Meta-Analysis of Artificial Intelligence Studies in Education from 2018 to 2025

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SUMMARY

With the assistance of artificial intelligence, which simulates human cognitive processes to draw conclusions and make predictions, computer systems can provide personalized guidance, support, and feedback to both students and teachers throughout the educational process. Consequently, this study aims to review global research on artificial intelligence in education from 2018 to 2025, with the goal of developing a comprehensive model. To achieve this, the selection and review of studies were conducted using the meta-synthesis method, which encompasses seven essential steps. A total of 37 studies, presented by various scholars and comparable in nature, were analyzed. From these studies, four main categories were identified: applications of AI, benefits of AI, the impact of AI on the educational process, and challenges associated with AI. Additionally, 45 sub-themes were extracted, ultimately leading to the development of an integrated model. The findings indicate that among the identified categories, the benefits of AI, with 22 sub-themes, received the most mentions in the reviewed literature. This was followed by AI applications in education, which had 10 sub-themes; the impact of AI on the educational process, with 8 sub-themes; and AI challenges, which included 5 sub-themes. Based on these results, AI emerges as a transformative technology with the potential to significantly enhance the education system, warranting special attention in the current era.

Keywords: Meta-synthesis, artificial Intelligence, education

INTRODUCTION

Recent advancements in science and technology have profoundly impacted societies. One significant development is artificial intelligence (AI), which is now successfully utilized across various industries. AI has gained increasing importance in recent years, inspiring numerous interdisciplinary studies and establishing itself as one of the most contemporary fields of research (Brandao, 2025). Today, AI research has become a key area of investment for many countries. With successful project implementations in recent years, it continues to attract growing attention. AI refers to the capability of computers to perform higher-level cognitive functions typically associated with human intelligence, such as perception, decision-making, problem-solving, generalization, learning from experience, and acting based on that experience (Yang, Hu, Yeter, Su, Yang, & Lee. 2024). The concept of artificial intelligence involves the use of machine learning, deep learning, algorithm development, and natural language processing. AI benefits both organizations and individuals by increasing efficiency, productivity, saving time and effort, and enhancing overall performance (Akgun & Greenhow, 2022; Ali, Abdelbaki, Shrestha, Elbasi et al 2023; Flavian & Casalo, 2021). AI demonstrates intelligence—the ability to perceive, synthesize, and infer information—through machines, contrasting with the intelligence exhibited by humans and animals. In an educational environment, AI may encompass adaptive assessments, automated evaluations, opportunities for practice, instruction, and personalized feedback, although it is not limited to these aspects (Sebesta & Davis 2023). AI is no longer a luxury in the field of education; it has become one of the pillars of educational development in developed countries. One of the most important tools for enhancing schools and digital systems is the use of AI in education to create interconnected data networks. This method involves developing large-scale neural networks capable of identifying weaknesses and determining how to address them, as well as managing information and solving problems, the most significant of which occurs in the classroom (Chen et al. 2020). In the context of education, AI is defined as information processing systems that can engage in processes typically performed by humans, such as learning, adaptation, synthesis, self-correction, and utilizing data for complex processing tasks (Guan, Mou & Jiang. 2020).

Moreover, artificial intelligence (AI) in education offers numerous features that contribute to sustainable development, grounded in four foundational pillars: knowledge, life, work, and knowledge transfer. By ensuring the sustainability of cultural, social, and economic resources, AI facilitates the identification of individual needs, helping learners achieve their educational and learning goals. Implementing strategies to assess educational outcomes acknowledges that addressing local needs often has international implications. AI in education encompasses three essential dimensions of sustainable development (Alkhayyal, Labib & Alsulaiman. 2019). Aldosari (2020) stated that AI's role in education is to promote sustainable development by fostering engagement

among families, communities, and institutions. This approach enhances democratic participation and cultivates a sense of citizenship, enabling individuals to recognize and respect the rights of others, including their differences (Aldosari 2020).

Therefore, this study conducted a meta-synthesis of research on artificial intelligence (AI) in education using a qualitative meta-synthesis method. The objective was to leverage insights from previous studies on AI in education and, by analyzing the identified components, to create an integrated model based on these studies. By understanding and developing this model, we can make significant strides toward advancing and effectively utilizing AI in educational settings.

LITERATURE REVIEW AND RESEARCH BACKGROUND

In recent years, artificial intelligence (AI) has made significant advancements and represents an emerging technology that is transforming and revitalizing how humans interact and live (Hinojo-Lucena, Aznar-Díaz, Cáceres-Reche & Romero-Rodríguez,. 2019). Since 1950, experts have periodically predicted that the world would soon witness the advent of general AI—systems that exhibit behavior indistinguishable from human cognitive, motor, and social intelligence (Haenlein & Kaplan 2019).In 1955, the first AI system, known as the Logic Theorist, was designed by Allen Newell and Herbert A. Simon and implemented by Clifford Shaw (Flasiński 2016). The term "artificial intelligence" was first coined by John McCarthy in 1956. Various researchers have defined AI in different ways. For instance, Baker, Smith, & Anissa (2019) define AI as "computers capable of performing cognitive tasks usually associated with the human mind" (Baker, Smith, & Anissa, 2019). Furthermore, AI is not a single technology but an umbrella term that encompasses a range of technologies, including machine learning, data mining, and natural language processing. AI can be described as the creation of intelligent machines that behave and react in human-like ways (Lakshmi & Majid 2022).

Popenici and Kerr (2017) argued that existing definitions in the literature primarily focus on cognition, neglecting other dimensions such as the political, psychological, and philosophical aspects of intelligence theory (Popenici & Kerr 2017). AI researchers define artificial intelligence as "computational systems capable of engaging in human-like processes, including learning, adaptation, synthesis, correction, and the utilization of data for complex processing tasks" (Majid & Lakshmi 2022).

Based on an in-depth review and analysis of existing scientific and specialized articles, several key aspects of artificial intelligence (AI) in education have been identified (Tahir, Hassan & Shagoo. 2024). AI is defined as a system's ability to perform tasks typically associated with human intelligence, such as reasoning and learning. The integration of AI technology in education offers a level of flexibility and adaptability that was previously unattainable, revolutionizing schools and classrooms while significantly reducing teachers' workloads. AI is poised to transform the educational landscape. Studies by Aljohani (2019) and Holmes, Bialik, and Fadel (2019) highlight the most prominent applications of AI technologies and systems in education, particularly in the realm of personalized learning. The current educational system adheres to the principle of equality in education, where all students participate in the same subjects, attend the same lectures, and take the same standardized tests to assess their proficiency, regardless of their individual understanding or future application of the concepts (Holmes, Bialik, and Fadel .2019).

Joshi, Rambola, and Churi (2021) noted that the use of artificial intelligence (AI) is now evident in nearly all aspects of our lives. AI is an advanced technology that transforms social interactions across various domains. In education, innovative learning solutions are being developed and tested in diverse contexts. Modern educational technologies facilitate the achievement and management of educational goals more effectively. Their study analyzes how AI can enhance educational outcomes and provides examples of how AI technology can assist teachers in utilizing data to improve equity rankings and education in developing countries (Joshi, Rambola, & Churi. 2021). Panigrahi (2020) emphasized that AI enables stakeholders in the education sector to understand the extent of AI's application in education and its perceived benefits (Panigrahi 2020). Huang, Saleh, and Liu (2021) highlighted that the emergence of innovative technologies has significantly influenced teaching and learning methodologies. With the rapid advancement of AI technology in recent years, its application in education has become increasingly apparent (Huang, Saleh & Liu. 2021).

METHOD

The meta-synthesis approach is an effective method for integrating previous research. This study employs a qualitative methodology, utilizing meta-synthesis as its primary strategy. Meta-synthesis serves to unify multiple studies and generate comprehensive findings. It examines the information and results extracted from various qualitative studies related to the same topic, aiming to uncover new themes by providing a systematic perspective for researchers (Sandelowski, Sandelowski & Barroso 2006). Similar to meta-analysis, meta-synthesis is conducted to achieve a unified conclusion from several studies, thereby yielding more comprehensive results

(Levitt, Bamberg, Creswell, et al. 2018). Sandelowski, Sandelowski & Barroso (2007) introduced a seven-step process for this method in the Handbook of Meta-Synthesis. In this study, the seven-step meta-synthesis model proposed by Sandelowski and Barroso (2007) was employed (Sandelowski, Sandelowski & Barroso 2006).
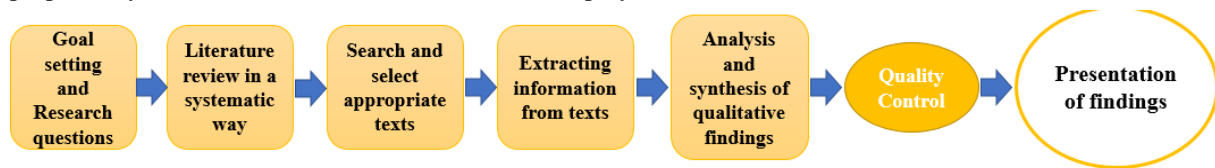

Figure 1. Sequential Steps of the Meta-Synthesis Method

This study is an applied and descriptive research project that focuses on the role of artificial intelligence in education from 2018 to 2025. A total of 78 articles directly addressing the topic of artificial intelligence were selected through theoretical and non-random sampling, as detailed in the following sections and in step three of this paper. To refine the search for relevant articles within the specified field, the phrase "artificial intelligence in education" was utilized. The selected articles were chosen based on their titles, content, accessibility, and the rigor of their research methodologies. To achieve the research findings, the following seven steps were undertaken:

Step One: Formulating the Research Question

The research question addresses various indicators that both influence and are influenced by it, including statistical population, time frame, geographical scope, and others. In this study, the following question was examined: What are the advantages and applications of artificial intelligence in education?

Step Two: Systematic Review of Articles

In the meta-synthesis method, existing documents and historical records are utilized as research data. Consequently, this study gathered sources from various online databases, including ResearchGate, Google Scholar, ScienceDirect, IranDoc, Erck, Sid, Noormags, Magiran, CORE, and Semantic Scholar.

Step Three: Searching for and Selecting Appropriate Texts

The review and selection process for this study was conducted as follows: Articles published between 2018 and 2025 that addressed the topic of artificial intelligence on a global scale were identified through keyword searches, resulting in a total of 78 studies. Non-relevant studies that merely mentioned artificial intelligence in their titles or abstracts were excluded, leaving 37 articles that were pertinent to the research topic.

Step Four: Data Extraction

In the fourth step, the selected 25 studies were reviewed to extract key content. Based on the research question, components were identified and categorized in Table 1.

Table 1. Summary of researchers' findings on artificial intelligence in education

No	The title of the research	Year	Researchers	Results
1	Artificial Intelligence and its Implications in Education	2018	Subrahmanyam & Swathi	Interpretation of Student Needs, Designing Appropriate Assessments, Adjusting Lesson Pace as Necessary, Creating a Personalized Learning Plan for Each Student, Providing a Virtual Teaching Assistant for Educators, Supporting Parents, Involving Parents in Their Children's Learning Environment, and Offering Essential Information to Facilitate Student Success During Absences from the Classroom.
2	Artificial Intelligence in Education	2019	Guo & Xiao	AI is an innovative and iterative technology that processes data and provides real-time feedback, thereby facilitating interaction between teachers and students.
3	Artificial intelligence in education: A review	2020	Chen, Chen & Lin	A more effective and efficient assessment of student assignments can lead to higher-quality educational activities. This process involves aligning the curriculum and content with students' needs, personalizing programs, enhancing the student experience, and ultimately improving the overall quality of learning.

4	Use of Artificial Intelligence in Education	2020	Panigrahi	Education for all entails cultivating a flexible learning environment, designing personalized learning experiences, implementing changes to enhance the educational process, and improving the overall quality of education.
5	A Review on Artificial Intelligence in Education	2021	Huang, Saleh & Liu	Some applications of artificial intelligence include curriculum planning, personalized education, management, universal access to global classrooms, medical education, marketing education, adaptive learning, teaching assessment, virtual classrooms, and smart campuses.
6	Evaluating Artificial Intelligence in Education for Next Generation	2021	Joshi, Rambola & Churi	Creating innovative learning solutions, testing diverse scenarios, managing educational objectives, and enhancing equity rankings and education in developing countries.
7	Exploring Opportunities and Challenges of Artificial Intelligence and Machine Learning in Higher Education Institutions	2021	Kuleto, IIic, Dumangiu, Rankovic, Martins, Paun, & Mihoreanu	The ability to meet the diverse educational needs of students, enhance the safety of institutions, and improve the efficiency of the educational system by supporting the teaching and learning processes.
8	Employing adaptive learning and intelligent tutoring robots for virtual classrooms and smart campuses: reforming education in the age of artificial intelligence	2022	Alam	AI technology on teaching and learning, it is conclusively inferred that AI has a beneficial effect on both the quality of instruction provided by teachers and on the learning outcomes of students.
9	Artificial intelligence in education. Iuniverse.	2022	Sadiku, Musa & Chukwu	Artificial intelligence in education (AIED) refers to the application of AI technologies in educational settings to facilitate teaching, learning, or decision making. AI will impact the education field in the areas of administration, instruction, and personalized, and individualized learning applications.
10	Artificial Intelligence in Education as a Mean to Achieve Sustainable Development in Accordance with the Pillars of the Kingdom's Vision 2030—A Systematic Review	2022	Abdullah	The improvement and development of education, the simplification of basic educational tasks, the support of educational institution managers, and the assistance in addressing challenges within the education sector—such as teacher inefficiency and the inability to meet learners' needs—are essential. The integration of intelligent content and AI applications in education aims to promote sustainable development. Investing in AI systems and raising awareness among professionals regarding the effective use of AI in education are crucial steps for overcoming these challenges.

11	Artificial Intelligence in Education	2022	Majid & Lakshmi	Helping students achieve their goals involves simplifying the educational process, improving accessibility, and facilitating communication between students and faculty. This approach saves time, allowing students to focus on other aspects of life. Additionally, it personalizes and assists students based on their unique abilities, preferences, and experiences, while adapting to their knowledge levels and aligning with their learning speeds and preferred objectives.
12	Artificial Intelligence in Education: AIEd for Personalised Learning Pathways	2022	Tapalova & Zhiyenbayeva	Improving the effectiveness of learning through education involves adapting educational content to meet students' individual needs, providing timely and consistent feedback, enhancing educational and cognitive processes, creating personalized learning pathways tailored to each learner, and increasing engagement and interest in the learning experience.
13	Artificial Intelligence in Education: A Review	2022	Krstić, Aleksić & Krstić	The obsolescence of traditional learning methods is transforming educational institutions at all levels. This shift facilitates effective learning, achieves learning objectives, promotes personalized education, and advances educational programs. Additionally, it increases interest in learning and highlights the impact of artificial intelligence on the educational process in the future. As AI continues to change the educational landscape, its integration into traditional learning processes becomes increasingly important.
14	Chatbots in Education System	2022	Lakshmi & Majid	The increasing interest in technologies from the Fourth Industrial Revolution is contributing to the achievement of sustainable development goals. These technologies are educating citizens to enhance their quality of life, utilizing artificial intelligence to promote lifelong learning, and ensuring inclusive and equitable access to quality education.
15	Artificial Intelligence in the Fourth Industrial Revolution to Educate for Sustainable Development	2022	Ally & Perris	Transforming education through self-organization, analyzing learning processes, leveraging the Internet of Things, and achieving sustainable development goals.
16	The Effectiveness of Artificial Intelligence on Learning Achievement and Learning Perception: A Meta-Analysis	2023	Zheng, Niu, Zhong & Gyasi	The presence of artificial intelligence (AI) is transforming various aspects of life, including social interactions, educational solutions, and goal management. AI also assists teachers in promoting equity.
17	Metaphorical Perceptions of Middle School Students Regarding the Concept of Artificial Intelligence	2023	Tartuk	51 distinct metaphors related to the concept of artificial intelligence, showcasing diversity and creativity. These include commonly used metaphors such as Human (10), Brain (8), Robot (4), Technology (3), and Scientist (3). The metaphors developed by students are categorized into four groups: Technical/Object and Human/Nature.

18	Exploring the relationship between Transhumanist and Artificial Intelligence in the Education Context: Particularly Teaching and Learning Process at Tertiary Education	2023	Mangera & Supratno	The types of artificial intelligence include intelligent tutoring systems, virtual intelligent tutors, automated assessments, personalized learning systems, and the preservation of the teacher's role. The primary responsibility of teachers should be to uphold humanistic values within an educational process that reflects the essence of education itself.
19	Is artificial intelligence really the next big thing in learning and teaching in higher education?	2023	O'dea & O'Dea	The focus of learning and education should be on developing educational capabilities, exploring the potential applications of artificial intelligence across various subject areas, and identifying the types of learning data that are necessary.
20	An Examination of the Challenges, Advantages, and Disadvantages of Artificial Intelligence in Education	2023	Doosti & Mousavi	The infiltration of artificial intelligence (AI) into various aspects of human life, including education, underscores that virtual reality (VR) technology is one of the most significant applications of AI. The integration of AI and VR technologies seeks to develop applications and games that enhance the learning process and improve the comprehension of educational subjects.
21	Vademecum of Artificial Intelligence Tools Applied to The Teaching of Languages	2024	Mateos Blanco, Álvarez Ramos, Alejaldre Biel & Parrado Collantes	The classification of generative artificial intelligence tools with potential educational applications illustrates that these AI tools enrich and enhance various aspects of learning. There is an urgent need to emphasize literacy in this technology, which is closely linked to the educational competencies of teachers and related fields. Language training is essential for educators, as it enables them to create, adapt, and effectively utilize digital resources, identify skills relevant to language learning, and recognize the role of language proficiency as a component of communicative competence.
22	the Factors Influencing Teacher Education Students' Willingness to Adopt Artificial Intelligence Technology for Information-Based Teaching	2024	Ma & Lei	Engaging in the teaching process within a digital educational environment requires the adoption of artificial intelligence technologies. It is essential to foster greater acceptance of these tools among educators, emphasize their concrete benefits and advantages in education, and advocate for the widespread integration of AI in digital learning.
23	Impact of ChatGPT on ESL students' academic writing skills: A mixed methods intervention study	2024	Mahapatra	The impact of AI-based automated writing assessment tools on students' writing skills, along with the positive effects of ChatGPT on their academic writing abilities.

24	Information Undergraduate and Non-Information Undergraduate on an Artificial Intelligence Learning Platform: An Artificial Intelligence Assessment Model Using PLS-SEM Analysis	2024	Zhong, Chang, Lai, Chen, Ku & Chen	The transformation of artificial intelligence (AI) education into a prominent trend in programming instruction presents several challenges, including the complexity of AI concepts, the need for advanced programming skills, and the depth of knowledge required. Furthermore, it is crucial to consider students' skill sets and the impact of AI learning across various disciplines.
25	Artificial Intelligence as a Double-Edged Sword: Wielding the POWER Principles to Maximize Its Positive Effects and Minimize Its Negative Effects	2024	Chen & Lin	The transformation of the world through advancements in artificial intelligence (AI) has significantly impacted all sectors of society, including education. AI has the potential to enhance student learning by making it more efficient and effective. However, concerns have been raised regarding the excessive use and potential misuse of this technology. The positive effects of AI in education include personalized learning, interactive support tailored to individual needs, and increased access to a diverse array of learning experiences. Conversely, the negative effects may involve the overuse and abuse of AI tools.
26	Artificial Intelligence Education for Young Children: A Case Study of Technology-Enhanced Embodied Learning	2024	Yang, Hu, Yeter, Su, Yang & Lee	AI literacy is a vital aspect of digital literacy, enabling individuals in today's technologically advanced world to engage with artificial intelligence and interact with intelligent agents in immersive learning environments for AI education.
27	Perceptions of Higher Education Students Towards ChatGPT Usage	2024	Das & Madhusudan	In the context of contemporary technological advancements, the significance of artificial intelligence (AI) in education is highlighted by the growing popularity of ChatGPT, the favorable perceptions among respondents regarding its academic applications, the perceived benefits of AI, and the existing ethical concerns.
28	An Utilization of Artificial Intelligence in Basic Education Learning Planning Management: Pemanfaatan Artificial Intelligence	2024	Nugraha	AI lie in data management efficiency, individual learning adaptation, effective feedback, increasing teacher administrative tasks, automatic evaluation, curriculum development, and increasing effectiveness. learning. The various successes of AI can be used as consideration for basic education planning management.
29	The Impact of Artificial Intelligence on Modern Society	2025	Brandao	Although AI offers major productivity benefits, it also raises ethical and socio-economic challenges. About 40% of global jobs are vulnerable to AI automation, which could worsen inequality. Moreover, issues like algorithmic bias, misinformation, and opacity highlight the need for stronger oversight, fairness, and data privacy protection.

30	Exploring pre-service teachers' knowledge, perceptions, and experiences regarding artificial intelligence (AI) in teaching and learning	2025	Dayagbil, Filomena & Boholano	Pre-service teachers view AI with cautious optimism, noting its limitations, ethical concerns, and need for human oversight. They stress the importance of training for responsible and effective use, highlighting AI's role in teaching, ethical challenges, integration training, and its link to critical thinking.
31	From Chalkboard to Chatbots: The Integration of Artificial Influence on Pedagogical Practices	2025	Moradi-Kelayeh	AI does not merely augment academic experiences and outcomes but can cultivate a milieu where technology and human values coexist in symbiotic harmony.
32	AI inom samhällskunskap : En kvalitativ studie om lärares uppfattningar om AI	2025	Ajobkhan	The results show that teachers mainly use AI for planning and efficiency, particularly on the operational level. However, some teachers also use AI creatively to support student learning, while others express concern that AI may hinder the development of students' critical and independent thinking.
33	AI (Artificial Intelligence) in the Workplace	2025	Cobian	AI can enhance efficiency and decision-making across many HR functions, but its growing use also raises concerns about fairness, diversity, and ethical responsibility in employment practices.
34	Artificial Intelligence and The Digital Transformation of Learning Management Systems in Higher Education	2025	Wasalatantri	AI has the potential to improve learning, but its effectiveness depends on strong data governance, transparency, and user trust. Without ethical, student-centered systems, successful adoption of AI in learning management remains limited.
35	El uso de herramientas de inteligencia artificial en el proceso de enseñanza-aprendizaje de los estudiantes de Ingeniería de Sistemas Informáticos, de la Facultad Multidisciplinaria Oriental, de la Universidad de El Salvador	2025	Guandique Flores	AI is increasingly used in academic tasks and offers many educational benefits, but its full potential depends on better teacher training and responsible, informed use by students.

36	A Scoping Review of the Strategic Integration of Artificial Intelligence in Higher Education: Transforming University Excellence Themes and Strategic Planning in the Digital Era	2025	Abulibdeh, Baya Chatti, Alkhereibi & El Menshawy	The findings indicate that while AI provides substantial benefits in higher education, its successful adoption requires careful implementation to manage the risks of emerging technologies and ensure it effectively complements traditional methods.
37	Conceptualizing AI as an Intellectual Bully: A Critical Examination	2025	Frimpong	Artificial Intelligence (AI) significantly changes how knowledge is shared, decisions are made, and discussions are held. While it can boost human thinking skills, its structured and sometimes inflexible nature raises concerns about its potential to dominate intellectual discourse.

Step Five: Analysis and Synthesis of Findings

During the analysis, the researcher identifies themes that emerge from the existing texts. Once the themes are recognized, a thematic classification is created, grouping similar topics under common themes, referred to as categories.

Step Six: Establishing Credibility

The credibility of the meta-synthesis method, like many qualitative research approaches, depends on several criteria, including transparency, the structure of research execution, the subject area under investigation, and the applicability of the findings (Kamali 2017). In the present study, to maintain credibility, sources were thoroughly examined. Subsequently, the narrative effort concentrated on prioritizing and accurately identifying the components of artificial intelligence education. Furthermore, in addition to the researcher responsible for coding, another researcher independently coded the same text without prior knowledge of the main researcher's work, demonstrating a high level of agreement between the expert and the researcher.

$$kappa = Pi = (PAo - PAE)/ (1 - PAE)$$

In this study, a coding agreement index of 76.5% was obtained using Excel software, indicating a high and verifiable level of agreement.

SUMMARY

This research examined 37 studies on the topic of artificial intelligence in education presented by various researchers worldwide. From the total of 37 studies analyzed, four main categories were identified: applications of artificial intelligence, advantages of artificial intelligence, the impact of artificial intelligence on the educational process, and challenges of artificial intelligence. Additionally, 45 themes were extracted within these categories.
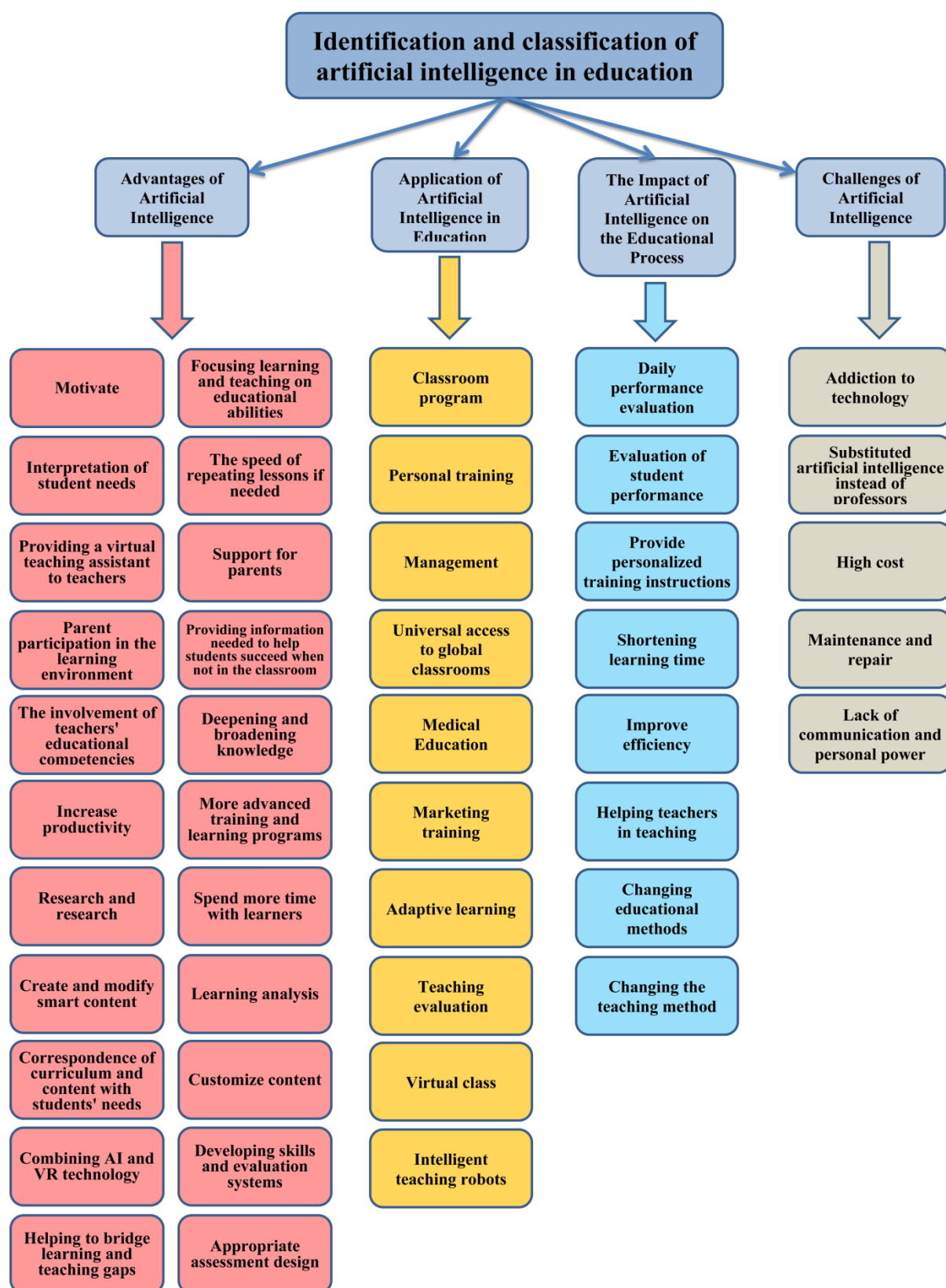
Figure 2. Model Derived from the Meta-Synthesis of Studies on Artificial Intelligence in Education

DISCUSSION AND CONCLUSION

The present study analyzed and synthesized 36 research articles published on artificial intelligence (AI) in education between 2018 and 2025, employing a qualitative meta-synthesis approach to identify patterns, trends, and existing gaps in the field. From the analyzed studies, four main categories were identified: AI applications, benefits of AI, AI's impact on the educational process, and AI-related challenges. Additionally, 45 subtopics were extracted within these categories.

The findings indicate that AI has the potential to bring significant transformation to education, enhancing teaching effectiveness, efficiency, and overall quality. Many studies converge on similar insights; for example, Subrahmanyam & Swathi (2018) and Tapalova & Zhiyenbayeva (2022) emphasize personalized instruction, interpreting student needs, individual learning pathways, and providing timely feedback. These findings align with Chen et al. (2020), who highlighted that curriculum alignment with student needs and content personalization positively influences learning quality. Furthermore, Guo & Xiao (2019) and Ally & Perris (2022) underscore AI's role in enhancing teacher-student interaction, achieving educational equity, and promoting learning flexibility, which aligns with Huang et al. (2021) regarding AI applications such as virtual classrooms, adaptive learning, and instructional management.

However, some studies indicate misalignments or limitations. Ajobkhan (2025) warns that AI may constrain students' critical and independent thinking, while Brandao (2025) and Moradi-Kelayeh (2025) highlight ethical, socio-economic challenges and the necessity of data governance and transparency. Cobian (2025) and Wasalatantri (2025) also emphasize the importance of user trust and teacher training for responsible AI use. These perspectives suggest that earlier findings that focused solely on AI benefits may not fully account for potential challenges and limitations.

In terms of benefits, AI offers a wide range of capabilities, including motivation enhancement, focus on educational competencies, interpretation of student needs, rapid lesson repetition, provision of virtual teaching assistants, parental involvement, enhancement of teachers' knowledge and skills, learning analytics, content personalization, and appropriate assessment design, as confirmed by Subrahmanyam & Swathi (2018), Majid & Lakshmi (2022), and Mateos Blanco et al. (2024). Moreover, practical applications of AI include classrooms, personalized instruction, educational management, global access to virtual classes, medical training, adaptive learning, educational assessment, and intelligent robots (Huang et al., 2021; Mangera & Supratno, 2023).

Analyses also indicate that AI has a significant impact on educational processes, such as daily assessment, provision of personalized instructions, reduction of learning time, assisting teachers in instruction, and transforming teaching methods (Chen & Lin, 2024; Doosti & Mousavi, 2023). However, attention to challenges and limitations—including technology addiction, teacher replacement, high costs, decreased human interaction, and ethical concerns—is essential (Brandao, 2025; Dayagbil & Boholano, 2025).

Finally, the present qualitative meta-synthesis indicates that AI is a transformative technology in education capable of enhancing efficiency, effectiveness, personalization, and educational equity. Successful utilization of this technology requires comprehensive planning, responsible implementation, adherence to ethical standards, and proper teacher training. When applied purposefully and thoughtfully, AI can create flexible, learner-centered, high-quality learning environments, maximizing its positive impact on the contemporary educational landscape.

RECOMMENDATIONS

Based on the findings of this study, several recommendations are proposed for researchers, policymakers, and educational institutions to optimize and responsibly utilize AI in education:

1. Focus on developing personalized learning models: Future researchers should design AI models that identify students' needs, learning pace, and individual pathways, providing flexible and tailored educational programs.

2. Objective and continuous assessment of educational performance: Developing AI systems capable of objectively and continuously measuring the impact of classroom activities, adaptive instruction, and learning content on students' outcomes can support predicting academic success or dropout risks and improve teachers' decision-making processes.

3. Teacher training and empowerment: The success of AI in education depends on teachers' knowledge and skills in utilizing AI technologies. Training programs should equip teachers to integrate AI intelligently into classrooms, analyze learning data, and provide targeted feedback effectively.

4. Research on AI ethics and responsibilities: Future studies should address ethical, socio-economic, and data governance issues in AI-based education to prevent misuse, algorithmic bias, and potential harm to educational equity.

5. Focus on practical and innovative applications: Research can explore integrating AI with virtual reality (VR), intelligent robots, generative content tools, and virtual learning environments to create interactive, engaging, and diverse learning experiences.

6. Learning Analytics and Trend Analysis: Utilizing AI for analyzing large-scale educational data, predicting trends, evaluating the effectiveness of teaching methods, and designing forward-looking educational programs can help reduce fragmentation and improve coordination across research studies (Guo & Xiao, 2019; Ally & Perris, 2022).

7. Policy Recommendations and Equitable Access: Research and policy efforts should focus on increasing students' access to smart classrooms and AI technologies, reducing educational inequities, and creating inclusive learning opportunities.

8. Examination of Side Effects and Limitations: Future studies should investigate potential side effects of AI on human interaction, critical thinking, mental health, and technology dependency, while proposing strategies to mitigate associated risks.

9. Linking AI to Sustainable Development Goals: Studies should examine the role of AI in achieving inclusive education, improving educational quality, and developing 21st-century skills, as well as explore ways to align AI technologies with long-term educational objectives.

By implementing these recommendations, it is possible to enhance educational effectiveness and equity, personalize learning, improve teacher productivity, and lay the groundwork for coordinated, comprehensive, and responsible future research on AI in education.

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