Journal of Technology and Innovation 13[31]1-16: e21331116
Article

Artificial Intelligence: Competencies for design in emerging creative environments

Inteligencia Artificial: Competencias para el diseño en entornos creativos emergentes

Rivera-Gutiérrez, Erika * [a], Higuera-Zimbrón, Alejandro [b] and Arguello, Georgina [c]

[a] Universidad Autónoma del Estado de México • AAJ-7948-2020 • 0000-0002-7851-7531 • 247442
[b] Universidad Autónoma del Estado de México • AAJ-7550-2020 • 0000-0001-6966-2721 • 22641
[c] Nova Southeastern University • JRW-7550-2023 • 0000-0002-9524-0685

Classification:

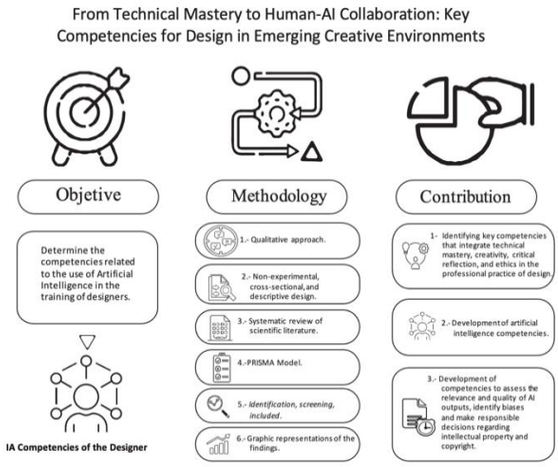
Area: Humanities
Field: Pedagogy
Discipline: Organization and planning of education
Subdiscipline: Organization and management of educational institutions

https://doi.org/10.35429/JTI.2026.13.31.2.1.16
History of the article:
Received: January 15, 2026
Accepted: March 31, 2026

* ✉ [eriverag@uaemex.mx]

Abstract

The study, titled From *Artificial Intelligence: Competencies for Design in Emerging Creative Environments*, aims to determine the competencies linked to the use of Artificial Intelligence in the training of designers, as well as to examine its impact on the professional environment. The advancement of AI has reconfigured not only the tools for design practice, but also the essential dynamics of the creative process. In emerging human-AI collaboration [HAIC] scenarios, these systems operate as cooperative agents and not merely as support tools. However, even though design students are progressively incorporating these technologies into their practice, a gap persists in the development of fundamental competencies for establishing effective interaction with these systems. Therefore, the need to strengthen disciplinary training through competencies that integrate critical interpretation, collaborative interaction, ethical and metacognitive reflection, in addition to specialized technical mastery is recognized. Based on the above, this research is structured around a comprehensive review of scientific literature, analysing studies retrieved from specialized databases in both design and higher education. The methodology will adopt the PRISMA [2021] systematic review protocol, which will ensure a rigorous process for the identification, selection, and synthesis of emerging competencies. The findings will be presented through graphic visualizations, and the discussion will incorporate relevant case studies. Ultimately, the study aims to offer an in-depth theoretical and methodological framework for future lines of research, highlighting the strategic role of AI competencies in the academic achievement and professional development of designers. These competencies are essential for overcoming limitations related to the originality, quality, and coherence of creative proposals, indispensable elements for competitive performance in educational and professional contexts.



Artificial Intelligence, Competencies, Design, Emerging Creative Environments.

Resumen

El estudio titulado *Inteligencia Artificial: Competencias para el Diseño en Entornos Creativos Emergentes,* tiene como finalidad determinar las competencias vinculadas al uso de la Inteligencia Artificial en la formación de diseñadores, así como examinar su incidencia en el entorno profesional. El avance de la IA ha reconfigurado no solamente las herramientas para la práctica del diseño, también la dinámica esencial del proceso creativo. En los escenarios de colaboración humano–IA [HAIC] emergentes, estos sistemas operan como agentes cooperativos y no únicamente como instrumentos de apoyo. No obstante, a pesar de que los estudiantes de diseño incorporan progresivamente estas tecnologías en su práctica, persiste una brecha en el desarrollo de competencias fundamentales para establecer una interacción eficaz con estos sistemas. Por ello, se reconoce la necesidad de fortalecer la formación disciplinar mediante competencias que articulen la interpretación crítica, la interacción colaborativa, la reflexión ética y metacognitiva, además del dominio técnico especializado.Con base en lo anterior, esta investigación se estructura a partir de una revisión exhaustiva de literatura científica, analizando estudios recuperados de bases de datos especializadas tanto en diseño como en educación superior. La metodología adoptará el protocolo de revisiones sistemáticas PRISMA [2021], que garantizará un proceso riguroso para la identificación, selección y síntesis de las competencias emergentes.Los hallazgos serán presentados por medio de visualizaciones gráficas, y la discusión integrará estudios de caso relevantes. En última instancia, el estudio aspira a ofrecer un marco teórico-metodológico a profundidad para futuras líneas de investigación, subrayando el papel estratégico de las competencias de IA en el logro académico y en la preparación profesional de los diseñadores. Estas competencias resultan esenciales para superar limitaciones relacionadas con la originalidad, la calidad y la coherencia de las propuestas creativas, elementos indispensables para un desempeño competitivo en contextos educativos y profesionales.

.

Inteligencia Artificial, Competencias, Diseño, Entornos Creativos Emergentes.

Area: Advocacy and attention to national problems

Citation: Rivera-Gutiérrez, Erika, Higuera-Zimbrón, Alejandro and Arguello, Georgina. [2026]. Artificial Intelligence: Competencies for design in emerging creative environments. Journal of Technology and Innovation. 13[31]1-16: e21331116.

1. Introduction

The accelerated incorporation of Artificial Intelligence [AI] into creative environments is substantially redefining the roles and responsibilities of designers, altering both the means of production and the very logic of the creative process. In the field of graphic design, AI has established itself as an operational agent capable of processing large volumes of visual information, generating formal proposals and executing complex tasks with unprecedented speed and synthesis. This technological change not only transforms modes of visual production, but also introduces new theoretical and educational challenges regarding how designers interpret, structure, and develop ideas within ecosystems influenced by algorithmic systems.

In contemporary contexts of human-AI collaboration [HAIC], artificial intelligence systems act not only as subordinate tools, but as cognitive collaborators that influence decision-making, the exploration of formal and conceptual alternatives, and even the aesthetic evaluation of proposals. This condition redefines the designer's creative agency and requires the development of skills that integrate technical, critical, and ethical aspects in a dynamic of shared responsibility with the machine. However, despite the rapid adoption of generative AI technologies by design students and professionals, a significant training gap has been identified between the instrumental use of these tools and the development of the skills necessary for effective collaboration with intelligent systems.

Various studies have documented this problem, including Ge and Fan [2024], who show that the educational paradigm surrounding AI in design is in its infancy, with a lack of curricular frameworks that define what knowledge and skills should be taught and how they should be articulated within curricula. Complementarily, Song et al. [2024] point out that human-AI collaboration processes require a set of emerging skills [the ability to interpret, negotiate, and co-evaluate results generated by intelligent systems] that are currently underdeveloped in design education. Likewise, studies by Rana et al. [2025] confirm that, without reflective and ethical training, the use of AI in educational environments tends to generate technological dependencies, loss of originality and homogenisation of creative solutions.

This evidence points to a problem in the training of designers: the gap between the demands of the professional context, increasingly mediated by AI, and the skills promoted in higher education. This situation has a direct impact on the quality and coherence of design projects, as well as on the ability of graduates to adapt to work ecosystems where artificial intelligence is an integral part of the innovation process. Educational institutions, therefore, face the challenge of redefining their training models to include a skills approach that is not limited to technical mastery of tools, but promotes critical understanding, collaborative interaction with intelligent systems, and ethical and metacognitive reflection on professional practice.

This study focuses on this emerging need and aims to identify, analyse, and categorise the AI competencies necessary for the training of designers, in order to understand their impact on academic and professional development. To this end, a systematic literature review will be conducted based on the PRISMA [2021] statement, which will ensure a process of searching, selecting, and analysing scientific sources with criteria of transparency, comprehensiveness, and methodological validity. This approach will not only map the current state of knowledge on AI skills in the field of design, but also recognise theoretical gaps and propose an integrative framework to guide future research and curricular transformations.

From an epistemological perspective, this study is based on the assumption that the absence of specific skills for human-AI collaboration limits designers' ability to generate original, coherent and ethically sound proposals. Consequently, the development of such skills should not be conceived as an instrumental extension of technological learning, but as a strategic dimension of contemporary design thinking. The identification of these competencies will make it possible to redefine the profile of the 21st-century designer, consolidating their role as a mediator between human creativity and algorithmic intelligence.

In short, this research seeks to contribute to the strengthening of the academic field of design by constructing a conceptual and pedagogical framework that responds to the demands of the current digital context.

ISSN: 2410-3993.
RENIECYT: 1702902

Rivera-Gutiérrez, Erika, Higuera-Zimbrón, Alejandro and Arguello, Georgina. [2026]. Artificial Intelligence: Competencies for design in emerging creative environments. Journal of Technology and Innovation. 13[31]1-16: e21331116.
https://doi.org/10.35429/JTI.2026.13.31.2.1.16

The systematisation of AI competencies [CIA] for designers will provide a theoretical and practical basis for curricular innovation, improved teaching and learning, and the consolidation of a more critical, ethical, and sustainable professional practice in the era of artificial intelligence. The results will be presented through graphical representations to visualise the relationships between competencies, artificial intelligence, design, creative process, critical thinking, and ethics. The discussion will highlight the contrasts between the findings and the in-depth literature review. Finally, the implications, recommendations and conclusions of the study will be presented.

2. Problem Statement

Currently, the incorporation of artificial intelligence [AI] into design practice and education has transformed the logic of creation, ideation and visual production. In this new scenario, designers' ability to interact with intelligent systems requires a set of complex skills that integrate technological understanding, critical interaction, ethical reflection, and strategic creativity. However, current empirical and theoretical evidence reveals that these skills are not yet consolidated in either educational programmes or professional design practices.

On the one hand, Imjai [2024] analyses the impact of AI skills on the capacity for innovation in entrepreneurial and design contexts, concluding that the combination of design thinking skills and technological mastery generates a synergistic effect in creative problem solving. According to the author, isolated learning of AI tools does not guarantee innovative results; on the contrary, the integration of AI into design processes requires superior cognitive skills, such as problem formulation, critical evaluation, and conceptual reinterpretation. This research supports the need to develop cross-disciplinary training in AI that enhances both creativity and analytical skills, which are essential aspects of design education.

Meanwhile, Almatrafi et al. [2024] propose a framework of AI literacy competencies. The authors identify five fundamental domains: technological knowledge, understanding of human actors in AI, mastery of the algorithmic process, user experience, and AI design competencies. This model provides a transferable basis for the field of graphic design, suggesting that effective interaction with intelligent systems requires not only technical skills, but also a deep understanding of the human, social and ethical implications of using AI. This approach is crucial for training designers who are capable of co-creating with AI in a thoughtful and responsible manner, preserving the originality and quality of their proposals.

Complementarily, Song et al. [2024] develop a conceptual framework called *Human–AI Collaboration by Design*, in which they classify the different roles that AI can play in design processes [consultant, ideator, evaluator, among others] and the human competencies required for each of them. The authors emphasise that effective collaboration with AI systems requires advanced prompting skills, critical analysis of results, multimodal communication, and conceptual iteration capabilities. This study reinforces the idea that AI skills for designers should be oriented towards the design of cognitive and creative relationships between humans and machines, rather than technical mastery of tools.

On the other hand, Svensson et al. [2024] explore the perceptions and practices of graphic design students and teachers regarding generative AI, showing that technological adoption has preceded critical and ethical training. Participants recognise benefits in terms of efficiency and visual experimentation, but also express uncertainty regarding the originality, authorship, and conceptual quality of AI-generated productions. The authors conclude that design education requires a pedagogical transformation that promotes ethical reflection, self-evaluation of the creative process, and understanding of the role of AI as a cognitive collaborator.

In view of the above, the convergence of these studies allows us to identify three critical dimensions in the training of AI skills for designers:

- **Cognitive and creative dimension**, linked to the ability to integrate design thinking and algorithmic intelligence [Imjai, 2024];
- **Structural and pedagogical dimension**, related to the curriculum design of AI skills based on technological and ethical literacy frameworks [Almatrafi et al., 2024]; and

ISSN: 2410-3993.
RENIECYT: 1702902

- **Relational and ethical dimension**, which addresses human-machine co-authorship and the need to develop critical and reflective practice [Song et al., 2024; Svensson et al., 2024].

This evidence confirms the gap between the instrumental use of AI and the development of collaborative and reflective skills in design programmes. It also reinforces the relevance of conducting a systematic review that identifies, analyses, and categorises the most relevant AI skills for designer training, in order to guide curricular innovation and strengthen professional preparation in a context where artificial intelligence is redefining the limits of creativity and authorship. Hence, this research seeks to provide a theoretical framework for understanding this transition, integrating technological, cognitive and ethical perspectives. The identification of these skills will contribute to consolidating a new educational model in design, where human-AI collaboration is conceived as a creative, critical and ethically informed process.

AI Competencies

On the one hand, Imjai [2024] explored how AI competencies and design thinking skills affect the innovation capacity of entrepreneurs/designers. He defines AI competencies *as* a multidimensional construct that brings together several interrelated components that enable individuals to apply AI strategically, efficiently and innovatively [*AI Knowledge, AI Integration, Data Curation, Continuous Learning*]. His findings identified that those with better competencies in both AI and design thinking skills achieved greater innovation capacity. Technical mastery of AI without a link to design thinking was not sufficient to maximise applied creativity. Consequently, this provides evidence that it is not enough for designers to know how to use AI: the synergy between AI and design thinking is key. Furthermore, it supports the argument that AI skills for designers must go beyond the technical.

For their part, Almatrafi et al. [2024] identified how 'AI literacy' has been conceptualised, what constructs/skills have been considered, how programmes have been implemented, and how they have been evaluated.

In this regard, they define AI literacy as an integrated set of conceptual knowledge, practical skills, critical judgement, creativity, and ethical integrity, aimed at the responsible, conscious, and productive use of AI in different contexts. They developed a content analysis to identify main themes, competency frameworks, and assessment tools. Among their findings, six key constructs in AI literacy stand out: *recognising, knowing and understanding, using and applying, evaluating, creating and navigating ethically.*

They also noted that most efforts are in the early stages of implementation, with little standardisation. Therefore, they highlight a broad framework that can be adapted to the context of graphic design to define AI competencies. In addition to reinforcing the need to systematise what 'AI competency' means for designers.

Also, Song et al. [2024] propose a conceptual framework for human-AI collaboration in design processes, identifying the roles that AI can assume and the competencies that designers must develop to collaborate effectively with those AI roles. These authors define AI competencies as those competencies that involve not only its technical ability to generate outputs [ideas, forms, data], but also its ability to collaborate dynamically, interact, adapt to the human context, and support creativity, conceptual exploration, and innovation. Their study focused on conceptual research with literature analysis, identification of role categories for AI [e.g., consultant, ideator, evaluator], and mapping of human competencies alongside each role.

Among their findings, they establish that AI can play different roles in the design process, and each role requires different competencies [e.g., advanced prompting, critical evaluation of outputs, iterative refinement, human-machine communication]. Furthermore, they highlight that 'collaborating with AI' is not the same as 'using AI': it requires negotiation, co-responsibility, and interpretation of algorithmic results. In this sense, this study directly articulates the idea of human-AI collaboration [HAIC] and the specific skills that emerge from that paradigm. On the other hand, Svensson et al. [2024] focused on investigating how graphic design students and teachers perceive and use generative AI tools in higher education settings, and what pedagogical implications emerge.

ISSN: 2410-3993.
RENIECYT: 1702902

It is worth mentioning that the authors define AI competencies as a hybrid set of technical knowledge, critical thinking, ethical competence, and creative integration skills. Their results show that, although students use AI tools for visual experimentation, they reported a lack of training in critical aspects such as evaluation of generated results, authorship ethics, conceptual coherence, and reflection on the creative process with AI. Teachers pointed out that there were still no clear frameworks for AI skills in design curricula. Hence, their work confirms 'in the field' what other studies suggest theoretically: that the adoption of AI without adequate training in specific skills can compromise the originality, critical judgement, and professional quality of design.

Application of AI Skills

Currently, studies on AI skills in higher education students and professionals in different fields have gained importance due to their potential to improve academic and professional outcomes, and design is no exception. Therefore, this literature review considers recent scientific studies that address the training and development of AI skills in the field of design, providing a general framework for understanding these essential skills for designers.

On the one hand, Santana [2023] comprehensively analyses the literature on the skills required to implement and leverage artificial intelligence [AI] in organisations. The research shows a systematisation of AI skills and abilities, highlighting the most important, basic, specialised and emerging topics, and providing an analysis of performance measures in this field. In addition, it is argued that the organisational challenge is to achieve a workforce with the necessary digital skills and to adapt human resource management practices to the challenges of AI.

Meanwhile, Yifat et al. [2024] argue that generative artificial intelligence [GenAI] is rapidly impacting all aspects of human life. Therefore, the authors develop and validate an AI competency framework tailored to teachers and students, with an emphasis on co-creation between researchers and teachers, highlighting the participation of teachers in the design process, ensuring the alignment of the framework with real-world educational practices.

This framework identifies four key skills: identification of AI mechanisms and how they work; effective and informed use of AI; AI agency: proactive and value-generating use of AI; and ethical use of AI, each with specific skills and components. It also describes the values, attitudes, and knowledge necessary to engage AI in education, with the aim of preparing teachers and students for a world saturated with AI.

For their part, Portocarrero Ramos et al. [2025] point out that artificial intelligence [AI] has established itself as a disruptive technology that redefines professional profiles and the skills required in the labour market.

Given this scenario, their study analysed the level of AI skills and their relationship with the employability of university students. Through a quantitative descriptive design, it was identified that greater mastery and regular use of AI tools is associated with better opportunities for entry into fields related to their areas of training. Likewise, a generational gap in digital skills and a perception of insufficient preparation for the current demands of the professional environment were evident. The authors conclude that AI skills are a decisive factor for employability, making their formal integration into university curricula a matter of urgency.

On the other hand, Smith et al. [2025] address the challenge posed by limited AI literacy among the general public, a condition that hinders their effective participation in the co-design of intelligent systems. To address this issue, the authors develop a card-based AI literacy toolkit aimed at informing non-technical audiences and stimulating idea generation. The kit incorporates 16 competencies derived from the conceptual framework of AI literacy and uses prompts designed to promote reflective questioning, in line with design-based approaches. The results show significant improvements in the quality of critical feedback and in the diversity of questions asked about AI after its use. These findings highlight the potential of AI literacy tools to strengthen the participation of non-technical audiences in the co-design of intelligent systems, contributing to more inclusive, informed and collaborative processes. Finally, Chulvi [2025] shows that Artificial Intelligence [AI] is establishing itself as a highly relevant tool in product design, due to its creative potential and the advantages it offers to design professionals.

ISSN: 2410-3993.
RENIECYT: 1702902

Rivera-Gutiérrez, Erika, Higuera-Zimbrón, Alejandro and Arguello, Georgina. [2026]. Artificial Intelligence: Competencies for design in emerging creative environments. Journal of Technology and Innovation. 13[31]1-16: e21331116.
https://doi.org/10.35429/JTI.2026.13.31.2.1.16

In this context, his study examines the use of various design methodologies by AI systems for the generation of creative concepts, with the aim of understanding how designers can integrate AI as an assistant in the design process and select the most appropriate methodologies according to the project's objectives.

The results revealed significant variations in the levels of creativity achieved depending on the methodology used, as well as differences associated with the degree of complexity of the problem. These findings provide evidence for the development of AI assistants aimed at designers, as well as for the creation of AI-based tools that support conceptual design in a collaborative manner.

Based on the findings of each of the studies and the critical dimensions in the formation of AI skills for designers, the following AI skills are identified [see Table 1].

Box 1

Table 1

Competencies/dimensions

No	Competency/ Dimension	Imjai (2024).	Almatrafi et al. (2024).	Song et al. (2024).	Svensson et al. (2024).	Additional Studies 2022–2025
1	**Technical Proficiency in AI / Usage Skills**	Use of generative AI tools	Technological knowledge, AI processes	Prompting, output refinement	Tool use, but superficial	Basic and advanced technical skills (Portocarrero Ramos, 2025).
2	**Critical Thinking / Evaluation of Results**	Evaluation of generated ideas	Evaluate and judge AI results	Critical evaluation of AI outputs	Lack of training in evaluation	Impact and quality assessment (Chulvi, 2025).
3	**Creativity and AI-Integrated Design**	Design thinking + AI	Create / generate ideas with AI	Co-creation with AI	Recognized but poorly trained	Applied design methods with AI (Chulvi, 2025).
4	**Human–AI Interaction / Collaboration**	Partial	User experience / interaction	Effective collaboration based on AI role	Reported as absent or weak	Co-creation frameworks with users (Smith et al., 2025).
5	**Ethics / Responsibility / Reflexivity**	Partial	Navigating ethically	Co-responsibility in outputs	Ethical reflection almost non-existent	Ethical considerations in AI competencies (Filo et al., 2024; Portocarrero Ramos, 2025).
6	**Metacognition / Reflection on Creative Process**	Partial	Understanding human actors and processes	Reflection on iteration and decisions	Absent in practice	AI literacy and reflection on results (Smith et al., 2025).
7	**Innovation / Employability**	Improves innovation capacity	Partial	Partial	Impact on employability and professional readiness	Impact on employability and professional readiness (Portocarrero Ramos, 2025).
8	**Adaptability / Continuous Learning**	Partial	Navigating in AI environments	Adjusting strategies based on AI role	Partial	Emerging competencies and adaptive learning (Mejeh & Rehm, 2024).

Note: Prepared by the author.

A review of recent studies reveals significant overlaps in the technical domain of AI, critical thinking, and creativity assisted by intelligent systems, competencies that appear consistently in most research. Likewise, human-AI interaction and effective collaboration are particularly highlighted in the work of Song et al. [2024] and in various publications from 2024 and 2025. However, significant gaps remain: the ethical dimension and metacognitive reflection continue to be insufficiently addressed, as pointed out by Svensson et al. [2024], while adaptability and continuous learning in AI-mediated environments, although recognised as fundamental, are rarely integrated in a structured way into training programmes.

Finally, recent studies [Portocarrero Ramos, 2025] emphasise that the development of AI skills has a direct impact on the employability and professional preparation of future graduates, reinforcing the need to strengthen these components in current training through programme curriculum design.

Based on the above, there is a clear need to determine the skills related to the use of Artificial Intelligence in the training of designers, as well as to examine their impact on the professional environment. The studies analysed provide a theoretical framework on AI skills, including question formulation, methodological structure, data collection and analysis, and effective communication of findings. The implementation of these competencies in design curricula will not only contribute to the academic training of students and future professionals, but will also enhance their ability to innovate and lead in the field of design.

To achieve the purpose of the study, the focus will be on questions that offer a precise and direct understanding of current competencies, the factors involved in their development, and their influence on the academic and professional performance of designers. Within this framework, the research question that guides the study is presented. *What artificial intelligence skills are essential for graphic designers to collaborate effectively with generative AI systems in creative, critical, and ethical processes?* This question will offer a broad perspective for designing effective strategies that strengthen creative and design training, thereby optimising academic performance within design programmes.

3. Method and Materials

To address the identified problem, the research is conducted using a qualitative approach, adopting a non-experimental, cross-sectional and descriptive design [Hernández-Sampieri & Mendoza, 2020]. This methodological choice allows for an in-depth and contextualised examination of artificial intelligence [AI] skills, the creative process, artificial intelligence and ethics, without altering or interfering with the natural conditions of the phenomenon under study. This ensures a holistic understanding of the educational and professional context, aligned with the principles of competency-based design.

ISSN: 2410-3993.
RENIECYT: 1702902

Rivera-Gutiérrez, Erika, Higuera-Zimbrón, Alejandro and Arguello, Georgina. [2026]. Artificial Intelligence: Competencies for design in emerging creative environments. Journal of Technology and Innovation. 13[31]1-16: e21331116.
https://doi.org/10.35429/JTI.2026.13.31.2.1.16

To address this, a *Systematic Literature Review* [SLR] will be conducted based on a rigorous search of scientific studies, including research and articles related to AI competencies in Design. The SLR will be structured according to the PRISMA [Preferred Reporting Items for Systematic Reviews and Meta-Analyses, 2021] model, which facilitates the identification of recent information through clearly defined criteria and allows each source to be analysed to ensure the relevance and accuracy of the process [Page et al., 2021]. This review will aim to answer the research question related to the phenomenon under study. The choice of this method responds to the need to establish a solid empirical framework that synthesises current knowledge on the subject, reducing bias and ensuring the transparency and reproducibility of the process.

According to Hernández-Sampieri [2018], the design of a RSL emphasises the application of systematic steps for data analysis, based on the procedure of Corbin and Strauss [2008]. Thus, an exhaustive search and analysis of primary sources will be carried out to provide diverse perspectives to strengthen the study. The central question guiding this review is: What artificial intelligence skills are essential for graphic designers to collaborate effectively with generative AI systems in creative, critical, and ethical processes? The RSL was structured around three stages: *identification, screening, and inclusion* [PRISMA, 2021]:

· ***Identification***

An exhaustive literature search was conducted in the *Web of Science,* ERIC, *Redalyc*, *Dialnet*, *ProQuest*, SciELO, and *Google Scholar databases.* The following words were considered: competencies [‘*competences*’], artificial intelligence [‘*artificial intelligence*’], design [‘*design’],* competencies for the use of artificial intelligence [‘*artificial intelligence competence’ OR ‘artificial intelligence skills’ OR ‘core* competencies’], artificial intelligence competencies for design, and artificial intelligence competencies in higher education [‘*artificial intelligence skills for design*’ *OR ‘artificial intelligence skills in higher education’ OR ‘undergraduate’ OR ‘student university’ OR “college”*], creativity and artificial intelligence *[‘creativity and artificial intelligence’*], creative process and artificial intelligence [*‘creativity process and artificial intelligence’],* critical thinking [*‘critical thinking’]*, and ethics [‘*ethics*’].

The filters were: year of publication [studies published between 2015 and 2025]; publication stage [research in the final stage]; language [Spanish and English]. Based on the application of the filters, 50 publications were considered in Web of Science, 20 in Scielo and 35 in Redalyc. Of the 150 articles identified, 45 were eliminated because they were duplicates.

· ***Screening***

From the 105 articles in the previous stage, studies were selected according to the keywords contained in both the title and the abstract. As a result, 45 studies that did not meet the criteria were eliminated. In line with the purpose of the RSL, precise inclusion and exclusion criteria were established. The inclusion criteria included: a] empirical studies developed using qualitative, quantitative or mixed approaches; b] research carried out in the field of higher education; and c] works that explicitly addressed AI skills. In contrast, the exclusion criteria considered: a] theoretical articles, systematic literature reviews, and meta-analyses; b] studies conducted in contexts outside higher education; and c] works in which AI skills were not the central variable of analysis. Based on these criteria, 42 documents were discarded.

· ***Included***

Subsequently, and in line with the objective of the RSL, inclusion and exclusion criteria were established. Based on the available information, four researchers carried out the evaluation of the systematic review process, without identifying any discrepancies in their opinions.

Additionally, a fifth researcher was brought in to analyse the risk of bias using the PRISMA [2021] digital checklist, with the aim of assessing the quality and relevance of the information selected for the study.

The flowchart below summarises the stages of the process, showing the three methodological moments that structure the SRP [see Figure 1].

ISSN: 2410-3993.
RENIECYT: 1702902

Box 2

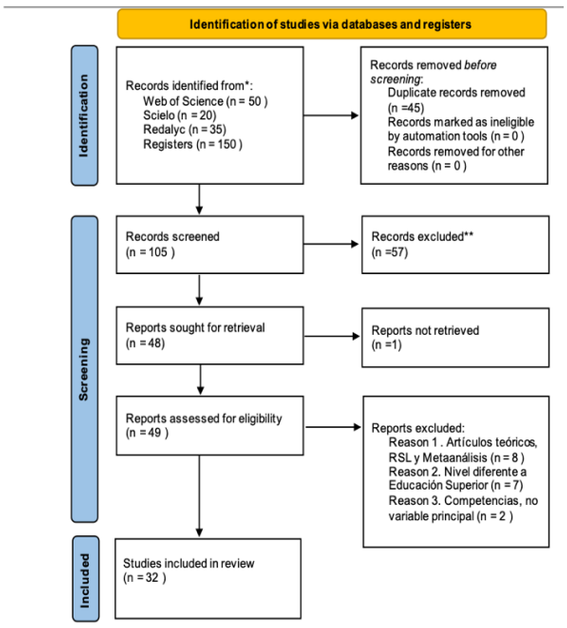


Figure 1

Flowchart of the article selection process

Note: Prepared internally. Adapted from the PRISMA [2021] flowchart.

Next, a systematic procedure was established for extracting information from the studies included in the RSL. To this end, the criteria that structured the extraction matrix were defined [see Table 2]. In the first phase, essential information was collected from each document in order to identify relevant data. Subsequently, this information was reviewed and verified to ensure the consistency, accuracy, and reliability of the records obtained.

Box 3

Table 2

Extraction matrix criterio

Criterion	Description
ID	Identification number of the study.
Citation	Surname of author(s) and year of publication of the study.
General Data	Country where the study was developed and disciplinary area.
Objective/Purpose	Objective of the study/Purpose of the study.
Theoretical Framework	Surname of author(s) and year of publication / Operationalization into dimensions or domains of research competencies.
Modalities	Instructional modalities for the development of research competencies.
Findings	Main findings regarding Research Competency (RC).
Recommendations	Future studies.

Note: Prepared by the author

4. Results

Based on the purpose of the study, to determine the skills linked to the use of Artificial Intelligence in the training of designers, as well as to examine its impact on the professional environment and the research question: What artificial intelligence skills are essential for graphic designers to collaborate effectively with generative AI systems in creative, critical, and ethical processes? the results of the 32 studies included in the RSL and the identification number [ID] of each one are presented, as well as the link to Design [see Table 3].

Box 4

Table 3

Coding of studies included in the RSL

ID	APA Reference	Country	Connection to the Design Field: AI Competencies for Designers
1	Almatrafi et al. (2024)	Arabia Saudita	Technical proficiency to use and create tools; Creativity in conceptualization; Ethics in use.
2	Fleischmann (2024)	Australia	Need for critical and technical training for the creative use of AI in design.
3	Rezwana y Maher (2022)	Australia	Collaboration with AI as a creative partner in the UX design process.
4	Husted Ramos et al .(2024)	Mexico	Technical proficiency to integrate AI in prototyping and project management.
5	Vaitiekunas (2024).	Brazil	Development of critical thinking to demystify and evaluate the use of AI in digital design.
6	Guillen (2025)	Chile	Technical proficiency in prompting and creativity linked to semiotic thinking for design generation.
7	Chen et al. (2025)	China	Creativity expanded by AI, maintaining human agency and technical proficiency.
8	Li et al. (2023)	China	Assisted creativity, but requiring technical proficiency and a critical vision of control.
9	Liu (2025)	China	Promotion of collaboration to define roles in co-creative design processes.
10	Song et al. (2024)	China	Collaboration with AI defining roles; Technical proficiency and critical thinking to evaluate.
11	Tang et al. (2025)	China	Strategies to maintain creative agency, critical sense, and project management.
12	Yang et al. (2024)	China	Development of technical capacity to formulate prompts and critical vision to interpret AI outputs.
13	Musafa (2023)	China	Creative use of AI with emphasis on ethical supervision in graphic design.
14	Morocho et al. (2025)	Colombia	Integration of ethics and technical skills in the design curriculum.
15	Heung (2025)	South Korea	Emphasis on ethical reflection and collaboration (communication) in design.
16	Carolus et al. (2023)	Germany	Need for a technical and critical-ethical standard in designer training.
17	Schauer et al. (2025)	Germany	Enhance technical and critical confidence in the creative use of AI.
18	Ghosh (2025).	Germany	Deepening critical-ethical thinking to identify and mitigate biases in design.
19	Dall'asta (2025)	USA	Integrate critical reflection, technical skills, and creative use into the design curriculum.
20	Mikalef et al. (2023).	Norway	Acquisition of management and ethical competencies in AI-assisted design projects.
21	López et al. (2024)	Spain	Urgency to standardize ethical training in AI use.
22	Berretta et al. (2023)	Italy	Foster collaboration, communication, and ethics in human-AI interaction.
23	Ranieri et al. (2024)	Italy	Measurement of technical and ethical literacy, fundamental for designers.
24	Beneito-Martí (2024).	Spain	Creativity in design is enhanced with AI-assisted ethical reflection.
25	Rondon-Morel et al. (2024)	Peru	Inclusion of technical skills, critical thinking, and curricular management of AI.
26	Mendoza et al. (2025)	Mexico	Need to strengthen the technical proficiency of designers in AI tools.
27	Sattele et al (2023)	Mexico	Creative use of AI in ideation, warning about dependency and critical control.
28	López-Fornies & Asión-Suñer (2024).	Argentina	Creativity is a competency that can be enhanced with guided AI use.
29	Piontkewicz et al. (2023).	Brazil	Technical and critical literacy in AI is mandatory for the professional profile.
30	Ivković et al. (2025).	Serbia	Need for risk management and critical-ethical vision for legal responsibility in design.
31	Weber – ICIS (2024)	Switzerland	Collaboration with AI to generate a creative stimulus in design.
32	Martsenyuk et al. (2024)	Ukraine	Definition of technical and critical thinking levels for training.

Note: Prepared by the author

According to the country where the studies were conducted, both Mexico and China have the highest average scientific output [Σ19.5%], followed by Germany, Brazil, Spain, Italy, and Australia [Σ7.6%]. The highest output is seen in the Americas [35%] and Europe [33%] [see Table 4].

ISSN: 2410-3993.
RENIECYT: 1702902

Rivera-Gutiérrez, Erika, Higuera-Zimbrón, Alejandro and Arguello, Georgina. [2026]. Artificial Intelligence: Competencies for design in emerging creative environments. Journal of Technology and Innovation. 13[31]1-16: e21331116.
https://doi.org/10.35429/JTI.2026.13.31.2.1.16

Box 5

Table 4

Region and country of scientific production

Region	Country	ID	n	%
Americas				
	Brazil	4, 29	2	*7%*
	Chile	6	1	*3%*
	Colombia	14	1	*3%*
	USA	19	1	*3%*
	MExico	4, 26, 27,	3	*8%*
	Peru	25	1	*3%*
	Argentina	28	1	*3%*
Asia				
	Arabia Saudita	1	1	*3%*
	China	7, 8, 9, 10, 11, 12, 13	7	*22%*
	South Korea	15	1	*3%*
Europe				
	Germany	16, 17, 18	3	*9%*
	Norway	20,	1	*3%*
	Spain	21,24	2	*7%*
	Italy	22, 23	2	*7%*
	Serbia	30	1	*3%*
	Switzerland	31	1	*3%*
	Ukrein	*32*	1	*3%*
Oceanía				
	Australia	*2, 3*	2	*7%*
Total		32	32	*100%*

Note: Prepared by the author

With regard to the disciplinary area, 18 of the 32 studies identified that students from various disciplines participated. The studies focus on the social sciences [35.5%], followed by arts, design and humanities [25.8%], and technology and engineering [19.4%]. The rest are distributed across the areas of economics, administration and education [see Table 5].

Box 6

Table 5

Disciplinary area in studies

Disciplinary Area	Sub-discipline	ID	n	%
Technology and Engineering	Computer Science / HCI / Prototyping / Engineering	3, 22,4	3	19.4 %
Education	Digital competencies / Technology / Educational Technology / Curricular innovation	29,23,1,16,11,14,17, 26, 32, 2, 5	11	6.4 %
Economics and Administration	Project Management	20	1	9.6 %
Social Sciences	Ethics / Communication / Educational ethics / Philosophy / Ethics / Public policy	15, 21,18, 30	4	35.5 %
Arts, Design, and Humanities	Co-creation / Creativity / AI / Design / Generative AI / Innovation / Digital design / Graphic design / Semiotics / Generative design	9, 27, 28, 2,12, 7, 31, 5, 13, 6	10	25.8 %
Total			32	100 %

Note: Prepared by the author

Of the 32 studies, only 6 [19.3%] consider a theoretical framework for conceptualising AI competencies [CIA]. Meanwhile, the documents that do not present one focus on defining CIA and subsequently operationalising them [see Table 6].

Box 7

Table 6

Theoretical framework for the conceptualisation of CIA

Theoretical Frameworks	ID	n	%
Studies that present a theoretical framework	5, 7, 13, 22, 24, 29	6	19.3
Studies that do not present one	1, 2, 3, 4, 6, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 23, 25, 26, 27, 28, 30, 31	25	80.6
Total		32	100

Note: Prepared by the author

Research Question

What artificial intelligence skills are essential for graphic designers to collaborate effectively with generative AI systems in creative, critical, and ethical processes? This question guides the identification of key skills that integrate technical mastery, creativity, critical reflection, and ethics into professional design practice. Therefore, based on the four dimensions mentioned above, the findings clearly show the AI skills for designers, breaking them down into specific skills that can be assessed or developed in academic and professional training [see Table 7].

Box 8

Table 7

Artificial intelligence skills for designers

Dimension	Specific Competencies
Technical AI Proficiency	• Manage generative AI tools for graphic design (DALL·E, MidJourney, Adobe Firefly). • Understand basic principles of algorithms used in design (machine learning, neural networks, image generation). • Apply AI techniques for the production of visual elements, prototypes, and creative solutions. • Integrate AI into design workflows, optimizing time and resources. • Resolve technical problems related to the implementation of AI tools in design projects.
Creativity and AI-Integrated Design	• Combine design thinking with AI-assisted content generation for original proposals. • Explore multiple conceptual solutions through iterations with AI. • Use AI as a co-creator while maintaining aesthetic and functional coherence. • Integrate AI-generated results while respecting the project's conceptual vision. • Adapt and customize AI outputs to enrich the visual narrative and user experience.
Critical Thinking and Ethical Reflection	• Critically evaluate AI-generated results, identifying errors, biases, or inconsistencies. • Make informed decisions regarding the relevance and use of AI-produced outputs. • Reflect on ethical implications associated with authorship, intellectual property, and social responsibility. • Incorporate sustainability and social justice criteria into AI usage. • Maintain a critical stance toward the limits of automation, preserving human originality.
Human–AI Collaboration and Professional Adaptability	• Interact effectively with AI systems through precise prompting and iterative adjustments. • Co-create innovative solutions by combining human creativity and algorithmic capacity. • Adapt to new tools, technologies, and emerging methodologies in graphic design. • Manage design projects that integrate AI, coordinating multidisciplinary teams and technological resources. • Learn autonomously and continuously about AI advances applied to design and integrate them into professional practice.

Note: Prepared by the author

ISSN: 2410-3993.
RENIECYT: 1702902

Rivera-Gutiérrez, Erika, Higuera-Zimbrón, Alejandro and Arguello, Georgina. [2026]. Artificial Intelligence: Competencies for design in emerging creative environments. Journal of Technology and Innovation. 13[31]1-16: e21331116.
https://doi.org/10.35429/JTI.2026.13.31.2.1.16

The results of this review consistently show that the absence of a clear training framework on artificial intelligence [AI] skills in the field of graphic design constitutes a critical gap for the academic and professional development of future designers. The identification and systematisation of skills related to technical mastery, AI-assisted creativity, critical-ethical thinking, and human-machine collaboration demonstrates that contemporary design practice requires deeply integrated skills and not just instrumental knowledge.

Likewise, the findings directly answer the research question by confirming that effective collaboration with generative AI systems depends on the designer's ability to understand how algorithms work, manipulate them creatively, evaluate their ethical implications, and adapt to hybrid processes where human agency and algorithmic capacity converge. Taken together, these results provide a solid basis for guiding curricular transformations and designing educational strategies that enable designers to operate with rigour, creativity, and responsibility in a professional environment marked by the growing presence of AI.

5. Discussion and Conclusions

The findings show that the integration of generative AI systems in the field of graphic design requires a set of multidimensional skills that current educational programmes do not yet systematically incorporate. The absence of specific skills for interacting with AI tools limits the ability of design students and professionals to harness the full creative potential of these technologies, affecting the originality, relevance and quality of their proposals. The literature indicates that essential competencies go beyond technical mastery, including the ability to generate AI-assisted ideas, adapt generated outputs, and articulate a hybrid human-machine workflow that enhances creativity without replacing the designer's professional judgement.

This finding highlights the need to rethink curricula to explicitly integrate creative, critical, and technical competencies, fostering learning that links technological knowledge with strategic and aesthetic thinking.

Therefore, the RLS suggests that ethical and critical competencies are a fundamental pillar for effective collaboration with generative

AI systems. Designers must develop skills to evaluate the relevance and quality of AI outputs, identify biases, and make responsible decisions regarding intellectual property and copyright. This implies that training cannot be limited to software management but must promote critical and ethical awareness to guide the application of AI in professional and academic contexts. Consequently, design programmes that integrate these competencies not only prepare students to use AI efficiently, but also strengthen their ability to generate creative solutions that are responsible and consistent with the ethical and professional standards of graphic design.

Based on the purpose of the study and the research question, the following proposal for AI competencies for designers is presented:

A. Technical mastery of AI

This dimension refers to the designer's ability to handle generative AI tools and systems, understand the technical fundamentals of the algorithms involved [machine learning, neural networks, automatic image/text generation] and apply these technologies within graphic design processes [from ideation to the production of deliverables].

In the context of design, this means that professionals must not only “use” AI as a black box, but also understand it sufficiently to integrate it in a controlled manner into their workflow, adapt parameters, interpret results and correct deviations. According to Martsenyuk et al. [2024] and Tang et al. [2025], technical competence [e.g., model knowledge, evaluation, data preprocessing] is an essential foundation for developing higher-level skills.

Furthermore, Yang et al. [2024] analysis of the interaction between designers and AI tools identifies that many design professionals lack the technical knowledge necessary to collaborate effectively with intelligent systems. This dimension therefore serves as a foundation: without it, the other competencies [integrated creativity, critical thinking, human-AI collaboration] cannot be fully developed.

ISSN: 2410-3993.
RENIECYT: 1702902

Rivera-Gutiérrez, Erika, Higuera-Zimbrón, Alejandro and Arguello, Georgina. [2026]. Artificial Intelligence: Competencies for design in emerging creative environments. Journal of Technology and Innovation. 13[31]1-16: e21331116.
https://doi.org/10.35429/JTI.2026.13.31.2.1.16

B. Creativity and integrated design with AI

This dimension groups together the skills that enable designers to combine design thinking, idea generation and conceptual exploration with the assistance of AI, while maintaining the originality and aesthetic and functional coherence of their proposals. Here, AI is not just an automation tool, but a co-creator that amplifies the professional's creative capacity. Chen et al. [2025] describe how AI can enhance the conceptual process and generate a diversity of ideas, but requires humans to redirect, refine and select in order to achieve creative quality. Similarly, Shi et al. [2023], in their analysis of collaboration between designers and AI, point out that AI-mediated creativity requires skills in iteration, refinement and a mixture of traditional and algorithmic methods. Therefore, this dimension implies that designers must not only master AI technically, but also integrate it as part of the conceptual design process, maintaining aesthetic and conceptual control and exploiting AI for innovation without losing the identity of the project.

C. Critical thinking and ethical reflection

This dimension addresses the designer's ability to critically evaluate the results generated by AI systems**,** make informed decisions about what to use and how to use it, and act with ethical responsibility in the visual, creative, and professional context.

This includes issues such as authorship, intellectual property, algorithmic biases, transparency, sustainability, and social responsibility. Yoo et al. [2023] in their review of human-AI collaboration competencies identify AI ethics and socio-cultural values as one of the key areas of competence.

Furthermore, Berretta et al. [2023] in their scoping review on human-AI teaming emphasise the need for a socio-technical approach, where AI is considered a member of the team and the professional must understand the social, trust and adaptability implications. Therefore, this dimension requires designers to take on a reflective role: not only ‘producing with AI’ but also evaluating, arguing decisions, identifying risks of automation or homogenisation, and ensuring that their creative practice preserves the values inherent to design.

D. Human-AI collaboration and professional adaptability

Finally, this dimension refers to the designer's ability to interact effectively with intelligent systems, co-create innovative solutions alongside AI, adapt to technological changes, manage new methodologies, and respond to emerging market demands.

In this sense, human-AI collaboration transcends the use of tools: it involves the design of hybrid workflows, dynamic roles, and continuous learning. Rezwana and Maher [2022] show that when AI communicates and collaborates interactively [rather than just receiving instructions], it improves the user experience and the sense of *creative partnership* in the human-AI system. Likewise, Donghua and Shen [2025] point out that although AI is evolving, collaboration models are still in an emerging phase and require humans to adapt their roles, communication skills, and work processes.

Therefore, this dimension requires designers not only to incorporate AI as a tool, but also to position themselves as facilitators/co-creators in a hybrid environment, to continuously learn and adapt, and to manage their professional practice in a context of rapid change.

6. Implications and Recommendations

Particularly in a context where generative artificial intelligence is redefining creative processes and professional dynamics. The absence of structured AI skills within educational programmes limits designers' ability to actively participate in technology-mediated creative, critical, and ethical processes. As UNESCO [2023] and Leong and Zhang [2025] point out, AI literacy is an essential component of ensuring safe, critical, and meaningful participation in advanced digital environments.

Furthermore, Fadiman [2024] and Syed and Asia [2025]. emphasise that human-AI collaboration requires not only technical skills [such as prompt engineering and the interpretation of algorithm-generated outputs], but also critical and ethical competencies that enable the evaluation of the quality, relevance and possible biases in the results generated.

ISSN: 2410-3993.
RENIECYT: 1702902

Rivera-Gutiérrez, Erika, Higuera-Zimbrón, Alejandro and Arguello, Georgina. [2026]. Artificial Intelligence: Competencies for design in emerging creative environments. Journal of Technology and Innovation. 13[31]1-16: e21331116.
https://doi.org/10.35429/JTI.2026.13.31.2.1.16

In this regard, educational institutions must recognise that the integration of AI skills is not optional, but fundamental to strengthening the creativity, autonomy and professional judgement of future designers.

Based on these findings, it is recommended that design education programmes adopt curricular strategies that explicitly and progressively incorporate the competencies identified in this study. UNESCO [2023] proposes the adoption of AI competency frameworks that articulate technical knowledge, ethical understanding, and analytical skills, which are essential elements for a comprehensive approach. Similarly, Dai et al. [2023] and Kim et al. [2023] emphasise the need to promote learning experiences that allow students to interact directly with AI tools in real projects, critically evaluating their usefulness and limitations. This involves developing specific subjects on AI for design, integrating cross-cutting modules on digital ethics, copyright and critical algorithm analysis, and encouraging collaborative human-machine practices that strengthen informed creativity.

Finally, it is recommended to promote teacher training programmes and lines of research that evaluate the impact of these skills on academic and professional performance, in order to build a more robust educational ecosystem that is aligned with technological transformations in the field of design.

7. Conclusions

The findings highlight the absence of specific skills in artificial intelligence [AI], which represents a critical challenge for the training of graphic designers. The ability to collaborate effectively with generative AI systems does not depend solely on technical mastery of the tools, but on a set of multidimensional skills that integrate creativity, critical thinking, ethical judgement, and strategic abilities. UNESCO [2023a] has highlighted the need to integrate AI skills into educational programmes, noting that "the integration of AI learning objectives into curricula is crucial for students to engage safely and meaningfully with AI. Furthermore, Fadiman [2024] and Federiakin et al. [2024] emphasise the importance of developing skills in writing precise instructions to guide AI, as well as in critically evaluating the results generated, to ensure responsible and effective professional practice.

Likewise, the systematisation of AI competencies for designers not only has an impact on academic development, but also strengthens professional practice, promoting creative and ethically responsible solutions. The reviewed literature indicates that designers must develop skills to evaluate the relevance and quality of AI outputs, identify biases, and make responsible decisions regarding intellectual property and copyright.

For their part, Kim et al. [2023] and Dai et al. [2023] emphasise that AI competence enables designers to understand, use and critically evaluate AI tools, facilitating informed and productive decision-making in the implementation of AI in their creative processes.

In short, it is confirmed that training in AI skills is essential to consolidate a holistic professional design practice capable of integrating human and artificial intelligence into a creative, critical and ethical framework aligned with contemporary design standards.

Declarations

Conflict of interest

The authors of this article declare that they have no conflict of interest. They have no known competing financial interests or personal relationships that could have appeared to influence the article reported herein.

Contribution of the authors

The contribution of each researcher to each of the points developed in this research was defined as follows:

Rivera-Gutiérrez, Erika: Development of the study focused on the topic addressed, defining the problem statement, study context, purpose, review of scientific literature, methodological design, implementation, results and discussion.

Higuera-Zimbrón, Alejandro: Review of scientific literature, implementation of the methodological design and discussion.

Argüello, Georgina: Data collection and analysis.

ISSN: 2410-3993.
RENIECYT: 1702902

Rivera-Gutiérrez, Erika, Higuera-Zimbrón, Alejandro and Arguello, Georgina. [2026]. Artificial Intelligence: Competencies for design in emerging creative environments. Journal of Technology and Innovation. 13[31]1-16: e21331116.
https://doi.org/10.35429/JTI.2026.13.31.2.1.16

Availability of data and materials

The data obtained in this research are available.

Funding

The research did not receive any funding.

Abbreviations

HAIC. Human–AI collaboration

IA. Artificial Intelligence

ID. Identification Number

CIA. AI skills

RSL. Systematic Review of Literature

PRISMA *Preferred Reporting Items for Systematic Reviews and Meta-Analyses*

References

Antecedents

Almatrafi, O., Almutairi, A., & Albugami, S. [2024]. A systematic review of AI literacy frameworks: Towards a comprehensive competency model. *Computers & Education: Artificial Intelligence*, 6, 100196.

Chulvi, V. [2025]. Effectiveness of the AI using different typologies of design methods. *Res Eng Design 36*, 7.

Filo, Y., Rabin, E., & Mor, Y. [2024]. *An artificial intelligence competency framework for teachers and students: Co-created with teachers*. *European Journal of Open, Distance and E-Learning, 26*[s1], 93–106.

Ge, P., & Fan, F. [2024]. *A systematic review of the role of AI [Artificial Intelligence] in design education*. En H. Grierson, E. Bohemia & L. Buck [Eds.], *Proceedings of the 26th International Conference on Engineering & Product Design Education [E&PDE 2024]* [pp. 103-108]. The Design Society.

Imjai, N. [2024]. The influence of AI competency and design thinking skills on innovation capacity. *Frontiers in Education*, 9, 1383374.

Mejeh, M. & Rehm, M. [2024]. Taking adaptive learning in educational settings to the next level: leveraging natural language processing for improved personalization. *Education Tech Research Dev* 72, 1597–162.

Portocarrero Ramos, H. C., Cruz Caro, O., Sánchez Bardales, E., Quiñones Huatangari, L., Campos Trigoso, J. A., Maicelo Guevara, J. L., & Chávez Santos, R. [2025]. Artificial intelligence skills and their impact on the employability of university graduates. *Frontiers in Artificial Intelligence*, *8*, 1629320.

Rana, V., Verhoeven, B., & Sharma, M. [2025]. Generative AI in design thinking pedagogy: Enhancing creativity, critical thinking, and ethical reasoning in higher education. *Journal of University Teaching & Learning Practice*, *22*[4].

Santana, M., Díaz-Fernández, M. Competencies for the artificial intelligence age: visualisation of the state of the art and future perspectives. *Rev Manag Sci* 17, 1971–2004 [2023].

Smith, F., Sadek, M., Wan, E., Ito, A., & Mougenot, C. [2025]. Codesigning AI with End-Users: An AI Literacy Toolkit for Nontechnical Audiences. *Interacting With Computers*, *37*[5], 444-456.

Song, B., Zhu, Q., & Luo, J. [2024]. Human-AI collaboration by design. *Proceedings of the Design Society*, *4*, 2247–2256. doi:10.1017/pds.2024.227

Svensson, E., Muji, S., & Faraon, M. [2024]. Engaging with artificial intelligence in graphic design education: Perceptions, practices, and pedagogical implications. *International Journal of Art & Design Education*, 43[2], 245–260.

Yifat, F., Eyal, R., & Yisha, M. [2024]. An artificial intelligence competency framework for teachers and students co-created with teachears. *European Journal of Open, Distance and E-Learning*. 26[S1] DOI: 10.2478/eurodl-2024-0012

Basics

Corbin, J., & Strauss, A. [2008]. *Basics of qualitative research: Techniques and procedures for developing grounded theory* [3rd ed.]. Sage Publications.

ISSN: 2410-3993.
RENIECYT: 1702902

Hernández-Sampieri, R. [2018]. *Metodología de la Investigación.* México: McGraw Hill

Hernández-Sampieri, R., & Mendoza, C. P. [2020]. *Metodología de la investigación: Las rutas cuantitativa, cualitativa y mixta* [1.ª ed.]. McGraw-Hill.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. [PRISMA] [2021]. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ, 372*, n71.

PRISMA. [2021]. *PRISMA Flow Diagram*.

Supports

Berretta, S., Tausch, A., Ontrup, G., Gilles, B., Peifer, C., & Kluge, A. [2023]. Defining human-AI teaming the human-centered way: a scoping review and network analysis. *Frontiers in Artificial Intelligence, 6*, Article 1250725.

Beneite-Martí, J. [2024]. ¿Inteligencia Artificial en Proyectos de Aprendizaje-Servicio? Innovación tecnológica y transformación social. *EDU REVIEW. International Education and Learning Review Revista Internacional de Educación y Aprendizaje*, *12*[2], 99–109.

Carolus et al. [2023]. MAILS. Meta AI literacy scale: Development and testing of an AI literacy questionnaire based on well-founded competency models. *Computers in Human Behavior Reports*, *12*, 100310.

Chen, Y., Song, Y., Guo, J., Sun, L., Childs, P., & Yin, Y. [2025]. How generative AI supports human in conceptual design. *Design Science, 11*, e9

Dall'asta, J. [2025]. Integrating artificial intelligence into the human-centered design process: Enhancing creativity and user-centricity in architectural education. In: Tareq Ahram, Antonio Lopez Arquillos, Juan Gandarias and Adrian Morales Casas [eds] Human Interaction and Emerging Technologies [IHIET-AI 2025]: Artificial Intelligence and Future Applications. AHFE [2025] International Conference. AHFE Open Access, vol -3. AHFE International, USA.

Federiakin, D., Molerov, D., Zlatkin-Troitschanskaia, O., & Maur, A. [2024]. Prompt engineering as a new 21st century skill. *Frontiers in Education*, 9.

Fleischmann, K. [2024]. Generative Artificial Intelligence in Graphic Design Education: A Student Perspective. *Canadian Journal of Learning and Technology*, *50*[1], 1–17.

Ghosh, M. [2025]. Artificial intelligence [AI] and ethical concerns: a review and research agenda. *Cogent Business & Management*, *12*[1].

Heung et al. [2025]. Theorizing AI literacy development using Habermas' three cognitive knowledge interests from a systematic review: *A STEM interdisciplinary perspective.*

Husted Ramos, S., Rodríguez-Garay, G. O., & Álvarez-Chávez, M. P. [2024]. *Prototipado creativo e inteligencia artificial generativa: Transformando el proceso de diseño de apps móviles en el aula.* En Aprendizaje 4.0: Inteligencia artificial, redes sociales y rol docente en la era digital [pp. 560–?] [Capítulo 33]. Universidad Autónoma de Ciudad Juárez.

Ivković, R., Vuckovic, D., Jecmenic, M., Ananieva, D., & Petkovic, M. [2025]. The EU AI act and its contractual and educational implications: AI, education, and the law of obligations. *International Journal of Cognitive Research in Science, Engineering and Education [IJCRSEE]*, 13[2], 551-562

Li, J., Cao, H., Lin, L., Hou, Y., Zhu, R., & El Ali, A. [2024]. *User experience design professionals' perceptions of generative artificial intelligence*. In Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems [CHI '24]. Association for Computing Machinery, New York, NY, USA, Article 381, 1–18.

Liu, Y. [2025]. Human-AI Co-Creation: A Framework for Collaborative Design in Intelligent Systems. *ResearchGate Publication*.

López-Fornies, I. & Asión-Suñer, L. [2024]. Potenciar la creatividad con inteligencia artificial. Cuaderno 223. Centro de Estudios en Diseño y Comunicación. DOI:

ISSN: 2410-3993.
RENIECYT: 1702902

López-Regalado, O., Morales-Almeida, P., & Infante-Moro, A. [2024]. Desafíos éticos y el uso de la Inteligencia Artificial en la educación universitaria: una revisión sistemática. *Pixel-Bit. Revista de Medios y Educación,* [70], 227-260.

Martsenyuk, V., Dimitrov, G., Rancic, D., Dirgova Luptakova, I., Jovancevic, I., Bernas, M., Klos-Witkowska, A., Gancarczyk, T., Kostadinova, I., & Mihaylova, E. [2024]. Designing a competency-focused course on applied AI based on advanced system research on business requirements. *Applied Sciences, 14*[10], 4107.

Mendoza, V. M. M., Saucedo, E. F., Martínez, V. R. I., & Luna, M. S. S. [2025]. Inteligencia artificial y alfabetización digital: Impacto en el proceso de enseñanza de estudiantes de Instituciones de Estudios Superiores. *Revista Ingeniería y Gestión Industrial*, *1*[4].

Mikalef, P., Islam, N., Parida, V., Singh, H., & Altwaijry, N. [2023] Artificial intelligence [AI] competencies for organizational performance: A B2B marketing capabilities perspective. *Journal of Business Research. 164*.

Morocho-Pintag, J. A., Yaselga-Auz, W. F., Lizano-Jácome, M. A., y Medina-Romero,M. Á. [2025]. Competencias digitales y de IA en la educación: Transformando a los estudiantes para liderar el futuro del trabajo. *Reincisol*, 4[7].

Mustafa, M. [2023]. The impact of artificial intelligence on the graphic design industry. *Arts and DesignStudies,* Vol. 104, pp. 1–15, 2023. IISTE.

Piontkewicz, R., Duarte, F. M. C., & Mendes J. R. [2023]. Digital competence of higher education professors in the adequation of remote teaching. *Revista Digital de Investigación en Docencia Universitaria*, *18*[1], e1589.

Ranieri, M., Biagini, G., & Cuomo, S. [2025]. AI literacy in higher education: A systematic approach to questionnaire development and validation. *International Journal of Digital Literacy and Digital Competence*, *16*[1]. DOI: 10.4018/IJDLDC.388469

Rezwana, J., & Maher, M. L. [2022]. Understanding user perceptions, collaborative experience and user engagement in different human–AI interaction designs for co-creative systems. En *Proceedings of the 14th International Conference on Creativity & Cognition [C&C '22]* [pp. 38–48]. Association for Computing Machinery.

Rondon-Morel, R. O., Pacotaipe-Delacruz, R., Alarcón-Nuñez, E. A., & Yepez-Salvatierra, P. N. [2024]. El impacto de la inteligencia artificial en la formación docente. *Revista Docentes 2.0*, *17*[2], 368–375.

Sattele, V., Reyes, M., & Fonseca, A. [2023]. La inteligencia artificial generativa en el proceso creativo y en el desarrollo de conceptos de diseño. *Umática. Revista sobre Creación y Análisis de la Imagen*, *6*, 53-73.

Schauer, S., Simbeck, K., & Pinkwart, N. [2025]. AI literacy among design students: A cross-sectional survey on attitudes and technical confidence. 17th International Conference on Computer Supported Education [CSEDU 2025].

Tang, X., Windham, J., & Bush B. [2025]. *Pre-AI and post-AI design: balancing human Creativity and AI Tools in the Industrial Design Process.* In Proceeding of the 2024 International Conference on Artificial Intelligence and Future Education [AIFE '24]. Association for Computing Machinery, New York, NY, USA, 100–108.

Vaitiekunas, P. C. [2024]. Desafios para o Design na era da Inteligência Artificial: reflexões e proposições para favorecer a ética no projeto. *Cuadernos Del Centro De Estudios De Diseño Y Comunicación*, [225].

Weber, S., Christian , K. H., Kordyaka, B., & Niehaves, B. [2024]. Designing successful Human-AI collaboration for creative-problem solving in architectural design. *International Conference on Information Systems [ICIS]*.

Yang, H.-H. [2024]. The acceptance of AI tools among design professionals: Exploring the moderating role of job replacement. *The International Review of Research in Open and Distributed Learning, 25*[3], 326–349.

ISSN: 2410-3993.
RENIECYT: 1702902

Rivera-Gutiérrez, Erika, Higuera-Zimbrón, Alejandro and Arguello, Georgina. [2026]. Artificial Intelligence: Competencies for design in emerging creative environments. Journal of Technology and Innovation. 13[31]1-16: e21331116.
https://doi.org/10.35429/JTI.2026.13.31.2.1.16

Discussions

Dai, Y., Shin, D., & Xia, F. [2023]**.** *Reconceptualizing ChatGPT and generative AI as a student-driven innovation in higher education*.

Donghua, Y. L., & Shen, L. [2025]. Consolidating human–AI collaboration research in organizations: A literature review. *Journal of Computer, Signal, and System Research, 9*[2], 138.

Fadiman, E. [2024]. *AI Design Skills Checklist for 2024*.

Kim, J., Kim, S., & Kim, H. [2023]. Exploring the AI competencies of elementary school teachers in South Korea. *Smart Learning Environments*, 10[12], 1–18.

Leong, W.Y., & Zhang, J.B. [2025]. Ethical design of IA for education and learning systems *ASM Science Journal*, *20*[1], 1–9.

Shi, Y., Gao, T., Jiao, X., & Cao, N. [2023]. Understanding design collaboration between designers and artificial intelligence: A systematic literature review. *Proceedings of the ACM on Human-Computer Interaction, 7*[CSCW2].

Syed, A. F., & Asia, B. A. [2025]. Human-AI Collaboration in Creative Design: Evaluating Cognitive Synergy. *International Journal of Social Impact, 10*[3], 84-94. DIP: 18.02.014/20251003, DOI: 10.25215/2455/1003014

United Nations Educational, Scientific and Cultural Organization [UNESCO]. [2023]. *AI competency framework for students*.

United Nations Educational, Scientific and Cultural Organization [UNESCO]. [2023a]. *AI competency framework for teachers*.

Yoo, Y., Cho, Y. H., & Choi, J. [2023]. A systematic review on the competences of human–AI collaboration. En J.-L. Shih, A. Kashihara, W. Chen, H. Ogata, R. Baker, B. Chang, S. Dianati, J. Madathil & A. M. Fahmy Yousef [Eds.], *Proceedings of the 31st International Conference on Computers in Education [ICCE 2023]* [Vol. 2, pp. 1071-1074]. Asia-Pacific Society for Computers in Education.

ISSN: 2410-3993.
RENIECYT: 1702902