TEACHER EDUCATION IN THE AGE OF ARTIFICIAL INTELLIGENCE: ACTIVE METHODOLOGIES AND EMERGING TECHNOLOGIES AS STRATEGIES FOR PEDAGOGICAL INNOVATION

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Eliane das Graças de Oliveira Abreu[1], Ítalo Domingos Costa[2], Felipe Antonio Xavier Andrade[3], Richard Lucas de Almeida[4], Esli Pinheiro dos Santos[5], Mirelly Marques Silva Ribeiro Soares[6], Adriana Frauzino Pereira[7], Solange do Rocio da Silva Augusto[8] and Eugênio Jesus Santana[9]

Abstract

The incorporation of Artificial Intelligence, active methodologies, and emerging technologies into educational processes has brought about significant changes in the ways teaching, learning, assessment, and pedagogical experiences are organized. In this context, teacher education assumes a strategic role, since pedagogical innovation does not automatically result from the presence of technologies, but rather

[1] Bachelor's degree in Physical Education from the Universidade Federal de Goiás (UFG). Postgraduate specialization in University Teaching from Universidade Estadual de Goiás (UEG)
E-mail: abreu.eliane9920@gmail.com
[2] Postgraduate specialization in Economic Criminal Law and Criminal Procedure from Universidade Maurício de Nassau – UNINASSAU
E-mail: italo@italocosta.adv.br
[3] Master's student in Emerging Technologies in Education at Must University
E-mail: felipexavier@uol.com.br
[4] Master's student in Emerging Technologies in Education at Must University. Teaching degree in Portuguese and English Language and Literature from Universidade Paulista (2020). Bachelor of Laws from the Universidade Evangélica de Goiás (2018). Postgraduate specialization in English Language Teaching Methodology from FAVENI(2025)
E-mail: prof.richardluca@gmail.com
[5] Postgraduate specializations in Integrated Management and Higher Education Didactics from Faculdade de Santo André and in Neuropsychopedagogy from UNIASSELVI. Master's student in Emerging Technologies in Education at MUST University
E-mail: eslipinheirosantos@gmail.com
[6] Teaching degree in Pedagogy from the Universidade Estadual de Goiás (UEG). Lato sensu postgraduate specialization in Clinical and Institutional Psychopedagogy from Centro Universitário Internacional (UNINTER)
E-mail: Mirellypedagogia@gmail.com
[7] Teaching degree in Portuguese Language and Literature from the Universidade Federal de Goiás (UFG). Lato sensu postgraduate specialization in Institutional Psychopedagogy from Universidade Castelo Branco (UCB)
E-mail: adrianaprofessora06@gmail.com
[8] Doctoral student in Educational Sciences at UNADES. Master's degree in Environmental Science Teaching from the Universidade Federal do Paraná. Specialist in Psychopedagogy from FAMEC; Specialized Educational Services and Autism Based on the Structured Teaching Model from Faculdade Pólis Civitas; Clinical and Relational Psychomotricity, Neuroscience with an Emphasis on Music Education, and Early Stimulation from FACUMINAS; and Education for People with Intellectual Disabilities from Universidade Tuiuti do Paraná. Bachelor's degrees in Pedagogy and Social Sciences from the Universidade Católica do Paraná
E-mail: solangerocioaugusto@gmail.com
[9] Doctoral student in Educational Sciences at Christian Business School — CBS and holder of a master's degree in Emerging Technologies in Education from Must University.
E-mail: eugeniojsant@gmail.com

from professionals' ability to integrate them critically, ethically, and in alignment with educational objectives. This study aims to analyze how teacher education, combined with active methodologies and emerging technologies, can contribute to the innovation of pedagogical practices in the age of Artificial Intelligence. Methodologically, it is characterized as bibliographic research with a qualitative approach and exploratory-descriptive objectives, grounded in scientific literature and institutional documents related to teacher education, Artificial Intelligence, active methodologies, digital competencies, and educational innovation. The literature indicates that methodologies such as problem- and project-based learning, the flipped classroom, and collaborative practices can enhance student participation, autonomy, and agency, while emerging technologies can support personalization, resource development, access to data, and the diversification of forms of knowledge representation. However, these possibilities depend on teaching competencies related to planning, critical curation, AI literacy, assessment, ethics, data protection, and continuous professional development. It is concluded that pedagogical innovation in the age of Artificial Intelligence requires teacher education that goes beyond instrumental approaches and enables the integration of pedagogical knowledge, digital competence, critical thinking, and professional responsibility.

Keywords: Active Methodologies, Artificial Intelligence, Emerging Technologies, Pedagogical Innovation, Teacher Education.

INTRODUCTION

The technological transformations observed in recent decades have significantly altered the organization of educational processes and the competencies required of education professionals. The expansion of digital platforms, virtual environments, data analysis systems, immersive technologies, and, more recently, Generative Artificial Intelligence tools has changed the ways information is produced, accessed, and shared, while broadening the possibilities for creating more flexible and diverse educational experiences.

In this context, Artificial Intelligence has assumed an increasingly prominent position in discussions of pedagogical innovation. Generative systems can produce texts, images, activities, questions, plans, explanations, and feedback within short periods, offering new possibilities for teachers' planning and mediation. UNESCO (2024), however, emphasizes that the incorporation of Generative AI into education must be guided by a human-centered approach and accompanied by attention to ethics, equity, privacy, diversity, and accountability for content and decisions produced with technological assistance.

The presence of technology alone does not constitute pedagogical innovation. Merely replacing printed materials with digital resources or using a platform in essentially transmission-based practices may modernize the medium without significantly altering the logic of teaching. In this sense, pedagogical innovation should be understood as an intentional transformation of practices, relationships with knowledge, and forms of student participation.

This distinction is fundamental because educational discourse frequently associates technological novelty with automatic improvements in learning. In formulating the Technological Pedagogical Content Knowledge (TPACK) model, Mishra and Koehler (2006) demonstrate that the effective integration of technologies depends on the articulation of technological knowledge, pedagogical knowledge, and content knowledge. This principle remains relevant in the context of AI: a technologically advanced tool acquires educational value only when its use is linked to coherent pedagogical objectives and strategies.

Teacher education therefore lies at the heart of this transformation. Teachers need to understand not only how to use technologies, but why, when, and under what conditions those technologies can contribute to learning. This process requires the development of competencies related to resource selection, critical analysis, planning, assessment, and the ability to reorganize practices according to students' needs.

Through the European Framework for the Digital Competence of Educators, Redecker (2017) demonstrates that teachers' digital competence is multidimensional and encompasses professional

engagement, the selection and production of digital resources, teaching and learning, assessment, student empowerment, and the development of learners' own digital competence. This framework shows that technology education cannot remain restricted to the operational mastery of tools.

The rapid expansion of AI has broadened this repertoire of requirements. Long and Magerko (2020) understand Artificial Intelligence literacy as a set of competencies that enables individuals to critically evaluate AI technologies, communicate and collaborate with these systems, and use them as tools. For teachers, this literacy acquires a specific professional dimension, since generated content must be verified before being incorporated into pedagogical processes.

In the AI Competency Framework for Teachers developed by UNESCO, Miao and Cukurova (2024) systematize 15 teaching competencies across five dimensions: a human-centered mindset, the ethics of AI, AI foundations and applications, AI pedagogy, and AI for professional development. The document reinforces that preparing teachers for the age of AI must integrate technical, pedagogical, and ethical capabilities while preserving human agency and responsibility.

Alongside Artificial Intelligence, active methodologies constitute another relevant dimension of pedagogical innovation. Bacich and Moran (2018) advocate practices that increase student participation through investigation, collaboration, experimentation, problem-solving, and project development. From this perspective, students cease to occupy an exclusively receptive position and begin to participate more directly in the construction of knowledge.

Moran (2018) emphasizes that active methodologies foster more participatory and meaningful learning experiences when linked to concrete situations, problems, and challenges. Their implementation, however, requires qualified planning and mediation. Merely including a group activity, for example, does not automatically transform a traditional practice into an active methodology.

Emerging technologies can enhance these strategies. Collaborative platforms, Artificial Intelligence systems, immersive environments, virtual and augmented reality resources, multimodal production tools, and adaptive systems broaden the possibilities for representation, participation, and

experimentation. The selection of these resources, however, must remain subordinate to pedagogical intentionality.

In this context, the teacher increasingly assumes functions related to mediation, curation, and the design of learning experiences. The availability of systems capable of generating content does not eliminate the need for professional knowledge. On the contrary, it increases the need for criteria by which to evaluate what has been produced.

Against this background, the following research question was established: How can teacher education, combined with active methodologies and emerging technologies, contribute to the innovation of pedagogical practices in the age of Artificial Intelligence?

The general objective is to analyze how teacher education, associated with active methodologies and the use of emerging technologies, can contribute to the innovation of pedagogical practices in the context of the expansion of Artificial Intelligence in education. Specifically, the study seeks to discuss the transformations imposed by AI on teaching practice; analyze the contributions of active methodologies to participation and learning; identify the competencies required for the pedagogical integration of emerging technologies; and examine the ethical, institutional, and teacher-education challenges related to innovation.

The relevance of this investigation lies in the need to move beyond a narrow conception of technology education. Given the expansion of AI, preparing teachers merely to operate platforms is an insufficient response. It is necessary to develop competencies that enable them to understand these systems, critically evaluate their outputs, connect them to educational objectives, and make responsible professional decisions.

In this sense, teacher education is the mediating element between technology and pedagogical innovation. AI can generate content, active methodologies can reorganize forms of participation, and emerging technologies can broaden experiences. Professional knowledge, however, determines the purpose, selects the resources, and evaluates the effects of these choices.

This study therefore proceeds from the understanding that pedagogical innovation in the age of Artificial Intelligence depends less on the number of technologies used and more on teachers' ability to integrate them coherently into teaching and learning practices. Educating teachers for this context means developing professionals capable of combining technology, methodology, critical thinking, ethics, and pedagogical knowledge while preserving the central role of human beings and the quality of education.

TEACHER EDUCATION AND PEDAGOGICAL INNOVATION IN THE AGE OF ARTIFICIAL INTELLIGENCE

The digital transformation of education has brought about changes that extend beyond the simple introduction of devices and platforms into school environments. Advances in Artificial Intelligence, generative systems, virtual environments, immersive resources, and data analysis technologies are changing the ways planning, material production, communication, learning monitoring, and assessment are carried out (Valente, 2025; Rial et al., 2026). In this context, teacher education assumes a strategic position, since pedagogical innovation depends less on the isolated presence of technology and more on professionals' ability to integrate it into educational objectives (Jesus, Santana, and Assis, 2026).

The relationship between technology and innovation must be analyzed critically. In formulating the TPACK model, Mishra and Koehler (2006) demonstrated that the pedagogical integration of technologies depends on the articulation of technological, pedagogical, and content knowledge. This principle remains pertinent to contemporary technologies, since using digital resources without aligning them with objectives, strategies, and the characteristics of the knowledge involved may simply reproduce traditional practices through new media (Valente, 2025).

The expansion of Artificial Intelligence intensifies this requirement because current systems do not function merely as means of presenting information. Generative tools can participate directly in the production of texts, activities, assessments, explanations, images, and feedback. Kasneci et al. (2023)

recognize significant opportunities associated with large language models in education, but also identify limitations related to reliability, bias, privacy, and the need for critical supervision of their outputs.

Professional education must therefore incorporate competencies capable of preserving the centrality of teachers' judgment. In 2024, UNESCO developed a specific AI competency framework for teachers, comprising 15 competencies distributed across five dimensions: a human-centered mindset, the ethics of AI, AI foundations and applications, AI pedagogy, and AI for professional development. The document organizes these competencies into three progressive levels, acquire, deepen, and create, reinforcing that AI-related professional development should be continuous rather than delivered through one-time training (Jesus, Santana, and Assis, 2026).

In this context, active methodologies and emerging technologies must be understood as dimensions that can converge to produce more participatory, investigative, and flexible practices. Bacich and Moran (2018) emphasize that active methodologies entail greater student participation in the learning process, while teachers assume responsibility for planning, mediation, monitoring, and assessment. Technologies can expand the resources available for these experiences, but they do not replace the pedagogical intentionality that gives meaning to the process (Rial et al., 2026).

TEACHER EDUCATION IN THE CONTEXT OF ARTIFICIAL INTELLIGENCE AND EDUCATIONAL TRANSFORMATIONS

Teacher education in the age of Artificial Intelligence must respond to concrete changes in the organization of pedagogical work (Silva et al., 2026). Generative systems can assist in developing activities, producing examples, planning, organizing materials, generating questions, and preliminarily adapting content. This capacity alters some of the activities traditionally performed by teachers, but it does not eliminate the need for specialized knowledge to evaluate what the technology produces (Santana et al., 2026).

UNESCO (2024) recognizes that the incorporation of AI changes the traditional relationship between teachers and students by adding technology as a new element in educational dynamics. For this reason, it considers it necessary to reexamine educators' professional functions and required competencies. The organization's framework is not limited to technical knowledge, but incorporates values, ethics, responsibility, pedagogy, and professional development, demonstrating that teacher education for AI must move beyond merely instrumental approaches (Silva et al., 2026a).

One of the fundamental competencies in this process is Artificial Intelligence literacy. Long and Magerko (2020) understand AI literacy as a set of competencies that enables individuals to critically evaluate AI technologies, communicate and collaborate with these systems, and use them as tools. This definition is especially pertinent to teaching because teachers cannot limit themselves to using technology. They must also be able to question how it operates and whether its outputs are valid (Jesus, Santana, and Assis, 2026).

Ng et al. (2021) also describe AI literacy as a multidimensional phenomenon involving knowledge, use, evaluation, and ethical issues. This perspective demonstrates that prompt development represents only one part of the necessary repertoire. A teacher may master techniques for interacting with a particular system and still be unprepared to recognize false information, nonexistent references, bias, or pedagogical inadequacies (Silva et al., 2026a).

Critical curation consequently becomes a core competency. The ease with which materials can be generated increases the need to verify content before using it. Kasneci et al. (2023) note that large language models can produce plausible, linguistically coherent responses that are not necessarily correct. In this sense, speed of generation and textual quality cannot be confused with scientific or pedagogical validity.

Teacher education must develop procedures for verifying concepts, data, sources, and references. It must also prepare teachers to assess whether a resource aligns with the curriculum, students' developmental level, the purpose of the activity, and the methodology employed. Such assessment

requires disciplinary and pedagogical knowledge that cannot be replaced by technical proficiency in operating a tool (Jesus, Santana, and Assis, 2026; Silva et al., 2026a).

Another relevant aspect concerns professional authorship. The use of content partially produced by AI changes the process through which resources are developed, but it does not eliminate teachers' responsibility. Teachers remain responsible for deciding what will be presented to students. In this context, authorship can also be understood as the ability to establish objectives, formulate criteria, select elements, review content, contextualize proposals, and assume responsibility for the final product (Ribeiro, 2026).

Assessment is another field directly transformed by AI. Generative systems can produce essays, solve certain problems, and develop highly complex responses. Consequently, assessment practices centered exclusively on the final product become more vulnerable to the replacement of students' intellectual activity with automated content. Teacher education must develop strategies capable of valuing the process, argumentation, application of knowledge, reflection, authorship, and the ability to justify choices (Ribeiro, 2026; Silva et al., 2026a).

The ethics of AI must likewise be integrated into teacher education. UNESCO's framework places this dimension among the five pillars of teaching competencies, addressing safe and responsible use, ethical principles, and the development of rules governing the use of technology. This demonstrates that ethical issues should not appear merely as a supplement to technology education (Santaella, 2025; Hermann, 2025).

Privacy, data protection, authorship, intellectual property rights, bias, and transparency must be incorporated into everyday decisions. A teacher who asks an external platform to personalize a particular activity may, for example, feel inclined to provide student data. Professional competence includes recognizing what information must not be shared and using only data that are strictly necessary and permitted (Santaella, 2025; Pereira et al., 2026).

Teacher education must also preserve teacher agency. UNESCO's framework was developed according to explicit principles concerning the protection of teachers' rights and the strengthening of human agency. This aspect is fundamental because systems capable of recommending content, strategies, or assessments can create dependency when their responses begin to replace professional judgment (Santana et al., 2026).

Artificial Intelligence therefore does not diminish the importance of teachers. It changes some of the competencies required and increases the need for interpretation, curation, and decision-making. The greater the automated capacity to produce content, the greater the importance of professionals capable of determining what has educational value.

ACTIVE METHODOLOGIES AS STRATEGIES FOR INNOVATING PEDAGOGICAL PRACTICES

Active methodologies are an important dimension of pedagogical innovation because they shift part of the teaching process away from predominantly transmission-based models and toward experiences in which students participate more directly in constructing knowledge. Bacich and Moran (2018) associate these methodologies with investigation, problem-solving, collaboration, experimentation, and production, emphasizing the need to engage students cognitively in the activity.

Moran (2018) emphasizes that active methodologies can foster deeper learning when they place students in meaningful situations requiring them to mobilize knowledge, make decisions, and reflect. This means that an activity does not become active merely because it involves movement, technology, or group work. The central element is the student's intellectual participation.

Problem-based learning is one of the strategies associated with this perspective. Teachers present or construct situations that require students to formulate hypotheses, conduct investigations, use information, and develop responses. Teaching competence consists of selecting problems consistent with curriculum objectives, providing appropriate resources, and making interventions that foster learning without directly supplying the solution (Bacich and Moran, 2018).

Project-based learning extends this principle by organizing experiences around problems, challenges, or products developed over a particular period. Teachers must establish objectives, stages, criteria, products, and monitoring procedures. In this case, innovation does not lie simply in the existence of a project, but in reorganizing students' relationship with knowledge and requiring them to apply what they learn (Bacich and Moran, 2018).

The flipped classroom also changes the functions of teachers and students. Bergmann and Sams (2012) demonstrate that the approach is not limited to making content available in advance, but seeks to reorganize shared time for application, discussion, and monitoring activities. Teacher education must therefore prepare teachers to plan the different stages as interconnected components of a learning experience (Bacich and Moran, 2018).

Collaborative practices likewise require specific competencies. Placing students in groups does not ensure collaboration. Responsibilities, interdependence, communication, monitoring, and participation criteria must be organized. Teachers need to observe the resulting dynamics and intervene when collective organization does not contribute to learning (Moran, 2018).

Formative assessment becomes particularly relevant in these contexts. Active methodologies create pathways that can hardly be understood through a final examination alone. Teachers must monitor progress, strategies, difficulties, collaboration, and the ability to apply knowledge, using this evidence to reorganize their interventions.

Artificial Intelligence can enhance certain stages of these methodologies. Generative systems can assist in the preliminary development of problem situations, the creation of different scenarios, the production of cases, the development of questions, and the organization of materials. Kasneci et al. (2023), however, demonstrate that their outputs must be verified, preventing speed of generation from replacing pedagogical planning.

AI can also support brainstorming, the development of alternatives, and the initial exploration of questions. In project-based learning, for example, it can be employed as an object of analysis, a source of

hypotheses, or a tool for organizing information. Its use, however, must be linked to the competency intended for development. When the tool performs the intellectual operation that students themselves were expected to develop, using it may undermine the objective of the methodology (Silva et al., 2026a).

This issue demonstrates that active methodologies and AI are not automatically complementary. Their integration must be planned. If the purpose is to develop argumentation, for example, using AI to provide a complete, ready-made argument may reduce cognitive participation. If the tool is used to produce conflicting positions that students will subsequently analyze critically, it may increase the complexity of the activity (Silva et al., 2026a).

Pedagogical innovation therefore depends on alignment among purpose, method, and technology. Mishra and Koehler (2006) had already demonstrated that technological knowledge must be integrated with pedagogical and disciplinary knowledge. In the age of AI, this principle becomes even more important because the potential for automation increases the possibility of pedagogically inappropriate uses of technology (Silva et al., 2026a).

Active methodologies also contribute to the development of contemporary competencies related to problem-solving, collaboration, communication, creativity, and autonomy. These outcomes, however, depend on actual conditions of implementation. A methodology presented as innovative may remain superficial when reduced to a sequence of techniques without adequate foundations or monitoring (Bacich and Moran, 2018).

Teacher education must therefore include experiences in which teachers themselves analyze, plan, and evaluate active methodologies. Knowing definitions is not enough. Teachers must develop the ability to determine when a particular strategy is appropriate, how to adapt it to the context, and what evidence will demonstrate that it has produced learning.

EMERGING TECHNOLOGIES AND ARTIFICIAL INTELLIGENCE APPLIED TO TEACHING AND LEARNING PROCESSES

Emerging technologies significantly expand the resources available for organizing teaching. Generative Artificial Intelligence, adaptive systems, augmented and virtual reality, immersive environments, educational data analysis, collaborative platforms, and various multimodal resources enable new forms of interaction with content, people, and environments (Rial et al., 2026).

A technology, however, acquires pedagogical relevance only when it responds to an educational need. In the Digital Competence Framework for Educators (DigCompEdu), Redecker (2017) demonstrates that teachers' digital competence involves the critical use of resources across different dimensions of practice, including teaching, learning, assessment, and student empowerment. This approach moves away from understanding digital competence as merely the ability to operate tools (Jesus, Santana, and Assis, 2026).

In the field of AI, content production is one of the most immediately visible applications. Teachers can request texts, examples, cases, questions, scripts, and different explanations. The principal operational advantage lies in speed and the capacity to produce multiple alternatives. The resulting output, however, becomes a pedagogical resource only after undergoing professional evaluation (Santana et al., 2026).

Personalization represents another relevant possibility. Systems can assist in developing different ways of presenting particular content or materials with differing levels of support. Technology-based personalization, however, must be carefully distinguished from the automated delegation of decisions. UNESCO (2024) establishes AI pedagogy as one of the central dimensions of teacher competence precisely to ensure that technology remains subordinate to responsible educational decisions.

Multimodality also broadens possibilities. Current technologies make it possible to combine verbal language, images, audio, and different representational formats. This diversification can support different ways of interacting with knowledge, provided that the resources are accessible and genuinely contribute to the learning objective (Rial et al., 2026; Pereira et al., 2026).

Virtual and augmented reality environments can provide simulated experiences and enable the visualization of phenomena that are difficult to access in school settings. In certain fields, these technologies may allow students to explore complex spaces, structures, or processes. Their use, however, requires analysis of cost, accessibility, infrastructure, and curriculum alignment (Rial et al., 2026).

Educational data analysis is another growing application. Platforms can produce indicators related to participation, completion of activities, and performance. These data can provide teachers with useful information, but should not be treated as a complete representation of learning. Quantitative indicators must be considered alongside observation, interaction, and contextual knowledge (Valente, 2025).

This use requires data literacy. Teachers must understand what a particular indicator actually represents, what information has not been captured, and what methodological limitations may exist. Transforming data into pedagogical decisions requires human interpretation rather than automatic acceptance of the system's recommendations (Jesus, Santana, and Assis, 2026).

Accessibility is another important dimension of emerging technologies. Conversion, reorganization, multimodality, and adaptation resources can broaden access to knowledge for different students. A tool, however, does not become inclusive merely because it offers personalization features. Its interface, compatibility with assistive technologies, and content quality must be evaluated (Pereira et al., 2026).

Security and privacy must also be incorporated into selection criteria. The educational use of digital systems entails the circulation of information about students and teachers. Teaching competence must include responsible procedures for using platforms, sharing information, and protecting the identities of the individuals involved (Santaella, 2025; Pereira et al., 2026).

Another central consideration is equitable access. The adoption of tools that depend on sophisticated devices, subscriptions, or high-quality connectivity can create inequalities among students and institutions. Technological innovation must consequently also be analyzed according to criteria of feasibility and educational justice (Rial et al., 2026; Pereira et al., 2026).

Teacher education must therefore develop competence in technology selection. Teachers should be able to question what pedagogical problem a particular tool is intended to solve, what evidence supports its use, what risks it presents, and whether a simpler alternative could achieve the same objective (Valente, 2025; Rial et al., 2026).

This perspective is consistent with UNESCO's competency framework, which defines the knowledge, skills, and values that teachers need to master while simultaneously emphasizing human agency, ethics, pedagogy, and continuous professional learning. Jesus, Santana, and Assis (2026) demonstrate that teaching with AI requires far more than learning to use specific systems.

Pedagogical innovation therefore emerges from the critical integration of technologies into teaching and learning processes. Emerging technologies expand possibilities for production, representation, interaction, and analysis; active methodologies reorganize forms of participation; and teacher education provides the criteria required to transform these possibilities into sound educational decisions.

In this sense, the age of Artificial Intelligence requires teachers who are technologically competent but not technologically subordinate. Professionals must retain the ability to question, select, adapt, and even reject particular tools when their use does not make a sufficient pedagogical contribution. Innovation lies in the quality of educational decision-making rather than in the novelty of the technology employed.

METHODOLOGY

This study was conducted to analyze how teacher education, combined with active methodologies and emerging technologies, can contribute to the innovation of pedagogical practices in the age of Artificial Intelligence.

Regarding its nature, the investigation is characterized as applied research because it addresses a concrete problem in the field of education: the need to prepare teachers to integrate contemporary technologies and strategies critically into teaching practices. Gil (2022) emphasizes that applied research

is oriented toward producing knowledge that can be used in specific situations. This classification is appropriate because the findings are intended to inform reflections and proposals related to initial and continuing teacher education.

Regarding the methodological approach, a qualitative perspective was adopted. The objective is not to statistically measure the effects of a particular tool or methodology on student performance, but to interpret the relationships among education, innovation, technology, and pedagogical practice. Vergara (2016) emphasizes the relevance of qualitative approaches to phenomena whose understanding requires the analysis of meanings, relationships, and contexts. This choice makes it possible to critically examine both the possibilities and limitations associated with the incorporation of technology.

Regarding its objectives, the research is exploratory and descriptive. The exploratory component is justified by the rapid pace of transformations related to Generative AI and the need to understand their implications for professional education. According to Gil (2022), exploratory research allows greater familiarity with the problem and enables a deeper examination of issues that are still developing.

The descriptive character arises from the need to identify and characterize the primary competencies, strategies, technologies, contributions, and challenges found in the literature. Vergara (2016) states that descriptive research makes it possible to present the characteristics of a particular phenomenon and establish relationships among its elements. The investigation therefore seeks to characterize how teacher education, active methodologies, and emerging technologies are connected to pedagogical innovation.

Regarding technical procedures, bibliographic research was adopted, using scientific articles, books, chapters, and institutional documents related to the object of study. Gil (2022) characterizes this procedure by the use of previously published materials as the basis for analyzing a problem. This choice makes it possible to integrate contributions from different fields and construct an integrated interpretation of the phenomenon.

The bibliographic survey was guided by descriptors in Portuguese and English, including "formação docente", "Inteligência Artificial na educação", "Inteligência Artificial Generativa", "metodologias ativas", "inovação pedagógica", "tecnologias emergentes", "competências digitais docentes", "teacher education", "artificial intelligence in education", "generative AI", "active learning", "educational innovation", "emerging technologies" and "digital teacher competence".

Priority was given to studies published between 2016 and 2026 in order to encompass recent literature related to the digital transformation of education. For discussions specifically associated with Generative AI, priority was given to publications issued after 2022, considering the recent expansion of these technologies. Earlier frameworks were retained when they had foundational importance, such as Mishra and Koehler (2006), regarding the integration of technology, pedagogy, and content.

Publications related to teacher education, digital competencies, AI literacy, active methodologies, technology integration, pedagogical innovation, technology-mediated assessment, digital ethics, and professional development were included. Relevant institutional frameworks were also incorporated, especially DigCompEdu and UNESCO documents on AI and teacher education. UNESCO's 2024 framework was considered particularly relevant because it defines 15 teaching competencies in AI and organizes them into five dimensions and three progressive levels.

Duplicate materials, strictly opinion-based publications, texts without an identifiable scientific or institutional foundation, and exclusively technical studies of algorithms that did not address educational or professional-development implications were excluded. These criteria were established to preserve the corpus's alignment with the research problem and avoid an excessively broad review of technology.

A bibliographic recording protocol was developed as an instrument for collecting and organizing information. It included authorship, year, objective, educational context, methodology or technology addressed, teaching competency discussed, identified pedagogical contribution, limitation, ethical implication, and recommendations for teacher education. This procedure made it possible to compare studies of different types and identify areas of convergence among the dimensions investigated.

Qualitative content analysis was adopted to process the data. Vergara (2016) regards this technique as appropriate for systematically organizing textual materials according to categories of analysis. Its use made it possible to identify recurring themes, divergences, and relationships among professional education, active strategies, and technology integration.

The first analytical category addressed the contributions of active methodologies and emerging technologies to pedagogical innovation. This dimension grouped evidence related to student participation, collaboration, problem-solving, personalization, diversification of representations, content production, feedback, and the reorganization of educational experiences.

The second category focused on teaching competencies and the challenges associated with integrating Artificial Intelligence into pedagogical practices. Elements related to AI literacy, critical curation, planning, assessment, ethics, data protection, digital competence, accessibility, continuous professional development, and preservation of teacher agency were analyzed.

ANALYSIS AND DISCUSSION OF THE RESULTS

The literature analysis showed that pedagogical innovation in the age of Artificial Intelligence does not result from the isolated adoption of technologies, but from the articulation of teacher education, pedagogical intentionality, teaching methodologies, and the critical use of digital resources (Valente, 2025; Rial et al., 2026). The findings demonstrate that active methodologies and emerging technologies have the potential to transform teaching and learning processes, although their effects depend on the professional competencies mobilized by teachers (Jesus, Santana, and Assis, 2026).

The studies analyzed converge on a conception of innovation that extends beyond the digitalization of traditional practices. Mishra and Koehler (2006) demonstrate that integrating technologies into teaching requires the articulation of technological knowledge, pedagogical knowledge, and content knowledge. This perspective makes it possible to understand that a technological resource is

not independent of pedagogical practice, but must be selected according to learning objectives and the characteristics of the educational context (Valente, 2025).

In the field of active methodologies, Bacich and Moran (2018) emphasize student participation, problem-solving, collaboration, and experimentation as relevant components for reorganizing educational experiences. The findings of the present investigation indicate that these strategies can be enhanced by emerging technologies when digital resources effectively expand opportunities for investigation, production, communication, and interaction (Silva et al., 2026b).

The expansion of Generative AI introduces new possibilities and challenges into this context. Kasneci et al. (2023) identify applications related to content creation, interaction, and the personalization of learning experiences, while also highlighting problems associated with bias, reliability, and the need for human supervision. The analysis of this evidence gave rise to two categories: the contributions of active methodologies and emerging technologies to pedagogical innovation; and the competencies, challenges, and prospects related to integrating AI into teaching practice.

CONTRIBUTIONS OF ACTIVE METHODOLOGIES AND EMERGING TECHNOLOGIES TO PEDAGOGICAL INNOVATION

The first category revealed that one of the main contributions of active methodologies lies in reorganizing student participation. In predominantly transmission-based models, student activity may remain focused on receiving and reproducing information. In active methodologies, learning tends to be organized around problems, projects, investigations, and situations requiring greater cognitive engagement (Bacich and Moran, 2018).

Bacich and Moran (2018) emphasize that active methodologies value experimentation, participation, and student engagement. The pedagogical innovation associated with these strategies does not reside simply in conducting different activities, but in reorganizing the relationships among teachers, students, and knowledge.

Problem-based learning proved particularly relevant because it makes it possible to organize situations in which students need to mobilize knowledge to understand and resolve issues. This structure can foster the development of investigation, analysis, and decision-making. Teachers, however, must select problems appropriate to the objectives and make interventions capable of supporting learning without replacing students' intellectual activity (Bacich and Moran, 2018; Silva et al., 2026b).

Project-based learning makes a similar contribution by enabling the integration of knowledge and the production of concrete outcomes. Project-based organization can foster collaboration, planning, autonomy, and the application of content. These outcomes, however, depend on clear objectives, structured stages, and teacher monitoring (Bacich and Moran, 2018).

The flipped classroom also offers opportunities for pedagogical reorganization. Bergmann and Sams (2012) propose redistributing particular activities so that interaction time is used more intensively for application, monitoring, and resolving difficulties. The findings indicate, however, that merely making videos or materials available in advance does not constitute innovation if the structure of pedagogical relationships remains unchanged.

Integrating these methodologies with digital technologies can broaden their possibilities. Collaborative platforms can support collective projects; multimodal resources can diversify forms of presentation and production; digital environments can facilitate information sharing; and generative systems can support particular stages of investigation and development (Rial et al., 2026).

Generative Artificial Intelligence particularly expands the capacity to produce pedagogical alternatives. Kasneci et al. (2023) identify possibilities related to content production and personalization, while emphasizing the need for clear pedagogical strategies, critical thinking, and information verification. AI can therefore support innovation, but does not in itself constitute evidence of innovation (Santana et al., 2026).

When planning a problem situation, for example, teachers can use generative systems to produce different scenarios or preliminary hypotheses. In projects, these systems can assist in organizing ideas,

comparing perspectives, and initially developing materials. Their use, however, must preserve the cognitive activity that constitutes the learning objective (Silva et al., 2026b).

This finding is significant. If a methodology is intended to develop argumentation but AI produces the arguments in their entirety, the technology may reduce precisely the activity that students were expected to perform. Conversely, if the system generates different positions for students to compare, verify, and critique, its use may increase the complexity of the activity (Silva et al., 2026b).

Pedagogical innovation therefore requires alignment among objectives, methodology, and technology. AI should not be incorporated merely because it enables a task to be performed more quickly. The pedagogically relevant question is whether its use expands opportunities to learn, investigate, produce, collaborate, or reflect (Valente, 2025; Santana et al., 2026).

Personalization emerged as another potential contribution. Digital systems can assist in developing different explanations, examples, resources, and levels of support. Kasneci et al. (2023) recognize this possibility, but observe that the educational integration of large language models requires new competencies and literacies among teachers and students. Personalization must therefore remain under pedagogical supervision (Pereira et al., 2026).

The findings also indicate contributions related to feedback. Digital resources can support more frequent feedback, while AI systems can assist in the preliminary development of explanations. Educational feedback, however, involves knowledge of students' objectives, trajectories, and needs, which is why automation should not eliminate professional evaluation (Silva et al., 2026a).

Another dimension identified is multimodality. Emerging technologies make it possible to combine texts, images, audio, simulations, and different representations. This diversity can broaden opportunities for understanding and expression, particularly when students have different ways of interacting with content (Rial et al., 2026; Pereira et al., 2026).

Immersive environments and virtual or augmented reality resources can also broaden educational experiences when they make it possible to observe phenomena, explore environments, or conduct

simulations that would otherwise be difficult to access. Their value, however, lies not in immersion itself, but in the relationship between the experience provided and the curriculum objective (Rial et al., 2026).

The findings further revealed that technological innovation must be analyzed according to criteria of accessibility and equity. Sophisticated resources that depend on expensive equipment, high-quality connectivity, or subscriptions can increase disparities among students and institutions. Pedagogical innovation consequently cannot be separated from concrete implementation conditions (Pereira et al., 2026; Rial et al., 2026).

The synthesis of this category demonstrates that active methodologies and emerging technologies have the greatest potential when they operate in complementary ways. Methodologies provide structures for reorganizing learning experiences; technologies expand the resources available for those experiences; and teachers provide the mediation necessary to align resources, methods, and objectives.

TEACHING COMPETENCIES, CHALLENGES, AND PROSPECTS FOR INTEGRATING ARTIFICIAL INTELLIGENCE INTO PEDAGOGICAL PRACTICE

The second category revealed that teacher education is the central mediating variable between technological availability and pedagogical innovation. The greater the capacity of AI systems to produce content and recommendations, the greater the need for professionals capable of understanding, evaluating, and supervising their outputs (Santana et al., 2026; Silva et al., 2026a).

In the AI Competency Framework for Teachers, UNESCO (2024) presents 15 competencies distributed across five dimensions: a human-centered mindset, the ethics of AI, AI foundations and applications, AI pedagogy, and the use of AI for professional development. The competencies are structured according to the levels acquire, deepen, and create, demonstrating a progressive conception of teacher education.

This framework confirms one of the investigation’s principal findings: teaching competence in AI cannot be reduced to operational ability. It encompasses the knowledge, skills, and values necessary for

the responsible use of technology, the preservation of human agency, and professional development (Jesus, Santana, and Assis, 2026; Silva et al., 2026a).

AI literacy constitutes one of the fundamental competencies. Long and Magerko (2020) associate this concept with the ability to understand, use, and critically evaluate Artificial Intelligence systems. Ng et al. (2021) add dimensions related to application, evaluation, and ethics. In teaching terms, this means understanding the technology sufficiently to make informed decisions about its use (Jesus, Santana, and Assis, 2026).

Critical curation emerged as a particularly important competency. Generative systems can produce linguistically coherent texts while simultaneously presenting incorrect information. Kasneci et al. (2023) emphasize the need for critical thinking, fact-checking, and continuous human supervision when integrating large language models into education.

Teachers must therefore verify information, references, concepts, and pedagogical suitability before using generated content. This responsibility demonstrates that AI does not eliminate the need for specialized knowledge. On the contrary, the greater the volume of automatically produced material, the greater the need for knowledge with which to evaluate it (Santana et al., 2026).

Prompt-development competence is important, but must be situated within this broader repertoire. Knowing how to structure commands can improve the outputs obtained, but does not ensure that they are true, ethical, or pedagogically appropriate. Teacher education centered exclusively on prompts is therefore likely to have limited scope (Silva et al., 2026a).

Ethical competence also proved indispensable. UNESCO (2024) includes the ethics of AI as a specific dimension of its framework and associates the proposal with protecting teachers' rights, strengthening human agency, and promoting sustainability. Decisions involving AI must therefore consider their consequences for students, teachers, and institutions (Santaella, 2025; Hermann, 2025).

Data protection is a concrete application of this competence. Teachers must recognize the risks associated with providing personal or educational information to external systems. The pursuit of

personalization cannot justify the indiscriminate sharing of student data (Santaella, 2025; Pereira et al., 2026).

Bias is another challenge. AI models are developed using large datasets and may reproduce problematic patterns present in those materials. Kasneci et al. (2023) include bias and responsible use among the challenges associated with the educational use of large language models. Teachers must be capable of identifying stereotyped representations or potentially discriminatory recommendations (Santaella, 2025).

Professional autonomy also emerges as a central issue. UNESCO (2024) maintains that its competency framework was developed according to principles intended to protect teachers' rights and strengthen human agency. AI should broaden possibilities for professional practice without transferring responsibility for educational decisions to automated systems (Santana et al., 2026).

This perspective has implications for planning. Systems may suggest strategies, but teachers must determine objectives, analyze class characteristics, select methodologies, and evaluate outcomes. An automated recommendation may constitute one source of information among others, but it does not replace contextual judgment (Valente, 2025; Santana et al., 2026).

Initial teacher education faces significant challenges. Teacher-education programs must integrate digital and AI-related competencies transversally, connecting them with didactics, curriculum, assessment, and the foundations of education. An isolated technology course is unlikely to be sufficient to produce effective integration (Jesus, Santana, and Assis, 2026; Silva et al., 2026a).

Continuing education presents a similar challenge. Practicing teachers need to develop competencies related to technologies that were not part of their initial education. The progressive structure proposed by UNESCO (2024), acquire, deepen, and create, provides an important reference because it conceives competency development as a continuous process.

The pace of technological change reinforces this need. Programs focused on specific tools can quickly become obsolete. Education must prioritize transferable competencies: critical thinking, curation,

planning, ethics, verification, technology selection, and the ability to learn continuously (Jesus, Santana, and Assis, 2026; Rial et al., 2026).

Institutional conditions also directly affect this process. It is not methodologically consistent to assign responsibility for innovation exclusively to teachers when institutions do not ensure connectivity, equipment, technical support, time for professional development, and policies governing technology use (Rial et al., 2026).

Inequalities in access represent another challenge. Teachers and institutions have different opportunities to experiment with technologies and participate in professional-development programs. Integrating AI without equity policies can create disparities among professionals and institutions (Pereira et al., 2026; Rial et al., 2026).

The findings therefore point to the need for systematic professional-development policies. Rather than one-time training sessions, teacher education must include experimentation, reflection on practices, case analysis, ethical discussion, and evaluation of the outcomes obtained through technology.

UNESCO (2024) observes that few countries currently have consolidated national AI competency frameworks or programs for teachers, indicating a gap between rapid technological expansion and the systematic professional preparation of educators.

The main prospect identified is the development of teacher education centered on human agency. This means educating teachers who are capable of using AI when it adds value, modifying its outputs when necessary, and rejecting it when its use is not pedagogically appropriate.

The responsible integration of Artificial Intelligence therefore depends on a combination of pedagogical competence, AI literacy, curation, ethics, assessment capability, and continuous professional development. Teachers do not need to compete with automated systems in the speed with which information is produced. They need to develop the competencies required to decide critically what to do with the information those systems generate.

CONCLUSION

This study aimed to analyze how teacher education, combined with active methodologies and emerging technologies, can contribute to the innovation of pedagogical practices in the age of Artificial Intelligence. The literature analyzed made it possible to conclude that these three elements have complementary relationships, but that their integration requires pedagogical intentionality, professional competencies, and appropriate institutional conditions.

In response to the research question, it was found that teacher education contributes to innovation when it prepares teachers not merely to use tools, but to understand their possibilities, critically evaluate their outputs, and integrate them into methodologies consistent with learning objectives. Innovation does not arise automatically from technology, but from the quality of the pedagogical decisions developed around it.

Active methodologies demonstrated the potential to increase student participation, investigation, collaboration, problem-solving, and autonomy. Their effectiveness, however, depends on planning, mediation, and assessment. Using project-based learning, problem-based learning, or the flipped classroom without effectively reorganizing student participation may result in only a formal change in practice.

Emerging technologies, in turn, expand possibilities for production, representation, interaction, personalization, and monitoring. Generative AI introduces an unprecedented capacity to produce content and alternatives rapidly. The same characteristics that increase its usefulness, however, also heighten the need for professional supervision.

Teacher education thus becomes the element connecting technology and pedagogical innovation. UNESCO’s framework confirms this need by establishing 15 competencies across five dimensions, combining a human-centered mindset, ethics, knowledge of AI, pedagogy, and professional development.

The competencies identified by the investigation include AI literacy, critical curation, planning, mastery of active methodologies, formative assessment, information verification, data protection, recognition of bias, digital competence, and continuous professional learning.

Critical curation deserves particular emphasis. In the context of systems capable of generating large quantities of material, teachers need to assume an even more rigorous role in validating what will be used. Automatically generated content must be treated as preliminary material subject to analysis rather than as a finished educational product.

It is also concluded that AI education should not be confused with prompt training. Although the ability to formulate commands has practical usefulness, it is only one skill within a much broader set. Education must enable teachers to understand outputs, identify errors, evaluate ethical implications, and determine whether the use of technology is pedagogically justified.

Another relevant finding concerns the preservation of teacher autonomy. The increasing use of systems capable of suggesting content, activities, and assessments must not transfer to algorithms decisions that require contextual knowledge and professional responsibility. The human-centered perspective advocated by UNESCO reinforces the need to preserve teacher agency and responsibility.

The investigation also demonstrated that responsibility for innovation cannot be assigned exclusively to teachers. Education systems and institutions must ensure infrastructure, connectivity, continuing education, support, data-protection policies, and institutional criteria governing the use of technologies.

One limitation is the bibliographic and qualitative nature of the research, which makes it possible to systematize and interpret contributions from the literature but does not directly measure the effects of the strategies discussed on learning or teachers' professional development. The rapid evolution of AI represents an additional limitation, requiring the continuous updating of evidence.

Future research should empirically investigate AI teacher-education programs, compare different competency-development models, and examine the integration of active methodologies and generative

systems in real teaching situations. Further studies are also needed on professional autonomy, bias, data protection, assessment, and the effects of sustained AI use on teachers' planning.

It is concluded that pedagogical innovation in the age of Artificial Intelligence should not be measured by the number of technologies present in the classroom, but by the ability to produce more meaningful, participatory, and pedagogically grounded educational experiences. Technology expands possibilities; methodology organizes pathways; and teacher education establishes the criteria required to transform these possibilities into quality education.

REFERENCES

Bacich, Lilian; Moran, José (eds.). *Metodologias ativas para uma educação inovadora*: uma abordagem teórico-prática [Active methodologies for innovative education: a theoretical and practical approach]. Porto Alegre: Penso, 2018.

Bergmann, Jonathan; Sams, Aaron. *Flip your classroom*: reach every student in every class every day. Eugene: International Society for Technology in Education; Alexandria: ASCD, 2012.

Gil, Antonio Carlos. *Como elaborar projetos de pesquisa* [How to develop research projects]. 7th ed. Barueri: Atlas, 2022.

Hermann, Nadja. Ética e inteligência artificial: o que inquieta? [Ethics and artificial intelligence: what causes concern?]. *Educação & Sociedade*, v. 46, e296750, 2025. DOI: 10.1590/ES.296750.

Jesus, Alexandra Virgínia das Graças de; Santana, Eugênio Jesus; Assis, Neuda da Cruz. Competência digital docente: revisão sistemática da literatura [Teachers' digital competence: a systematic literature review]. *Revista Ibero-Americana de Humanidades, Ciências e Educação*, v. 12, n. 2, p. 1–18, 2026. DOI: 10.51891/rease.v12i2.24339.

Kasneci, Enkelejda; Sessler, Kathrin; Küchemann, Stefan; Bannert, Maria; Dementieva, Daryna; Fischer, Frank; Gasser, Urs; GROH, Georg; Günnemann, Stephan; Hüllermeier, Eyke; Krusche, Stephan; Kutyniok, Gitta; Michaeli, Tilman; Nerdel, Claudia; Pfeffer, Jürgen; Poquet, Oleksandra; Sailer,

Michael; Schmidt, Albrecht; Seidel, Tina; Stadler, Matthias; Weller, Jochen; Kuhn, Jochen; Kasneci, Gjergji. ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences*, v. 103, art. 102274, 2023. DOI: 10.1016/j.lindif.2023.102274.

Long, Duri; Magerko, Brian. What is AI literacy? Competencies and design considerations. In: *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. New York: ACM, 2020. p. 1–16. DOI: 10.1145/3313831.3376727.

Miao, Fengchun; Cukurova, Mutlu. *AI competency framework for teachers*. Paris: UNESCO, 2024. DOI: 10.54675/ZJTE2084.

Mishra, Punya; Koehler, Matthew J. Technological pedagogical content knowledge: a framework for teacher knowledge. *Teachers College Record*, v. 108, n. 6, p. 1017–1054, 2006. DOI: 10.1111/j.1467-9620.2006.00684.x.

Moran, José. Metodologias ativas para uma aprendizagem mais profunda [Active methodologies for deeper learning]. In: Bacich, Lilian; Moran, José (eds.). *Metodologias ativas para uma educação inovadora*: uma abordagem teórico-prática [Active methodologies for innovative education: a theoretical and practical approach]. Porto Alegre: Penso, 2018. p. 1–25.

Ng, Davy Tsz Kit; Leung, Jac Ka Lok; Chu, Samuel Kai Wah; Qiao, Maggie Shen. AI literacy: definition, teaching, evaluation and ethical issues. *Proceedings of the Association for Information Science and Technology*, v. 58, n. 1, p. 504–509, 2021. DOI: 10.1002/pra2.487.

Pereira, Natalia Rezende; Feitosa, Cristiane Izilda Trindade Alcântara; Pinto, Daniel Vinícius; Almeida, Roma Reis de; Santana, Eugênio Jesus; Rodrigues, Alessessandre Roque Garcia; Passos, Leila Nazaré dos Santos; Braznick, Francielle; Barreto, José Augusto. Inteligência artificial generativa e educação inclusiva: desafios éticos, pedagógicos e legais na garantia do direito à aprendizagem [Generative artificial intelligence and inclusive education: ethical, pedagogical, and legal

challenges in ensuring the right to learning]. *Revista Ibero-Americana de Humanidades, Ciências e Educação*, v. 12, n. 4, p. 1–21, 2026. DOI: 10.51891/rease.v12i4.25629.

Redecker, Christine. *European framework for the digital competence of educators*: DigCompEdu. Luxembourg: Publications Office of the European Union, 2017. DOI: 10.2760/159770.

Ribeiro, Ana Elisa. Definições atualizadas e uso com moderação: um ensaio sobre inteligência artificial na Educação Básica [Updated definitions and use in moderation: an essay on artificial intelligence in Basic Education]. *Texto Livre*, Belo Horizonte, v. 19, e62700, 2026. DOI: 10.1590/1983-3652.2026.62700.

Rial, Gilvan Marinho; Augusto, Solange do Rocio da Silva; Andrade, Felipe Antonio Xavier; Souza, Vanuza Aparecida Pereira de; Silva, Ângela Cristina Rodrigues da; Britto, Alexandre Queiroz; Silva, Clebson Correia da; Santana, Eugênio Jesus; Resende, Kamila Barbosa; Barros, Estanislau de Lima; Schreiber, Juliana Meregalli. Formação docente e tecnologias emergentes: investigação qualitativa sobre práticas pedagógicas na educação contemporânea [Teacher education and emerging technologies: a qualitative investigation of pedagogical practices in contemporary education]. *Revista edUCA – Revista Multidisciplinar da Faculdade Católica Paulista*, v. 9, n. 4, e604, 2026. DOI: 10.54901/educa.v9-604.

Santana, Eugênio Jesus; Goulart, Michelle Soares Teixeira; Andrade, Felipe Antonio Xavier; Jesus, Priscila Keller da Mata de; Almeida, Richard Lucas de; Nascimento, Soraya de Fátima Inácio; Bortolini, Rosecler Valentim; Rezende, Michely Leal Polastreli; Bertoldo, Maria Josiane Barros; Santos, Mateus dos. *Inteligência artificial na educação básica*: substituição do professor ou reconfiguração da prática docente? [Artificial intelligence in Basic Education: replacing teachers or reconfiguring teaching practice?]. Aurum Editora (e-Books*)*, p. 475–491, 2026. DOI: 10.63330/aurumpub.057-025.

Santaella, Lucia. A ética como guia para o uso da inteligência artificial generativa [Ethics as a guide to the use of generative artificial intelligence]. *Educação & Sociedade*, v. 46, e296469, 2025. DOI: 10.1590/ES.296469.

Silva, Angela Cristina Rodrigues da; Santos, Sinamon Vieira; Pinto, Daniel Vinícius; Rios, Luiz Daniel Alves; Santana, Eugênio Jesus; Lopes, Giselle Dantas; Lima, Isabela Regina Nunes da Luz; Rial, Gilvan Marinho. Metodologias ativas mediadas por inteligência artificial no ensino de Matemática: análise das práticas pedagógicas orientadas por resolução de problemas [Artificial Intelligence-mediated active methodologies in Mathematics teaching: an analysis of problem-solving-oriented pedagogical practices]. *Revista Ibero-Americana de Humanidades, Ciências e Educação*, v. 12, n. 4, p. 1–15, 2026. DOI: 10.51891/rease.v12i4.25981.

Silva, Rafael Roberto da; Turatto, Alessandra Verginelli; Cordeiro, Vívian Cristina Fonseca da Silva; Ribeiro, Leni Pardo Almeida; Santana, Eugênio Jesus; Pioner, Luiza Bortolaci; Oliveira, Patrícia Duarte de. IA e formação docente: competências necessárias para o ensino mediado por tecnologias generativas [AI and teacher education: competencies required for teaching mediated by generative technologies]. *Revista Ibero-Americana de Humanidades, Ciências e Educação*, v. 12, n. 4, 2026. DOI: 10.51891/rease.v12i4.25546.

UNESCO. *Guidance for generative AI in education and research*. Paris: UNESCO, 2023.

Valente, José Armando. Currículo e processos formativos: perspectivas na Linha de Pesquisa Novas Tecnologias em Educação da PUC-SP [Curriculum and educational processes: perspectives from the New Technologies in Education Research Area at PUC-SP]. *Revista e-Curriculum*, v. 23, e73815, 2025. DOI: 10.23925/1809-3876.2025v23e73815.

Vergara, Sylvia Constant. *Projetos e relatórios de pesquisa em Administração* [Research projects and reports in Business Administration]. 16th ed. São Paulo: Atlas, 2016.