4.2. EUROPEAN EXPERIENCE OF ARTIFICIAL INTELLIGENCE INTEGRATION INTO GENERAL SECONDARY EDUCATION: TRENDS AND STRATEGIES

https://doi.org/10.32405/mono-lomza-kyiv-2025-4-2

Oksana Shparyk,

PhD in Education, Senior Researcher,
Senior Research Fellow of the Scientific and Organisational Department,
National Academy of Educational Sciences of Ukraine
Senior Research Fellow of the Comparative Education Department,
Institute of Pedagogy of NAES of Ukraine, Kyiv, Ukraine

https://orcid.org/0000-0001-7507-4950

Oksana Hlushko,

PhD in Education, Senior Research Fellow of the Comparative Education Department,
Institute of Pedagogy of NAES of Ukraine, Kyiv, Ukraine

https://orcid.org/0000-0003-0101-9910

Zoia Sharlovych,

PhD in Education, Vice-Dean for International Affairs,
International Academy of Applied Sciences in Lomza, Lomza, Republic of Poland

https://orcid.org/0000-0001-8115-9838

The modern world is undergoing a digital transformation, a key driver of which is the rapid development of artificial intelligence (AI). This technology is already having a significant impact on all areas of human life, including economics, medicine, science, and, of course, education. Recognizing the importance of AI for shaping the future requires the immediate integration of relevant knowledge and skills into curricula, especially at the level of general secondary education, which lays the foundation for a person's further development and successful adaptation in modern life.

The integration of artificial intelligence into general secondary education is not just a technological innovation but a necessary step to prepare a new generation for the challenges and opportunities of the 21st century. This will allow students

not only to understand the principles of AI but also to critically evaluate its impact, develop skills for collaborating with intelligent systems, and form a responsible attitude toward the ethical and social aspects of this technology.

According to a study by Shivani Zoting, "Artificial Intelligence in Education Market Size, Share, and Trends from 2025 to 2034," the global AI in education market is estimated at $7.05 billion in 2025 and approximately $112.3 billion by 2034. It is projected to grow at a compound annual growth rate (CAGR) of 36.02% from 2025 to 2034. The AI in education market size in the United States was $1.48 billion in 2024 and is projected to grow to $32.64 billion by 2034, with a CAGR of 36.21% (Zoting, 2025).

In the European market, the CAGR for AI in education is expected to be 31.9% from 2025 to 2030 (Horizon Grand View Research, 2025).

According to research from the McKinsey Global Institute (MGI), artificial intelligence could add $575.1 billion to the European economy by 2030. AI technologies can help Europe achieve an annual productivity growth rate of up to 3% by 2030. Although European organizations lag behind their American counterparts by 45–70% in AI adoption, it is in these figures that researchers see the greatest potential. Scaling the introduction of generative artificial intelligence into all spheres of life can lead to breakthrough innovations that will change people's daily lives. Especially in education, personalized learning and game-based learning using AI methods can become the most effective (McKinsey Global Institute, 2024).

The integration of artificial intelligence into general secondary education faces several significant challenges that require careful analysis. First, there is a conflict between the potential of AI and the inertia of the traditional educational system. AI promises revolutionary changes, such as personalized learning, the automation of routine tasks, and the reduction of administrative burdens on teachers. However, traditional teaching methods are often not ready for such changes, remaining tied to outdated curricula and assessment methods. Second, high expectations for AI often clash with limited resources: effective implementation requires significant financial investment in infrastructure and software, as well as qualified personnel and time, which are often in short supply. There is also a need for innovative teaching approaches that contradict traditional methods focused on knowledge transfer rather than the development of critical thinking and creativity. These skills are key to the effective use of artificial intelligence technologies in education.

The changing roles of teachers and students is another important aspect. The intended purpose of artificial intelligence is to serve as a tool for teachers, reducing

their workload of monotonous tasks and freeing up more time to focus on individual interaction with students. However, there are fears within the pedagogical community that AI might diminish the teacher's value or even partially replace them, leading to resistance and uncertainty.

For students, AI can facilitate self-directed learning and the development of self-regulation skills. At the same time, it carries the risk of encouraging passive information consumption and an over-reliance on cheating, which undermines the principles of academic integrity. Additionally, despite the personalization opportunities offered by AI, over-dependence on it can limit the crucial face-to-face interaction between students and teachers that is key for developing social skills, collaboration, and emotional intelligence.

Ethical and social aspects also demand attention. Despite AI's potential to make education more accessible, there is a risk of deepening the digital divide due to unequal access to technology. A serious challenge is data protection and privacy: for AI to work effectively, it requires the collection and analysis of large volumes of students' personal data, raising concerns about their security, especially for minors.

Moreover, it's important to remember that AI's objectivity is an illusion; algorithms trained on existing data can inherit hidden biases, potentially leading to unfair evaluations or even discrimination, which contradicts the fundamental principles of equality and fairness in education. The opacity of some AI algorithms creates additional difficulties in determining ethical responsibility for potential errors or negative outcomes generated by artificial intelligence. Thus, for the successful integration of AI into education, it is necessary to develop adaptive curricula that account for the dynamics of technological progress and foster the development of critical thinking, creativity, and social skills. Society must actively work to overcome existing barriers to fully realize the potential of artificial intelligence in the educational process.

The relevance of this study is deeply rooted in several interrelated factors that define the contemporary educational landscape. First and foremost, we are witnessing a global digital transformation, where artificial intelligence (AI) has become an integral part of both daily life and professional activities. AI in education is no longer a futuristic concept or a science fiction plot, but an inevitable reality that requires practical implementation and deep reflection. Young people who do not understand the essence and possibilities of AI will inevitably face limitations in their competitiveness in the labor market and their ability to adapt to new conditions.

This is directly related to the need to prepare the "human of the future." Modern education must meet the demands of our time, providing students not only with

the knowledge to use AI, but also with the skills to develop it and solve complex problems that arise from its application. This includes the development of critical thinking, creativity, problem-solving skills, digital literacy, and ethical awareness. For the Ukrainian education system, this research presents both significant opportunities and certain challenges. Ukraine is seeking to integrate into the European space, and therefore it is extremely important to take into account the best practices of our European partners. European countries are actively investing in the development of AI in education, creating innovative approaches to teaching, assessment, and administration. Studying this experience will allow Ukraine to avoid common mistakes, adapt successful strategies, and significantly accelerate the process of AI implementation in the national educational process.

Analysis of European experience in integrating AI into general secondary education. The European Union is actively developing common strategies and policies for the integration of artificial intelligence into the education system, recognizing its potential to fundamentally transform the learning process and prepare citizens for the challenges and opportunities of the digital age.

These efforts are focused on several key areas:

- developing a regulatory framework for AI;
- creating ethical guidelines for its application;
- supporting research and innovation projects;
- fostering cooperation and the exchange of best practices.

The European Commission report, "The Impact of Artificial Intelligence on Learning, Teaching, and Education" (2018), prepared by researchers under the leadership of Ilkka Tuomi, emphasizes that the implementation of AI in the educational sphere will lead to systemic transformations. The authors stress the urgent need to rethink the role of education in modern society, its organization, goals, and objectives, in order to ensure the relevance of the learning process in the context of a new technological paradigm (Tuomi et al., 2018, p. 2). Artificial intelligence (AI) in education is the use of computer systems to simulate human learning and decision-making with the aim of improving teaching and learning (Tuomi et al., 2018).

The report defines the concept of "artificial intelligence" as "a computer system capable of performing tasks that are typically associated with intelligent beings" (Tuomi et al., 2018, p. 10). This definition emphasizes the machine's ability to imitate human cognitive functions. Historically, the first clear definition of artificial intelligence was proposed in a financial proposal to the Rockefeller Foundation back in 1955. It

was based on the assumption that "every aspect of learning or any other feature of intelligence can be so precisely described that a machine can be made to simulate it" (ibid). This vision laid the groundwork for the further development of AI technology.

In the EU document "Artificial Intelligence for Europe" (2018), the concept of "artificial intelligence (AI)" was defined as systems that "display intelligent behavior by analyzing their environment and taking actions – with some degree of autonomy – to achieve specific goals" (European Commission, 2018). Thus, compared to the previous definition, this new interpretation emphasized the ability of AI to analyze the environment and act with a certain degree of autonomy to achieve specific goals.

The modern understanding of AI expands upon this initial definition, adding adaptability, the ability to learn, and predictable actions to its key characteristics. These features allow AI systems not just to imitate but to evolve in their interaction with the environment and accumulated data. Therefore, artificial intelligence is not merely a technology but a powerful catalyst that demands a rethinking of educational paradigms to prepare future generations for life and work in the context of digital transformation and global challenges of the modern world. This is a process of modeling and reproducing human thinking, demonstrating autonomy and effectiveness in decision-making. A comprehensive analysis of these definitions leads to the conclusion that artificial intelligence is not just a technology but a dynamic field that develops systems capable of analyzing information, learning, adapting, and acting autonomously to achieve set goals.

In the context of education, this means not only automating routine tasks but also creating new opportunities for personalized learning, data analysis, early identification of educational needs, and the development of future skills. Understanding AI as a tool that can function with a certain degree of autonomy and intellectually and dynamically respond to its environment is critically important for shaping effective educational policies and practices in the digital age.

The main element of the regulatory framework is the AI Act. Although this law does not focus exclusively on education, it is a foundational document that regulates the use of AI in all sectors, including education. It establishes general principles and requirements that will affect the development, implementation, and use of AI systems in educational institutions.

In parallel, the European Commission and expert groups are developing detailed ethical guidelines designed to ensure the responsible implementation of AI solutions in the educational environment. These guidelines cover several key aspects. First, they

require adherence to the principles of fairness and non-discrimination to prevent AI systems from reinforcing existing biases that could unfairly affect students. Second, transparency and human oversight are crucial: it is necessary to clearly explain how AI works and always maintain the possibility for a human to intervene or verify its decisions. Significant attention is paid to data privacy and security, ensuring robust protection of the personal information of students and teachers processed by AI. The guidelines also define accountability, clearly distinguishing who is responsible for decisions made or supported by artificial intelligence systems. Among other things, they emphasize the well-being of students and teachers, ensuring that AI is used to benefit the learning process and does not harm the mental or physical health of participants in the educational process.

It is worth noting that the EU actively supports numerous research and innovation projects aimed at developing and implementing AI in education through programs such as Horizon Europe and Erasmus+. These projects explore personalized learning, intelligent assessment systems, teacher support, and the creation of virtual learning environments. Currently, the EU actively promotes cooperation and the exchange of best practices among member states and with international partners, which helps countries learn from each other and avoid duplicating efforts in developing national strategies and implementing AI in education. All these joint strategies and policies reflect a comprehensive EU approach that combines legal regulation, the development of digital skills, ethical considerations, unique ways of using digital technologies in the educational process, innovation support, and international cooperation (Dzhurylo & Shparyk, 2019; Shparyk, 2021; Sharlovych et al., 2023).

EU Regulatory Framework for AI. Today, few countries have comprehensive legislation on artificial intelligence. Only two countries stand out for their early and significant steps in this area: China and Singapore. In 2021, China adopted the Law on Promoting the Development of the Internet of Things and Artificial Intelligence. This law lays down the principles of responsible AI development, with a focus on data security and risk management. In the same year, 2021, Singapore introduced its Directive on AI Governance. The document establishes key principles for the use of AI, such as transparency, accountability, and non-discrimination (Hrytsenchuk, 2024).

In May 2025, Japan approved the “Act on the Promotion of Research and Development and the Utilization of AI-Related Technologies.” This law aims to balance innovation with risk management, recognizing potential threats such as crime, personal data leaks, and copyright infringement. It grants the government the

authority to investigate serious incidents. Other major players, such as the United States, the United Kingdom, Canada, and India, are also actively working on their own regulatory frameworks for AI, although their initiatives may currently be less comprehensive or still in the development stage.

That is why the Artificial Intelligence Act, proposed by the European Commission in 2021, is extremely important. The working group of developers, relying on the achievements of the international community of specialists from various fields, presented this draft for a wide discussion (Hrytsenchuk, 2024). In March 2024, the European Parliament adopted the Artificial Intelligence Act (AI Act) (European Parliament, 2024).

Its main provisions and objectives can be summarized as follows:

1. Risk Classification. The Act introduces a risk-based approach, classifying AI systems into four risk levels: unacceptable, high, limited, and minimal. This allows for the regulation to be adapted to the potential harm an AI system could cause.

– Unacceptable Risk. AI systems with unacceptable risk, which threaten people's safety, livelihoods, and rights, are prohibited. Examples include social scoring, manipulating human behavior, and the unrestricted use of real-time biometric identification.

– High Risk. High-risk AI systems, such as those used in critical infrastructure, education, employment, healthcare, and law enforcement, are subject to strict requirements, including conformity assessments, data quality controls, transparency, and human oversight.

2. Support for Innovation. Despite strict regulations, the Act aims to stimulate innovation in the field of AI. It provides for the creation of regulatory sandboxes and support mechanisms for small and medium-sized enterprises (SMEs) to develop and test innovative AI systems in controlled environments.

3. Transparency and Obligations. The legislation sets high transparency requirements for AI systems, especially for general-purpose AI (GPAI) models and generative AI systems. Developers must provide detailed information about their systems, including the data used for training and evaluation metrics. For generative AI, it is also mandatory to label content as being AI-generated.

4. Protection of Human Rights. The Act focuses on protecting fundamental human rights. It establishes clear obligations for AI developers and providers to avoid discrimination, ensure privacy, and adhere to ethical standards. Mechanisms are provided for citizens to file complaints regarding AI systems.

5. Governance and Oversight. To ensure the Act's enforcement, a new European AI Office is being established. It will be responsible for overseeing the implementation

and application of the rules and for fostering cooperation among national authorities (European Parliament, 2024).

Overall, the AI Act strikes a balance between promoting innovation and ensuring safety, transparency, and ethical principles in artificial intelligence. This makes it a key document for the future development and implementation of AI in Europe and beyond.

The AI Act is part of a broader package of policy measures aimed at fostering trustworthy artificial intelligence, which also includes the AI Innovation Package, targets for launching AI factories, and a coordinated plan on AI. Together, these measures guarantee safety, respect for fundamental rights, and a human-centric approach to AI, while also increasing the pace of AI adoption, investment, and innovation across the EU (CEE Digital, 2024).

EU Strategies on AI in Education. The European Union has consistently built a strategic framework for the development and regulation of artificial intelligence (AI). This began in April 2018 with the publication of the European Commission's agenda for promoting AI in Europe (European Commission, 2018).

In the spring of 2020, the "White Paper on Artificial Intelligence" was published (European Commission, 2020b), which proposed a framework for trustworthy AI based on the principles of excellence and trust. The document aimed to stimulate the development and adoption of AI while minimizing risks such as decision opacity and discrimination. The strategy envisaged creating an "ecosystem of excellence" by mobilizing resources for AI research, innovation, and implementation, including support for small and medium-sized enterprises. Simultaneously, it aimed to create a regulatory framework that would ensure AI systems comply with European values and fundamental rights, especially for high-risk systems. The document emphasized the need to increase investment, advance research, address skills gaps, and ensure access to data and computing infrastructure to strengthen Europe's global leadership in trustworthy AI.

A further step towards the EU's global leadership in this area was the "Coordinated Plan on Artificial Intelligence," published in April 2021 (European Commission, 2021a). The main goal of the document is to strengthen the EU's global leadership in the development of human-centric, trustworthy, and sustainable artificial intelligence (AI) by accelerating investments, taking active steps on AI strategies, and aligning AI policies to overcome fragmentation and address global challenges. The document is based on the eponymous plan from 2018, which laid the foundation for cooperation

and encouraged member states to develop national AI strategies. As a result, most member states have adopted national AI strategies, investments in the sector have increased, and the EU has mobilized significant resources to support these processes.

At the same time, the European Commission presented "Proposal for a Regulation laying down harmonised rules on artificial intelligence" (European Commission, 2021b), which marked the first step toward creating the European AI Act. These efforts culminated in the final version of the AI Act being adopted in December 2023, following successful trilateral negotiations among EU institutions, which ensured its status as law.

The key EU initiative that determines how technology can support education and training is the strategic document titled "Digital Education Action Plan – DEAP" (2020) (European Commission, 2020). In particular, it includes goals and actions related to AI. The DEAP plays a crucial role in integrating artificial intelligence into the EU's educational system. Specifically, it aims to build digital skills, enhance digital literacy, and develop the ability to work with AI among pupils, students, and teachers. This involves not only a technical understanding of AI fundamentals but also an awareness of its ethical aspects and practical applications. Furthermore, the DEAP actively supports digital transformation, encouraging the use of AI and other digital technologies to improve teaching and learning methods, which in turn fosters the personalization of the educational process and the creation of adaptive learning environments. The plan also actively supports the development of new, innovative AI solutions for the education sector and promotes the exchange of best practices among EU member states, helping to spread successful experiences and move forward together.

It should be noted that the sixth action of the DEAP was focused on developing ethical guidelines for teachers and educators on the use of AI and data in teaching and learning. These guidelines addressed several key aspects. Primarily, they were intended to raise awareness of how artificial intelligence and data can be used in education, as well as to draw attention to all related risks, particularly ethical ones. In addition, an important task was to provide practical support to primary and secondary school teachers, especially those with limited experience working with AI. The guidelines also aimed to support the development of appropriate systems and administrative processes that would facilitate the implementation of AI in the educational environment. They provide advice on the effective use of AI and its adaptation to achieve various educational goals.

In 2022, the European Commission published the "Ethical guidelines on the use of artificial intelligence (AI) and data in teaching and learning for educators" (European Commission, Directorate-General for Education, Youth, Sport and Culture, 2022). This document is a crucial component of the EU's overall strategy, which aims to ensure the ethical and responsible use of AI, particularly in a key sector like education.

A key aspect of these guidelines is the ethical integration of AI into education. This field is of critical importance for societal development and the training of future specialists, which underscores the European Union's commitment to the responsible and human-centered development of AI.

The document is also aimed at raising awareness and fostering critical thinking among teachers and educators. It helps them understand the potential benefits and risks of using AI in education, thereby promoting a positive, critical, and ethical interaction with AI systems. This fully aligns with the broader EU strategies that ensure the development and implementation of AI is human-centric, reliable, and responsible.

By providing practical recommendations for teachers and educators, the document actively promotes the development of AI literacy and ethical awareness from the very beginning of the educational process. This is an extremely important step for the successful and responsible integration of AI into various sectors of society and the economy.

Finally, the unified European approach to this issue is underscored by the fact that the document is available in many official EU languages. This demonstrates a commitment to its widespread dissemination and the adoption of ethical principles across all member states, strengthening the common European strategy for AI governance.

Thus, the European Union is demonstrating a comprehensive and proactive approach to integrating artificial intelligence into the education system, seeking to maximize its transformative potential and prepare citizens for the challenges of the digital age. This work includes the formation of a regulatory framework, notably the AI Act, which governs the use of AI in all sectors, including education. The EU is also developing ethical guidelines for teachers and educators that focus on fairness, transparency, and data protection, while supporting innovative projects and fostering the exchange of best practices. This balanced approach allows for the responsible and effective use of AI's potential, distinguishing the EU's strategy from many other countries. All of this ensures a human-centric development of AI in the educational sphere for the benefit of future generations and the creation of a more inclusive, effective, and individualized educational system in Europe.

In 2023, the European Commission published a report on artificial intelligence titled "AI report: by the European Digital Education Hub's Squad on artificial intelligence in education" (European Commission, European Education and Culture Executive Agency, 2023). This report is a key document highlighting the current state and future directions of artificial intelligence integration into school education in the European Union countries. It covers a wide range of issues, from the necessary competencies for teachers to the ethical and legal aspects of using AI.

Specifically, the document presents general trends and approaches to integrating artificial intelligence (AI) into the European educational system, and also analyzes the associated potential risks and methodological challenges.

In the context of the European Union's educational system, general trends and approaches to artificial intelligence (AI) integration are observed, which include the application of a three-dimensional approach to implementing AI in the learning process:

Teaching for AI. This approach is fundamental for building "AI literacy," particularly among teachers and students. It focuses on developing competencies for confident, critical, and safe interaction with AI systems in everyday life. Key aspects include understanding the daily impact of AI, critical thinking and bias detection, safe and responsible interaction, as well as ethical and legal considerations. This approach lays the groundwork for all students, regardless of their future career paths.

Teaching with AI. This direction is focused on the practical application of AI tools to enhance the teaching and learning process and involves using AI as an auxiliary tool to achieve educational goals. Applications include personalized learning, automated assessment and feedback, content generation, collaborative support, and optimization of administrative tasks. Specifically:

- Personalized learning pathways. Adapting courses to students' individual needs, learning styles, and pace.
- Intelligent tutoring systems. Providing virtual mentors that offer one-on-one guidance, diagnose knowledge gaps, and provide feedback.
- Automated assessment and feedback. Streamlining the evaluation of both objective and subjective work, which reduces teacher workload and provides prompt feedback for students.
- AI-driven content creation. Generating diverse learning materials such as textbooks, presentations, and quizzes, allowing for quick content updates and varied learning formats.

- Virtual and augmented reality (VR/AR) in learning: creating immersive, interactive learning environments that offer realistic simulations without physical constraints (e.g., medical training, historical reconstructions).
- Gamification with AI. Integrating game elements into learning, creating adaptive and engaging experiences that motivate students through personalized challenges and rewards.

It is crucial for teachers to be able to critically select AI tools that align with the curriculum and pedagogical goals (EIMT, 2025).

Teaching about AI. This is the more technical part, aimed at teaching students the fundamentals of AI from a developer's perspective, including principles of perception, representation and reasoning, learning (machine learning), and natural interaction. This requires basic knowledge of mathematics, programming, and computer science.

Among other significant trends, a human-centric approach, the development of teacher competencies, personalized learning, the reduction of administrative burden, and the promotion of inclusion and equity should be highlighted.

The report highlights several significant risks associated with the use of AI in education:

- Risk of bias and discrimination. AI systems trained on biased data can reinforce existing stereotypes and lead to discrimination.
- Privacy and data protection. The collection and analysis of large volumes of students' personal data raise serious privacy concerns, highlighting the importance of adhering to GDPR.
- Lack of transparency (Black Box Problem). AI algorithms often operate as "black boxes," making it impossible to understand their decisions.
- Dependency and loss of human control. Excessive reliance on AI can lead to a loss of human judgment, especially in cases that affect students' future opportunities.
- Academic integrity. Generative AI poses a threat to traditional assessment formats and raises concerns about plagiarism.
- Risk of exclusion (Digital Matthew Effect). Unequal access to AI technologies can exacerbate existing inequalities.
- Ethical implications. Broad ethical questions concerning the impact of AI on human rights, democracy, and the rule of law.

Moreover, AI-related risks are classified by their level of danger, which requires an appropriate management approach:

- Unacceptable risk. AI systems that pose a clear threat to people's safety, life, and rights will be banned (e.g., emotion recognition in educational institutions).
- High risk. AI systems used in critical infrastructures, as well as those that can affect a person's access to education or career path, require strict risk assessment, high data quality, transparency, and human oversight.
- Limited risk. AI systems with specific transparency obligations (e.g., chatbots, where users must know they are interacting with a machine).
- Minimal or no risk. Free use of AI with minimal risk, such as AI games or spam filters.

Thus, according to the document, the use of artificial intelligence in education is of great importance, as it offers significant benefits. AI can improve the learning process by providing formative feedback, assisting teachers with lesson planning and administrative tasks, and adapting learning strategies through learning analytics.

Overall, the EU's strategic vision for AI in education is a balanced approach that maximizes benefits while minimizing risks. The European Union emphasizes the importance of human oversight, especially in cases where AI begins to influence key aspects of the educational process. The document warns against over-reliance on AI for decision-making and underscores the need to support human values in educational applications. Special attention is paid to the implementation of Explainable AI, which allows for understanding the logic behind decisions made by AI systems. The risk level of AI use is determined by the context of its application, not the tool itself, which requires a thorough analysis before implementation. The document also recommends starting with minimal-risk applications, such as providing feedback and assisting with administrative matters, and warns against the use of AI for decisions that could affect students' future opportunities.

Several other common European initiatives in the field of AI implementation, which directly or indirectly relate to the field of education, should also be mentioned. In February 2025, at the AI Summit in Paris, European Commission President Ursula von der Leyen officially announced the launch of the InvestAI initiative. This initiative is aimed at mobilizing 200 billion euros in investments to accelerate the development of artificial intelligence (AI) in the European Union. A key element of InvestAI is the creation of a new European fund of 20 billion euros, designated for building "AI gigafactories." These advanced computing centers are designed to ensure the open and collaborative development of state-of-the-art AI models, which should strengthen Europe's position as a leading global player in this field (CEE Digital, 2024).

The creation of four AI gigafactories is planned, which will be located in different EU countries. Their main task will be to train complex and the newest AI models, which requires significant computing power. Each of these factories will be equipped with approximately 100,000 state-of-the-art AI chips, which is four times the power of existing computing centers. They will become the world's largest public-private partnership aimed at developing trustworthy artificial intelligence, and their activities will support open innovation as well as industrial and strategic applications. Access to such powerful computing resources will help increase the competitiveness of smaller companies and startups on the global market. The European Commission has already announced the creation of seven AI factories and plans to announce five more. The 10 billion euros in investments, co-financed by the EU and its member states, represent the largest public support for an AI project in the world, and they are expected to attract ten times more private investment (CEE Digital, 2024).

In addition to the InvestAI fund, the European Commission is implementing a number of accompanying measures to stimulate innovation in the field of AI in Europe. These include financial support through the "Horizon Europe" and "Digital Europe" programs dedicated to generative AI. An important direction is the strengthening of the EU's human potential in the field of generative AI through education, training, and reskilling. The Commission also continues to encourage public and private investment in startups and the scaling of AI companies, particularly through venture capital. The development and implementation of common European data spaces, which are critically important for training and improving AI models, are being accelerated. The "GenAI4EU" initiative has been launched, aimed at supporting the development of new applications of generative AI in 14 European industrial ecosystems (including robotics, healthcare, manufacturing, etc.) and in the public sector. Additionally, the Commission is creating a European Artificial Intelligence Research Council to pool resources and explore the potential of data to support AI. By the end of 2025, the "Applying AI" initiative is planned to be launched to stimulate the industrial implementation of AI in key sectors (CEE Digital, 2024).

Although the InvestAI initiative and the creation of AI gigafactories are aimed at the overall development of AI infrastructure and innovation in Europe, their impact on education is critically important. Providing access to vast computing power to smaller companies and startups means that educational technology developers will also get the opportunity to create and test more complex and effective AI solutions. And the support for the EU's human potential in generative AI through education, training, and

reskilling indicates direct investment in the educational sphere to prepare specialists who will work with new AI technologies. While the "GenAI4EU" initiative covers 14 industrial ecosystems, it will also create new use cases that can be integrated into curricula and methodologies. Thus, these initiatives are part of a broader EU strategy aimed at creating an ecosystem that supports the development, implementation, and ethical use of AI in all sectors, including education, which ensures the preparation of future generations for the digital economy and society.

So, the European Commission is actively working on a common European strategy for artificial intelligence (AI) that aims to drive scientific breakthroughs and tech leadership, while making sure new tech works for all Europeans and respects their rights. This joint approach to strengthening Europe's innovation potential focuses on several interrelated key areas (see Table 1 and Table 2).

Table 1

Key directions for strengthening European innovation potential

Political goals and investments	The EU's main political goal is to achieve global leadership in trustworthy AI. This involves a significant expansion of investment and development of AI infrastructure. The vision is to establish a clear AI policy and attract large-scale investments. The total annual investment in artificial intelligence is planned to be €20 billion, including both public and private funds. To achieve this goal, the development of an "AI-on-demand" platform is envisioned to provide access to AI resources, as well as targeted funding for companies and startups through the European Fund for Strategic Investments (EFSI) and the InvestEU program. Special attention is paid to the application of AI in the public sector through the "AI uptake" program.
Education, research, and skills	A key element of the strategy is to promote education and research in the field of AI. This includes developing skills related to artificial intelligence in order to retain and attract the best scientists. The EU aims to bring together centres of excellence and support changes in the labour market through special training programs funded by the European Social Fund. The goal is not only to provide technical training for specialists, but also to foster broad AI literacy and ethical awareness.
Infrastructure	Significant investments are being made in the development of AI infrastructure. This includes investments in high-performance computers, quantum computers, and AI and data infrastructure itself. The EU is also committed to further developing the European Cloud for Open Science and developing a common European high-performance computing infrastructure, which is a fundamental basis for innovation in AI.

to the content >>

Ethical and legal framework	To ensure the reliable and responsible development of AI, the EU is actively creating an ethical and legal framework. The main document is the EU Artificial Intelligence Act (AI Act), which is a legally binding regulation. In addition, standards are being developed to clarify the content of this Act for practical application (through CEN and CENELEC), as well as concepts for monitoring and certifying risky AI systems. The ethical principles for AI development are based on the EU Charter of Fundamental Rights and are being developed in close cooperation within the European Alliance on Artificial Intelligence, with a focus on existing European directives on data protection and product liability.
Market transition and cooperation	The EU strategy also provides for active market transition and promotion of practical AI implementation. This is being implemented through the creation of a network of European centers of excellence in AI, test centers (e.g., for autonomous driving), and the development of platforms and large-scale pilot projects with AI elements in key sectors such as energy, healthcare, manufacturing, mobility, geoinformation, and agriculture. The aim is to promote the integration of AI and data analytics into cutting-edge initiatives and to move from isolated test projects to concrete, far-reaching value creation measures. This is accompanied by the further development of Member States' national strategies on artificial intelligence, as well as the development of joint measures for specific sectors and active coordination within the framework of strategic measures and coordination.

Source: compiled by the authors

Table 2

AI in school education

Pilot projects and exchange of experience	The EU actively supports pilot projects in member states that demonstrate the effective implementation of AI tools at the school level. Examples from Italy and Germany show how AI can be used for personalized learning and improving intelligent assessment systems. These national initiatives are harmoniously integrated with common European strategies. Another important aspect is the exchange of knowledge between member states; the EU actively promotes the dissemination of best practices, successful implementation models, and effective solutions to overcome challenges using platforms such as the Digital Education Hub and other cooperation networks.

to the content >>

Training and retraining of teachers	The successful implementation of AI in education is impossible without proper training and retraining of teachers. The EU funds programs for the development of teachers' digital competencies through initiatives such as Erasmus+ and Horizon Europe. These programs include courses, training, and the development of methodological guides aimed at improving digital literacy and developing practical skills for working with AI. In addition to technical aspects, great attention is paid to the ethical training of teachers, teaching them to recognize and resolve ethical dilemmas related to the use of AI, such as algorithm bias, student data privacy, and the potential impact of technology on psychological well-being.
Development and availability of AI tools for schools	The EU is investing in the development and accessibility of AI tools for educational institutions. Initiatives such as InvestAI and the creation of AI "gigafactories" provide EdTech solution developers with access to significant computing power. This contributes to the creation of more sophisticated, effective, and accessible AI tools for schools. In addition, the formation of European data spaces plays a key role in the development of educational AI solutions that meet European values and standards. To ensure quality and safety, developers have the opportunity to test their AI solutions in "regulatory sandboxes" before their widespread implementation in educational institutions.
Challenges and overcoming barriers	Despite significant efforts, there are certain challenges and barriers to the full implementation of AI in school education. The EU is actively working to overcome digital inequality by ensuring equal access to technology and AI resources for all regions and schools. Another important aspect is overcoming resistance to change on the part of teachers, students, and parents, which requires effective communication and outreach. At the same time, ensuring the quality and safety of AI systems used in education is a priority. This is achieved through the development and implementation of certification and monitoring mechanisms that comply with the requirements of the AI Act.

Source: compiled by the authors

Overall, the EU demonstrates a comprehensive and proactive approach to integrating artificial intelligence into its educational system. This strategy combines legal and regulatory frameworks, the development of ethical guidelines, significant investments in infrastructure (InvestAI), and support for research and the development of digital skills. The goal is to create a more inclusive, effective, and individualized

educational system that maximizes the benefits of AI while ensuring its responsible, human-centered, and ethical use to prepare future generations for the digital economy and society.

National strategies and policies on AI in education in key European countries. As of 2025, most EU countries are actively integrating aspects of artificial intelligence (AI) into their education systems, although the level of detail and specificity of approaches vary. Some countries have clearly defined strategies specifically for AI in education, while others include educational aspects in broader national AI strategies:

Germany is investing heavily in AI education. In October 2024, the Conference of Ministers of Education of the Federal States (Bildungsministerkonferenz) adopted "Recommendations for action for education administrations on the use of artificial intelligence in educational processes in schools" (Eurydice Unit Germany (Länder), 2025). Germany's national AI strategy, updated in 2020, also focuses on developing AI skills and competencies (German Federal Government, 2020). There is also a digital learning platform called AI Campus, funded by the Federal Ministry of Education and Research (BMFTR).

Italy is actively introducing artificial intelligence into its schools. The Italian government is experimenting with AI-supported software in classrooms (The Role of AI in Modern Education, 2024). Italy's national AI strategy, published in June 2022 (Minister for Technological Innovation and Digitalization of Italy, 2022), prioritizes the education system, which includes the development of skills and talents, as well as the integration of AI at all levels of education.

France has a national AI strategy called "France 2030" (updated in 2021, covering the period 2022-2025), which continues the work of the previous phase, "AI for humanity" (European Commission / Digital Skills & Jobs Platform, n.d.). This strategy aims to increase the number of AI-trained specialists and accelerate France's research potential. It includes the development of digital skills in education. There is also an initiative "AI4T - Artificial Intelligence for and by teachers", that explores and supports the use of AI in secondary education.

Spain's National Artificial Intelligence Strategy (ENIA) (Ministry of Economic Affairs and Digital Transformation of Spain, 2020) provides for a wide range of policies in the field of education and training to develop digital skills and the ability to understand and develop AI technologies. It includes the expansion of postgraduate programs and master's and doctoral programs offering training in AI.

Poland has a strategic document on AI development titled "AI Development Policy in Poland since 2020" (Ministerstwo Cyfryzacji, 2021). This document serves as a framework for the country's approach to AI, setting out directions for action in six key areas, including education. The policy's provisions are aimed at making Poland a significant player in the AI field by developing education, supporting businesses, and promoting scientific research. The document places significant emphasis on integrating AI into the educational system at all levels, from primary to higher education. The implementation of AI in school education is focused on several key areas: teaching digital competencies, adapting curricula, introducing various programs for schools and teachers, and establishing national AI laboratories in schools.

As we can see, Poland is actively integrating artificial intelligence into education, starting from primary school, in line with its "AI Development Policy in Poland since 2020" strategy. Key positions include teaching digital competencies and understanding how AI works, not just how to use it. This is achieved through curriculum adaptation, integrating AI-related topics, and implementing special programs for schools and teachers, such as "AI Schools & Academy". These programs, which have different levels (from kindergarten to secondary school), teach children programming, algorithms, logical thinking, and the use of AI tools like Scratch and IBM Watson. Additionally, National AI Laboratories are being launched in schools, providing teachers with training, equipment, and educational materials. All this is aimed at preparing students for the future job market and creating a digitally literate society.

Overall, in the field of education, the strategy envisions creating AI training units for professionals, introducing AI-related courses/modules in schools and universities, and establishing a committee to monitor changes caused by AI in academic and professional circles. Significant funds have also been allocated for digital education reforms, infrastructure, and teacher training (Ministerstwo Cyfryzacji, 2021, p. 42–45).

In addition, we would like to note that on December 16, the document "Artificial Intelligence Development Policy in Poland 2025–2030" (Polityka Rozwoju Sztucznej Inteligencji w Polsce 2025–2030), developed by the Artificial Intelligence Working Group (GRAI), was published on the website of the Ministry of Digital Affairs. It presents a vision for the development of artificial intelligence in Poland, based on four pillars: human capital, innovation, investments, and implementation. This document was released as a draft and is currently undergoing public consultations (Ministerstwo Cyfryzacji, 2024).

The Netherlands has a Strategic Action Plan for AI (Ministry of Economic Affairs and Climate Policy of Netherlands, 2019), which includes building a foundation for education and skills development, as well as promoting research and innovation in this field.

Sweden has a national approach to AI (Government Offices of Sweden, 2018), which is aimed at leveraging the opportunities of digital transformation. Although specific details regarding education may vary, skills development is a key component of most national AI strategies.

Most European countries are actively integrating aspects of artificial intelligence (AI) into their educational systems, recognizing its key role in digital transformation and future economic development. Approaches vary in level of detail, but common features include:

Integration of AI into Educational Systems. Countries either have separate strategies for AI in education (e.g., Germany) or include educational aspects as a priority in broader national AI strategies (e.g., Italy, France, Spain, Poland, the Netherlands, Sweden).

Development of Skills and Competencies. A central element is the development of digital and AI-related skills at all levels of education, from schools to postgraduate programs. This includes training AI specialists and ensuring that teachers and students understand and can use AI.

Investment and Funding. Significant investments and budget allocations are directed toward supporting AI research, expanding curricula, implementing AI solutions in classrooms, and training educators.

Research and Innovation. Countries actively promote research potential and innovation in AI, often through national strategies and specialized initiatives designed to connect laboratories with the market.

Collaboration and Initiatives. Initiatives exist to support teachers in using AI ("AI4T" in France) and to create digital learning platforms (AI Campus in Germany), demonstrating a systemic approach to AI integration.

In general, European countries demonstrate a clear understanding of the need to adapt their education systems to the challenges and opportunities presented by artificial intelligence, with an emphasis on developing human capital and ensuring leadership in this field.

There are several key European platforms and initiatives where information on common European policy and national strategies in the field of artificial intelligence can be found (see Table 3).

Table 3

European resources with information on common European policies and national strategies in the field of artificial intelligence

Resource name	Description
European Commission – Digital Strategy / Artificial Intelligence	This is the main official resource that provides information about the EU's overall AI strategy. Here you will find official documents such as the AI Act, which is the world's first comprehensive AI regulation, as well as other policies and initiatives. In particular, their "Shaping Europe's digital future" website has a dedicated section on artificial intelligence: https://surl.lu/afovtj. Here you can also find information about initiatives like the «AI Continent Action Plan» and plans for developing AI infrastructure.
AI Watch (European Commission, Joint Research Centre - JRC):	«AI Watch» is an initiative of the European Commission that monitors the development, implementation, and impact of artificial intelligence in Europe. They publish reports, analytics, and data on the national AI strategies of EU member states, providing a detailed overview of each country's approach.
The European AI Alliance	This European Commission initiative was created to facilitate open dialogue on artificial intelligence policy. It brings together thousands of stakeholders through events, public consultations, and online forums. Although it is primarily a platform for discussion, it also provides information on current policy directions and the positions of various stakeholders.
European Parliament	The European Parliament website provides information on legislative processes related to AI, including the adoption of the AI Act and other regulatory initiatives.
Digital Skills and Jobs Platform	This platform is the official website of the European Union. It gives an overview of national strategies, policies, and nationwide initiatives related to developing digital skills. The main goal of the platform is to promote and support the development of digital competencies for ICT professionals, workers, citizens in general, and education systems in EU member states. The platform also contains information on various topics, such as artificial intelligence, cybersecurity, 5G, and digital transformation, and allows you to filter strategies by topic, geographical context, and level of digital skills.

to the content >>

Organization for Economic Co-operation and Development – OECD	Although the OECD is not strictly a European organization, it plays an important role in shaping global recommendations on AI, which often influence European policies. They publish reviews of national AI strategies from various countries, including European ones, and provide recommendations on responsible AI. OECD.AI The OECD AI Policy Observatory is a specialized platform that provides policy, data, and analysis for trustworthy AI. This integrated initiative was created in July 2024 by combining the efforts of the Global Partnership on AI (GPAI) initiative and the work of OECD member countries in the field of AI under a single GPAI brand. The platform offers a variety of resources, including the "AI Wonk" blog, up-to-date data, country-specific information, and details on priority issues such as risks and accountability, AI, data, and privacy, generative AI, the future of work, and AI in healthcare. It also includes tools like the AI Incidents and Hazards Monitor (AIM) and the Catalogue of Tools & Metrics for Trustworthy AI. OECD DPP (The Digital Economy Policy Programme (DEPP) directly covers AI policies and strategies, and provides internationally comparable information on the national digital strategies and key digital policies of OECD member and partner countries. One of the key aspects of these strategies is artificial intelligence. The OECD DEPP complements the information available on OECD.AI.
Centre for European Policy Studies – CEPS, and Bruegel	Many European think tanks are actively engaged in research and publish reports on European AI policy. They often provide in-depth analysis and recommendations that complement official sources.

Source: compiled by the authors

Therefore, when analysing the common European strategic vision for the development of AI and its implementation in school education in EU countries, several key aspects can be identified. The European Union recognizes the transformative potential of AI and strives to create an ecosystem that is human-centred, reliable, and ethical. This is reflected in the AI Act, which classifies AI systems by risk level, imposing strict requirements on high-risk systems used, in particular, in education. This approach ensures not only technological development but also the protection of fundamental rights and values. In addition, the European Commission is actively developing ethical guidelines for educators, emphasizing the importance of responsible use of AI in the learning process. In general, the EU's strategy is not only to

introduce AI as a tool, but also to develop "AI literacy" among citizens, the ability to think critically and interact ethically with intelligent systems.

In the context of implementing AI in school education, Europe is adopting a multifaceted approach that includes developing competencies for interacting with AI, using AI as a tool to enhance the learning process, and a deeper, technical study of AI fundamentals. This reflects the understanding that AI is not just changing teaching methods but also transforming the very essence of the skills needed for the future. Initiatives like the Digital Education Action Plan aim to improve digital skills and media literacy among students and teachers, and support innovative projects through programs like Horizon Europe and Erasmus+. At the same time, challenges such as algorithmic bias, data protection, the transparency of AI "black boxes," and the risk of digital exclusion are being actively discussed and addressed.

In Ukraine, despite the lack of a single, comprehensive national strategy for the targeted implementation of artificial intelligence (AI) specifically in general secondary education (unlike, for example, Poland's "AI Development Policy"), there is active work in this area. A significant regulatory framework exists, and an intensive process of developing relevant documents is ongoing, which forms the basis for integrating digital technologies, including AI, into the educational process. Among the key documents and initiatives related to the implementation of AI in school education are: the Law of Ukraine "On Education" (2017), the "New Ukrainian School" Concept (2016), the Concept for the Development of the Digital Economy and Society of Ukraine for 2018–2020 and Beyond (2018), the Concept for the Development of Artificial Intelligence in Ukraine (2020), the National Strategy for the Development of Artificial Intelligence in Ukraine until 2030 (2021), the Roadmap for the State's European Integration in Education and Science until 2027 (2023), and the Recommendations of the Ministry of Education and Science of Ukraine jointly with the Ministry of Digital Transformation on the Responsible Use of Artificial Intelligence in General Secondary Education Institutions (2024).

According to the Concept for Artificial Intelligence Development in Ukraine (2020), the main directions for applying artificial intelligence (AI) in general secondary education are focused on improving the educational and methodological base, enhancing the qualifications of teaching staff in the field of AI and data, and promoting digital literacy among students, including the use of AI tools and media literacy (Kabinet Ministriv Ukrainy, 2020).

In the Concept, artificial intelligence (AI) is defined as "an organized set of information technologies, with the application of which it is possible to perform complex tasks by

using a system of scientific research methods and algorithms for processing information, which is either obtained or independently created during work, as well as to create and use one's own knowledge bases, decision-making models, algorithms for working with information, and to determine ways to achieve set goals" (Kabinet Ministriv Ukrainy, 2020).

Both in Ukrainian legislative documents and in acts of the European Union, the concept of AI is characterized as a technology or a set of systems designed to solve complex tasks that traditionally require human intelligence, as well as the ability to process information and make decisions. However, the key difference in the initial definitions lay in the emphasis: the Ukrainian interpretation (Kabinet Ministriv Ukrainy, 2020) viewed AI primarily as a set of tools that function through organized processes to achieve specific goals. In contrast, in the European Union's definitions from the same period (Tuomi et al., 2018; European Commission, 2018), the focus was shifted to the dynamic nature of AI and its ability to learn, adapt, and operate with a certain degree of autonomy.

It should be noted that contemporary Ukrainian analytical documents and recommendations (specifically, the Methodological Guidelines for the Implementation and Use of Artificial Intelligence Technologies in General Secondary Education Institutions, 2024; the Recommendations on the Responsible Implementation and Use of Artificial Intelligence Technologies in Higher Education Institutions, 2025), which are currently under public discussion, already take into account such characteristics of AI as autonomy in decision-making, adaptability, and flexibility. This indicates an evolution in the understanding and harmonization of approaches to defining artificial intelligence in Ukrainian educational policy and practice.

An example of the effective use of digital technologies to ensure broad access to educational content is the "All-Ukrainian Online School" project, developed by the Ministry of Education and Science of Ukraine. This platform has the potential for further integration of advanced technologies, including artificial intelligence (AI), which will allow for the development of adaptive learning. The Deputy Minister of Education and Science of Ukraine for Digitalization, Dmytro Zavhorodnii, notes that this project demonstrates a wide reach of the target audience while maintaining a relatively low cost of operation. Statistical data indicate a high demand for the resource: the monthly number of video lesson views on the "All-Ukrainian Online School" platform exceeds 2 million (Boiko, 2025).

The implementation of artificial intelligence (AI) related subjects in general education schools is one of the key elements of the National AI Development Strategy

in Ukraine. This direction aims to prepare students for life and work in conditions of rapid digital transformation and active use of AI. The plan is not simply to add a separate subject, but to integrate basic knowledge about AI into existing school curricula, particularly in the subjects of computer science, mathematics, technology, and possibly other fields through interdisciplinary projects. (Ministerstvo osvity i nauky Ukrainy, Natsionalna akademiia nauk Ukrainy, Instytut problem shtuchnoho intelektu, 2021).

Currently, the Ministry of Digital Transformation of Ukraine, together with partners and experts, is actively working on the Artificial Intelligence Development Strategy until 2030. This document will become a roadmap for the integration of AI into key areas: healthcare, economy, education, security, public administration, etc. In 2025, the Ministry of Digital Transformation of Ukraine, in cooperation with the Ministry of Education and Science of Ukraine, developed recommendations for the responsible implementation and use of artificial intelligence technologies in higher education institutions (Ministerstvo tsyfrovoi transformatsii Ukrainy, Ministerstvo osvity i nauky Ukrainy, 2025).

Thus, the implementation of AI in education is potentially disruptive technology that will fundamentally change our approach to learning by providing a personalized learning experience, automating administrative tasks, and improving educational outcomes. For Ukraine, the European experience of integrating artificial intelligence technologies into education is of great importance. In its pursuit of integration into the European space, Ukraine can draw several key lessons from it.

First, there is a need to develop a clear national strategy for AI integration into education that will comply with European standards of safety, ethics, and transparency. This includes the development of an appropriate legislative and regulatory framework to govern the use of AI systems in schools.

Second, Ukraine should actively work on increasing “AI literacy” among teachers and students, as quality AI integration is impossible without an understanding of its principles and potential consequences. This requires the development of new curricula, the retraining of teaching staff, and the provision of access to modern technologies.

Finally, it is important to focus on developing critical thinking and an ethical attitude toward AI in schoolchildren, as well as on finding solutions to overcome the digital divide and ensure equal access to AI technologies for all students, regardless of their socioeconomic status or place of residence.

to the content >>

Overall, adapting European best practices will allow Ukraine not only to modernize its educational system but also to prepare a competitive generation for life and work in the digital age while minimizing possible risks. However, it should be emphasized that the analysis of innovative European practices for using artificial intelligence in education must be applied considering the strategic development priorities and specific features of Ukraine's national education system.

Therefore, the integration of AI into Ukrainian education is not just a step forward in technology but a strategic investment in national security, economic development, and the formation of a strong, modern Ukraine.

References

Boiko, A. (2025). Yak shtuchnyi intelekt intehruiut v ukrainsku osvitu. Rozbyraiemo plany Mintsyfry, MON ta kliuchovi ryzyky. https://dou.ua/lenta/articles/ai-in-the-ukrainian-education-2025/?from=toppost

CEE Digital. (2024). CEE AI Challengers 2024: The Rise of AI in Central and Eastern Europe. https://ceedigital.org/assets/pdf/Report_CEE_AI_CHALLENGERS_2025.pdf

Dzhurylo, A., & Shparyk, O. (2019). ICT competence for secondary school teachers and students in the context of education informatization: Global experience and challenges for Ukraine. Information Technologies and Learning Tools, 70(2), 43–58. https://doi.org/10.33407/itlt.v70i2.2438

EIMT. (2025, May 31). Top 10 AI trends reshaping the future of education. Retrieved June 12, 2025, from https://www.eimt.edu.eu/top-10-ai-trends-reshaping-the-future-of-education

European Commission / Digital Skills & Jobs Platform. (n.d.). France: National Strategy on AI. Retrieved July 2, 2025, from https://digital-skills-jobs.europa.eu/en/actions/national-initiatives/national-strategies/france-national-strategy-ai

European Commission, Directorate-General for Education, Youth, Sport and Culture. (2022). Ethical guidelines on the use of artificial intelligence (AI) and data in teaching and learning for educators. Publications Office of the European Union. https://data.europa.eu/doi/10.2766/153756

European Commission, European Education and Culture Executive Agency. (2023). AI report: by the European Digital Education Hub's Squad on artificial intelligence in education. Publications Office of the European Union. https://data.europa.eu/doi/10.2797/828281

European Commission. (2018). Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions Artificial Intelligence for Europe (COM(2018) 237 final). https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52018DC0237

European Commission. (2020a). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on Digital Education Action Plan 2021-2027 - Resetting education and training for the digital age (SWD (2020) 209 final). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52020DC0624

European Commission. (2020b). White Paper on Artificial Intelligence – A European approach to excellence and trust. https://commission.europa.eu/system/files/2020-02/commission-white-paper-artificial-intelligence-feb2020_en.pdf

European Commission. (2021a, April 21). Coordinated Plan on Artificial Intelligence 2021 Review. European Commission. https://digital-strategy.ec.europa.eu/en/library/coordinated-plan-artificial-intelligence-2021-review

European Commission. (2021b, April 21). Proposal for a Regulation laying down harmonised rules on Artificial Intelligence (Artificial Intelligence Act). European Commission. https://digital-strategy.ec.europa.eu/en/library/proposal-regulation-laying-down-harmonised-rules-artificial-intelligence

European Parliament. (2024). European Parliament legislative resolution of 13 March 2024 on the proposal for a regulation of the European Parliament and of the Council on establishing a European Union Artificial Intelligence Act and amending certain Union legislative acts (COM(2021)0206 – C9-0168/2021 – 2021/0106(COD)) (TA-9-2024-0138). https://www.europarl.europa.eu/doceo/document/TA-9-2024-0138_EN.html

European Parliament. (2024). European Parliament legislative resolution of 13 March 2024 on the proposal for a regulation of the European Parliament and of the Council on establishing a European Union Artificial Intelligence Act and amending certain Union legislative acts (COM(2021)0206 – C9-0168/2021 – 2021/0106(COD)) (TA-9-2024-0138). https://www.europarl.europa.eu/doceo/document/TA-9-2024-0138_EN.html

Eurydice Unit Germany (Länder). (2025, May 22). Germany: Recommendation for action on the use of artificial intelligence in school education processes. https://eurydice.eacea.ec.europa.eu/news/germany-recommendation-action-use-artificial-intelligence-school-education-processes

German Federal Government. (2020). Artificial Intelligence Strategy of the German Federal Government. Retrieved June 12, 2025, from https://www.ki-strategie-deutschland.de/files/downloads/Fortschreibung_KI-Strategie_engl.pdf

Horizon Grand View Research. (2025). Europe AI In Education Market Size & Outlook, 2024–2030. https://www.grandviewresearch.com/horizon/outlook/ai-in-education-market/europe

Hrytsenchuk, O. O. (2024). Normatyvno-pravova pidtrymka vykorystannia shtuchnoho intelektu v osviti v konteksti yevrointehratsii. Informatsiinyi biuleten № 4, 2024. ITsO NAPN Ukrainy. https://surl.li/drjfsv

Kabinet Ministriv Ukrainy. (2020). Pro skhvalennia Kontseptsii rozvytku shtuchnoho intelektu v Ukraini (№ 1556-r). https://zakon.rada.gov.ua/laws/show/1556-2020-%D1%80#Text

Kabinet Ministriv Ukrainy. (2018). Pro skhvalennia Kontseptsii rozvytku tsyfrovoi ekonomiky ta suspilstva Ukrainy na 2018–2020 roky ta zatverdzhennia planu zakhodiv shchodo yii realizatsii (№ 67-r). https://zakon.rada.gov.ua/laws/show/67-2018-%D1%80#Text

Kremen, V. H. (red.). (2024). Zakhyst i pidtrymka mentalnoho zdorovia ukraintsiv v umovakh voiennoho stanu: vyklyky i vidpovidi: monohrafiia. NAPN Ukrainy. https://doi.org/10.32405/978-617-7118-51-9-2024-188

McKinsey Global Institute. (2024, October 1). Time to place our bets: Europe's AI opportunity. Sukharevsky, A., Hazan, E., Smit, S., Chevasnerie, M.-A. de la., De Jong, M., Hieronimus, S., Mischke, J., & Dagorret, G. https://www.mckinsey.com/capabilities/quantumblack/our-insights/time-to-place-our-bets-europes-ai-opportunity

Minister for Technological Innovation and Digitalization of Italy. (2022). National Strategic Programme on Artificial Intelligence. https://docs.italia.it/italia/mid/programma-strategico-nazionale-per-intelligenza-artificiale-en-docs/en/bozza/index.html

Ministerstvo osvity i nauky Ukrainy, Ministerstvo tsyfrovoi transformatsii Ukrainy. (2024, traven 22). Instruktyvno-metodychni rekomendatsii shchodo zaprovadzhennia ta vykorystannia tekhnolohii shtuchnoho intelektu v zakladakh zahalnoi serednoi osvity. Proiekt. https://tinyurl.com/sst93r6u

Ministerstvo osvity i nauky Ukrainy, Natsionalna akademiia nauk Ukrainy, Instytut problem shtuchnoho intelektu. (2021). Natsionalna stratehiia rozvytku shtuchnoho intelektu v Ukraini na 2021–2030 roky. https://tinyurl.com/mjz8befm

Ministerstvo osvity i nauky Ukrainy. (2016). Nova ukrainska shkola. Kontseptualni zasady reformuvannia serednoi shkoly. https://zakon.rada.gov.ua/rada/show/v1072729-24#Text

Ministerstvo osvity i nauky Ukrainy. (2023, 11 hrudnia). Pro zatverdzhennia dorozhnoi karty yevropeiskoi intehratsii Ukrainy u sferakh osvity i nauky do 2027 roku (№ 1501). http://surl.li/tjjac

Ministerstvo tsyfrovoi transformatsii Ukrainy, Ministerstvo osvity i nauky Ukrainy. (2025). Rekomendatsii shchodo vidpovidalnoho vprovadzhennia ta vykorystannia tekhnolohii shtuchnoho intelektu v zakladakh vyshchoi osvity. https://mon.gov.ua/static-objects/mon/sites/1/news/2025/04/24/shi-v-zakladakh-vyshchoi-osvity-24-04-2025.pdf

Ministerstwo Cyfryzacji. (2021). Policy for the Development of Artificial Intelligence in Poland from 2020. https://tinyurl.com/6fzapjsm

Ministerstwo Cyfryzacji. (2024, Grudzień 16). Ekspertyza ws. aktualizacji Polityki AI w Polsce. https://www.gov.pl/web/cyfryzacja/ekspertyza-ws-aktualizacji-polityki-ai-w-polsce

Radiuk, I., & Radiuk, V. (2025). Metodychni aspekty vprovadzhennia shtuchnoho intelektu v osvitnii protses pochatkovoi shkoly. Naukovi zapysky. Seriia: Pedahohichni nauky, (219), 278–282. https://doi.org/10.36550/2415-7988-2025-1-219-278-282

Sharlovych, Z., Vilchynska, L., Danylyuk, S., Huba, B., & Zadilska, H. (2023). Digital Technologies as a Means of Improving the Efficiency of Higher Education International. Journal of Information and Education Technology, 13(8), 1214–1221. https://doi.org/10.18178/ijiet.2023.13.8.1923

Shparyk, O. (2021). Kontseptualni zasady tsyfrovoi transformatsii osvity: yevropeiskyi ta amerykanskyi dyskurs. Ukrainskyi Pedahohichnyi zhurnal, (4), 65–76. https://doi.org/10.32405/2411-1317-2021-4-65-76

The Role of AI in Modern Education: Italy's Experiment with AI Assisted Teaching. (2024, November 15). Airtics Blog. https://airtics.org/blog/the-role-of-ai-in-modern-education-italys-experiment-with-ai-assisted-teaching/

Tuomi, I., Cabrera, M., Vuorikari, R., & Punie, Y. (2018). The Impact of Artificial Intelligence on Learning, Teaching, and Education. Luxembourg, Publications Office of the European Union. https://doi.org/10.2760/12297

Zakon Ukrainy «Pro osvitu». (2017, 5 veresnia). http://zakon.rada.gov.ua/laws/show/2145–19

Zoting, Shivani. (2025, May 16). AI in Education Market Size, Share and Trends 2025 to 2034. Precedence Research. https://www.precedenceresearch.com/ai-in-education-market