



## Critical thinking and artificial intelligence: Modern possibilities of interaction

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**Abstract.** The relevance of this study was determined by the need for human thinking to navigate the world of information technology. This world poses challenges related to processing and analysing rapidly spreading information. However, this information is not always true; it is often fake or manipulated. The purpose of the present study was to investigate the concept of critical thinking in historical retrospect, its practical significance for the modern world, and the challenges posed to humans by the development of artificial intelligence. The study discussed the development of technology and the related interest in artificial intelligence. However, human thinking and the individual facing the challenges posed by the rapid development of information technology deserve increasing attention. Based on current findings in this area, it was generalised that critical thinking is emerging as one of the principal skills of the 21<sup>st</sup> century, along with communication skills and creative thinking. Although many people are aware of the value of critical thinking, its popularisation requires more effort. This study analysed the significance of critical thinking and its practical usefulness in helping to improve human thinking. The historical and philosophical processes of forming human thinking, as well as methods of improving it, were also explored. However, this problem should also be considered in the context of modern technology development, including artificial intelligence. Such theoretical methods as generalisation, analysis and synthesis were employed to study the concepts of critical thinking and artificial intelligence. This revealed the potential for interaction between the two fields, which could improve human thinking. This is useful for schoolchildren, students and graduate students, as well as anyone who wants to counteract the manipulative practices of modern times. Overall, artificial intelligence can harm the development of human thinking, but if it is used in conjunction with critical thinking, such cooperation can yield a good productive result that would lead to human success in the rapidly developing world of nanotechnology

**Keywords:** knowledge; logical thinking; AI; nature of consciousness; human consciousness; transformational processes; postmodern science

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## Introduction

The 21<sup>st</sup> century has seen a rapid development in the field of technology and artificial intelligence. Artificial intelligence is gradually penetrating all areas of people's lives at different levels, such as self-service in stores, online shopping, smart homes, the medical field, and now even the psychological sphere, where one can find a friend with artificial intelligence and easily communicate with them via smartphone. Some studies by modern scientists reveal certain aspects of this issue. Thus, J. Haber (2020) noted that one factor confirming the tremendous development of AI is AlphaGo, a computer game that defeated the world champion in 2016. The development of artificial intelligence has gone even further, with ChatGPT becoming popular among general users, not just professional IT specialists, since 2007 (Stone-Gross, 2023). From that moment on, interest in artificial intelligence and its applications has been growing. Improvements in artificial intelligence mean that it is now capable of performing highly complex tasks. However, it also poses significant threats to humans, as emphasised by S. Gracová & M. Graca (2024), as well as highlighting the lack of legislative documents to regulate AI development and its potential harm to humanity. It is difficult to give a simple definition of what artificial intelligence is. However, it is worth outlining what is usually meant by this term. Firstly, artificial intelligence was created as a prototype of human thinking with greater capabilities. Unlike the human mind, which can forget information over time, artificial intelligence does not forget anything if it is embedded in the system. A few search operations will generate the required information. Secondly, the inventors of artificial intelligence built a certain rational process into its virtual actions. But, in fact, "artificial intelligence" is a term used to refer to machines (computers) that mimic human cognitive functions, such as learning and problem solving, or can handle complex tasks in the same way as human experts (Spec- tor & Ma, 2019).

Scientists now fear that in a hypothetical future, the development of technology will become uncontrollable, which could lead to dramatic changes in the lives of people and the entire world. This is confirmed by other researchers, such as J. Rudolph *et al.* (2023), who noted that the emergence of advanced technologies often produces violent emotions ranging from doomsday to euphoria. This is why concerns about the dominance of artificial intelligence and its rapid spread into almost all areas of human activity have become so acute. Admittedly, artificial intelligence has already surpassed human thinking in many ways. At least when it comes to storing and remembering large amounts of information, the human brain is certainly capable, but it is in no way comparable to a computer programme. Another challenge posed by artificial intelligence to modern humans is its ability to replace humans in some areas of their usual activities, or even displace them entirely.

Notably, there are several types of artificial intelligence. The simplest types can perform certain actions according to an algorithm. However, there are also strong types of artificial intelligence that are potentially capable of self-development. In such conditions, they can exceed human thinking in almost everything. That is why this issue is extremely relevant and widely discussed in academic circles, as the researchers note some specific features of AI and its interaction with humans, specifically B. Southwell *et al.* (2019), D. Cotton *et al.* (2023), W. Lim *et al.* (2023), and others. In addition, there is a search for counteraction and cooperation between artificial intelligence and human thinking. Critical, logical, analytical, and creative human thinking can facilitate interaction between the two. Therefore, education and self-improvement enable a modern person to develop artificial intelligence and improve human thinking (Zhao *et al.*, 2021). Focusing on critical thinking, M. Rusandi *et al.* (2023) noted that it can enable a person to develop and find harmony in the use of artificial intelligence in education, training, and life. However, artificial intelligence

is developing much faster than human thinking. This should motivate modern people to work on their thinking and constantly improve themselves. The purpose of the present study was to identify opportunities for interaction between artificial intelligence and critical thinking, and to suggest practical ways to develop critical thinking.

### Materials and Methods

The methodology of this study was based on the research of the interaction between human critical thinking and artificial intelligence. In some cases, the two are opposed to each other, while in others they can work together. This topic was studied by summarising and systematising information to define and understand the meaning of both concepts for the modern scientific elite, and to assess their respective significance to a modern person who wants to succeed. Analysis and synthesis were widely applied throughout this study. Analysis involved a detailed examination of scientific information sources, including studies that explored the effects of artificial intelligence on human critical thinking. The study analysed the development of the concept of critical thinking, from Aristotle's early work on systematising logical knowledge to the contributions of modern authors like D. Kahneman & A. Tversky (1979), J. Haber (2023), and others. The analysis of this literature helped to systematise the general skills and abilities that a modern person must have to apply critical thinking in decision-making, as well as the significance of artificial intelligence as an opportunity to improve and help develop critical thinking in a modern person. The issue of challenges posed by artificial intelligence to humans was also considered separately. The synthesis method was employed to combine the results obtained through analysis and design into a single system. This method was also applied to demonstrate the integration of various artificial intelligence capabilities for the development of critical thinking. The available data from various scientific sources were combined in this way, providing a general idea of the potential relationship between critical thinking and artificial intelligence.

Generalisation was employed primarily to formulate the conclusions of this study. Generalisation was also used to identify general patterns of artificial intelligence's impact on critical thinking. In this context, the method of systematisation was also applied to present the principal findings logically and consistently, from the beginnings of human thinking to the possibility of its replacement by artificial intelligence. Systematisation was also employed to organise knowledge on human thinking, the process of its formation, and various aspects of its development and degradation.

A careful selection of literature and scientific sources was carried out, based on a series of criteria, such as relevance, fundamental nature in terms of the historical nature of the formation of concepts, practicality of methods for improving thinking, and the modernity of the study. The material was processed using articles and books that describe modern approaches to the interaction between critical thinking and artificial intelligence, as well as studies on the practical impact of AI on modern humans. The literature search was conducted in various scientometric databases, including Google Scholar, Web of Science, and Scopus. The key concepts used for scientific research were "critical thinking", "artificial intelligence", "consciousness", "logical thinking", "analytical thinking", etc. Popular databases were used to broadly cover scientific sources of information, which were then analysed to explore the theoretical and practical implications of artificial intelligence on human thinking and critical thinking specifically. Holistically applying these methods highlighted the opportunities and problematic aspects of the interaction between critical thinking and artificial intelligence for individuals seeking to succeed in the globalised nanotechnology sector.

### Results and Discussion

#### **Access to information, freedom of choice, and critical thinking as human challenges**

The 21<sup>st</sup> century is characterised by the rapid development of science and technology, as well as by dramatic changes in human values. Modern

society is characterised by a complex, multi-level structure of interaction and influence. This is generally carried out through transformational processes that can be summarised by the concepts of the globalised world, the post-industrial society and the information society. These concepts represent a new type of society that is emerging under the influence of global processes and the social revolution originating from the rapid development of information and communication technologies and artificial intelligence (Upadhyay *et al.*, 2022). Since the time of F. Bacon, possession of knowledge has been an indispensable criterion of intelligence, but access to information was required. Now, unimpeded access to information via the internet ensures this. However, a new challenge for people and society is the ability to work with this information and generalise it to the level of knowledge. Along with easy and simple access to information, a person also receives challenges that they must constantly address.

The postmodern world affects social processes within countries and across the globe, as well as humanity as a whole. Multiculturalism, which is one of the characteristics of modernity, also ensures transformation in human consciousness. Postmodern consciousness aims to deny traditionalism and the norms that existed before, requiring adaptation to new realities. Ethical, aesthetic, and hermeneutical changes, reflected in and influencing attitudes towards moral values, are marked by the levelling of the traditional nature of societies and cultures, authorities and rules, and human behaviour in relation to other people (Galushko & Batmanglich, 2023). Freedom of expression and the rejection of all kinds of norms, rules, and ideals leads to new problems, one of the first being the problem of making choices. Comparing postmodern culture with modernity, it is worth noting that in modernity, people had certain forms of thought and clear norms of behaviour that gave them a certain vector for their actions and decision-making. The global space of postmodern culture gives a person complete freedom of choice but requires the

use of a special tool to plan and implement their intentions in decision-making. Critical thinking is a valuable tool, which is why there is a growing interest in this phenomenon in Ukraine and around the world, in both the humanities and the applied sciences (Butler *et al.*, 2017).

Although the term 'critical thinking' is often attributed to psychology, it actually combines knowledge from a series of disciplines, including philosophy, logic, analytics, and psychology, among others. Critical thinking covers almost all spheres of human activity. Modern researchers of critical thinking, such as K. Larsson (2017), E. August & J. Trostle (2018), O. Pylypenko (2020), and others agree that the processes taking place around a modern person, namely the complexity of social life, the multilevel and multidimensional nature of social processes, the rapid development of artificial intelligence require a person to use the sharpness of their mind, to reach a greater level of intellectual development, which means the use of critical thinking. Understanding the concept of critical thinking is directly related to categories such as 'thinking' and 'criticism', where the idea that thinking is a process through which all human activity is realised is fundamental. Thinking is the most advanced form of human cognition. Through thinking, a person can reach a level higher than sensory cognition. This is why the study of thinking is at the intersection of many sciences. The human thought process is studied by philosophy, logic, neurobiology, psychology, sociology, cybernetics, and many other disciplines, which is why it could be argued that critical thinking is interdisciplinary. Critical thinking is a form of higher-order thinking comprising a variety of components that contribute to rational human thought.

Consider the historical development of this concept and the areas and disciplines that have shaped it. Main proponents of critical thinking, such as J. Dewey (2008), believe that certain skills aid in developing this type of thinking. One such skill is considering a problem from different perspectives. This is why the historical approach to the formation of the concept of "critical thinking"

is worth paying attention to. The intellectual progress of humankind, marked by the flowering of ancient Greek philosophy, laid the foundations for the development of scientific knowledge. This began to shape human thinking, moving it from sensory cognition to a greater level of abstract thought. The key figures in the development of philosophical science at that time were Socrates, Plato, and Aristotle. Each of these thinkers made a valuable contribution to philosophy and the study of human thought. The science of thinking, or logic, was established by Aristotle in ancient times and involves the study of the processes involved in forming concepts, judgements, and conclusions. As the founder of the systematisation of logical knowledge, in which the classification of information is paramount, he proposed methods for organising and analysing logical arguments, determining the truth or falsity of knowledge and much more besides. His work on rhetoric demonstrates how persuasive and argumentative language can influence human thought (Aristotle, 2005).

The long-standing debate between faith and reason during the Middle Ages, the Renaissance and the modern era paved the way for the scientific and technological revolution and the Enlightenment, where independence, science, and rationality played a pivotal role in shaping human thought. This approach gradually developed into the “scientific method”. As J. Haber (2023) observed, “according to this approach, one formulates a question and then proposes an answer, or a “hypothesis”, which one then treats as confirmed while collecting evidence to either support or refute it. Hypotheses that can withstand such scrutiny become “theories” that, while not necessarily true forever or under all conditions, are considered a sufficient foundation for further research”. This approach has become the foundation of modern science, where constructive scepticism is employed to shape and develop human thought based on scientific statements. The critical thinking approach requires analysing answers in terms of rationality, causality, and only then drawing a conclusion.

A person wants to perceive and understand the reality around them. Understanding means defining concepts for oneself, grasping the essence of objects and phenomena, building cause-and-effect relationships, and identifying the crux of the matter. This understanding is only possible through a mental phenomenon that takes place in complex psychological processes and is called thinking. Such processes cannot be determined by sensory cognition alone. With the help of thought, a person can confidently navigate the world around them, applying their previously acquired knowledge, skills, and abilities to particular situations in life, and generalising, systematising and analysing these processes. Human activity is reasonable when it realises and understands the basic logical laws and relationships formed in objective reality.

#### **Human progress and development: Critical thinking and AI**

The essence of human thinking can be defined as an understanding of universal relationships and the generalisation of all processes around a person, as well as an awareness of the impact of particular phenomena on general processes. Thinking can be defined as a reflection of reality that manifests in a material form. Logic, pragmatism, and psychology have all influenced the modern understanding of critical thinking. Pragmatism is the view that all things are determined by practical consequences rather than metaphysical or experiential features. Psychology is the study of how human thinking progresses from simple actions to higher-order realisations. W. James (1890) and C. Peirce (1877) laid the foundations for the ideas and work of J. Dewey (2008) popularised the concept of ‘critical thinking’. The study “How We Think” demonstrated the significance of pragmatism from the standpoint of psychological understanding. “Thinking is a tool by which we dispel doubt, and doubt is a source of inner pain; people will do anything to eliminate it” (Dewey, 2008). In his discussion of thinking, J. Dewey also talks about the significance of a logical approach to thinking. However, he argued

that this is insufficient for drawing conclusions, as it is necessary to collect all the evidence and conduct all the experiments required to either refute or confirm the idea being considered. J. Dewey refers to this type of thinking as 'reflective', defining it in his study as "the active, persistent, and careful consideration of any belief or possible form of knowledge in light of the evidence that supports it and the subsequent conclusions to which it leads" (Dewey, 2008). Over time, other researchers have replaced the term 'reflective' with 'critical' thinking.

When studying the impact of critical thinking on human progress and development, it is worth noting the work of E. Glaser (1941), whose thesis offered a holistic definition of the concept. His formulation included three components: "1) an openness to thoughtful consideration of problems and things within one's personal experience; 2) knowledge of the methods of logical enquiry and reasoning; and 3) some skill in applying these methods". In 1941, E. Glaser and G. Watson first created and published the Watson-Glaser Critical Thinking Test (n.d.). Another practical tool for critical thinking is Bloom's Taxonomy, which classifies actions according to their level of mental complexity (Anderson & Krathwohl, 2001). Starting with the most basic level, it progresses through knowledge, understanding, application, analysis, synthesis, and evaluation, with each subsequent level requiring the completion of all previous stages. Since 1956, the theoretical format has been replaced by a practical one in which it is necessary to apply and demonstrate all of the above concepts. In the 1960s and 1970s, D. Kahneman & A. Tversky (1979) questioned the effectiveness and stability of thinking. They challenged the idea that humans are distinguished from animals solely by reason, arguing that people often act intuitively, at the level of instinct, which proves that reason does not always 'prevail' and has many shortcomings. As J. Haber (2023) noted: "It turns out that the human mind does not apply its full power to every situation, instead taking "shortcuts" to optimise the flow of information from the senses and transform this information into an understanding that guides

decisions". However, critical thinking is a skill that requires the combination and practical application of a variety of other skills, such as deduction, analysis, language and logic, argumentation, the ability to criticise and defend different ideas, the ability to come to factual and strategic conclusions, the ability to make reasonable assumptions, the ability to construct a cause-and-effect system, etc. (Cahill & Bloch-Schulman, 2012). However, over time, the absorption of information evolves into effective thinking, which requires the ability to communicate and compromise successfully. As conventional knowledge becomes increasingly accessible thanks to information technology and the internet, the modern person needs more than just the ability to search for information on a phone or computer; they need the ability to use knowledge effectively and think critically.

At the same time, however, humans face enormous challenges from the global and rapid development of technology, particularly in the field of information technology – namely, artificial intelligence (Chaplinska & Kabanova, 2021). The world itself has not changed; only the technologies have changed, requiring new knowledge and skills from each of us. Modern society faces a dilemma: human thinking and its forms have not changed since Aristotle first defined them, yet the world is undergoing rapid change, especially in technology, where people must constantly adapt. The world of technology gives humanity quick access to information. Thirty to forty years ago, it was unimaginable that any book could be found online without going to the library.

On the other hand, however, modern science is degrading because artificial intelligence can now generate unique texts in minutes or communicate with people instead of psychologists or friends. The latest development in this area is the creation of female robots in China that can replace a real woman. They can be programmed according to preference and look no different from a living person (AI engineer builds..., 2017). Still, such rapid and powerful developments in artificial intelligence provide twenty-first-century people with

information, but not with intelligence (Bontridder & Poulet, 2021). After all, when we define the human mind and thought processes, it is worth noting that artificial intelligence cannot replace humans because humans have something more. However, when it comes to algorithms and programmed actions, artificial intelligence can perform perfectly.

Various European Union countries are developing governmental documents aimed at regulating the use of artificial intelligence (AI) in different areas. One such document is the EU Artificial Intelligence Act, which is the first law to regulate the relations between AI and humans, as well as protect human rights. Humans constantly face various challenges in AI development (EU AI Act, 2023). One of the key tools for humans in this area is critical thinking, which can help counteract the various manipulations that AI can generate and spread to the public, as well as facilitate its successful use for self-development and improvement.

### Conclusions

Thus, when defining the process of developing critical thinking in modern individuals, it must also be recognised that they are greatly influenced by their interaction with information technology resources, especially artificial intelligence. The development of science and technology cannot be stopped, and therefore it is necessary to use them harmoniously to improve the human mind. The best tool for this is critical thinking, which can find compromises to successfully solve problems and find effective solutions. Therefore, it is essential to discuss not only the shortcomings of artificial intelligence, but also how it is used by humans. Notably, the

combination of a highly educated person with critical thinking skills and artificial intelligence could usher in a new era of relations between humans and technology. However, humanity should also be wary of excessive reliance on artificial intelligence, as it can reduce the cognitive load on humans by delegating some of their responsibilities to machines. Nevertheless, this can result in the loss of the ability to think critically, logically, analytically, and creatively. Based on the findings of the present study, it was concluded that, if used wisely, artificial intelligence can enhance a person's capabilities, including critical thinking. However, unconscious use of artificial intelligence can harm a person and limit their mental development. This highlights the need to find ways for human critical thinking and AI to cooperate, allowing both humans and science to develop further. Considering the limitations of this descriptive study, it should be emphasised that the results require further analysis and expansion. Specifically, future research could focus on developing and testing the practical impact of AI on human thinking and on formulating a strategy for facilitating the interaction between critical thinking and AI.

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### Conflict of Interest

The author of this study declares no conflict of interest.

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## Критичне мислення та штучний інтелект: сучасні можливості взаємодії

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**Анотація.** Актуальність статті визначено необхідністю людського мислення орієнтуватися в світі інформаційних технологій, що ставить перед людиною виклики, які пов'язані з обробкою та аналізом інформації, що швидко розповсюджується, але не завжди ця інформація має істинний характер, часто це може бути фейк або маніпуляція. Мета статті полягала в дослідженні поняття «критичне мислення» в історичній ретроспективі, його практичного значення для сучасного світу та викликів, які постають для людини через розвиток штучного інтелекту. У статті було розглянуто питання розвитку технологій та пов'язана з цим цікавість до штучного інтелекту, разом з цим все більшої уваги заслуговує і мислення людини, і сама людина, яка стоїть перед викликами швидкого розвитку інформаційних технологій. Опираючись на сучасні дослідження в цій галузі, було узагальнено, що критичне мислення постає одним з головних навичок XXI століття, разом з комунікативними навичками та креативним мисленням. Хоча велика кількість людей і усвідомлює важливість критичного мислення, проте його популяризація потребує більших зусиль. У статті проаналізовано важливість критичного мислення та його практична корисність, що допомагає вдосконалюватися людському мисленню. Було також досліджено історико-філософські процеси формування мислення людини, а також методи його вдосконалення. Проте варто розглядати цю проблему і в контексті сучасного розвитку технологій, зокрема і штучного інтелекту. Саме тому були використані такі теоретичні методи, як узагальнення, аналіз та синтез для дослідження понять «критичне мислення» та «штучний інтелект», що дало змогу побачити можливості їх взаємодії на шляху до вдосконалення людського мислення, що є корисним як для дітей шкільного віку, так і для студентів, аспірантів та загалом для людей, що хочуть протидіяти маніпулятивним практикам сучасності. Загалом штучний інтелект може зашкодити розвитку людського мислення, але якщо його використовувати в поєднанні з критичним мисленням, то така співпраця може дати хороший продуктивний результат, що призведе до успіху людини у світі нанотехнологій, що швидко розвиваються

**Ключові слова:** знання; логічне мислення; ШІ; природа свідомості; свідомість людини; трансформаційні процеси; постсучасна наука