remain up to date while fostering critical reflection, collaborative exchange, and improvement of pedagogical practice. However, in regions such as Sabana de Occidente, Cundinamarca, more targeted policies are required to address the structural and sociotechnical barriers faced by teachers, especially in rural areas.

The rural-urban digital divide is one of the main limitations to the development of digital competencies in subregional contexts. Recent studies in Colombia (Uribe-Zapata et al., 2023; López et al., 2023) show that, while urban institutions have connectivity, technological resources, and support staff, rural areas face significant shortcomings in these aspects. This directly affects the implementation of technology-mediated teaching strategies and limits access to continuous training opportunities (Mora, 2024). Furthermore, territorial disconnection translates into inequalities in the pedagogical use of ICT and in teachers' digital empowerment (Ramírez, 2022). In response to these challenges, UNESCO developed its AI Competency Framework for Teachers, which outlines 15 competencies across five dimensions: understanding AI, ethical use, digital pedagogy, assessment, and continuous professional development (UNESCO, 2024). This framework proposes three proficiency levels—basic, intermediate, and advanced—and offers concrete guidance for integrating AI responsibly, critically, and inclusively into educational processes. Its approach is especially relevant in contexts requiring clear and adaptable guidelines for incorporating emerging technologies into teaching practice.

Other studies, such as those by Nyaaba (2024), highlight the urgency of developing AI competencies in teachers from both an instrumental and an ethical-civic perspective. AI literacy involves preparing teachers to question, adapt, and use these tools for the benefit of learning, without falling into uncritical or merely automated use (Gil et al., 2024). As Cobo and Moravec (2020) and Gradada (2021) note, providing access to technology is not enough; training processes must be sensitive to territorial, cultural, and pedagogical realities. In this sense, UNESCO's framework becomes a strategic reference to guide both initial and continuous teacher training at all levels.

3. METHODOLOGY

This research adopts a non-experimental, cross-sectional design, since data collection was carried out at a single point in time, directly in the real context

where teachers perform their work. This approach sought to obtain information that would describe and help understand the current situation. As Creswell (2013) notes, non-experimental designs are appropriate when researchers observe phenomena in their natural environment without manipulating variables. The study population and sample consisted of teachers from public educational institutions located in the municipalities that make up the Sabana de Occidente region in the department of Cundinamarca. A non-probability convenience sampling method was used, selecting approximately 145 active teachers proportionally distributed across the institutions of the territory, who voluntarily agreed to participate in the study.

For data collection, a five-point Likert-type scale instrument was designed, structured based on the conceptual foundations of the theoretical framework. The questionnaire focused on three dimensions: (1) UNESCO's AI Competency Framework for Teachers, (2) Digital teaching competencies in rural and subregional contexts, and (3) The use of AI in pedagogical practice. Each dimension included 10 statements to identify proficiency levels—basic, intermediate, and advanced—allowing for the characterisation of profiles and the identification of gaps in digital competencies. The instrument was subjected to content validation by expert teachers, and a pilot test with 15 teachers was conducted to refine wording, verify clarity, and assess reliability.

AI-based tools were also used in this process.

Reliability was established through Cronbach's Alpha coefficient, calculated for both the entire instrument and each dimension individually. The following values were obtained: total: 0.90; and individually: 0.89, 0.85, and 0.85, respectively, which demonstrates high internal consistency.

The procedure was carried out in four phases: *Data coding*, which involved symbolising responses on an ordinal scale (Low, Medium, and High) in relation to the evaluated dimensions. *Construction of contingency tables*, using cross-tabulations that related independent variable categories with the levels of digital competence development in each dimension: UNESCO AI Competency Framework for Teachers, digital competencies in rural and subregional contexts, and the use of AI in teaching practice. *Application of the Chi-square test*, conducted using SPSS software with support from Excel, which allowed the calculation of the statistic for each hypothetical relationship and established whether the differences between expected and observed frequencies were significant ($p < 0.05$). *Interpretation of results*, considering relationships with p-values below 0.05, which indicated the existence of dependency between variables, showing that the development of digital competencies could be associated with factors such as academic training or access to technological resources.

Table 1: Specific Hypotheses.

No.	H1. Alternative Hypothesis	H0. Null Hypothesis
H1	There is a significant relationship between UNESCO's AI Framework and the application of ICT knowledge in rural and supranational contexts, demonstrating the impact of international guidelines on teachers' technological appropriation.	There is no significant relationship between UNESCO's AI Framework and the application of ICT knowledge in rural and supranational contexts.
H2	The application of ICT knowledge in rural and supranational contexts is directly associated with the use of AI in teaching practice, showing that technological appropriation fosters the integration of AI into pedagogical processes.	There is no significant association between the application of ICT knowledge in rural and supranational contexts and the use of AI in teaching practice.
H3	UNESCO's AI Framework is significantly related to the use of AI in teaching practice, indicating that international reference frameworks guide and strengthen the development of teaching competencies in educational innovation.	There is no significant relationship between UNESCO's AI Framework and the use of AI in teaching practice.

Note: The Authors.

The general hypothesis stated that: "The level of development of digital competencies among teachers in public educational institutions in the Sabana de Occidente region is positively associated with the implementation of UNESCO's AI Competency Framework for Teachers." Likewise, three specific hypotheses were established, as presented in Table 1.

4. FINDINGS

The results reveal a relevant panorama regarding the development of digital competencies and the incorporation of AI into teaching practice, with significant progress and a group of highly competent teachers leading transformative processes in education within the territory. At the

same time, the findings highlight the gaps stemming from difficulties in accessing and using

ICT, which directly affects teacher training and pedagogical support in regional contexts.

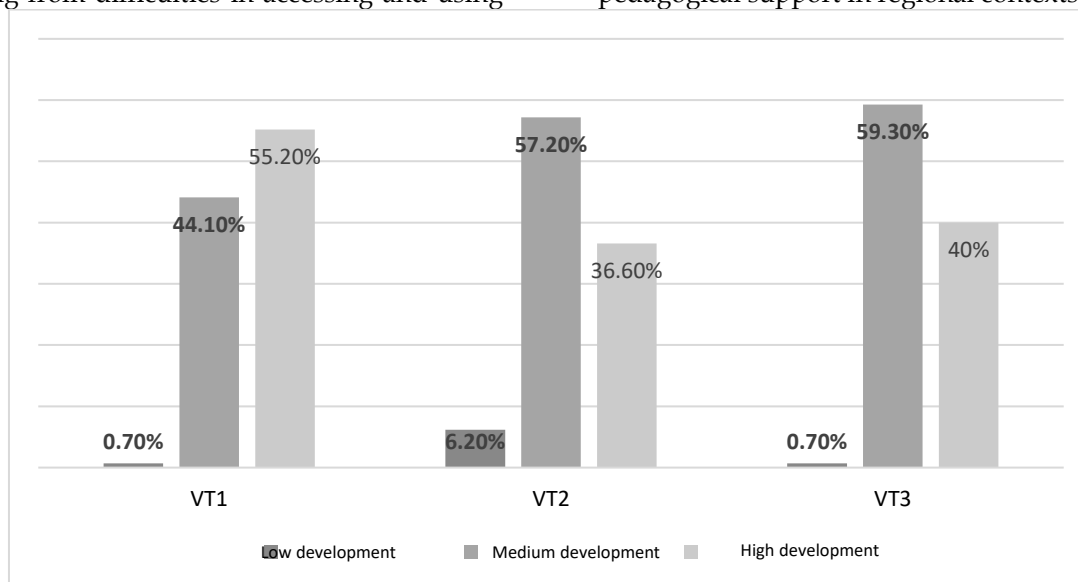


Figure 1: Level of Development across the Three Dimensions of the Study on Teachers' Digital Competencies in the Sabana De Occidente Region.

Note: VT1 = UNESCO AI Framework; VT2 = Application of ICT Knowledge In Rural and Subregional Contexts; VT3 = Use of AI In Teaching Practice. Source: Authors, Based on Data Generated By SPSS.

Based on the interpretation of Figure 1, it can be observed that at least 93.8% of teachers demonstrate, as a minimum, an intermediate level of development in digital competencies. This reflects significant progress in the knowledge and use of technologies within the educational field. However, only about one third of this group achieves a highly competent performance. At the same time, there remains a segment of teachers who face serious difficulties in accessing, using, or integrating ICT into their pedagogical practice. A progressive acceptance and significant appropriation of AI in teaching practices within the regional contexts analysed can also be observed, as 40% of teachers report a high level of development. This suggests the existence of a solidly skilled group, likely leading initiatives or serving as reference figures within their institutions or territories. Nevertheless, challenges persist, as the majority remain at an intermediate level of development, with a very small proportion at a low level of development (59.3% and 0.7%, respectively).

These data present a positive outlook regarding teachers' appropriation of the UNESCO ICT Competency Framework for Teachers. The fact that a considerable percentage demonstrate competent incorporation of ICT into their pedagogical practices highlights a strong implementation of the competencies defined by the framework. Such appropriation translates into the creation of more dynamic, personalised learning environments

aligned with current technological realities. It also points to advances in key dimensions such as the pedagogical use of ICT, the management of digital learning environments, technology-supported assessment, and ongoing participation in professional communities of practice. From the analysed context, the results reflect a positive trend in the development of teachers' digital competencies in rural and subregional contexts. However, persistent gaps remain regarding access, use, and technological appropriation, which must be addressed. Therefore, it is essential to implement strategies for continuous and differentiated training, ensure minimum conditions of technological infrastructure, and promote collaborative work among teachers in order to consolidate existing good practices and contribute to reducing the digital divide in these territories.

4.1. Association between the Study Variables

To identify whether there are statistically significant differences in the levels of development of the different dimensions analysed—namely, the UNESCO ICT Competency Framework for Teachers, teachers' digital competencies in rural and subregional contexts, and the use and perception of Artificial Intelligence in teaching practice—a Chi-square test of independence was applied. The test examined the relationship among the variables stated in the specific hypotheses.

Table 2: Hypothesis Test Statistics.

Hypothesis	Pearson Chi-Square	Likelihood Ratio	df	Asymptotic Significance (2-sided)	Linear-by-Linear Association
H1	173,616 ^a	42,392	4	0,000	32,665
H2	74,979 ^a	48,560	4	0,000	42,114
H3	21,159 ^a	21,916	4	0,000	20,798

^a Three Cells (55.6%) Have An Expected Count Less Than 5. The Minimum Expected Count Is .03.

Note: The Values Obtained from The Linear-By-Linear Association Test (32.665; 42.114; And 20.798) Show Statistical Significance ($P < 0.05$), Which Allows Us to Reject the Null Hypothesis (H_0) And Accept the Research Hypotheses. This Confirms the Existence of a Direct Relationship Between the Variables VT1 (UNESCO AI Framework), VT2 (Application of ICT Knowledge In Rural and Supranational Contexts), And VT3 (Use of AI In Teaching Practice).

These results indicate that there is a statistically significant association among the respective variables analysed. Accordingly, it can be stated that, for all three hypotheses, the null hypothesis (H_0) is rejected, and the research hypothesis is accepted. Likewise, it should be noted that the significant values obtained from the Linear-by-Linear Association (32.665; 42.114; and 20.798) indicate a direct relationship between the variables studied.

5. DISCUSSION

With respect to the general hypothesis, which states: “The level of development of digital competencies among teachers in public educational institutions in the Sabana de Occidente region is positively associated with the implementation of UNESCO’s AI Competency Framework for Teachers,” the hypothesis is accepted. Firstly, results showed that 93.8% of teachers achieved at least an intermediate level of digital competence, reflecting a favourable outlook in terms of technological appropriation. Secondly, the statistical tests applied –namely the Chi-square test and the Linear-by-Linear Association–yielded significant values (32.665; 42.114; and 20.798), with a significance level of $p < 0.05$. These results confirm the existence of a direct and positive relationship among the variables considered, implying that the implementation of UNESCO’s AI Competency Framework for Teachers is significantly associated with the level of development of teachers’ digital competencies.

The findings of this study are consistent with the theoretical references reviewed, particularly regarding the development of digital competencies in rural and subregional contexts. As Tituaña et al. (2025) and Ochoa et al. (2024) indicate, the consolidation of these competencies not only enhances pedagogical management but also expands opportunities for inclusion, innovation, and curricular adaptation. In this sense, the results from Sabana de Occidente—showing that 93.8% of teachers have at least an intermediate level of performance—confirm the positive trend described in previous studies and highlight the relevance of

reference frameworks such as DigCompEdu and UNESCO’s AI Competency Framework for Teachers.

The persistence of gaps in ICT access and use is consistent with the findings of Uribe-Zapata et al. (2023) and López et al. (2023), who warn that the lack of technological infrastructure in rural areas limits the pedagogical use of digital tools. Indeed, while 40% of the teachers analysed achieved a high level of AI use, the majority remain at an intermediate level, with a minority experiencing serious difficulties in integration. This situation also reinforces what Mora (2024) and Ramírez (2022) suggest regarding the impact of territorial disconnection on teachers’ digital empowerment.

Furthermore, the progressive appropriation of AI by teachers analysed in this study aligns with Nyaaba (2024) and Gil et al. (2024), who emphasise the urgency of AI literacy that combines instrumental use with an ethical and civic perspective. The results suggest that the group of teachers with high performance may serve as institutional and territorial benchmarks, leading initiatives in educational innovation and peer support. This is consistent with Ramírez and Bernal (2023), who underline the importance of ongoing and collaborative training. In sum, the findings confirm that international frameworks—particularly that of UNESCO—provide relevant guidance for the development of teachers’ digital competencies in rural contexts. However, the effectiveness of their implementation largely depends on targeted policies, the provision of minimum infrastructure conditions, and the creation of continuous training opportunities that acknowledge territorial realities.

6. CONCLUSIONS AND RECOMMENDATIONS

This study made it possible to highlight the current state of digital competency development and the appropriation of Artificial Intelligence (AI) among teachers in public institutions in the Sabana de Occidente region. Based on the statistical analysis of data obtained through a Likert-scale survey administered to 145 teachers, it was found that more

than 93.8% of participants demonstrated intermediate or high levels of digital competence. This indicates a strong potential for technology-supported educational transformation in the territory. A solid appropriation of UNESCO's ICT Competency Framework for Teachers was identified, which translates into technology-mediated pedagogical practices, the management of virtual learning environments, and participation in professional communities of practice. At the same time, the study reveals persistent challenges, particularly in terms of access, infrastructure, and continuous training—factors that condition the consolidation of an inclusive digital culture. With regard to the integration of AI into teaching practice, most teachers are still at intermediate levels.

Based on these findings, several recommendations can be made. Although significant progress has been made in developing digital competencies and integrating AI into teaching practice, gaps remain that require attention. It is therefore recommended to strengthen continuous training programmes with an emphasis on the pedagogical appropriation of ICT and AI in rural and subregional contexts. Likewise, further empirical evidence should be sought to strengthen diagnosis, thereby encouraging institutional policies that promote equitable access to technological resources. Finally, fostering teacher support networks can help drive leadership, innovation, and the establishment of benchmarks in the educational field.

REFERENCES

- Caena, F., & Redecker, C. (2019). Aligning teacher competence frameworks to 21st century challenges: The case for the European Digital Competence Framework for Educators (Digcompedu). *European journal of education*, 54(3), 356-369. <https://doi.org/10.1111/ejed.12345>
- Cárdenas-Rodríguez, J. y Suárez-Monzón, N. (2024). La inteligencia artificial en el desarrollo de las competencias digitales de los educadores: Una revisión sistemática. *Revista Mexicana de Investigación e Intervención Educativa*, 3(2), 62-70. <https://pablolatapisarre.edu.mx/revista/index.php/rmiie/article/view/85/73>
- Chaudhry, M. & Kazim, E. (2022). Artificial Intelligence in Education (AIEd): A high-level academic and industry note 2021. *AI and Ethics*, 2(1), 157-165.
- Chiu, T. (2021). A holistic approach to the design of artificial intelligence (AI) education for K-12 schools. *TechTrends*, 65(5), 796-807.
- Chiu, T. (2024). Future research recommendations for transforming higher education with Generative AI. *Computer & Education: Artificial Intelligence*, 6, 100197, <https://doi.org/10.1016/j.caeai.2023.100197>
- Cobo, C. y Moravec, J. (2020). Aprendizaje invisible: Hacia una nueva ecología de la educación. *Colectivo Transmedia XXI*. <https://redi.ani.org.uy/jspui/handle/20.500.12381/384>
- Creswell, J. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Thousand Oaks, CA: SAGE Publications. https://www.ucg.ac.me/skladiste/blog_609332/objava_105202/fajlovi/Creswell.pdf
- Cronbach, L. (1951). *Coefficient alpha and the internal structure of tests*. *Psychometrika*, 16(3), 297-334. <https://doi.org/10.1007/BF02310555>
- Domínguez-González, M., Luque de la Rosa, A., Hervás-Gómez, C., & Román-Graván, P. (2025). Teacher digital competence: Keys for an educational future through a systematic review. *Contemporary Educational Technology*, 17(2), ep577. <https://doi.org/10.30935/cedtech/16168>
- El-Hamamsy, L., Monnier, E., Avry, S. (2023). An adapted cascade model to scale primary school digital education curricular reforms and teacher professional development programs. *Educ Inf Technol* 29, 10391-10436. <https://doi.org/10.1007/s10639-023-12043-6>
- Falloon, G. (2020). From digital literacy to digital competence: The teacher digital competency (TDC) framework. *Educational Technology Research and Development*, 68(5), 2449-2472. <https://doi.org/10.1007/s11423-020-09767-4>
- Fernández, O. & Aquino, O. (2025). Teacher Digital Competence: a scoping review on the subject. *Caderno Pedagógico*, 22(10), e18893. <https://doi.org/10.54033/cadpedv22n10-055>
- Gil, C., Vilela, J., Martínez, M., Llontop, F. y Bernal, C. (2024). Epistemología, Ética, Educación e Inteligencia Artificial. *Editorial Internacional Alema*. <https://editorialalema.org/libros/index.php/alema/article/view/29>
- Goenechea, C. y Valero-Franco, C. (2024). Educación e inteligencia artificial: Un análisis desde la perspectiva de los docentes en formación. REICE. *Revista Iberoamericana sobre Calidad, Eficacia y Cambio en Educación*, 22(2), 33-50. <https://doi.org/10.15366/reice2024.22.2.002>

- Granda A., Romero, L. & Játiva, D. (2021). El docente y la alfabetización digital en la educación del siglo XXI. *Sociedad & Tecnología*, 4(S2), 377–390. <https://doi.org/10.51247/st.v4iS2.158>
- Hernández, R., Fernández, C. y Baptista, P. (2014). *Metodología de la investigación* (6.ª ed.). McGraw-Hill.
- Hwang, G. J., Xie, H., Wah, B. & Gašević, D. (2020). Vision, challenges, roles and research issues of Artificial Intelligence in Education. *Computers and Education: Artificial Intelligence*, 1, 100002.
- López, J., Cañón, E., y Camargo, N. (2023). Brecha digital: apropiación docente rural y urbana en tiempos de pandemia COVID-19. <https://doi.org/10.11144/Javeriana.10554.60694>
- Michel, C., & Pierrot, L. (2024). Towards the design of model-based means and methods to characterize and diagnose teachers' digital maturity. <https://doi.org/10.48550/arXiv.2411.02025>
- Michel, L., & Pierrot, J. (2024). Modelo MUME: Medición unificada de la madurez digital docente. *arXiv preprint arXiv:2411.02025*.
- Mishra, P., & Koehler, M. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054. <https://doi.org/10.1111/j.1467-9620.2006.00684.x>
- Mora, E. (2024). Apropiación de las tecnologías de la información y comunicación (TICS) en contextos rurales de Colombia y América Latina. <http://hdl.handle.net/10584/13354>
- Nyaaba, M. (2024). Transforming teacher education in developing countries: The role of generative AI in bridging theory and practice. <https://doi.org/10.48550/arXiv.2411.10718>
- Ocaña, Y., Valenzuela, L., & Garro, L. (2019). Inteligencia artificial y sus implicaciones en la educación superior. *Propósitos y Representaciones*, 7(2), 536–568. <https://dx.doi.org/10.20511/pyr2019.v7n2.274>
- OCDE. (25 de septiembre de 2023). OECD finds growing transparency efforts among leading AI developers. <https://www.oecd.org/>
- Ochoa, C., Claro, M., & Hinostroza, J. (2024). Systematic review of quantitative research on digital competences of in-service school teachers in Latin America. *International Journal of Educational Technology*, 38(2), 56–75. <https://www.sciencedirect.com/science/article/abs/pii/S0360131524000447>
- Ramírez, F., & Bernal, A. (2023). La competencia digital para fortalecer del desarrollo profesional docente. *Memorias Sifored - Encuentros Educación UAN*, (7). <https://revistas.uan.edu.co/index.php/sifored/article/view/1700>
- Ramírez, S. (2022). La existencia de brecha en Competencia Digital Docente: Un estudio comparativo entre zonas rurales y zonas urbanas en la provincia de Córdoba. <http://riull.ull.es/xmlui/handle/915/27895>
- Redecker, C., & Punie, Y. (2017). *European Framework for the Digital Competence of Educators: DigCompEdu*. Publications Office of the European Union. <https://doi.org/10.2760/159770>
- Rivas, A. (2025). *La llegada de la IA a la educación en América Latina: en construcción*. ProFuturo - OEI. [la-llegada-de-la-ia-a-la-educacion-en-al-en-construccion-oei-profuturo.pdf](https://profuturo-oei.org/la-llegada-de-la-ia-a-la-educacion-en-al-en-construccion-oei-profuturo.pdf)
- Sánchez M, y Aldana, A. (2025). Impacto de la digitalización de los establecimientos de comercio en Sabana de Occidente. <https://repository.unilibre.edu.co/handle/10901/31050>
- Scherer, R., Siddiq, F., Howard, S. & Tondeur, J. (2023). The more experienced, the better prepared? New evidence on the relation between teachers' experience and their readiness for online teaching and learning. *Computers in Human Behavior*, 139, 107530.
- Seo, K., Tang, J., Roll, I., Fels, S., & Yoon, D. (2021). The impact of artificial intelligence on learner-instructor interaction in online learning. *International Journal of Educational Technology in Higher Education*, 18(1), 1–23.
- Tituaña, L., González, N., Cumbal, M. & Shiguango, H. (2025). Competencias digitales docentes en la educación superior: evaluación, desafíos y estrategias para su fortalecimiento institucional. *Multidisciplinary Journal of Sciences, Discoveries, and Society*, 2(3), 3. <https://dialnet.unirioja.es/servlet/articulo?codigo=10186014>
- UNESCO. (2022). *Directrices para la formulación de políticas y planes maestros de TIC en educación*. París. <https://unesdoc.unesco.org/ark:/48223/pf0000385091>
- UNESCO. (2024). AI Competency Framework for Teachers. <https://www.unesco.org/en/articles/ai-competency-framework-teachers>
- UNESCO. (2025). *AI competency framework for teachers*. P. 5–52. <https://doi.org/10.54675/ZJTE2084>
- Uribe-Zapata, A., Zambrano-Acosta, J. & Cano-Vásquez, L. (2023). Usos educativos de TIC en docentes rurales de Colombia. *Revista de Investigación, Desarrollo e Innovación*, 13(2), 287–298. <https://doi.org/10.19053/20278306.v13.n2.2023.16834>