Eduweb, 2026, enero-marzo, v.20, n.1. ISSN: 1856-7576
Doi: https://doi.org/10.46502/issn.1856-7576/2026.20.01.3

Original Article

Professional competence and digital literacy in pre-service art teachers

Competencia profesional y alfabetización digital en futuros docentes de arte

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Recibido: 11/12/25
Aceptado: 30/01/26

Cómo citar:
Chovriy, S., Hudovsek, O., Sotska, H., Svyrydiuk, O., & Kolchenko, I. (2026). Professional competence and digital literacy in pre-service art teachers. *Revista Eduweb, 20*(1), 46-57. https://doi.org/10.46502/issn.1856-7576/2026.20.01.3

Abstract

The study examines the effectiveness of digitally oriented pedagogical conditions for the formation of professional competence in future art teachers. The aim of this study is to evaluate the effectiveness of pedagogical conditions for the formation of professional competence in future art teachers through the integration of digital technologies. The research employed a mixed-methods quasi-experimental design involving 124 pre-service art teachers, divided into an experimental group (n = 60) and a control group (n = 64). Professional competence was assessed using motivational, cognitive, and creative–activity criteria through questionnaires, tests, self-assessment tools, interviews, and pedagogical observation. The experimental group was trained using a competency-based digital model, while the control group followed a traditional program. The findings confirm that the systematic integration of digital technologies within a competency-based framework leads to measurable improvements in the professional competence of future art teachers.

Keywords: digitalization, professional competence, future art teachers, digital literacy of the individual, innovation process.

Resumen

El estudio examina la efectividad de las condiciones pedagógicas orientadas digitalmente para la formación de competencias profesionales en futuros profesores de arte. El objetivo de este estudio es evaluar la efectividad de las condiciones pedagógicas para la formación de competencias profesionales en futuros profesores de arte a través de la integración de tecnologías digitales. La investigación empleó un diseño cuasiexperimental de métodos mixtos que involucró a 124 futuros profesores de arte, divididos en un grupo experimental (n = 60) y un grupo de control (n = 64). La competencia profesional se evaluó utilizando criterios motivacionales, cognitivos y de actividad creativa a través de cuestionarios, pruebas, herramientas de autoevaluación, entrevistas y observación pedagógica. El grupo experimental fue entrenado utilizando un modelo digital basado en competencias, mientras que el grupo de control siguió un programa tradicional. Los hallazgos confirman que la integración sistemática de las tecnologías digitales dentro de un marco basado en competencias conduce a mejoras mensurables en la competencia profesional de los futuros profesores de arte.

Palabras clave: digitalización, competencia profesional, futuros profesores de arte, alfabetización digital del individuo, proceso de innovación.

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Introduction

Digitalization of education is a defining trend in modern educational development and significantly transforms the requirements for the professional training of future teachers, particularly in the field of art education. In the context of the transition to a digital educational environment, not only are the teaching tools changing, but also the very structure of the professional competence of an art teacher, which increasingly combines pedagogical, artistic, creative, and digital components (Espinoza-Castro et al., 2025). However, the practice of training future art teachers in higher education institutions indicates significant difficulties in systematically integrating digital technologies into professionally oriented training, which negatively affects graduates' readiness for effective pedagogical activity in a digital educational environment (Messuti, 2017).

An analysis of modern research shows that scientists are actively considering the problems of digitalization of pedagogical education, the development of digital literacy and the use of digital tools in the artistic training of future teachers. At the same time, the majority of works focus either on general pedagogical aspects of digital competence or on individual digital tools and technologies, without taking into account the specifics of the professional activity of an art teacher as a combination of artistic and creative, communicative and pedagogical activities UNESCO Institute for Statistics (2018). The integrative aspect of the professional competence of future art teachers remains insufficiently researched, in particular the coordinated formation of motivational, cognitive and creative-activity components in the process of purposeful digitalization of professional training (García-Huidobro Munita & Ferrada Sulivan, 2020). This gap, confirmed by the latest scientific publications, determines the need to develop and experimentally test pedagogical conditions that ensure the systematic formation of professional competence of future art teachers using digital technologies.

Literature Review

The formation of professional competence of future art teachers is considered in contemporary pedagogical research as a complex and multidimensional process that integrates pedagogical knowledge, artistic creativity, communicative skills, and value orientations (Gavilanes-Sagnay et al., 2019). Scholars emphasize that professional competence in art education cannot be reduced to subject mastery alone, as it also involves the ability to interpret artistic meanings, facilitate creative expression, and support students' personal and cultural development. However, many studies conceptualize professional competence within relatively stable educational contexts, without fully accounting for the structural changes introduced by the digital transformation of higher education (González-Quiñones et al., 2018; Nella Escala et al., 2024).

Comparative analysis of international research indicates a growing recognition that digitalization reshapes the professional roles and responsibilities of teachers, including those in the arts. Nevertheless, the specific mechanisms through which digitalization influences the formation of professional competence in pre-service art teachers remain insufficiently theorized and empirically validated (Pérez, 2023).

Digital competence is increasingly viewed as an essential structural component of teachers' professional competence. Research demonstrates that the ability to use digital tools meaningfully enhances pedagogical effectiveness, supports innovative teaching practices, and expands opportunities for professional self-development. In

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art education, digital competence acquires particular importance due to the growing role of visual media, multimodal texts, and digital creative tools.

Gavaldon & McGarr (2019) show that the use of comics and graphic narratives in teacher education strengthens future teachers' ability to communicate complex ideas through visual and verbal means. Their findings indicate that digital visual storytelling not only improves learning outcomes but also contributes to the development of professional skills relevant to contemporary art education. At the same time, these studies focus primarily on specific digital tools, leaving open the question of how such practices contribute to the holistic formation of professional competence.

Chen & Gao (2025), Bacca-Pachón & Sierra-Castro, (2022) examined the effect of digital literacy on art teachers' intention to integrate ICT using the Extended Technology Acceptance Model (TAM2). Surveying 580 teachers and applying structural equation modeling, they found that digital literacy significantly influences perceived usefulness and perceived ease of use, and that the model explains 65% of the variance in ICT integration intention. Subjective norms had both direct and indirect effects (via image and perceived usefulness), while ICT output quality positively affected perceived usefulness; job relevance and result demonstrability were not significant. The study underscores digital literacy as a key driver of ICT adoption and highlights the role of social norms and ICT quality in supporting technology integration in art education.

Digital teaching methodologies in art education represent a rapidly developing research area. Scholars explore blended learning, online platforms, and digitally mediated creative practices as means of enhancing student engagement and expanding artistic expression. Gavaldon & McGarr (2019) emphasize the pedagogical potential of digital narratives, while Gutiérrez-Cabello Barragán et al. (2021) analyze critical artistic practices in digital environments, demonstrating how digitalization reshapes artistic literacy and pedagogical interaction in higher education.

Some studies included in this review originate outside the narrow field of art education but offer conceptually relevant insights. For example, Meyer (2022), examining digitalization in martial arts education, provides transferable perspectives on embodiment, virtual interaction, and the transformation of practice-based disciplines in digital contexts. Although the disciplinary focus differs, the study is relevant for understanding how digital environments influence experiential and creative learning –core elements also central to art teacher education. Nevertheless, such studies rarely address pedagogical conditions tailored specifically to the professional preparation of future art teachers.

McDougald's (2018) research on CLIL methodology contributes an additional cross-disciplinary perspective, highlighting the role of integrative and competency-oriented teaching approaches in fostering lifelong learning and cultural competence. While not exclusively focused on art education, this work supports the argument that digitalization requires holistic methodological frameworks that transcend single-subject boundaries.

However, most reviewed studies either focus on descriptive analysis or lack experimental validation of assessment tools. There is limited empirical evidence demonstrating how specific pedagogical conditions and digital methodologies influence measurable changes in the professional competence of future art

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teachers. Moreover, comparative experimental designs that contrast traditional and digitalized training models remain scarce.

The reviewed literature demonstrates substantial progress in understanding professional competence, digital competence, and digital teaching methodologies in education. However, a clear research gap persists at their intersection within the context of pre-service art teacher education. Specifically, there is a lack of integrative studies that: conceptualize digital competence as a structural component of professional competence in future art teachers, implement and empirically test pedagogical conditions for competence formation through digitalization, and employ a multidimensional assessment framework within an experimental research design. Addressing this gap provides the conceptual and methodological foundation for the present study and directly informs its objective and research methodology.

Methodology

Research design

The study employed a mixed-methods quasi-experimental design aimed at examining the effectiveness of pedagogical conditions for the formation of professional competence in future art teachers through digitalization. The research combined theoretical analysis with empirical methods and included three sequential stages: the ascertaining (diagnostic), formative, and control stages. This design enabled both the identification of the initial level of professional competence and the assessment of changes resulting from the implementation of digitally oriented pedagogical interventions.

Participants

The empirical study was conducted during 2023–2025 and involved 124 pre-service art teachers enrolled in higher education institutions. Participants were divided into an experimental group (EG, n = 60) and a control group (CG, n = 64). Group allocation was based on the principle of comparability to ensure homogeneity in terms of age, educational background, and initial level of professional competence. Prior to the formative intervention, an initial diagnostic assessment confirmed that there were no statistically significant differences between the experimental and control groups regarding the key indicators of professional competence. Participation in the study was voluntary, and ethical principles of anonymity and confidentiality were observed throughout the research process.

Conceptual framework and variables

Professional competence of future art teachers was conceptualized as an integrative construct comprising three interrelated components:

- Motivational component, reflecting value orientations, professional motivation, self-esteem, and readiness for professional development.
- Cognitive component, encompassing professional knowledge, cognitive interests, self-regulation, and reflective abilities.
- Creative–activity component, including professional skills, communication, empathy, and creative expression.

The independent variable was the implementation of pedagogical conditions for competence formation through digitalization, while the dependent variable was the level of professional competence development across the defined components.

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Pedagogical intervention

The formative stage of the experiment involved the implementation of a set of pedagogical conditions in the experimental group, including:

- Motivation enhancement for professional competence development through digital technologies.
- Updating educational content and methodological support based on a competency-based and digitally oriented approach.
- Integration of digital teaching tools and creative digital tasks into professional training.
- Promotion of self-reflection and objective self-assessment of professional competence.
- Practical orientation of learning tasks toward future professional activity.

Additionally, a specialized course focused on the formation of professional competence through digitalization was introduced for the experimental group. The control group followed the traditional curriculum without targeted digital pedagogical interventions.

Data collection methods

Data were collected using a combination of qualitative and quantitative methods:

- Questionnaires and surveys to assess motivational indicators and attitudes toward professional development.
- Testing to evaluate cognitive components of professional competence.
- Interviews and structured conversations to obtain qualitative insights into students' experiences.
- Self-assessment instruments to measure reflective and regulatory aspects of competence development.
- Pedagogical observation to monitor changes in professional behavior during the formative stage.

All instruments were aligned with the defined competence components and applied consistently at the ascertaining and control stages of the experiment.

Assessment procedure

Levels of professional competence formation were classified as high, medium, or low based on predefined criteria and indicators for each component. The assessment framework enabled a comprehensive evaluation of competence dynamics in both experimental and control groups.

Data analysis

Quantitative data were analyzed using descriptive and inferential statistics. To determine the statistical significance of differences between groups before and after the intervention, the Pearson's chi-square (χ^2) test was applied. The significance level was set at $p < 0.05$ to ensure an acceptable probability of error. Qualitative data obtained from interviews and observations were analyzed using content analysis, which allowed for the identification of recurring patterns and contextual interpretation of the results.

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Research validity and reliability

The validity of the study was ensured by aligning the research objectives, conceptual framework, methods, and assessment tools. Reliability was supported by the repeated application of diagnostic instruments, consistency of data collection procedures, and the use of both control and experimental groups. The mixed-methods approach enhanced the robustness of findings by enabling triangulation of quantitative and qualitative data.

Results and Discussion

Results

Professional competence of future art teachers was assessed according to three criteria: motivational, cognitive (knowledge), and creative–activity. Each criterion was evaluated at three levels (high, medium, low) based on predefined indicators.

Ascertaining stage

At the ascertaining stage, both the experimental group (EG, n = 60) and the control group (CG, n = 64) demonstrated comparable distributions of professional competence levels across all criteria. The results for the motivational criterion are presented in Tables 1 and 2, for the cognitive criterion in Tables 3 and 4, and for the creative–activity criterion in Tables 5 and 6.

Table 1.
State of formation of professional competence of EG respondents by motivational criterion (confirmatory stage of the experiment)

LEVELS	Value orientations	Communication	Self-esteem	Professional experience
High	22 %	24 %	24 %	24 %
Average	41 %	40 %	38 %	39 %
Low	37 %	36 %	38 %	37 %
TOTAL	100 %	100 %	100 %	100 %

Table 2.
State of formation of professional competence of CG respondents by motivational criterion (determinative stage of the experiment)

LEVELS	Value orientations	Communication	Self-esteem	Professional experience
High	20 %	21 %	21 %	22 %
Average	37 %	38 %	37 %	40 %
Low	43 %	41 %	42 %	38 %
TOTAL	100 %	100 %	100 %	100 %

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Table 3.
State of formation of professional competence of EG respondents by the knowledge criterion (the ascertaining stage of the experiment)

LEVELS	Professional knowledge	Cognitive interests	Self-regulation	Reflection
High	24 %	22 %	24 %	24 %
Average	38 %	39 %	44 %	43 %
Low	38 %	39 %	32 %	33 %
TOTAL	100 %	100 %	100 %	100 %

Table 4.
State of formation of professional competence of CG respondents by knowledge criterion (confirmatory stage of the experiment)

LEVELS	Professional knowledge	Cognitive interests	Self-regulation	Reflection
High	23 %	21 %	23 %	24 %
Average	37 %	38 %	45 %	40 %
Low	40 %	41 %	32 %	36 %
TOTAL	100 %	100 %	100 %	100 %

Table 5.
State of formation of professional competence of EG respondents by the creative criterion (the ascertaining stage of the experiment)

LEVELS	Professional communication skills	Empathy	Creativity
High	22 %	23 %	23 %
Average	38 %	40 %	39 %
Low	40 %	37 %	38 %
TOTAL	100 %	100 %	100 %

Table 6.
State of professional competence of the respondents of the CG by the creative criterion (asserting stage of the experiment)

LEVELS	Professional communication skills	Empathy	Creativity
High	20 %	21 %	22 %
Average	40 %	39 %	38 %
Low	40 %	40 %	40 %
TOTAL	100 %	100 %	100 %

Across all three criteria, the majority of respondents in both groups were concentrated at medium and low levels. High-level indicators did not exceed 22–24% in the EG and 20–22% in the CG. Pearson's chi-square test confirmed that no statistically significant differences between the EG and CG were observed at this stage ($\chi^2 < \chi^2_{crit}$, $p > 0.05$), indicating initial group homogeneity.

Formative and control stages

Following the implementation of digitally oriented pedagogical conditions in the EG, substantial changes were observed. According to the motivational criterion (Tables 7 and 8), the proportion of EG students with a high level of professional competence increased to 55%, while low-level indicators decreased to approximately 10%. In the CG, high-level indicators remained below 25%, and low-level indicators showed no meaningful reduction.

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Table 7.
State of formation of professional competence of respondents of the EG by the motivational criterion (formative stage of the experiment)

LEVELS	Value orientations	Communication	Self-esteem	Professional experience
High	55 %	55 %	55 %	55 %
Average	35 %	35 %	34 %	35 %
Low	10 %	10 %	11 %	10 %
TOTAL	100 %	100 %	100 %	100 %

Table 8.
State of formation of professional competence of CG respondents by motivational criterion (formative stage of the experiment)

LEVELS	Value orientations	Communication	Self-esteem	Professional experience
High	23 %	24 %	25 %	23 %
Average	41 %	42 %	41 %	43 %
Low	36 %	34 %	34 %	34 %
TOTAL	100 %	100 %	100 %	100 %

Similar dynamics were identified for the cognitive criterion (Tables 9 and 10). In the EG, high-level indicators increased to 54–57% across all cognitive components, whereas in the CG the distribution of competence levels remained close to the initial measurements.

Table 9.
State of formation of professional competence of EG respondents by knowledge criterion (formative stage of the experiment)

LEVELS	Professional knowledge	Cognitive interests	Self-regulation	Reflection
High	55 %	57 %	54 %	57 %
Average	35 %	34 %	36 %	33 %
Low	10 %	9 %	10 %	11 %
TOTAL	100 %	100 %	100	100 %

Table 10.
State of formation of professional competence of CG respondents by knowledge criterion (formative stage of the experiment)

LEVELS	Professional knowledge	Cognitive interests	Self-regulation	Reflection
High	24 %	25 %	23 %	25 %
Average	40 %	40 %	45 %	40 %
Low	36 %	35 %	32 %	35 %
TOTAL	100 %	100 %	100 %	100 %

The most pronounced changes were recorded for the creative–activity criterion (Tables 11 and 12). In the EG, high-level indicators increased to 57–58%, and low-level indicators declined to 7–9%. In contrast, the CG demonstrated minimal change, with high-level indicators not exceeding 24% and low-level indicators remaining above 30%.

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Table 11.
The state of formation of professional competence of EG respondents by the creative criterion (formative stage of the experiment)

LEVELS	Professional communication skills	Empathy	Creativity
High	57 %	58 %	58 %
Average	34 %	33 %	35 %
Low	9 %	9 %	7 %
TOTAL	100	100	100

Table 12.
State of formation of professional competence of CG respondents according to the creative criterion (formative stage of the experiment)

LEVELS	Professional communication skills	Empathy	Creativity
High	24 %	24 %	24 %
Average	44 %	43 %	44 %
Low	32 %	33 %	32 %
TOTAL	100 %	100 %	100 %

The statistical significance of the observed changes was verified using Pearson's chi-square (χ^2) test. In the EG, the calculated value ($\chi^2_{emp} = 32.45$, df = 2) exceeded the critical value at the 0.05 significance level ($\chi^2_{crit} = 7.815$), indicating statistically significant differences between the distributions before and after the intervention. In the CG, the calculated χ^2 value ($\chi^2_{emp} = 0.85$) did not reach the critical threshold ($p > 0.05$), confirming the absence of statistically significant changes under traditional training conditions.

Discussion

The results of the quasi-experimental study provide empirical evidence that the systematic integration of digital technologies within a competency-based pedagogical framework leads to measurable improvements in the professional competence of future art teachers.

The most substantial gains were observed in the creative–activity component. Pedagogically, this can be explained by the use of digital tools that expanded opportunities for creative expression, professional communication, and collaborative artistic activity. Digital platforms and interactive visual tools enabled students to engage in learning tasks that more closely resembled authentic professional situations, thereby strengthening creative and communicative competencies.

Positive dynamics in the motivational component indicate that digitally enriched learning environments contribute to the development of professional value orientations, self-confidence, and readiness for continuous professional development. These findings suggest that digitalization influences not only skill acquisition but also students' attitudes toward their future professional roles.

Improvements in the cognitive component reflect the role of digital tools combined with reflective and self-assessment practices in fostering deeper professional understanding, self-regulation, and reflection. This supports the view that digital competence functions as a structural element of professional competence rather than as an auxiliary skill.

The comparison between the EG and CG confirms that digitalization alone does not automatically improve learning outcomes. Statistically significant changes were

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observed only when digital technologies were embedded within clearly defined pedagogical conditions aligned with competence criteria and assessment procedures.

The results of the study provide clear empirical evidence that the proposed pedagogical conditions and the specialized course significantly enhanced the professional competence of future art teachers in a digitalized educational environment. The most substantial improvements were observed in the creative–activity and motivational components, suggesting that digitalization, when pedagogically structured, has a particularly strong impact on students' engagement, self-expression, and readiness for professional activity.

The pronounced growth in the creative–activity criterion can be explained by the integration of digital tools and creative tasks that expanded students' opportunities for artistic experimentation, communication, and collaborative work. This finding aligns with previous studies emphasizing the role of digital visual narratives and interactive media in fostering creative competence in art education (Gavaldon & McGarr, 2019; Gutiérrez-Cabello Barragán et al., 2021). Unlike earlier research that focused on isolated digital practices, the present study demonstrates the effectiveness of a systematic pedagogical framework that embeds digital tools within competency-oriented training (Na et al., 2024).

Improvements in the motivational component indicate that the digitalized learning environment and reflective practices contributed to stronger professional value orientations and increased awareness of the importance of continuous professional development. This result supports the conclusions of McDougald (2018), who highlight the role of integrative and socially oriented educational approaches in shaping professional identity, although the present study extends these insights specifically to pre-service art teachers within an experimental design (Zamperetti et al., 2017; Cárdenas-Pérez et al., 2016).

From a methodological perspective, the use of a quasi-experimental design, multidimensional competence assessment, and inferential statistical analysis strengthens the reliability and validity of the findings. The statistically significant differences between the EG and CG provide robust evidence that the observed changes were not incidental but resulted from the intentional implementation of pedagogical conditions and the specialized digital course.

Overall, the discussion confirms that digitalization alone does not automatically lead to improved professional competence. Rather, its educational potential is realized when digital tools are embedded within a coherent pedagogical strategy that integrates motivational, cognitive, and creative dimensions of professional training. These findings contribute to the existing literature by offering experimentally grounded evidence on how professional competence of future art teachers can be systematically developed in the context of digital transformation.

Conclusions

The results of the experimental study confirm the effectiveness of the proposed pedagogical conditions for the formation of professional competence of future teachers of art disciplines by means of digitalization. A comparative analysis of the indicators of the experimental and control groups showed statistically significant positive changes in the experimental group in all identified components of professional competence.

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The most pronounced improvement was recorded in the creative and activity component, which was manifested in the growth of the level of creativity, professional communication and empathy of future art teachers. This indicates the high potential of digital tools and creative digital tasks for the activation of artistic and pedagogical activity and the development of students' creative self-expression. Significant positive changes were also found in the motivational component, in particular in the formation of value orientations, professional motivation and conscious readiness for further professional development. The cognitive component demonstrated a steady increase in indicators of professional knowledge, self-regulation and reflection, which confirms the effectiveness of combining digitalization with methodically structured pedagogical support.

The central contribution of this study is an experimentally substantiated model of the formation of professional competence of future teachers of art disciplines, in which digital competence is considered not as an additional element, but as a structural component of professional training. Unlike previous studies, which mostly focused on individual digital tools, this work proves the effectiveness of the systematic implementation of digital pedagogical strategies within the framework of competency-based training.

However, the study has certain limitations. First, the sample included students from a limited number of higher education institutions, limiting the generalizability of the results to a wider population. Second, the diagnostic tools used, despite their validity, were partly based on self-assessment, which may affect the subjectivity of the results. Thirdly, the quasi-experimental design of the study did not provide for long-term monitoring of the stability of the formed competencies in the professional activities of graduates.

The practical consequences of the study are the possibility of using the developed pedagogical conditions and a special course in the system of training and advanced training of teachers of art disciplines. The results obtained can be used to update educational programs, develop digital pedagogical strategies, as well as to methodologically support the professional training of future teachers in the context of the digital transformation of education.

Prospects for further research are associated with expanding the sample, conducting longitudinal studies of the effectiveness of digital pedagogical strategies, as well as with an in-depth study of the training of art teachers to use innovative digital technologies (AR/VR, artificial intelligence, digital platforms for collaborative creativity) in professional activities. Of particular scientific interest is the study of the impact of digitalization on the formation of professional identity and pedagogical autonomy of teachers of art disciplines.

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