

ARTÍCULO PRODUCTO DE INVESTIGACIÓN

The impact of Artificial Intelligence on education and learning processes

El impacto de la inteligencia artificial en la educación y los procesos de aprendizaje

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Abstract

This paper aims to analyze the impact of artificial intelligence (AI) on modern education and learning processes, both from a theoretical and empirical perspective. The first part discusses the essence of AI, its definitions, main types, and the key opportunities and risks associated with its implementation across various areas of social life. Particular attention is given to education as a space for technological adaptation and the development of innovative teaching methods. The second chapter examines the influence of AI on the education system, highlighting its dual role as both a challenge and an opportunity for teachers, students, and educational institutions. Various applications of AI technologies in teaching are presented, including intelligent tutoring systems, personalized learning tools, and automated assessment solutions. The role of educational theory in the design of machine learning algorithms is also discussed, along with a brief historical overview of AI's development and integration into educational environments. The empirical section presents the results of original research analyzing statistical correlations between the use of AI and the quality of educational and learning processes. The findings indicate that the integration of AI-based tools enhances

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individualized learning, increases student motivation, and supports cognitive skill development. However, it also reveals the need for critical reflection on the ethical and responsible use of these technologies. The conclusions confirm that artificial intelligence is becoming an integral component of modern education, necessitating updates to curricula, teacher training programs, and the creation of ethical and legal frameworks governing its application.

Keywords: artificial intelligence, learning processes, teaching innovation, ethics in AI

Resumen

El presente artículo tiene como objetivo analizar el impacto de la inteligencia artificial (IA) en la educación moderna y en los procesos de aprendizaje, tanto desde una perspectiva teórica como empírica. En la primera parte se aborda la esencia de la IA, sus definiciones, sus principales tipos y las oportunidades y riesgos clave asociados a su implementación en diversos ámbitos de la vida social. Se presta especial atención a la educación como espacio para la adaptación tecnológica y el desarrollo de métodos de enseñanza innovadores. El segundo capítulo examina la influencia de la IA en el sistema educativo, destacando su doble papel como reto y oportunidad para los docentes, los estudiantes y las instituciones educativas. Se presentan diversas aplicaciones de las tecnologías de IA en la enseñanza, incluidos los sistemas de tutoría inteligente, las herramientas de aprendizaje personalizadas y las soluciones de evaluación automatizada. También se analiza el papel de la teoría educativa en el diseño de algoritmos de aprendizaje automático, junto con una breve visión histórica del desarrollo de la IA y su integración en los entornos educativos. La sección empírica presenta los resultados de una investigación original que analiza las correlaciones estadísticas entre el uso de la IA y la calidad de los procesos educativos y de aprendizaje. Los resultados indican que la integración de herramientas basadas en la IA mejora el aprendizaje individualizado, aumenta la motivación de los estudiantes y favorece el desarrollo de las habilidades cognitivas. Sin embargo, también revelan la necesidad de una reflexión crítica sobre el uso ético y responsable de estas tecnologías. Las conclusiones confirman que la inteligencia

artificial se está convirtiendo en un componente integral de la educación moderna, lo que requiere actualizaciones de los planes de estudios y de los programas de formación del profesorado, así como la creación de marcos éticos y legales que regulen su aplicación.

Palabras clave: inteligencia artificial, procesos de aprendizaje, innovación docente, ética en la IA

Introduction

Education has always been the foundation of societal development, shaping the competencies, values, and attitudes of successive generations. In an era of dynamic technological change, particularly the development of artificial intelligence, educational processes are undergoing a revolution, influencing teaching, learning, and the organization of the educational system. The introduction of innovative AI-based solutions creates both new opportunities and challenges for teachers, students, and educational institutions. On the one hand, this technology enables the personalization of learning the automation of assessment and supports the development of digital competencies and future-oriented skills. On the other hand, it raises questions about ethics, safety, interpersonal relationships, and the risks associated with excessive dependence on technology.

This study aims to determine the relationship between education and learning processes and the development of artificial intelligence. The paper presents both theoretical aspects and empirical research findings demonstrating how artificial intelligence shapes the quality of education, student motivation, and learning effectiveness. The research problem addressed the following question: "Can the development of artificial intelligence influence education and learning processes?" The primary research method was a survey, followed by statistical and graphical methods.

Given the increasingly widespread use of artificial intelligence in education, it is important to develop a legal, pedagogical, and ethical framework that will ensure its effective and safe use

for the quality of teaching and learning. The article consists of three parts. The first discusses the nature of artificial intelligence, highlighting its types, opportunities, and threats. The second presents education and learning processes, and the third is devoted to the author's own research, where statistical correlations are also examined.

1. The essence of artificial intelligence

Artificial intelligence (AI) is a field of computer science that focuses on creating systems and programs that can perform tasks that largely require human intelligence, such as speech and image recognition, planning, learning from data, logical reasoning, problem-solving, and decision-making. The essence of AI is to replicate and imitate human cognitive abilities using algorithms. AI is divided into various types, from narrow AI, which focuses on a single task, to general AI, capable of performing a wide range of activities. Its development is aimed at automating processes, increasing efficiency, and supporting humans in solving more complex problems.

1.1 Artificial intelligence and its types

The most well-known concept of artificial intelligence is the ability of a machine to imitate or mimic human intelligence (Zalewski, 2020, p. 2). Artificial intelligence can also be understood as a system that allows for tasks requiring a learning process, considering new circumstances arising during problem solving, and that can automatically interact with the environment (Zalewski, 2020, p. 14). AI is also understood as a computer program that performs activities that are typically the domain of humans, especially within the scope of the human intellect. It is a machine that behaves similarly to humans (McCarthy et al., 1955, p. 3). According to A. Turing (1950, p. 439), it will be a machine that provides answers that the observer cannot distinguish from human responses.

The EU Commission developed the following definition of AI: "Artificial Intelligence" refers to systems that exhibit intelligent behavior (to a certain extent autonomous) by analyzing their environment to achieve specific goals (Definition developed ..., 2018). As you can see, this is

a relatively concise definition, but the meaning of "intelligent behavior" remains unclear. In the same year, the EC's HLEG group of independent experts developed a definition of AI as a system designed by humans that operates in the physical and digital worlds by interpreting collected data, concluding it is useful for achieving a set goal (Zalewski, 2020, p. 8).

For this study, the following definition of artificial intelligence was adopted: it is a machine-based system that can, for a given purpose, recommend, predict, or make decisions important for humans at various levels of autonomy.

Artificial intelligence covers various spheres of functioning and comes in various forms, for example:

- . Strong artificial intelligence—used to perform tasks that require the ability to "understand" them (the ability to learn, understand the environment, and adapt to the current situation). This refers to the ability of AI to outperform humans in every intellectual task—in reality, it does not exist (Żybula, 2024, p. 10),
- . Narrow, weak—it is used to perform specific tasks without the ability to "understand" them in general. This is the highest level of AI development that humans have achieved so far (image recognition, board game recognition, speech recognition, autonomous vehicles, and personal digital assistants). So-called "AI thinking" does not include consciousness or emotions (Dudek, 2022, p. 7),
- . mental—serves to emulate thinking (the ability to learn independently, understand the environment, and process natural language) (Żybula, 2024, p. 10),
- . augmenting augmented intelligence—combines human forces with the capabilities of artificial intelligence to amplify human actions (Kurulishvili, 2021, p. 38),
- . safe—used to control the compliance of AI activities with ethics (Ministry of Digital Affairs, 2025, p. 32)
- . reverse—involves modeling human thought processes to better understand machine interactions depending on human expectations (Żybula, 2024, p. 10),

. predictive—deals with predicting results based on available information (weather forecasting, election results, stock prices) (Maternowska, 2019, p. 66),

. a superintelligence that would intellectually surpass humans. It would be capable of acting completely autonomously in various situations (Prus 2024, p. 50).

In summary, artificial intelligence is a machine system that mimics human intelligence by performing tasks requiring learning, understanding the environment, and making decisions. It is defined in various ways, but most often as systems exhibiting intelligent behavior and acting to achieve specific goals. Different types of AI are distinguished, from weak, specialized AI focused on specific tasks to strong, hypothetical AI capable of general reasoning and outperforming humans in every respect.

1.2 Opportunities and threats related to the implementation of artificial intelligence

The use of artificial intelligence can bring many benefits, improving people's quality of life. AI is bringing positive change on many levels in various industries, fields, and disciplines, such as education, agriculture, media, banking, commerce, medicine, and the military. For example, in the retail sector, companies that have implemented this technology gain a competitive advantage (Łochnicka et al., 2022, p. 406). AI algorithms analyze significantly more data than the human brain can process, with a lower probability of error and much faster. AI is already being used to detect changes in customer preferences, allowing retailers to offer the right product, at the right time, to the right person. It can also predict upcoming trends, accelerate decision-making, and assist in decision-making, enabling businesses to operate at a higher level (Sokolnicki & Rostek, 2019, p. 63).

In the medical sector, AI is useful in the following areas: performing administrative tasks, managing patient medical interviews, assisting with surgeries (assistive robots), and optimizing healthcare system costs (Olech, Lis, 2020, p. 14). One of the most important benefits of using AI in medicine is improving the diagnostic process. AI diagnoses diseases more accurately and faster than humans. Artificial intelligence has also found applications in

biotechnology and biopharmaceutical companies, primarily to conduct more accurate and effective drug research (Tarabasz, 2023, p. 24).

Artificial intelligence in the military has important implications for national security, for example, in intelligence collection and analysis, logistics, and autonomous vehicles. It is particularly important in image recognition and analysis, surveillance operations, and threat monitoring (Moy et al., 2020, p. 8).

The greatest challenge for the development of intelligent machines is building an effective memory system. Such a system should be as capacious as the layer of the human brain responsible for cognitive functions (the cerebral cortex), i.e., consciousness, thinking, memory, and language. The fundamental difficulty in implementing such a memory system lies in its capacity and the connections between memory cells. While capacity can be relatively easily increased by miniaturizing devices, a silicon-based interconnection system will be extremely difficult to implement. The prospect of intelligent machines capable of independent thought is causing anxiety among people. Humans may turn out to be of little use for most tasks. However, these concerns appear unfounded, as humans are unable to create, at least for now, a machine with consciousness and a personality of its own (Rózanowski, 2007, pp. 132-133).

The dangerous use of this technology could pose a significant threat, potentially leading to catastrophes or other incidents, particularly in wartime situations. Another alarming prospect is the possibility of producing a false message from a given person, who could appear on TV screens and smartphones and express views that contradict those of the real person (*bots*). Attention should also be paid to various social issues. Many people will lose their jobs. Robots are already replacing baristas and waiters, and chatbots are replacing *call center workers*. Centers and image creators are replacing artists. In the future, artificial intelligence will replace drivers, shop assistants, and pharmacists. People in the music industry will also be threatened by artificial intelligence (Tyson, Zysman, 2022, p. 257).

In summary, this section of the study concludes that artificial intelligence offers numerous benefits, including improved quality of life, faster data processing, and increased work efficiency in various industries (medicine, commerce, and the military). AI also poses significant challenges and threats, including difficulties in creating efficient machine memory systems, the risk of using this technology in terrorist or warfare activities, information manipulation, and job losses. Concerns about security and ethics arise in the context of creating false information. Despite their dynamic development, modern machines lack consciousness or a personality of their own, which limits their independent thinking.

2. Education and learning processes

Education and learning processes are the foundation of individual and societal development, playing a crucial role in shaping the attitudes, competencies, and knowledge necessary to function in an increasingly digital world. Contemporary approaches to learning and teaching focus on understanding the mechanisms that influence the effectiveness of the educational process, considering psychological and social aspects.

2.1 Artificial intelligence is a challenge for the education system

The development of AI brings opportunities to improve many areas of life, but also challenges, especially for education. The introduction of AI into the teaching and learning process raises questions for the education system regarding the adaptation of teaching methods, teacher competencies, and the ethical aspects of using new technologies.

2.1.1 The importance and types of artificial intelligence in education

The structures created by AI will become increasingly complex, and their understanding by humans will become increasingly difficult. These elements may have a fundamental impact on the use of artificial intelligence in education. Teachers today often use AI tools that are useful in teaching and learning, helping prepare students to connect the real and virtual

dimensions (Jaskuła, 2023, p. 15). Applying AI to educational processes can improve their scope and quality, as well as reduce the costs of education. It can also support the development of students' competencies by supporting their self-assessment and individual and teamwork (Jaskuła, 2023, p. 15).

Recently, so-called virtual mentors have appeared, available to every student 7 days a week, who provide omnipresent support, integrating knowledge and instilling social behavior (Jakubiec, 2025, p. 12).

In addition to supporting teachers in their work, artificial intelligence may also hurt educational processes, for example, by eliminating values typical of traditional education (shaping a direct teacher-student relationship in a personal category, acquiring communication skills, developing interpersonal communication, and sensitizing to humanistic values (Jaskuła, 2023, p. 16).

Artificial intelligence has the potential to revolutionize the education sector by improving educational practices, supporting teachers, and offering students a more personalized learning experience (Kamalov, Gurrib, 2023, p. 4).

One of the most frequently mentioned types of artificial intelligence that has found applications in education is AI based on unsupervised or self-supervised machine learning models—trained on specific information that can generate original images, sounds, and texts (Giannakos et al., 2024, p. 12). This technology can even independently create innovative results based on the data it has.

Another type is the GPAI system. Models in this technology are characterized by the versatility of the tasks they perform. These models are trained using self-supervised, unsupervised, or reinforcement learning (Kurowski, 2020, p. 5).

In education, this type of AI is primarily used in adaptive learning platforms, from creating innovative content to generating personalized learning materials to automating assessments and feedback. For example, it can be used as an AI search tool to get instant answers to questions about a specific topic, and students can also get support with homework and learn new skills. AI can also help with reading and writing by suggesting correct syntax and grammar. It can also create intelligent tutoring systems that provide personalized guidance and support. For example, the goblin. The Tools app can help students with attention deficit hyperactivity disorder by simplifying tasks for them (Rashid et al., 2024, pp. 54-55).

From a teacher's perspective, AI provides the ability to plan lessons and activities, create personalized content, and differentiate and personalize teaching, assessments, and professional development (Kasneci et al., 2024, p. 2).

The greatest threat associated with the use of AI in education is the weakening of the relationship between teachers and students over time, and excessive dependence on the support of artificial intelligence tools may also weaken students' ability to work independently and think independently (Bozkurt et al., 2024, p. 493).

As we can see, artificial intelligence presents both a tremendous opportunity and a significant challenge for the education system. On the one hand, its potential to personalize learning, support teachers, and automate teaching processes can significantly improve the quality and effectiveness of education, making it more accessible to a wide range of students. On the other hand, serious concerns arise regarding the loss of direct interpersonal relationships, the development of social skills, and the risk of excessive reliance on technology, which can undermine students' independence and creativity. Therefore, it will be crucial to develop appropriate ethical frameworks, teaching methods, and teacher competencies to effectively and responsibly integrate artificial intelligence into the educational process.

2.1.2 Educational theory in creating artificial intelligence algorithms

It should be noted that many teachers and educational institutions may lack the knowledge and experience to effectively integrate new technologies. For example, the use and integration of large-scale language models in teaching. Integrating language models into teaching practice requires understanding their effective use, capabilities, and limitations (Kasneci et al., 2024, p. 6).

An area where AI could revolutionize education is automatic grading using machine learning algorithms. AI is capable of pre-grading both written and oral exams (Fazlagić, 2022, p. 105). It can also, using machine learning algorithms, replace tutoring with hands-on learning. For example, CoPilot suggests code snippets in interactive mode, as well as common comments and questions.

Instead of theoretical considerations or artificial training examples that can then be adapted to suit your needs, CoPilot tools take you from the absolute basics to practice, where AI algorithms suggest the right solutions based on context alone. This allows you to create educational materials (lesson plans, reports, presentations), analyze student data (student results, progress trends, adapting teaching methods to student needs), and improve communication (organizing meetings, reminders, and quick task management) (Jakubiec, 2025, p. 14).

The use of AI in education is subject to more risks than in other fields. Risks associated with creating flawed algorithms in education include the following categories: risks related to the use of inappropriate theory; risks related to the algorithm's erroneous reasoning and thus the application of inappropriate tasks; and risks related to negative side effects or unintended consequences of the AI-guided learning process (Fazlagić, 2022, pp. 27-28). It should be noted that the use of inappropriate theories in AI algorithms can be harmful. There is a real danger that algorithms will be created that are based on false theoretical assumptions.

2.2 Artificial intelligence in teaching processes

The implementation of AI in learning processes is having an impact on students of all generations today, with a particularly significant impact on Generation Alpha and Generation Z, who are now entering high school. Generation Z is experiencing some of the benefits of AI in education, while Generation Alpha youth are developing in an environment where AI is even more integrated into their daily learning processes, both within and outside formal education.

2.2.1 Historical outline

The origins of artificial intelligence in teaching processes date back to the mid-20th century (1950-1960). During this period, simple learning systems were developed, such as SHRDLU, which enabled limited interaction in natural language (a program conducting a dialogue with a computer-robot, involving moving objects on a simulated table and answering questions) (Dul, 2014, p. 40).

The 1970s and 1980s saw the development of expert systems, including the MYCIN system for diagnosing diseases. During this time, work also began on algorithms for language understanding and logical reasoning, and expert systems were used to support teaching, systemically diagnose student problems, and create individual learning paths (Raszyd et al., 2024, p. 376).

The years 1990–2000 saw the beginning of the era of machine learning and adaptive learning systems. Machine learning involves creating systems capable of learning from data. Educational platforms were created that adapted content and methods to student requirements (ALEXA+, an intelligent voice assistant based on AI algorithms). E-learning technologies and the personalization of learning also developed (Blicharz, Raszewska-Skałeczka, 2025, p. 81).

The creation of more advanced systems for text, image, and speech recognition analysis has been enabled by artificial intelligence based on deep learning, which has given rise to learning support systems such as chatbots and adaptive learning platforms, as well as recommendation systems (Carnegie Learning, Duolingo) (Gałuszka et al., 2017, p. 292; Jakubiec, 2025, p. 2). Data analysis and learning based on huge data sets allow for even better tailoring of educational methods to individual student needs.

To sum up, it can be noted that the history of AI in teaching is a sequence of events from simple programs to support learning, through expert systems, to modern, adaptive platforms based on artificial intelligence technologies, which are developing towards more personalized support for the educational process.

2.2.2 Artificial intelligence in school and in the classroom

It is anticipated that AI could be a tool in education that will relieve teachers of routine tasks (taking attendance, grading) and support them in their work with students. In turn, it will provide students with learning methods tailored to their personalities. For example, interactive programs using a human-computer interface. Such a system monitors student work, selects appropriate tasks, and provides feedback. Combining such programs into a classroom system represents a shift in the teacher's role. The teacher's role becomes adapted to the learning environment in which students supported by AI technology will learn (Fazlagić, 2022, p. 75).

The core curriculum for general education in secondary schools indicates the teacher's responsibilities, who should individualize the development of each student according to their needs and abilities, as well as prepare them for life in the information society (Maciąg, Świtalski, 2025, p. 223). The emergence of artificial intelligence tools in education has individualized the learning process; it can be said that this is already an educational trend, with the traditional model of knowledge acquisition limited to the development of students' subject-specific abilities (Christ, 2013, pp. 24-25). From the perspective of individualized education, the proportion of the individual to the community plays a crucial role. In this sense,

the curriculum or educational requirements, the prepared course of lessons, methods, goals, and teaching aids are sometimes considered in relation to a universal approach for every student, which is in contradiction to the natural diversity of the group in terms of temperament, learning style, personality, and predispositions (Christ, 2013, p. 34).

Adaptive learning platforms using AI in the classroom enable personalized learning models based on test results. Artificial intelligence analyzes answers in real time and continuously modifies the spreadsheet, adapting the learning level to the user and verifying observations regarding the student's special educational needs. Based on student results, personalized learning paths are built, organizing and presenting school material in a way tailored to the student's abilities. Educational platforms allow teachers to track students' progress and preferred learning styles. They also serve to plan revisions, emphasizing the teacher's role as a mentor and coordinator of individual learning paths (Karsenti, 2024, p. 115).

As the analysis above demonstrates, AI promotes individualization of the learning process, enabling the creation of personalized learning paths based on student performance. This shifts the role of the teacher, adapting learning methods to the diverse needs of students. Furthermore, adaptive learning platforms allow for ongoing progress analysis and optimization of the educational process, which aligns with the trend of personalizing learning and preparing students for life in the information society.

3. Results of own research

The research methodology includes an analysis of the interrelationships between artificial intelligence, education, and learning processes, focusing on appropriate research techniques, tools, and methods. Both the theoretical foundations of the methods used and their practical context were discussed, allowing for an understanding of the research process and its impact on research results.

The research subject may be a person, an institution, or an enterprise (Pilch, Bauman, 2010, p. 22), i.e., *selected opinions of the surveyed people*. The research subject is understood as things, phenomena, or objects about which considerations will be conducted or those about which statements are formulated relating to the assumed research questions (Sołoma, 2002, pp. 37-39). *The subjects that appeared in the presented research are artificial intelligence, education, and learning processes.*

The aim of the research carried out in the studies, understood as obtaining knowledge that is as precise, certain, simple, and general as possible with the optimal content of the acquired information (Pilch, Bauman, 2010, p. 23), *consists in determining the dependence of education and learning processes on the development of artificial intelligence.*

Next, research questions were defined, which should concern a specific section of the set of questions requiring detailed answers (Apanowicz, 2002, p. 42). These could be questions that would define a certain dimension of ignorance or an activity defining the boundaries or purpose of research (Pilch, Bauman, 2010, p. 45). The following *research problem was adopted: Can the development of artificial intelligence influence education and learning processes?*

3.1 The quality of educational processes

The quality of educational processes is influenced by the following circumstances (Chmielecka, Kraśniewska, 2019, pp. 24-27):

- . teachers' qualifications and competences—high level of knowledge, teaching skills, motivation, and continuous professional development of teachers,
- . curriculum—coherent, up-to-date, adapted to the needs of students and the requirements of the labor market, with elements of innovation and practical application of knowledge,
- . teaching methods and techniques—diverse, activating students, based on modern pedagogical methods, promoting critical thinking and creativity,

- . educational environment—safe, conducive to learning and development, with appropriately equipped rooms, access to technology and educational materials,
- . assessment and evaluation of teaching outcomes—systematic monitoring of students’ progress, adapting methods and programs to their needs,
- . involvement of students and their parents—active participation, support, and motivation to learn,
- . material and organizational conditions—appropriate infrastructure, financial resources, and effective management of the educational institution,
- . innovation and adaptability—the ability to introduce new solutions, respond to changing conditions, and social needs.

3.2 Learning efficiency

The following circumstances influence the effectiveness of learning (Szablowski, 2012, pp. 122-123):

- . motivation—strong internal motivation and purposefulness of learning increase commitment and perseverance,
- . learning strategies—using appropriate techniques such as repetition, mind maps, notes, or teaching by teaching,
- . active participation—active involvement in the learning process, e.g., asking questions, discussing, solving problems,
- . organization and planning—setting goals, dividing material into smaller parts, establishing learning schedules,
- . learning environment—appropriate conditions, silence, no distractions, access to necessary materials,
- . memory support—using memorization techniques such as mnemonics or repetition at specific time intervals,
- . rest and regeneration—ensuring adequate sleep and breaks while studying, which affects concentration and the ability to absorb knowledge,

. reflection and self-assessment—analyzing your own progress, identifying difficulties, and adapting learning methods,

. Physical and mental health—well-being, lack of stress, and a proper diet—support cognitive functions.

3.3 Statistical relationships

The study involved 387 respondents (teachers) from various secondary schools. They were selected using stratified random sampling, considering demographic criteria such as age (up to 30 years, 31 to 45 years, 46 to 60 years, and over 60 years), education (secondary, higher), and place of residence (rural, urban—Table 1).

Table 1 The impact of new technologies on the quality of educational processes, parental involvement and motivation, and learning effectiveness

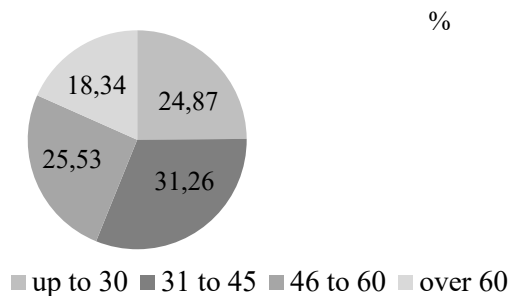
LP.	Question	Variables	Number of people	%
1.	Age (in years)	up to 30	96	24.87
		31 to 45	121	31.26
		46 to 60	99	25.53
		over 60	71	18.34
2.	Education	medium	11	2.77
		higher	376	97.23
3.	Domicile	village	6	1.48
		city	381	98.52
The quality of educational processes				
4.	Teachers' qualifications and digital competences	Very high	64	16.6
		High	108	27.8
		Medium	113	29.1
		Low	58	14.9
		Very low	45	11.6

5.	The educational environment and organizational conditions of the school in the field of digitalization	Very good	45	11.6
		Good	88	22.8
		Medium	106	27.3
		Badly	83	21.4
		Very bad	65	16.9
Parental involvement and motivation				
6.	Involvement of students' parents in financing digital issues and materials	Very high	49	12.7
		High	62	15.9
		Medium	94	24.2
		Low	125	32.4
		Very low	57	14.8
7.	Motivation to learn about artificial intelligence tools (robotics, educational portals)	Very high	78	20.2
		High	79	20.4
		Mean	84	21.8
		Low	106	27.3
		Very low	40	10.3
Learning efficiency				
8.	Active participation of students in lessons related to artificial intelligence	Very high	82	21.2
		High	98	25.3
		Medium	80	20.8
		Low	86	22.1
		Very low	44	11.4
9.	Reflection and self-assessment of students and teachers regarding their digital competencies related to artificial intelligence	Very high	47	12.2
		High	70	18.1
		Mean	87	22.4
		Low	109	28.2
		Very low	74	19.1

Source: own study based on own research

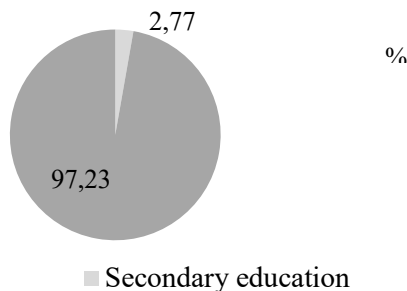
The largest number of respondents are people aged 31 to 45 (31.26%), and the smallest – people over 60 (18.34%) and up to 30 years (24.87%) – Figure 1. The analysis of the education structure of the respondents showed that the vast majority of the respondents included people with higher education (97.23%) – Figure 2. The analysis of the respondents' place of residence showed that the vast majority of respondents lived in the city (98.52%) – Figure 3.

Figure 1. Age structure of respondents



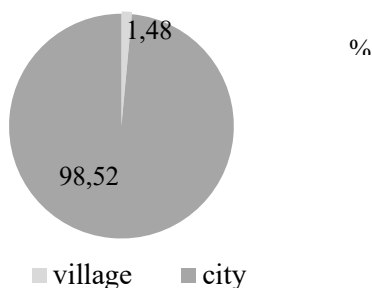
Source: own study based on Table 1

Figure 2. Education structure of respondents



Source: own study based on Table 1

Figure 3. Respondents' place of residence



Source: own study based on Table 1

According to the respondents, the greatest impact on the quality of educational processes is exerted by the qualifications and digital competences of teachers (high and very high: 45.7%) and, to a lesser extent, the educational environment and the organizational conditions of the school in terms of digitalization (high and very high: 34.4%).

Parental involvement, which is a component of the quality of educational processes, plays a much smaller role (high and very high: 28.6%), while appropriate motivation of students turns out to have quite a large impact on the quality of educational processes (40.6%).

The greatest impact on learning effectiveness is exerted by students' active participation in lessons related to artificial intelligence (high and very high: 46.5%) and, to a lesser extent, by students' and teachers' reflection and self-assessment of their digital competences related to artificial intelligence (high and very high: 30.3%).

The frequency distribution for assessing the impact of new technologies on the quality of educational processes, parental involvement and motivation, and learning effectiveness is presented in Table 2. The actual numbers are presented in Table 3, and the theoretical numbers in Table 4.

Table 2 Frequency distribution for assessing the impact of new technologies on process quality, educational, parental involvement and motivation, and learning effectiveness

The impact of new technologies	The quality of educational processes		Parental involvement and motivation		Learning efficiency	
	Teachers' qualifications and digital competences (A)	The educational environment and organizational conditions of the school in	Parental involvement in financing digital issues and materials	Motivation to learn about artificial intelligence tools (D)	Active participation of students in lessons related to artificial intelligence	Reflection and self-assessment of students and teachers regarding their digital competences

			the field of digitalisation (B)		(C)				(E)		(F)	
	n	%	n	%	n	%	n	%	n	%	n	%
Very high	64	16.6	45	11.6	49	12.7	78	20.2	82	21.2	47	12.2
Wysoki	108	27.8	88	22.8	62	15.9	79	20.4	98	25.3	70	18.1
Średni	112	29.1	106	27.3	94	24.2	84	21.8	77	20.0	87	22.4
Niski	58	14.9	83	21.4	125	32.4	106	27.3	86	22.1	109	28.2
Very low	45	11.6	65	16.9	57	14.8	40	10.3	44	11.4	74	19.1
Total:	387	100	387	100	387	100	387	100	387	100	387	100

Source: own study based on Table 1

Table 3 Actual numbers

The impact of new technologies	A	B	Sum	C	D	Sum	E	F	Sum
Very high	64	45	109	49	78	127	82	47	129
High	108	88	196	62	79	141	98	70	168
Średnia	112	106	218	94	84	178	77	87	164
Niska	58	83	141	125	106	231	86	109	195
Bardzo niska	45	65	110	57	40	97	44	74	118
Ogółem:	387	387	774	387	387	774	387	387	774

Source: own study based on Table 2

Table 4 Theoretical numbers

The impact of new technologies	A	B	C	D	E	F
Very high	55	55	49	78	82	47
High	98	98	62	79	98	70
Mean	109	109	94	84	77	87
Low	70	70	125	106	86	109
Very low	55	55	57	40	44	74
Total:	387	387	387	387	387	387

Source: own study based on Table 2

Statistical relationships:

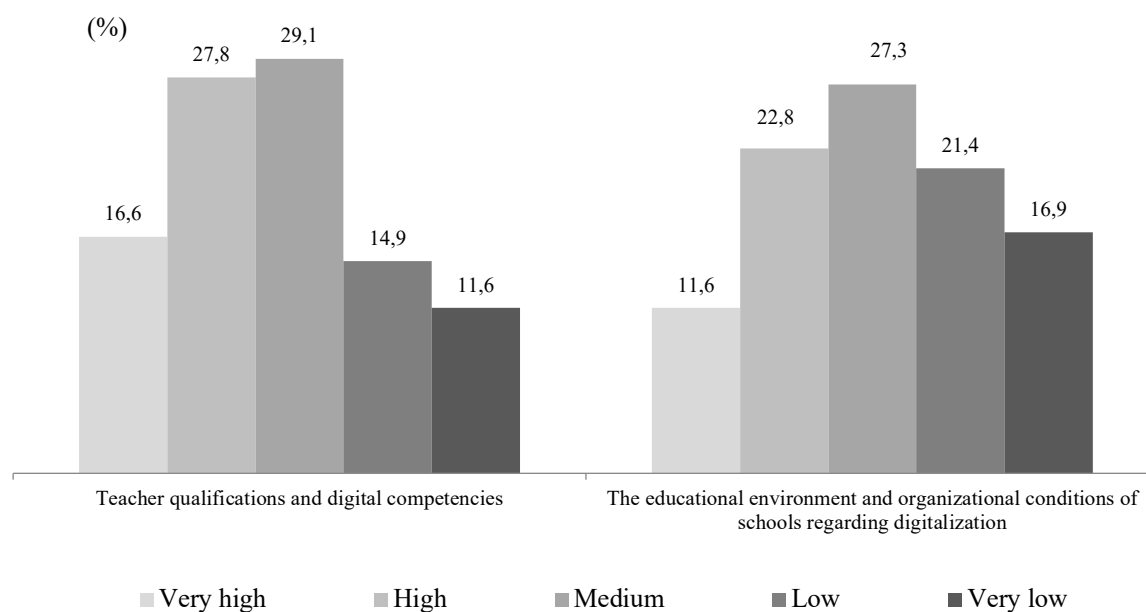
$\chi^2 = 13.88$; significance $p = 0.0076 < 0.01$, hence the variables: "Impact of new technologies" and "Quality of educational processes" – show a statistically significant relationship.

$\chi^2 = 14.07$; significance $p = 0.00707 < 0.01$, hence the variables: "Impact of new technologies" and "Parental involvement and motivation" – show a statistically significant relationship.

$\chi^2 = 24.61$; significance $p = 0.00006 < 0.01$, hence the variables: "Impact of new technologies" and "Learning effectiveness" – show a statistically significant relationship.

The impact of new technologies (artificial intelligence) on the quality of educational processes is statistically significant ($p = 0.0076 < 0.01$) and was most highly indicated for the qualifications and digital competences of teachers (44.4%) and for the educational environment and organizational conditions of the school in terms of digitalization (34.4%) – Figure 4.

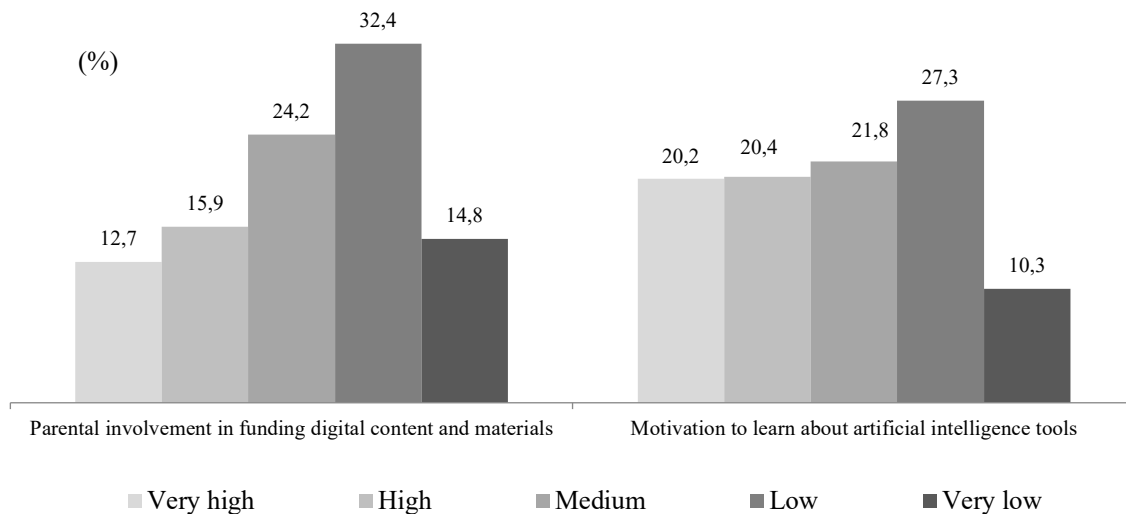
Figure 1. The impact of new technologies on the quality of educational processes for the qualifications and digital competences of teachers and for the educational environment and organisational conditions of schools in the field of digitalisation



Source: own study based on Table 2

The impact of artificial intelligence on parental involvement and motivation is statistically significant ($p = 0.00707 < 0.01$) and was indicated most highly for parental involvement in financing digital issues and materials (28.6%) and for motivation to learn about artificial intelligence tools (40.6%) – Figure 5.

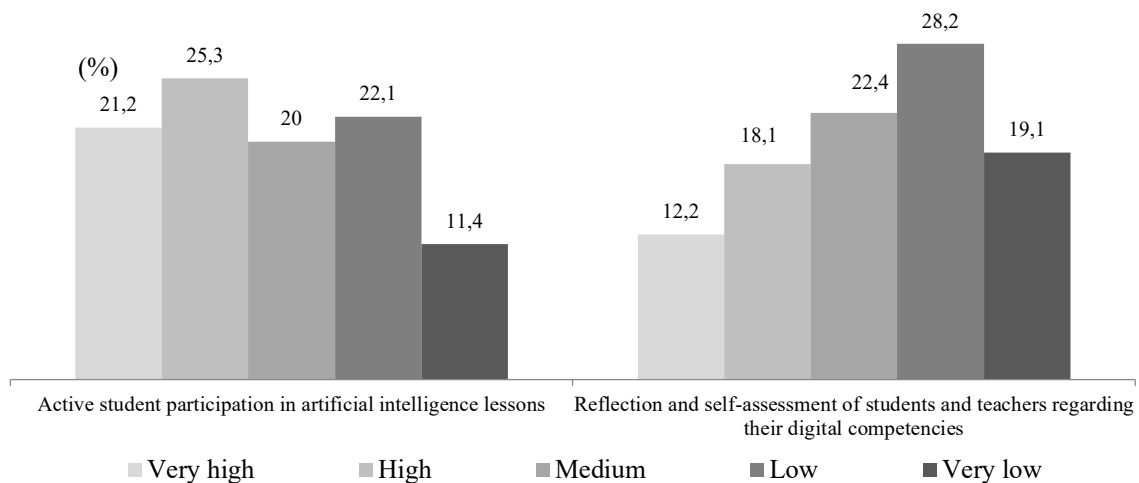
Figure 2. The impact of new technologies on parental involvement in financing digital issues and materials and on motivation to learn about artificial intelligence tools



Source: own study based on Table 2

The impact of artificial intelligence on learning effectiveness is statistically significant ($p = 0.00006 < 0.01$) and was indicated most highly for active participation of students in lessons related to artificial intelligence (46.5%) and for reflection and self-assessment of students and teachers in terms of their digital competences (30.3%) – Figure 6.

Figure 3. The impact of new technologies on students' active participation in lessons related to artificial intelligence and on students' and teachers' reflection and self-assessment in terms of their digital competencies



Source: own study based on Table 2

This chapter presents detailed analyses of surveys conducted among 387 teachers from various secondary schools. Respondents were selected using stratified random sampling, considering demographic criteria such as age, education, and place of residence.

The largest group in the study consisted of teachers aged 31 to 45 (31.26%), while the smallest group consisted of those over 60 (18.34%). The vast majority of respondents had higher education (97.23%), and almost all of them came from urban areas (98.52%).

Analysis of the results indicates that the greatest impact on the quality of educational processes is exerted by digital competences and teacher qualifications, particularly high and very high qualifications (45.7% overall). Second place goes to the school's organizational conditions regarding digitalization (34.4%). Respondents assessed the level of teachers' digital competence as an important factor influencing the quality of education.

In terms of parental involvement and student motivation, the most important role is played by student motivation to learn artificial intelligence tools (40.6%), while parental involvement in financing digital materials is assessed as less important (28.6%).

In terms of learning effectiveness, the highest impact is achieved by students' active participation in lessons related to artificial intelligence (46.5%) and reflection and self-assessment in the field of digital competencies (30.3%).

Statistical analyses of the relationships showed that the impact of artificial intelligence on the quality of educational processes, parental engagement and motivation, and learning effectiveness is statistically significant ($p < 0.01$). Particularly strong correlations exist between the perceived impact of technology and teachers' digital competences, school conditions, and student activity.

In summary, the research results confirm that key factors influencing the effective implementation of new technologies in education include teachers' digital competences,

school organizational conditions, and student and parent engagement. The impact of artificial intelligence on educational processes is significant and depends on teachers' digital competencies and student engagement.

Conclusion

Theoretical analyses and empirical research findings indicate that artificial intelligence is becoming a key factor shaping contemporary education. Its dynamic development impacts both the quality of teaching processes and the motivation and effectiveness of learning. Research has confirmed that AI-based technologies foster individualized learning, support student engagement, and enhance reflection on one's own digital competencies. At the same time, they clearly emphasize that the effectiveness of implementing these tools is strongly dependent on teachers' digital competences and the appropriate organizational conditions of the school.

It's important to emphasize that the use of artificial intelligence in education presents both opportunities and challenges. On the one hand, it enables the creation of personalized learning paths, the automation of some teaching processes, and the improvement of teachers' work. On the other hand, it raises questions about ethics, data security, and the balance between technology and the teacher/student relationship, which remains the foundation of effective education. Research findings also indicate the need for greater parental involvement and for systematically developing student motivation to use AI tools.

Given the interdependencies presented, it becomes clear that the development of artificial intelligence will increasingly impact learning processes. Therefore, it is necessary to prepare teaching staff, strengthen the digital competences of the entire school community, and create appropriate ethical and legal frameworks enabling the safe and responsible use of these technologies. Education of the future should utilize the potential of AI, but in a sustainable, conscious manner, focused on developing students as individuals capable of critical thinking, independence, and creative action.

In summary, artificial intelligence is not merely a technological innovation but a phenomenon that is redefining the functioning of modern schools. Research findings confirm that, when properly implemented, it can become a valuable tool supporting educational processes. A necessary condition, however, is a wise and responsible approach to its integration, based on pedagogical reflection and concern for the quality of education. Only then will AI truly support, rather than threaten, education and learning processes.

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