Articles

AI literacy: concepts, approaches and open questions

Michal Černý

Abstract

The study presents a basic conceptualisation of AI literacy as a new form of literacy related to the development of artificial intelligence systems and their impact on education and the labour market. The study identifies the meaning and purpose of this new competency and the approaches to it found in the literature. The final discussion highlights open questions and issues that should be the subject of further research investigation.

Keywords: AI literacy, Artificial Intelligence Literacy, AI; digital competence, competency, Turing test.

Gramotnost pro umělou inteligenci: koncepty, přístupy a otevřené otázky

Abstrakt

Studie přestavuje základní pojetí konceptualizace pojmu AI gramotnost, jako nové formy gramotnosti, která souvisí s rozvojem systémů s umělou inteligencí a jejich dopadem na vzdělávání i pracovní trh. Studie identifikuje význam a smysl této nové kompetence a přístupy k ní, které se vyskytují v literatuře. V závěrečné diskusi poukazuje na otevřené otázky a problémy které by měly být předmětem dalšího výzkumného zkoumání.

Klíčová slova: umělá inteligence (AI), AI gramotnost/gramotnost pro umělou inteligenci, kompetence, digitální kompetence, Turingův test.

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Introduction

Artificial Intelligence is not a new phenomenon. Its development as a computer science discipline can be discussed since the turn of the 1950s and 1960s. In literature and culture, it can be associated with Čapek's novel RUR and especially with the novels of Asimov. In 1997, Deep Blue defeated Kasparov (Newborn, 2012) in a chess game, opening a new phase of reflection on the possibilities of artificial intelligence in competition with humans. In 2011 the Watson (Ferrucci et al., 20213) system won Jeopardy! In 2016, the AlphaGo artificial neural network system (Li & Du, 2018) succeeded in Go over Sedol. Again, this run was groundbreaking because its game strategies were unlike those that humans have played with. It demonstrated that AI systems can indeed learn and be – in some ways – creative.

The level of creativity has become the focus of the next revolution related to the use of AI systems. Midjourney, Dalle-2 or Stable Diffusion have fundamentally changed the view of creativity in artificial systems in the second half of 2022 (McCormack et al., 2023; Hunt, 2023). They were able to generate images at a quality higher than the average human is capable of, based on text input in an environment that was easily accessible to the user. ChatGPT 3 (later 3.5 and 4) in early 2023 made it possible to have a dialogue with a computer based on working with an extensive over-trained neural network in a way that reasonably naturally raised questions about the future of work and the possibilities of human creativity (Baidoo-Anu & Owusu Ansah, 2023; Kasneci et al., 2023). His answers were only partially reliable, but they fundamentally revolutionised the fluidity of dialogue.

These are not the only applications of artificial intelligence we encounter. In the field of machine translation, artificial neural networks are used in tools such as DeepL or Google Translator (Rescigno et al., 2020), grammar can be corrected in Grammarly, and Google search is built on AI in the same way as recommended videos on YouTube (Bridle, 2018). AI has become a technology that is ubiquitous and increasingly poses a significant challenge to education.

Artificial intelligence could be understood in the 1950s as a theory of human intelligence that machines can manifest, but it is currently challenging to define (Bini, 2018). The relationship between artificial intelligence as a form of thinking and human thinking has been addressed by Bostrom (1998, 2016) and the authors responding to

him (Katritsis, 2018; Baum, 2018). In a narrow sense, it is the technical implementation of a non-deterministic algorithm solving a specific problem (narrow AI).

Artificial intelligence can be considered an overarching concept of machine learning (Helm et al., 2020). Dobrev (2012, p. 2) boldly asserts that "artificial intelligence will be a program that performs no worse than a human in any world". Turing's approach (Elkins & Chun, 2020) similarly envisages that an intelligent system is one that we cannot distinguish from a human in dialogue (Danziger, 2022; Alberts, 2022). Speech and linguistic communication are crucial to this school. Still, at the same time, we can see a large number of applications of AI in language – in medicine (Haug & Drazen, 2023), art (Civit et al., 2022), biology (Kolluri et al., 2022), and fields in which AI work has precise results while not being dialogical or speech act in nature.

In our study, we recognise the limitations of these definitions, which always work only with a specific aspect of human activity, and we will understand artificial intelligence as a non-deterministic algorithm that uses machine learning to solve a specific set of problems. Artificial intelligence in this conception is not an entity (Bostrom, 1998) but a part of software products that can be used by humans in different areas of human activity – at work (Pallathadka et al., 2023; Ahmad et al., 2022), in entertainment (Qi & Lyu, 2022) and education (Zafari et al., 2022). As such, it brings a range of benefits and opportunities, transforming the labour market (Aghion et al., 2019; Webb, 2019) while also posing many threats and ethical challenges (Bridle, 2018; Bel, 2021; Salvagno et al., 2023; Nguyen et al., 2023).

Sokol (2016), when defining the purpose of school, talks, among other things, about the role of school which is to teach students to deal with situations that are not manageable intuitively, to equip them with knowledge, skills, attitudes and other intellectual tools to be able to cope and understand the changing world. Similarly, the European Framework of Digital Competences for Citizens refers to digital competencies as tools that enable learning, civic engagement, entertainment and labour market participation in the digital age. Zlatuška (1998), in his description of the information society, states, *"The substantial use of digital processing, storage and transmission of information characterises the information society. Information processing is becoming a significant economic activity that both permeates traditional economic or social activities and creates entirely new opportunities and activities that significantly affect the nature of society."* These transformative processes are increasingly linked to artificial intelligence, which employees, students and guarantors will need to be able to use.

Therefore, a concept called "AI literacy" or "artificial intelligence literacy" is gradually shaping the educational grasp of this phenomenon. Although it is not yet reflected in the Czech environment, it already appears in some critical international documents (Adams, 2023) – World Economic Forum (2019); United Nations Educational, Scientific and Cultural Organization (Miao et al., 2021) or United Nations Children's Fund (Unicef, 2021). This study will aim to provide a basic conceptualisation of this phenomenon.

Since 2016, there has been a gradual formation of basic concepts. After 2019, we can see a rapid and dynamic increase in the number of scientific studies addressing AI literacy.

The term AI literacy itself (Ng et al., 2022) could be misleading in that we could relate it to the literacy possessed by AI systems. However, it refers in the literature to the people who are supposed to work with AI. AI literacy can therefore be seen as one form of new literacy (Ng et al., 2022; Molnár et al., 2022) that respond to the changing environment in which learners must navigate (Southworth et al., 2023; Baker et al., 2015).

1 Critical approaches to AI literacy

In the literature, one can encounter several basic ways in which AI literacy is conceptualised or theoretically framed in sub-studies. Kandlhofer et al. (2016) or Wienrich and Carolus (2021) emphasise the role of AI conceptualisation as a starting point for the whole notion of literacy. A good understanding of how AI works – from the technical design to the ways of constructing datasets and working with data – is fundamental. They start from the belief that understanding the fundamentals and theories allows the topic to be critically reflected upon and developed further.

Julie et al. (2020) and Leichtmann et al. (2023) focus considerably more on the ability to use sub-tools. AI literacy means having the ability to use the selected tools to solve problems. In their study, Chan et al. (2023) conceptualise AI literacy in the context of the ability to make optimal use of appropriate tools. Thus, the goal is to equip students or employees to work with the selected tools. Within this discourse, one can also include the study by Laupichler et al. (2022), who understand AI literacy as the ability to use available medical tools in practice.

Other approaches focus on the ability and willingness to program, design and develop tools that work with A.I. Chan et al. (2022) build a unique university course to develop this skill. Similarly, Kaspersen et al. (2022) focus on machine learning education to develop AI literacy, and similar approaches can be seen in Rodríguez-García et al. (2020) or How and Hung (2019).

Many studies focus on the ethical aspects of working with A.I. Fyfe (2022) points out that classical notions of ethical concepts that could be intuitive about generative AI do not work and need to be recaptured and reflected upon through systematic education. Jang et al. (2022) also include ethics among the core dimensions of AI literacy. Chai et al. (2020) discuss the relationship between AI and the common good as a goal of literacy-oriented education. Kaspersen et al. (2022) emphasise the social and individual reflection of working with AI systems.

These four domains are used to conceptualise AI literacy by Ng et al. (2021; 2021b), who articulate all other studies through the lens of these four domains. These authors have been highly influential in the conceptualisation, and school-based grasp of the

AI literacy phenomenon, and their articulation has substantially impacted all research practice. Another significant number of studies refer to Long and Magerko's (2020) definition, according to which AI literacy encompasses "a set of competencies that enable individuals to critically evaluate AI technologies, communicate and collaborate effectively with AI, and use AI as a tool online, at home, and in the workplace."

However, some studies fall outside these divisions. Eguchi et al. (2021) emphasise AI literacy in the context of the cultural specifics of the target group. Content and examples are always dependent on cultural realities, the reflection of which should play a crucial role in practical educational design. Yi (2021) argues that two essential characteristics should be associated with AI literacy. First, metacognition is related to the ability to set meaningful goals in a complex world; he points out that simple knowledge of rules, procedures or concepts is of only practical use if coupled with highly developed metacognitive skills. The second aspect he mentions is the ability to orient oneself towards the future, to anticipate it (in part) and to choose appropriate tools and procedures in light of it.

Other authors have pointed out that a critical aspect of AI literacy is the ability to interact with technology (Cetindamar et al., 2022) or that the very notion of AI literacy is complicated in that it is too broad – Carolus et al. (2023) write about specific skills and approaches to working with AI systems through voice interfaces, and Wienrich and Carolus (2021) take a similar stance. Chan and Lin (2023) argue that AI literacy must have five core characteristics; the learner must engage with technology purposefully, optimally, wisely (reflectively), ethically and responsibly about AI.

At the same time, it is evident from the above approaches that some authors' concepts overlap or fall into more than one area.

Discussion and conclusion

Henry et al. (2021) point out that while AI literacy is an essential component of the competency profile, we also need teachers to be prepared for it if we want to develop this area in students. Ng et al. (2023b) systematically examine how teachers approach this topic. A systematic look at the literature shows that this is a topic associated with many experimental or pilot studies, on the one hand, and represents a systematically researched area of education.

Our study shows a muscular tension between two fundamental conceptions of AI literacy. On the one hand, there is an emphasis on conceptualisation and understanding of deeper contexts. These authors emphasise that understanding the principles gives humans a particular perspective, freedom, and power over technological solutions. Sometimes, the actual design of AI systems or their programming follows this conception.

On the other hand, there is a more skill-oriented conception – that is, an attempt to create a conception of AI literacy that will lead to a person being able to select the appropriate tool and work with it effectively (DePietro, 2013; Israel & Nsibirwa, 2018). The reasoning for this conception can have two basic levels. The first will lean towards pragmatism, emphasising that thinking and acting form an integrated whole (Šíp, 2019) that cannot be separated. At the same time, experience will be emphasised as the fundamental structure of thinking underpinning AI literacy. A second line of argumentation could be (and we did not find it in the literature) a way of emphasising that we need to understand most of the technology in our world, but we can still use it meaningfully. Perhaps just the opposite – the ability to use a smartphone effectively is more likely to be possessed by a manager or secretary than a software engineer.

A specific open question is the position of AI literacy in the structure of competencies. Some authors associate it with information literacy because the focus is on how data and information are processed, evaluated, organised, and structured. It is common to include it among digital competencies. However, there are authors who, on the contrary, point out that AI literacy is too general a concept and that different practical applications contain fundamentally differentiated competence clusters.

This study aimed to introduce and conceptualise the topic of AI literacy briefly. We believe that, although it is a relatively new and narrow topic (86 studies with the keywords «AI literacy» or «Artificial Intelligence Literacy» can be found in the SCOPUS database), it will be – considering the impact of this technology on all areas of human life – a topic that will be further systematically developed and researched and will need to be given due attention from all pedagogical perspectives and contexts.

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Contact
RNDr. Michal Černý, Ph.D.
Department of Information and Library Studies
Faculty of Arts, Masaryk University
Arne Nováka 1, 602 00 Brno, Czech Republic,
e-mail: mcerny@phil.muni.cz