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The significance of artificial intelligence in fostering professional competencies of the future: a systematic review

La importancia de la inteligencia artificial en el fomento de las competencias profesionales del futuro: una revisión sistemática

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Abstract

The purpose of this study is to conduct a systematic review of relevant materials published between 2018 and 2025, with a focus on analysing the advantages and disadvantages of AI adoption. PRISMA guidelines were applied to search, screen and partially analyse the scientific literature. A total of 54 sources were selected, including experimental papers, review studies, monographs, conference proceedings and analytical articles. The systematic review proceeded in three phases: (1) analytical reading, (2) screening

and (3) examination and reporting. The results show that numerous studies emphasise the potential benefits of emerging technologies, beginning at school level and, consequently, the preparation of teachers to integrate them creatively. Among the studies reviewed, 39% were experimental studies (EXP), while 36% were theoretical reviews (TR). Most of the studies were conducted in higher education institutions with the participation of students and teachers. Methodologically, researchers have mainly undertaken theoretical and survey-based investigations of AI use, although experimental studies are also noteworthy. The conclusions suggest that, given the rapid evolution of digital technologies, an integrated approach combining empirical and theoretical research is optimal for determining the impact of AI systems on the formation of professional competences.

Keywords: automation, critical thinking, opportunities, risks, professional competence, educational process.

Resumen

El objetivo de este estudio es realizar una revisión sistemática de materiales relevantes publicados entre 2018 y 2025, centrada en analizar las ventajas y desventajas de la adopción de la inteligencia artificial (IA). Se aplicaron las directrices PRISMA para la búsqueda, selección y análisis parcial de la literatura científica. Se seleccionaron 54 fuentes, entre ellas artículos experimentales, estudios de revisión, monografías, actas de congresos y artículos analíticos. La revisión sistemática se llevó a cabo en tres fases: (1) lectura analítica, (2) cribado y (3) examen e informe. Los resultados muestran que numerosos estudios destacan los beneficios potenciales de las tecnologías emergentes desde la etapa escolar, así como la preparación del profesorado para integrarlas de manera creativa. Del total de estudios revisados, el 39 % fueron investigaciones experimentales y el 36 % revisiones teóricas. La mayoría se desarrollaron en instituciones de educación superior con participación de estudiantes y docentes. Metodológicamente, predominaron las investigaciones teóricas y basadas en encuestas, aunque los estudios experimentales también fueron significativos. Las conclusiones indican que, dada la rápida evolución de las tecnologías digitales, un enfoque integral que combine investigación empírica y teórica resulta óptimo para evaluar el impacto de la IA en la formación de competencias profesionales.

Palabras clave: automatización, pensamiento crítico, oportunidades, riesgos, competencia profesional, proceso educativo.

Introduction

The contemporary labour market is undergoing radical change owing to the digital transformation of society. Modern professionals must therefore demonstrate appropriate competencies alongside adaptability and flexibility. Artificial intelligence (AI) is a principal driver of these transformations and is being actively integrated into education. According to the World Economic Forum in 2023, more than 40% of essential skills are expected to change by 2027 and more than 85 million jobs could be displaced by artificial intelligence, while 97 million new roles could emerge that are more adapted to human-machine collaboration. Recent studies observe that technology-enhanced learning expands opportunities for developing professional competencies (Bond et al., 2021). Yet new challenges are emerging. Investigation of AI's role in future competency frameworks is timely, since traditional training methods are losing effectiveness amid rapid shifts in skill demands and automation. Technological progress thus underpins the relevance of the present study. Evidence confirms that AI is becoming a powerful educational tool and is promoting personalised learning (Essel et al., 2022). Moreover, AI is one of the key drivers of changes and is being integrated into the education system. According to reports from World Economic Forum in 2023 and empirical research by Essel et al. (2022) AI is being implemented in secondary and higher education to develop personalized learning, automated feedback, and adaptive assessment of knowledge. By analysing individual learner profiles, AI can refine teaching strategies. Nevertheless, implementation faces critical barriers. Access to technology remains uneven (Makransky & Lilleholt, 2018; Ramadhona et al., 2022); deploying AI requires substantial resources and may widen the digital divide. Moreover, particular algorithms can introduce bias in assessment and in the design of learning pathways.

Several research gaps persist. Core future competencies that can be delineated through AI are not yet fully defined, and integration of AI into traditional education remains problematic. Inconsistent methodological approaches and multiple ethical concerns further complicate adoption. Consequently, the central research problem is to establish how AI can foster competencies aligned with labour market needs.

The present study adopts a critical systematic review, whereas most prior work has examined only isolated aspects of AI's educational impact. This approach enables a holistic appraisal of AI's contribution to the formation of professional competencies. Thus. this study responds to these challenges and offers a critical systematic review of the literature. Unlike previous studies that have only considered individual aspects of the impact of AI on education, this review aims to comprehensively assess the potential of AI in shaping professional competencies that meet the requirements of the modern labor market.

Aim: to conduct a systematic review of AI's role in shaping future professional competencies and to evaluate its broader effects on the education system.

Objectives

Undertake a comprehensive search, selection and analysis of recent publications (journal articles, monographs, conference proceedings) on AI's influence on competency formation.

Identify key trends and mechanisms through which AI supports the development of professional competencies.

Determine the principal challenges associated with AI deployment and propose directions for future research on innovative educational technologies that cultivate relevant competencies.

Literature Review

The research is based on several concepts, including the transformation of education in the context of digitalization and the theory of the competency approach, the latter focusing not only on knowledge, but also on the ability to apply them in real situations (soft skills, transferable skills, 21st-century skills).

Changing the context of education and the labor market under the influence of AI

Given the circumstances of alteration of the economy and education, AI allows us to build competencies that affect the development and career of the future. Modern scientists have described various problems of AI's impact on personnel training (Bingham, 2024; Ramadhona et al., 2022; Kurebay et al., 2023). The authors' research also draws attention to adapting education to new labour market requirements that have been significantly influenced by digitalization (Ramadhona et al., 2022). All these processes have a general impact on transforming education and science. Several scientific studies have shown that AI technologies are changing traditional education and training methods. Intelligent, personalized learning systems affect adaptive learning, which contributes to the effective assimilation of knowledge (Chen et al., 2020; Ciolacu et al., 2018; Ramadhona et al., 2022). Baidoo-Anu et al. (2024) used the ChatGPT Student Experience Scale (SCES) to assess students' views on AI as an education tool. Berendt et al. (2020) identified the principal risks and benefits of using AI in education with a special emphasis on compliance with fundamental human rights. Overall, the study is based on a review of the main challenges. Catchpoole (2022) emphasized the prominence of adhering to ethical standards in modern education. At the same time, scientists noted that AI not only automates routine tasks but also affects the personalization of education and allows for effective monitoring of students' results. A vital change influenced by AI is adaptive learning (Makransky & Lilleholt, 2018). By analyzing large amounts of data, algorithms allow us to determine the individual requirements of each student and offer materials of the appropriate level of complexity. Another notable trend mentioned by the authors is the automation of knowledge assessment (Huang, 2023). The scientific literature shows that AI influences the automation of student work checking

and reduces teachers' workload. At the same time, AI-based systems allow for the analysis of tests, essays, and student responses (Luckin & Cukurova, 2019). This, in turn, affects the provision of quick and objective feedback.

Digital support for competence development and automation of the educational process

According to current research, AI promotes improving skills in many areas, including medicine, finance, engineering, and management (Luckin & Cukurova, 2019). At the same time, the active use of machine learning technologies influences the creation of new professional training models. Jain & Raghuram (2023) noted that integrating AI into the educational process allows the improvement of different skills. Other studies have noted the impact of AI on digital skills and analytical abilities. Such competencies are critical today in the context of rapid automation and changes in the labour market. In addition, studies have shown that AI affects the automation of routine processes and leaves more time for developing strategic thinking and creativity skills (Kumar, 2024; Stolpe & Hallström, 2024). As a result, critical thinking skills are increasing, as students can evaluate proposed options and choose the best solutions (Muraina et al., 2025). Modern authors have conducted separate systematic reviews of AI but did not focus on analyzing the impact of AI on professional development (Xu & Ouyang, 2022; Zhang & Aslan, 2021). However, AI has been shown to improve the educational process, as intelligent systems can automatically adapt curricula and help students with time management. However, despite these benefits, the authors also point to several challenges. They point out that there are several ethical issues and risks of job automation (Sharma & Sharma, 2025). In addition, a notable challenge in different countries is the lack of adequate legal regulation of the use of AI (Sharma & Sharma, 2025). Another significant challenge is training teachers to use AI in the educational process, as not all teachers have the appropriate skills to use AI (Chassignol et al., 2018).

Gaps in the scientific literature

Thus, the analyzed literature shows that AI has a vital role in modern education and affects the development of various skills. Still, the authors also pointed out some problems. This requires revising existing concepts and conducting comprehensive research. In addition, the scientific literature lacks an organised analysis of the role of AI in developing professional skills, as most authors have focused on individual aspects of AI implementation in education. This study will fill in these gaps and provide an analysis of the effectiveness of AI in different educational environments.

Methodology

Research design

The review's objectives were to analyse and deduce the results in light of predefined research topics and criteria that indicate potential future directions. The predefined research focuses were the purpose, subject matter, approach, and results. This review was conducted in 3 stages: critical reading of research papers, their screening, analysis and reporting. This type of research was chosen because of the importance of systematizing the existing knowledge on the use of AI, which is currently lacking in the scientific literature.

Sample and Materials

The source selection is based on purposive criterion sampling. The study envisages using different sources: scientific articles, chapters from monographs, and materials from scientific conferences. The sample is limited to a strict chronological range: from 2018 to 2025. This was done in order to attract the latest and most relevant scientific literature for analysis.

In addition, attention was paid to the credibility of the sources and methodological aspects. Content relevance was also an important criterion. The primary language of publications is English. Table 1 shows the main criteria for including and excluding scientific sources.

Table 1.
Inclusion and exclusion criteria of materials

Criterion	Description
Inclusion criteria	
Chronological framework	Research 2018-2025
Authority of sources	Articles published in peer-reviewed journals or scientific monographs are eligible for inclusion
Methodological quality	Papers of various methodological types are included: review, experimental, meta-analyses, pilot studies, etc.
Contentual relevance	All studies must relate to the using of AI in education
Language of publication	Scientific works written in English
Exclusion criteria	
Outdated sources	Scientific papers written before 2018
Duplicates	All duplicates and works without scientific novelty are excluded
Non-peer-reviewed publications	Popular science articles from blogs, Wikipedia, popular media without scientific confirmation are excluded
Lack of full text	Those works that did not have a full content text were rejected

Source: Authors' compilation

Procedures and Instruments

The PRISMA methodological approach was used to search for scientific literature, screen it, and analyze it. This approach is recognized by modern scholars who consider it relevant for conducting reviews and systematic studies. This systematic review was not registered in PROSPERO or other databases; however, the protocol was developed a priori and followed PRISMA guidelines (Page et al., 2021).

This method was also chosen because it effectively collects new scientific and relevant information. For this purpose, scientometric databases: Crossref, Scopus, Web of Science, and Google Scholar were selected. The search queries included the following keywords: "artificial intelligence", "AI", "technology", "innovations", "professional development", "advanced skills", and "digitalization". A total of 3,291 items were received. After that, all duplicates and articles that did not contain scientific novelty were removed (-1191).

Next, all results that did not correspond to this study's content and thematic part were rejected. This was done by analyzing keywords and titles (-915). Next, the authors examined the results and rejected all publications that did not correspond to the chosen issue (-791). After that, 4 exclusion criteria were used (See Figure 1).

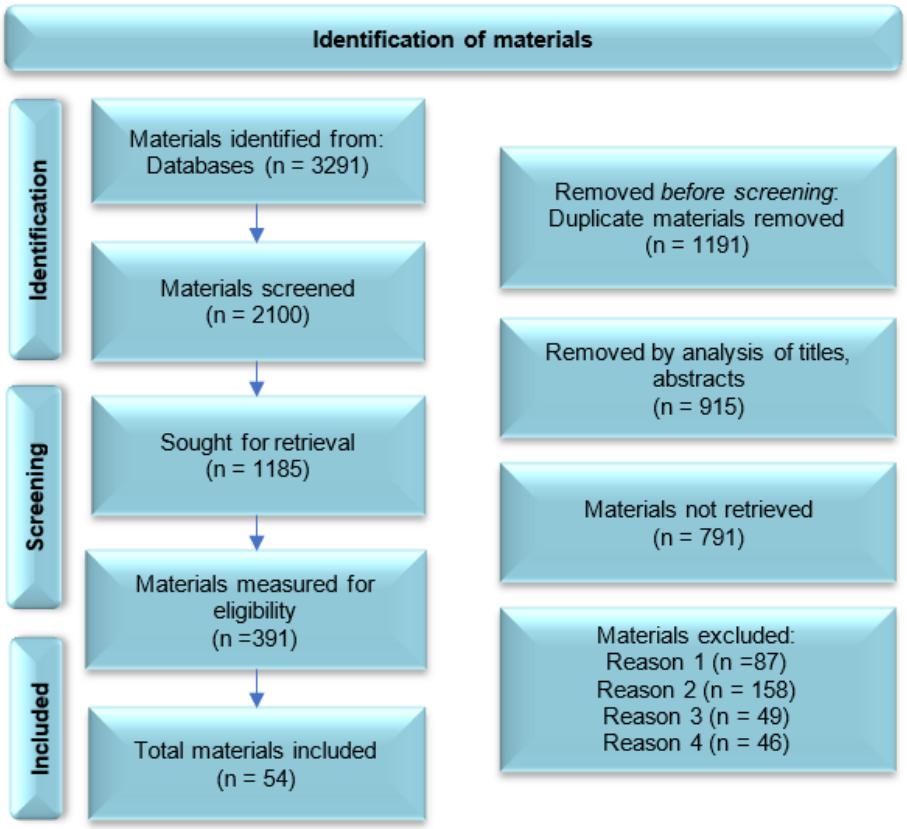

Figure 1. Identification of Materials
Source: Authors' compilation

Data Analysis

The data was analyzed within the Excel program. This software was chosen because of its accuracy and simplicity in organizing data.

Thematic analysis was conducted based on 54 selected sources. Thematic analysis was used for the study, which consisted of several steps. The first step was a thoughtful reading of the collected scientific materials. The second step was the coding process, which consisted of forming the main categories and dividing the overall text into general parts. Primary coding was carried out manually with subsequent use of categorical generalization. The principal content codes defined these parts. At this stage, a deductive approach was used, which involved the use of existing concepts to clearly define concepts: "personalization", "adaptation", "accessibility", "critical thinking" "professional growth". The principal codes are therefore divided into the following parts:

1. Capabilities: "autonomy", "adaptation", "personalization".
2. Skills: "critical thinking", "support for creativity", "flexibility", "interactivity".
3. Challenges: "digital divide", "privacy challenges", "transforming the role of teachers".

The codes were then grouped and combined into broader categories: "main AI opportunities", "impact on professional development", "core challenges". This allowed us to identify the main connections between the themes and characterize key methodological trends. After that, the data obtained was compared with other scientists' data.

To ensure the trustworthiness of the results, two independent researchers performed double coding of 35% of the sample (n=20 sources). After comparing the codes, discrepancies were discussed, and the final themes were agreed upon.

To assess inter-coder consistency, Cohen's Kappa coefficient (κ = 0.81) was calculated, indicating a high degree of consistency.

The coding results were also submitted for review to an external expert in the field of psychological and pedagogical research, which allowed for peer-review of interpretations.

Results

The potential of new teaching methods that influence the formation of competencies that are most needed in the modern challenges is a relevant area of modern academic research on education development. Such competencies in the educational system include design and research, which change the learning process by adding a research and design component. This is the basis for developing critical competencies of future teachers (by the new educational standards) and students (in accordance with the ideas of professional learning).

Specifically, scientists from several disciplines are conducting systematic research on the potential and challenges of artificial intelligence, including individual systems, identifying their capabilities, practical algorithms, and security measures that should be considered when incorporating them into the field of study. According to some researchers, current work on AI is enabling the improvement of large language models (LLMs) (Stolpe & Hallström, 2024). The emphasis has been placed on a completely new digital information source that needs to be integrated into the learning process without destroying the already established basic principles based on the relationship between teachers and students.

Numerous research focused on the potential profits of new technologies, starting with schooling and, as a result, on preparing teachers to structure it creatively (Zhai et al., 2021b). Moreover, the studies positively assess the potential of AI in acquiring the necessary professional competencies, noting some advantages of integrating artificial intelligence into the educational system (Table 2).

Table 2.
Advantages of using AI in the development of professional competencies

№	Opportunities	Description
1	Personalization of education	AI systems allow you to quickly create personalized curricula, consider the previous levels of knowledge and learning style of each student. Personalization contributes to more effective use of educational materials and the formation of individual learning trajectories.
2	Working with large amounts of digital information	Following the modern need to navigate large volumes of information, there is a need to establish work on processing large amounts of information. AI systems allow you to analyze the most effective teaching methods, forecast labour market needs, adjust educational programs, and acquire the necessary professional competencies to adapt to current trends.
3	Development of critical thinking and creative work	Working together with AI systems allows you to find new and rather non-standard solutions, analyze various practices and alternative approaches. Providing such a relevant understanding of the material opens up further opportunities for the active development of analytical skills and creative abilities. In modern market realities, this significantly contributes to professional growth.
4	Automatic execution of routine tasks and saving time	The use of advanced AI systems allows students to engage in more creative and relevant work, freeing up more time for learning and performing much more complex and creative tasks. Such optimization of the educational process provides more opportunities for acquiring the professional skills necessary for training specialists.
5	Organization of monitoring and feedback	Systems that operate using AI can quickly assess the level of mastery of professional knowledge, identify gaps and provide recommendations for their elimination in the future. Such efficiency significantly improves the quality of specialist training.

Source: compiled by the authors based on Morandini et al. (2023); Zhai et al. (2021a); Khudoliy & Voitsekhivska (2015)

In general, AI systems' role in acquiring professional competencies in future specialists is highly relevant. Such integration into the educational process can significantly increase the efficiency of educational activities and adapt them to the critical challenges of our time. It is equally essential that AI can contribute to the training of highly skilled and competitive specialists in the labour market.

The researchers relied on different aspects of AI applications in education (see Table 3). In particular, current research has introduced AI in general education, online education, STEM (STEMA) education, and secondary education. Some areas deal with more specialized learning: computer science, machine learning, and interactive learning.

As for the methodological approach, most of the scientific papers belong to systematic studies (SR), theoretical reviews (TR), pilot studies (PS), narrative reviews (NR), and general reviews (R). However, much less attention is paid to empirical or experimental studies and bibliometric analyses. In addition, in modern works, the authors more often evaluate both the progressive and harmful impact of introducing and using AI in the education system at all levels. Table 3 shows the main directions, methodological approaches, and main results of AI use in the modern educational system.

Table 3.
Characterization of educational directions, approaches, and results in modern research on AI[1]

Authors	Learning Subject	Educational level	Approach	Participants	Results
Zhai et al. (2021a)	Education	All levels	SR	-	OUT+
Xu & Ouyang (2022)	STEM education	All levels	SR	-	OUT+
Fidalgo et. al. (2020)	Education Online education	Higher education	EXP PS	Undergraduate students in Portugal, UAE and Ukraine	OUT+
Siraj-Blatchford (2023)	Early education	Early education	TR	-	OUT+\-
Elmahdi et al. (2018)	Technology for Formative Assessment	Higher education	EXP	166 students from university	OUT+\-
Nafea (2018)	Machine learning	Higher education	TR	-	OUT+
Kokku et al. (2018)	Augment traditional teaching	All levels	TR	-	OUT+\-
Zhu et al. (2020)	Online learning Blended learning	Higher education	EXP	94 university students	OUT+\-
de la Torre & Baldeon-Calisto (2024)	Education	Higher education	SR	-	OUT+
Chan & Hu, 2023)	Education	Higher education	EXP	399 undergraduate and postgraduate students	OUT+\-
Chassignol et al. (2018)	Education	All levels	NR	-	OUT+
Zhang & Aslan (2021)	Education	All levels	TR	-	OUT+\-
Dai et al. (2020)	Computer science	Secondary education	EXP	707 students from 17 schools 25 teachers	OUT+
Knox (2020)	Education	All levels	TR	-	OUT+\-
Song & Wang, (2020)	Education	All levels	BA	-	OUT+\-
Joo et al. (2018)	The using of technology	Higher education	EXP	296 participants ot the College of Education	OUT+\-

[1] SR stands for Systematic Review, EXP – Experimental Study, PS – Pilot Study, TR – Theoretical Review, NR – Narrative Review, BA – Bibliometric Analysis, and R – Review. Additionally, OUT+/- indicates that the study describes both the positive and negative impacts of technologies.

Webb et al. (2020)	Machine learning	All levels	TR	-	OUT+\-
Winters et al. (2019)	Education	All levels	TR	-	OUT+\-
An et al. (2021)	Online teaching	Higher education	EXP	110 teachers completed the survey	OUT+\-
Zhai et al. (2021b)	Machine learning	All levels	TR	-	OUT+\-
Tuma (2021)	Interactive teaching	All levels	NR	-	OUT+\-
Ramadhona et al. (2022)	Online learning platforms	Secondary education	EXP	Two sample classes of 11-grade science students (38 students), the social science class (25 students). Total - 53 students	OUT+\-
Fahimirad, & Kotamjani (2018)	Teaching and learning	Higher education All levels	R	-	OUT+\-
Fuchs & Aguilos, (2023)	Education	Higher education	EXP	27 students	OUT+\-
Huang et al. (2020)	Education	Higher education	MA	-	OUT+
Khoroshailo, & Kocherhina (2023)	Education Teaching foreign languages	Higher education	TR		OUT+
Baidoo-Anu et al. (2024)	Education	Higher education	EXP	277 students from universities and college	OUT +/-

Source: Author's development

Therefore, this review consists of different approaches, dominated by experimental studies (EXP) and reviews (TR, NR). Experimental studies have been mainly conducted in higher education with student participants, while review studies often cover a broader educational context. Data collection methods in experimental studies include surveys, interviews, observations, while reviews are based on the analysis of previously published materials. Systematic reviews (SR) are used to generalize existing results from different levels of education. Despite the diversity of methods, the results of most studies are positive (OUT+), indicating the effectiveness of the applied technologies and methodologies. At the same time, some studies contain mixed or neutral results (OUT+/-), which may be due to different sample quality or context features.

Hence, 35% of the selected studies reported mostly positive results (OUT+), highlighting the contribution of AI to personalized learning, critical thinking, automation of routine tasks, and improved feedback mechanisms.

65% of the selected papers presented mixed or partial results (OUT+/-). These studies often cited limitations related to technological dependency, limited human interaction, algorithmic bias, and issues of equal access (digital divide).

Thus, the review also made it possible to draw attention not only to the tangible benefits of using AI systems in education. Some educational process risks were also noted, which need to be considered in the subsequent use of intellectual digitalization to form the necessary professional competencies. In particular, essential risks include dependence on technology and decreased human factors. For instance, the increasing role of automated systems in education may lead to a decrease in the role of teachers (Brauner et al., 2025). In addition, there may be a dependence on technology, when excessive trust in AI algorithms will reduce the ability to make independent decisions, critical thinking, and overreliance on AI instead of their analytical work. It is quite paradoxical that AI systems, on the one hand, are aimed at individualizing learning, and on the other hand, contribute to the standardization of knowledge and methods. Excessive use of AI can generate limited approaches to learning that do not develop creativity. In addition, AI algorithms are patented technologies that are kept secret. Potential biases or unrepresentative data may hurt the objectivity of assessments or pedagogical recommendations

(Sharma & Sharma, 2025). In addition, the imperfection of algorithmic solutions is a significant challenge. However, a significant problem in the modern learning space is the digital divide between students and teachers, which needs to be addressed urgently. Implementing AI-based solutions for the acquisition of professional competencies is a rather expensive process. This problem may become noticeable in the global dimension, when access to quality education in less affluent regions is limited. (Table 4).

Table 4.
Risks of using AI systems in the acquisition of professional competencies

№	Risks	Description
1	Increased dependence on technology, weakening of the human factor in contacts	May lead to a decrease in the role of teachers. This will destruction the development of interpersonal skills among students (Brauner et al., 2025). In addition, there may be a dependence on technology.
2	Uniformity of training and bias of AI algorithms	Artificial intelligence contributes to the standardization of knowledge and approaches. Its excessive use can limit the development of creativity (Hryhorak et al., 2023). In addition, AI algorithms are closed patented technologies, which can lead to bias and biased educational recommendations.
3	Accessibility and digital divide	Implementing AI-based solutions for the acquisition of professional competencies is a rather expensive process. (Sharma & Sharma, 2025). The existence of a digital divide will not help access to education.

Source: Author's development

Along with the inevitable emphasis on the advantages and disadvantages of the application, it is essential to consider those aspects that are still poorly assessed in the scientific literature. In particular, the use of AI in education and forming professional competencies has been studied fragmentarily. First, the existing works emphasize the theoretical foundations of AI in education. At the same time, empirical calculations, individual experiments, and long-term studies of AI (including the impact on professional skills development) are pretty rare. Scientists pay little attention to the cross-disciplinary approach to the use of AI, particularly in combining technological, psychological, and pedagogical knowledge. A separate problem is the lack of established approaches to assessing the effectiveness of AI in creating professional competencies, including the process of individualizing learning.

Based on this, it is possible to formulate specific research recommendations that could be used for further study of this issue. First, further integration of AI systems into educational programs can be identified as an important area: the use of adaptive platforms or virtual assistants in training. The process of teachers acquiring additional digital competencies to enable them to use AI efficiently will require a separate assessment. Special training and seminars would allow us to rethink certain features of the training of modern teachers, which is an important area for future research. There is also a need to study potential adjustments that need to be made to train students to improve their professional competencies.

Discussion

The research of the function of AI systems in modern education is a highly relevant issue, given the potential for such digitalisation in the future. The purpose of the proposed research is to conduct a review of AI in forming professional competencies of the future and to analyse its impact on the education system in general. As a result, it is envisaged to find answers to the primary research tasks, in particular, to analyse current publications on the impact of AI and identify its positive role on the progress of professional competencies.

The proposed results note that an essential aspect of research is to determine the potential of new teaching methods that would create the competencies that are most needed in the context of modern challenges, especially considering current problems with education development. Such competencies in the educational system include design and research, which change the learning process by adding a research

and design component. The results obtained indicated that one of the key areas of influence of AI is the development of critical thinking, creativity, and problem-solving skills, which are identified by international structures (WEF) as the most in demand in the 21st century.

Current work on AI enables the improvement of large-scale language models that validate incredible capabilities in various fields. This poses a significant challenge to the traditional understanding of learning or cognition. Many studies have focused specifically on exploring the potential benefits of new technologies, starting with schooling and, as a result, on preparing teachers to structure it creatively. In general, the potential of AI systems to acquire professional competencies required by the labour market was positively assessed. Among the most obvious advantages are the personalisation of education, the ability to procedure large amounts of digital information, the active development of critical thinking and creativity, autonomous and accelerated performance of routine tasks, and high-quality monitoring of the educational process and feedback. Other researchers also identify the same benefits but arrange them in different sequences according to their theoretical concepts or empirical calculations (Bingham, 2024; Luckin & Cukurova, 2019). Time is now highlighting opportunities for the development of critical thinking and creativity in students, which directly contributes to the further improvement of professional competencies (Rodríguez Illera, 2024; Sijing & Lan, 2018; Turchyn et al., 2023). Less attention is paid to such an option as self-education. Only a few researchers emphasise this aspect, pointing out that education in the modern world is also based on acquiring informal knowledge, which can also be obtained through AI systems (Yi et al., 2024).

The proposed results show that the function of AI systems in the acquisition of professional competencies by specialists of the future is highly relevant. Therefore, the analysis of scientific literature also made it possible to draw attention not only to the tangible benefits of using AI systems in education. The most immediate risks of using AI systems to acquire professional competencies are the growing dependence on technology, the bias of AI algorithms, the digital divide, and the problem of technology accessibility. The findings confirm other scholars' conclusions that specific challenges need to be addressed in the next work on the impact of AI on the educational process (Catchpoole, 2022; Kumar, 2024; Omelchuk et al., 2022). The proposed results also note that most scientific studies openly note AI's advantages and disadvantages. Other scholars also emphasise this feature (Chen et al., 2020; Muraina et al., 2025). While the use of AI allows for individualisation of the educational process and the formation of individual learning trajectories, the fascination with AI technologies and their excessive use, on the contrary, makes learning typical and inflexible and causes certain forms of dependence on students. We should agree with researchers who point out the meaning of finding a balance in the use of modern technologies (Huang, 2023). Excessive use of AI systems does not contribute to developing professional competencies in education.

The analysis has revealed that certain aspects are still poorly assessed in the scientific literature: the lack of empirical calculations, the lack of attention to the cross-disciplinary approach to the use of AI, and the lack of established approaches to assessing the effectiveness of AI in creating professional competencies. Hence this article identified different gaps in scientific literature. In particular, the weak treatment of the topic of self-education as an important channel for acquiring professional skills through AI systems. Despite the popularity of the concept of lifelong learning, only a few authors (Yi et al., 2024; Guerrero-Quiñonez et al., 2023) pay attention to non-formal and informal forms of learning that are implemented thanks to digital technologies. Another underestimated area is the interdisciplinary approach to studying AI in education. Most scientific works remain within the framework of pedagogy or IT sciences, while the effective integration of AI requires considering legal, social, psychological and ethical factors (Sharma & Sharma, 2025; Gutierrez et al., 2022).

Recommendations for further research directions include the study of the integration of AI systems into educational programmes, the process of teachers acquiring additional digital competencies, and potential adjustments to be made to the training of students to improve their professional competencies (Ciolacu et al., 2018; Salas-Pilco & Yang, 2022). In particular, this statement is relevant to the importance

of conducting comprehensive research and systematic analysis to determine further advantages and disadvantages of using AI to acquire professional competencies.

The results in the paper, even though they do not lessen the significance of the findings.

Conclusions

A systematic analysis of 54 studies of AI systems' impact on professional competencies development has demonstrated the advantages, disadvantages, difficulties, and prospects for further research on this issue and the general use of AI in the educational process. Among the reviewed studies 39% were experimental studies (EXP), mostly conducted in higher education institutions with the participation of students; 36% were theoretical reviews (TR). Other methodological approaches included systematic reviews (SR) – 7%, descriptive reviews (NR) – 7%, general reviews (R) – 3%, meta-analyses (MA) – 3%, bibliometric analyses (BA) – 3%. This has led to a dominance of theoretical studies over empirical or data-driven studies. Theoretical studies (TR, SR, NR, R, BA, MA) make up ≈ 62.96% At the same time, experimental studies (EXP, PS) account for ≈ 37.04% Hence, only about 2 in 5 studies presented detailed quantitative data or robust long-term results on the impact of AI on competency development. However, 35% of studies reported predominantly positive results (OUT+) and emphasized the position of AI in personalized learning, automation of routine tasks, and improved feedback mechanisms. At the same time, 65% presented mixed or partial results (OUT+/-). These studies often cited limitations related to technological dependency, limited human interaction, algorithmic bias, and issues of equal access (digital divide)

These results indicate the high potential of AI in individualizing learning, automating assessment, developing critical thinking and analytical skills. At the same time, the presence of mixed or partially positive results (65% of studies) suggests that the effectiveness of AI largely depends on the context of application, the quality of the digital infrastructure and the digital skills of teachers and students.

The originality of the review lies in the synthesis of qualitative analysis of the content of studies with a quantitative assessment of the types of methodologies and results. This approach made it possible to demonstrate the structural disproportion between theoretical and empirical studies. In addition, the study also revealed a lack of experimental data, which narrows the possibilities of forming educational policies based on evidence.

There are several limitations on this study. Priority one should be given to PRISMA's scientific methodology, which includes choosing and categorizing pertinent scientific sources. This does not rule out the possibility that the systematic review may have overlooked some important previous articles. These factors must be taken into account while evaluating? (what?). Certain limitations open up new directions for research. In particular, future work should develop tools to measure the effectiveness of AI in the formation of professional competencies. Special attention should be paid to empirical verification of the use of an interdisciplinary approach to assess the role of AI in education (with the involvement of pedagogy, psychology, ethics, IT industry). Finally, an important direction is to determine the type of digital competence of teachers based on the analysis of individual advanced training programs.

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