Artificial Intelligence as A Key Element of Digital Education

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Summary
The article proposes a typology of the goals of using AI systems, corresponding to three key aspects of understanding education (education as a system, education as a process, education as a result) and corresponding to significant trends in the development of education (increasing flexibility and decentralization of the global education system, personalization of the education process, digital fixation of competence-based educational outcomes). The article describes that in relation to the systemic aspect of education, AI technologies will be able to bring education management closer to the use of methods based on a significant amount of qualitative data and contribute to the formation of evidence-based educational policy. It is shown that problems with the interpretation of the decision-making model in administration directly affect the assessment of the effectiveness of artificial intelligence support for managerial decisions in the educational sphere. It is shown that the process of teaching and upbringing can be personalized and individualized with the support of AI through the formation of individual educational programs by format, by content, by the educational environment; methodological support of training courses; increasing the motivation and involvement of students. The transformation of models of interaction between educational subjects is ambiguous in terms of the impact on the autonomy and responsibility of the subjects, on the results of socialization and upbringing, on the labor intensity and transparency of the educational process, including in the light of the prospects for the emergence of "human-AI" systems as a trained agent. In the effective aspect of education, it was revealed that AI is attractive as a tool for monitoring and recording educational achievements and expended resources, capable of clarifying the links between educational activities and results.

Key words:
artificial intelligence, methods of system analysis, education, productivity, progress, technology, smart devices, digital literacy.

1. Introduction

Different meanings are put into the concept of "artificial intelligence" - from the recognition of intelligence in computers that solve logical or even any computational problems, to referring to intellectual only those systems that solve the entire complex of tasks carried out by a person, or an even wider set of them. We will try to isolate the meaning of the concept of "artificial intelligence", which is most consistent with real research in this area.

As noted, in research on artificial intelligence, scientists are distracted from the similarity of processes occurring in a technical system or in programs implemented by it, with human thinking. If a system solves problems that a person usually solves through his intellect, then we are dealing with an artificial intelligence system.

However, this limitation is insufficient. The creation of traditional computer programs - the work of a programmer - is not the construction of artificial intelligence. What tasks, solved by technical systems, can be considered as constituting artificial intelligence?

To answer this question, one must first of all understand what a task is. As psychologists note, this term is also not sufficiently definite. Apparently, as a starting point, one can accept the understanding of a task as a mental task that exists in psychology. They emphasize that the task is only when there is work for thinking, that is, when there is a certain goal, and the means to achieve it are not clear; they must be found through thinking. D. Polya said well about this: "... the difficulty of solving to some extent is part of the self-concept of the problem: where there is no difficulty,

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there is no problem either". If a person has an obvious means by which a desire can probably be fulfilled, he explains, then the problem does not arise. If a person possesses an algorithm for solving a certain problem and has the physical ability to implement it, then the problem in its proper sense no longer exists [1-3].

The task understood in this way is essentially identical to the problem situation, and it is solved by transforming the latter. Its solution involves not only the conditions that are directly specified. A person uses any information in his memory, a "model of the world" available in his psyche and including the fixation of various laws, connections, relations of this world.

If the task is not mental, then it is solved on a computer using traditional methods and, therefore, is not included in the range of tasks of artificial intelligence. Its intellectual part is made by man. The machine is left with a part of the work that does not require the participation of thinking, that is, "thoughtless", non-intellectual.

The word "machine" here means a machine together with its aggregate mathematical support, which includes not only programs, but also the "models of the world" necessary for solving problems. The lack of this understanding is mainly its anthropomorphism. It is advisable to define the tasks solved by artificial intelligence in such a way that a person, at least in the definition, is absent. When characterizing thinking, we noted that its main function is to develop schemes of expedient external actions in infinitely varying conditions. The specificity of human thinking (in contrast to the rational activity of animals) is that a person develops and accumulates knowledge, storing it in his memory. The development of schemes of external actions does not take place according to the "stimulus-response" principle, but on the basis of knowledge obtained additionally from the environment, for the behavior in which the scheme of action is developed.

This way of developing schemes of external actions (and not just actions according to commands, even if they change as a function of time or as uniquely defined functions of the results of previous steps), in our opinion, is an essential characteristic of any intelligence. It follows that artificial intelligence systems include those that, using the rules for information processing inherent in them, develop new schemes of expedient actions based on the analysis of environmental models stored in their memory. The ability to rearrange these models themselves in accordance with newly received information is evidence of a higher level of artificial intelligence [4-6].

Most researchers believe that technical systems have their own internal model of the world as a prerequisite for their "intelligence". The formation of such a model, as we will show below, is associated with overcoming the syntactic one-sidedness of the system, i.e. with the fact that the symbols or that part of them, which the system operates, are interpreted, have semantics.

Characterizing the features of artificial intelligence systems, points out: 1) the presence in them of their own internal model of the external world; this model provides individuality, relative independence of the system in assessing the situation, the possibility of semantic and pragmatic interpretation of requests to the system; 2) the ability to replenish existing knowledge; 3) the ability to deductive conclusion, i.e. to the generation of information that is not explicitly contained in the system; this quality allows the system to construct an information structure with new semantics and practical orientation; 4) the ability to operate in situations related to various aspects of fuzziness, including "understanding" of natural language; 5) the ability to interact with a person in a dialogue; 6) the ability to adapt [1-3].

When asked whether all of the above conditions are mandatory, necessary for the recognition of an intellectual system, scientists answer in different ways. In real studies, as a rule, it is considered absolutely necessary to have an internal model of the external world, and at the same time it is considered sufficient to fulfill at least one of the conditions listed above.

P. Armer put forward the idea of a "continuum of intelligence": different systems can be compared not only as having and not having intelligence, but also according to the degree of its development. At the same time, he believes, it is desirable to develop a scale of the level of intelligence, taking into account the degree of development of each of its necessary features. It is known that at one time A. Turing proposed a "game of imitation" as a criterion for determining whether a machine can think. According to this criterion, a machine can be recognized as thinking if a person, conducting a dialogue with it on a sufficiently wide range of questions, cannot distinguish its answers from those of a person.

The Turing criterion in the literature has been criticized from various points of view. In our opinion, a really serious argument against this criterion lies in the fact that in Turing's approach the sign of identity is put between the ability to think and the ability to solve problems of processing information of a certain type. A successful "game of imitation" cannot be recognized as a criterion of its ability to think without a preliminary thorough analysis of thinking as a whole.

However, this argument misses the mark if we are not talking about a thinking machine, but about artificial intelligence, which should only produce physical bodies of signs, interpreted by humans as solutions to certain problems. Arguing that it is most natural, following Turing, to consider that some device created by man is artificial intelligence, if, after conducting a sufficiently long dialogue with him on a more or less wide range of issues, a person cannot distinguish, he talks with an intelligent living being or with an automatic device. If we take into account the possibility of developing programs specially designed to mislead a person, then perhaps we should talk not just about a person, but about a specially trained expert. This criterion, in our opinion, does not contradict the features of the artificial intelligence system listed above.

But what does it mean for "a fairly wide range of issues", which is referred to in the Turing criterion and in the statement. At the initial stages of the development of the problem of artificial intelligence, a number of researchers, especially those engaged in heuristic programming, set the task of creating an intelligence that successfully functions in any field of activity. This can be called the development of "general intelligence". Now most of the work is aimed at creating "professional artificial intelligence", that is, systems that solve intellectual problems from a relatively limited area (for example, port control, function integration, proof of geometry theorems, etc.). In these cases, "a fairly wide range of issues" should be understood as the relevant subject area.

The starting point of our reasoning about artificial intelligence was the definition of such a system as solving mental problems. But tasks are also set before her that people usually do not consider intellectual, since when solving them, a person does not consciously resort to restructuring problem situations. These include, for example, the task of recognizing visual images. A person recognizes a person whom he saw once or twice, directly in the process of sensory perception. Based on this, it seems that this task is not intellectual. But in the process of recognition, a person does not solve mental problems only insofar as the recognition program is not in the sphere of the conscious. But since the model of the environment stored in memory participates in solving such problems at an unconscious level, these tasks are essentially intellectual. Accordingly, the system that solves it can be considered intellectual. Moreover, this refers to the "understanding" of phrases in natural language by the machine, although a person does not usually see this as a problematic situation.

The theory of artificial intelligence encounters epistemological problems in solving many problems.

One of these problems is to clarify the question whether the possibility or impossibility of artificial intelligence is theoretically (mathematically) provable. There are two points of view on this score. Some consider it mathematically proven that a computer, in principle, can perform any function performed by natural intelligence. Others believe, as mathematically proven, that there are problems that can be solved by the human intellect that are fundamentally inaccessible to computers. These views are expressed by both cyberneticists and philosophers.

2. Theoretical Consideration

The epistemological analysis of the problem of artificial intelligence reveals the role of such cognitive tools as categories, a specific semiotic system, logical structures, and previously accumulated knowledge. They are revealed not through the study of physiological or psychological mechanisms of the cognitive process, but are revealed in knowledge, in its linguistic expression. The tools of cognition, which are ultimately formed on the basis of practical activity, are necessary for any system that performs the functions of abstract thinking, regardless of its specific material substrate and structure. Therefore, in order to create a system that performs the functions of abstract thinking, that is, ultimately forms adequate schemes of external actions in significantly changing environments, it is necessary to endow such a system with these tools.

The development of artificial intelligence systems over the past decades has followed this path. However, the degree of progress in this direction with respect to each of the indicated cognitive tools is not the same and, on the whole, is still insignificant.

1. To the greatest extent, artificial intelligence systems use formal-logical structures, which is due to their non-specificity for thinking and, in essence, algorithmic nature. This enables their relatively easy technical implementation. However, even here cybernetics has a long way to go. In artificial intelligence systems, modal, imperative, question and other logics are still poorly used, which function in human intelligence and are no less necessary for successful cognitive processes than the forms of inference that have long been mastered by logic and then by cybernetics. An increase in the "intellectual" level of technical systems is undoubtedly associated not only with the expansion of the logical means used, but also with their more intensive use (for checking information for consistency, constructing computation plans, etc.).

2. The situation is much more complicated with semiotic systems, without which intelligence is impossible. The languages used in computers are still far from the semiotic structures with which thinking operates.

First of all, to solve a number of problems, it is necessary to consistently approximate the semiotic systems with which computers are endowed with natural language, more precisely, with the use of its limited fragments. In this regard, attempts are being made to endow the input computer languages with language universals, for example, polysemy (which is eliminated when processed in a linguistic processor). The problem-oriented fragments of natural languages have been developed, which are sufficient for solving a number of practical problems by the system. The most important result of this work is the creation of semantic languages (and their formalization), in which word-symbols have interpretation.

However, many universals of natural languages, necessary for them to perform cognitive functions, are still poorly implemented in artificial intelligence languages (for example, openness) or are used to a limited extent (for example, polysemy). The increasing incarnation in semiotic systems of the universals of natural language, conditioned by its cognitive function, is one of the most important lines of improving artificial intelligence systems, especially those in which the problem area is not rigidly defined in advance.

Modern artificial intelligence systems are capable of translating from one-dimensional languages to multidimensional ones. In particular, they can build diagrams, diagrams, drawings, graphs, display curves on screens, etc. The computers also produce reverse translation (describe graphs and the like using symbols). This kind of translation is an essential element of intellectual activity. But modern artificial intelligence systems are not yet capable of direct (without translation into symbolic language) use of images or perceived scenes for “intellectual” actions. The search for ways to operate globally (rather than locally) with information is one of the most important promising tasks of the theory of artificial intelligence.

3. The embodiment of analogs of categories into information arrays and programs of artificial intelligence systems is still in the initial stage. Analogs of some categories (for example, "whole", "part", "general", "individual") are used in a number of knowledge representation systems, in particular as "basic relations", insofar as it is necessary for certain specific subject or problem areas with which systems interact.

In the formalized conceptual apparatus of some knowledge representation systems, separate (theoretically significant and practically important) attempts have been made to express some aspects of the content and other categories (for example, "cause", "effect"). However, a number of categories (for example, “essence”, “phenomenon”) are absent in the languages of knowledge representation systems. The problem as a whole has not yet been fully understood by the developers of artificial intelligence systems, and there is still a lot of work for philosophers, logicians and cybernetics to implement analogs of categories in knowledge representation systems and other components of intelligent systems. This is one of the promising directions in the development of the theory and practice of cybernetics.

4. Modern artificial intelligence systems almost do not imitate the complex hierarchical structure of the image, which does not allow them to rebuild problem situations, combine local parts of knowledge networks into blocks, rebuild these blocks, etc.

The interaction of the newly arriving information with the aggregate knowledge fixed in the systems is not perfect either. In semantic networks and frames, methods are still insufficiently used, thanks to which human intelligence is easily replenished with new information, finds the necessary data, rebuilds its knowledge system, etc.

5. Even to a lesser extent, modern artificial intelligence systems are able to actively influence the external environment, without which they cannot; self-education and, in general, the improvement of "intellectual" activities.

Thus, although certain steps towards the embodiment of the epistemological characteristics of thinking in modern systems of artificial intelligence have been made, on the whole, these systems are still far from possessing the complex of epistemological tools that a person has and which are necessary to perform a set of functions of abstract thinking. The more the characteristics of artificial intelligence systems will be close to the epistemological characteristics of human thinking, the closer their “intelligence” will be to human intelligence, more precisely, the higher their ability to combine symbolic structures perceived and interpreted by a person as a solution to problems and generally the embodiment of thoughts will be.

This raises a difficult question. When analyzing the cognitive process, epistemology abstracts from the psychophysiological mechanisms through which this process is realized. But it does not follow from this that these mechanisms are irrelevant for the construction of artificial intelligence systems. Generally speaking, it is possible that the mechanisms necessary to implement the inherent characteristics of an intelligent system cannot be implemented in digital machines or even in any technical system that includes only components of an inorganic nature. In other words, in principle it is possible that although we can cognize all the epistemological laws that ensure the fulfillment of a person's cognitive function, their totality is realizable only in a system that is substratum identical to a person [3,4, 6-8].

“The bodily organization of a person, - he writes, - allows him to perform ... functions for which there are no machine programs - those not only have not yet been created, but do not even exist in the project. These functions are included in the general ability of a person to acquire bodily skills and abilities. Thanks to this fundamental ability, the subject endowed with a body can exist in the world around him, without trying to solve the impossible task of formalizing everything and everyone ”.

Emphasizing the importance of "bodily organization" for understanding the characteristics of mental processes, in particular the ability to perceive, deserves attention. Qualitative differences in the ability of specific systems to reflect the world are closely related to their structure, which, although it has relative independence, cannot overcome some of the framework set by the substrate. In the process of biological evolution, the improvement of the property of reflection took place on the basis of the complication of the nervous system, that is, the substrate of reflection. It is also possible that the difference between the substrates of computers and humans can cause fundamental differences in their ability to reflect, that a number of functions of human intelligence are in principle inaccessible to such machines [3, 9-11].

Sometimes in the philosophical literature it is argued that the assumption of the possibility of a technical system performing the intellectual functions of a person means reducing the higher (biological and social) to the lower (to systems of inorganic components) and, therefore, contradicts materialistic dialectics. However, this reasoning does not take into account that the ways of complication of matter are not unambiguously predetermined and it is possible that society has the ability to create from inorganic components (abstractly speaking, bypassing the chemical form of motion) systems no less complex and no less capable of reflection than biological ones. The systems created in this way would be components of society, a social form of movement. Consequently, the question of the possibility of transferring intellectual functions to technical systems, and in particular of the possibility of endowing them with the epistemological tools considered in this work, cannot be solved only on the basis of philosophical considerations. It should be analyzed on the basis of specific scientific research.

The computer operates with information that does not matter, meaning. Therefore, a computer requires an enumeration of a huge number of options. The bodily organization of a person, his body allows us to distinguish what is meaningful from what is insignificant for life and to search only in the sphere of the former. For a "non-corporeal" computer, Dreyfus argues, this is not available. Of course, a particular type of body organization allows a person to limit the space of possible search. This happens already at the level of the analyzer system. The situation is quite different in computers. When a general task is posed in cybernetics, for example, the recognition of images, this task is transferred from a sensually visual level to an abstract one. This removes the limitations that are not realized by a person, but contained in his "body", in the structure of the sense organs and the body as a whole. They are ignored by computers. Therefore, the search space increases dramatically. This means that higher requirements are imposed on the "intellect" of computers (search in a wider space) than on the intellect of a person, to which the inflow of information is limited by the physiological structure of his body.

Systems with a psyche differ from computers primarily in that they have biological needs due to their material, biochemical substrate. The external world is reflected through the prism of these needs, in which the activity of the mental system is expressed. The computer does not have needs organically related to its substrate, for it, as such, information is insignificant, indifferent. Genetically assigned significance to humans has two types of consequences. The first circle of search is shortened, and thus the solution of the problem is facilitated. The second is that the fundamental needs of the organism, which are not erased from memory, determine the one-sidedness of the mental system. Dreyfus writes in this connection: “If a Martian found himself on Earth, he would probably have to act in a completely unfamiliar environment; the task of sorting the relevant and irrelevant, essential and inessential, which would arise before him, would be as insoluble for him as for a digital machine, unless, of course, he is able to take into account any human aspirations. " One cannot agree with this. If a “Martian” has a different biology than a man, then he also has a different fundamental layer of inalienable needs, and it is much more difficult for him to accept “human aspirations” than a computer, which can be programmed for any purpose [2,6-8].

An animal, in principle, cannot be reprogrammed in relation to this fundamental layer, although for some purposes it can be programmed again through training. In this (but only in this) sense, the potential intellectual capabilities of a machine are broader than those of animals. In humans, social needs are built on top of the fundamental layer of biological needs, and information for him is not only biologically, but also socially significant. Man is universal both from the point of view of needs and from the point of view of the possibilities of their satisfaction. However, this universality is inherent in him as a social being that produces means of purposeful activity, including artificial intelligence systems.

Thus, bodily organization not only provides additional opportunities, but also creates additional difficulties. Therefore, it is important for a person's intellect to be armed with systems that are free from his own bodily and other needs and preferences. Of course, it is unreasonable to demand from such systems that they independently recognize images, classify them according to the characteristics by which a person does it. They need to set goals explicitly.

At the same time, it should be noted that technical systems can have an analogue of a bodily organization. A developed cybernetic system has receptor and effector appendages. The development of such systems was initiated by integral industrial robots, in which a computer mainly performs the function of memory. In robots of the third generation, computers also perform “intellectual” functions. Their interaction with the world is designed to improve their "intelligence". Robots of this kind have a “bodily organization”, the design of their receptors and effectors contains certain restrictions that reduce the space in which, abstractly speaking, a digital machine could search [1,11].

Nevertheless, the improvement of artificial intelligence systems based on digital machines may have boundaries, due to which the transition to the solution of intellectual tasks of a higher order, which requires taking into account the global nature of information processing and a number of other epistemological characteristics of thinking, is impossible on discrete machines with an arbitrarily perfect program. ... This means that the technical (and not only biological) evolution of reflecting systems turns out to be associated with a change in the material substrate and design of these systems. Such evolution, i.e., hardware improvement of artificial intelligence systems, for example, through more intensive use of analog components, hybrid systems, holography and a number of other ideas, will take place. This does not exclude the use of physical processes in the brain, and those that the psyche does not use as its mechanisms. Along with this, the possibilities of improving artificial intelligence systems by using the epistemological characteristics of thinking, which were discussed above, in the functioning of digital machines, are still far from exhausted.

Conclusions

The development of information technology has made it possible to compensate a person for the psychophysiological limitations of his body in a number of directions. The "external nervous system" created and expanded by man has already enabled him to develop theories, discover quantitative laws, and push the limits of cognition of complex systems. Artificial intelligence and its improvement turn the boundaries of complexity available to humans into systematically expandable ones. This is especially important in the modern era, when society cannot develop successfully without rational management of complex and super-complex systems. The development of artificial intelligence problems is a significant contribution to the human's awareness of the laws of the external and internal world, to their use in the interests of society and thereby to the development of human freedom.

Now, with all of the above, we can return to discussing the problem of the relationship between social being and social consciousness. In developed and developing countries, it is growing rapidly the number of specialists receiving modern higher education using achievements in the field of AI, used in the practice of teaching various scientific disciplines. The social consciousness enriched in this way intensively affects all segments of social life, and it would not be an exaggeration to say that the determining role of social consciousness in the functioning and development of modern society is constantly increasing. Achievements in the field of AI play an important role here, on which modern educational technologies and methods of polydisciplinary education are built and improved.

So, while positively assessing the very fact of the expanding application of AI achievements in the systems of modern higher education, I at the same time consider it very significant development of timely measures to prevent any possibility of negative consequences of this process.

References

[1] Spitzer, M. (2012). Digitale Demenz. Wie wir uns und unsere Kinder um den Verstand bringen. München: Droemer.

[2] Grant W. Pressure Groups, Polities and Democracy in Britain. Homel Hempstead, Harvester Wheatsheaf, 2011, 230 p.

[3] Barratt, J. (2013). Our Final Invention: Artificial Intelligence and the End of the Human Era. New York: Thomas Dunne Books St. Martin's Press. Pp. 271-274.

[4] Engels, F., Marx K. [Critique of Political Economy]. In: Marx, K., Engels, F. Sochineniya [Collection of Works]. Vol. 13, Moscow, 1956. P. 491.

[5] A. Syrotenko, O. Sotnikov M. Iasechko, V. Larin, S.Iasechko O. Ochkurenko, and A. Volkov. Model of Combined Solid Plasma Material for the Protection of Radio-Electronic Means of Optical and Radio Radiation, IJATCSE, 8(4), 2019, pp. 1241 — 1247. doi:10.30534/ijatcse/2019/33842019.

[6] O. Turinskyi, M. Burdin, M. Iasechko, V. Larin, Y. Gnusov, D. Ikaev, V. Borysenko, and V. Manoylo. Protection of board radioelectronic equipment from the destructive powerful electromagnetic radiation with the use of natural technologies, IJETER, 7(11), 2019, pp. 542 — 548. doi: 10.30534/ijeter/2019/2371120 19.

[7] M.Iasechko, Y. Gnusov, I. Manzhai, O. Uhrovetskyi, V.Manoylo, A. Iesipov,O. Zaitsev, M. Volk, and O. Vovk. Determination of requirements for the protection of radio-electronicequipment from the terroristic influence by electromagnetic radiation, IJETER, 7(12), 2019, pp. 772 - 777. doi: 10.30534/ijeter/2019/077122019.

[8] McMillan R. Man Builds Twitter Bot That Humans Actually Like. Wired. URL: wired.com/2012/06/twitter_arm/

[9] Ktepi B. Deception in political social media // ed. K. Harvey. Encyclopedia of social media and politic. Vol. 4. Thousand Oaks, CA: SAGE Publications. P. 357-359.

[10] Kotler P., Lee N. Corporate social responsibility: Doing the most good for your company and your cause. Hoboken, New Jersey: John Wiley & Sons, Inc., 2005.

[11] Rampton S ., Stauber . J . Trust us! We're experts: How industry manipulates science and gambles with your future . Tarcher. 2002.