

Serie #1 | The Ends of the Humanities Edited by Johannes Pause, Christoph Purschke, Isabell E. Baumann, Till Dembeck & Georg Mein



The Humanities and the Rise of Al

Implications of Cultural and Societal Engineering

Johannes Pause, Christoph Purschke, Isabell Eva Baumann, Till Dembeck & Georg Mein

Why should we teach AI in schools?

Alexander Scheidt André Schmiljun

The Ends of the Humanities - 3 Edited by Isabell Baumann, Till Dembeck, Georg Mein, Johannes Pause and Christoph Purschke



Published in **Melusina Press**, 2025 11, Porte des Sciences L-4366 Esch-sur-Alzette https://www.melusinapress.lu

Management: Niels-Oliver Walkowski, Johannes Pause Copyediting: Carolyn Knaup, Niels-Oliver Walkowski Cover and Layout: Valentin Henning, Erik Seitz

The digital version of this publication is freely available at https://www.melusinapress.lu. The PDF and the master copy are generated with the help of princeXML. Print and Distribution is carried out by BoD - Books on Demand, Norderstedt

Bibliographic information of the National Library of Luxembourg: The National Library of Luxembourg lists this publication in the Luxembourg National Bibliography; detailed bibliographic data are available on the Internet at bnl.public.lu.

978-2-919815-79-1
978-2-919815-80-7
978-2-919815-81-4
10.26298/1981-5791-wswt
10.26298/1981-5791
10.26298/2716-7550
2716-7550

This work is licensed under CC BY-SA 4.0. Information about this license can be found at https://creativecommons.org/licenses/by-sa/4.0/deed.de. The images and resources contained in this work are subject to the same license unless licensed otherwise or taken from another source.



Why should we teach AI in schools?

Alexander Scheidt & André Schmiljun

Introduction

This essay aims to provide a constructive critique of the arguments justifying the inclusion of Artificial Intelligence (AI) in school curricula. Two arguments are commonly advanced in support of teaching AI in schools. The first, which we will call the "future argument," asserts that children should become acquainted with AI concepts today in order to better equip them for future careers. The second, referred to as the "ubiquity argument," states that because AI is increasingly prevalent in everyday life, it is essential for schoolchildren to understand AI concepts and methods.

The motivation for this essay is driven by enthusiasm for both AI and institutions of human learning. While we support the idea of teaching AI in schools, we also believe that both the future and ubiquity arguments are deserving rigorous critique.

Our first point of critical analysis concerns the logical structure of both arguments. Merely stating that "AI is everywhere" (or "AI is the future") does not logically imply that AI should be taught in schools. Our second point addresses the tendency of these arguments to neglect the motivational and pedagogical considerations essential for effective teaching and learning. Techno-ethical considerations form our third point of criticism. We argue that both the future and ubiquity arguments are based on a problematic view of artificial intelligence, one that fails to consider human autonomy, and does not emphasize the unique capabilities of human thought. Ethically, we advocate for prioritizing a broader understanding of human intelligence over a limited technological perspective.

Our argument draws inspiration from Joseph Weizenbaum. In his work, *Computer Power and Human Reason, Weizenbaum* (1976) argues that human autonomy and values must prioritize technology. This perspective is echoed in his comments on the role of computers in schools, where he maintains that educational priorities should align with this prioritization of human values:

"The questioning should start the other way — it should perhaps start with the question of what education is supposed to accomplish in the first place. Then perhaps [one should] state some priorities — it should accomplish this, it should do that, it should do the other thing. Then one might ask, in terms of what it's supposed to do, what are the priorities? What are the most urgent problems? And once one has identified the urgent problems, then one can perhaps say, 'Here is a problem for which the computer seems to be well-suited.'" (Weizenbaum, 1985, p. 2)

Accordingly, before rushing to justify the inclusion of AI in school curricula, it is crucial to first consider the fundamental purpose of education. As educators and policymakers, we should first ask the following questions: What are the objectives of schooling? What should drive the formulation of curriculum goals? Once these questions are answered, we will be better equipped to determine why and how AI should be taught in schools.

Weizenbaum's line of reasoning is central to our critique. We claim that the two most prevalent arguments—the future and ubiquity arguments—frame AI and education solely in instrumental terms. In the instrumental view, AI and schooling are seen merely as means to an end. In this perspective, AI and schooling are valued primarily for their utility in achieving predefined goals like workforce preparation rather than for their broader contributions to human values such as scientific understanding, critical thinking, or ethical reflection.

The problem with a purely instrumental perspective—both on the quality of school education and on the engagement with AI in school subjects—is that it neglects precisely what makes science and learning intruiging: engaging with philosophical questions, striving for more profound understanding, and mastering scientific reasoning, critical inquiry, and methodological approaches. Therefore, we advocate for value-based arguments. These arguments present AI as a discipline that integrates technical and formal methods. Value-based approaches highlight the connections between AI and other school subjects, such as mathematics and science, and portray AI as fundamentally about problem-solving, decision-making, pattern recognition and language, making it deeply connected to logic, mathematics, and cognitive science. Moreover, humanistic in nature, value-based arguments view AI not merely as a technical skill but rather deeply attached to social responsibility. Its societal impacts should prompt democratic engagement and ethical awareness.

Our argument is in line with Max Weber's (1978) distinction between instrumental rationality and value rationality. Instrumental rationality refers to a human action that is "determined by expectations as to the behavior of objects in the environment and of other human beings; these expectations are used as 'conditions' or 'means' for the attainment of the actor's own rationally pursued and calculated ends; value rational (wertrational), that is, determined by a conscious belief in the value for its own sake of some ethical, aesthetic, religious, or other form of behavior, independently of its prospects of success" (Weber, 1978, pp. 24-25).

It is important to note that value and instrumental rationality are not mutually exclusive; both guide human behavior. While scientific research largely serves instrumental goals, and empirical knowledge is distinct from value judgments, as noted by Weber in 1904, this does not imply that scientific endeavors should be "value-free" (Weizenbaum, 1976, p. 263). A value-free science, which pursues goals without ethical considerations, may lead to outcomes that harm society. Therefore, from an ethical standpoint, prioritization of values is required. Uncritically trusting an AI algorithm's output can lead to highly unfair effects in reality. This is known as automation bias. Similarly, simply proving that an AI algorithm works might not sufficiently reflect or resolve the underlying complex problem structure, which is known as deep automation bias (Strauß, 2021).

Therefore, AI necessitates a value-rational approach if we are to use this technology responsibly.

The development of educational policies also requires a value-rational perspective. Decisions about what and how children learn in school shape their thinking, problemsolving, and ability to tackle challenges. However, viewing education solely through an instrumental lens causes the importance of intrinsic and social motivations for learning to be overlooked. Yet, these motivations are crucial for fostering innovation and achievement. A value-rational approach prioritizes the intrinsic and social values of education, making a fundamental difference in both the practice and experience of schooling. This distinction lies between the teaching of pure facts and skills on the one hand, and indepth reflection and orientation towards personal and social goals on the other. We advocate for a value-rational approach to integrating AI as a subject in schools. We argue that reevaluating both schooling and AI from a value-oriented perspective enriches the educational experience and fosters more profound engagement with AI and computer science.

In the first section, we explore various international initiatives and projects that promote AI in schools since 2016. The second section critically examines the principal arguments advocating for AI as a school subject, analyzing their limitations from a pedagogical perspective. In the third section, we propose an enhanced argumentation strategy that prioritizes a value-based approach, ultimately leading to a redefinition of AI from a humanistic standpoint.

Two widespread arguments for bringing AI into schools

We explored the justifications for AI curricula in the literature by reviewing papers and documents published since 2016, categorizing arguments by topic. Our focus was primarily on publications and papers from international journals (n = 11), political initiatives (n = 3) as well as international training programs (n = 1) that specifically addressed AI and education. We conducted the literature review with a preliminary approach, so we do not claim our findings to be exhaustive. To contextualize the results, we drew on contemporary perspectives from educational theory and pedagogy.

Our goal was to understand how authors address the question: Why should AI be taught in schools? We identified two prevalent types of responses in nearly every publication:

The "future argument": AI should be taught in schools because it will become increasingly critical in the future. Learning AI skills today can significantly improve students' chances of securing well-paid jobs later on.

The "ubiquity argument": AI should be taught because it is pervasive in our world. Understanding AI is essential for students to comprehend the environment they live in. Proponents of the future argument stress the importance of acquainting children with AI concepts early on to prepare them for careers in science and technical fields. They anticipate a growing demand for AI experts capable of programming. This type of argument is reinforced by current research, such as the OECD report by Squicciarini and Nachtigall (2021). Their study registers a sharp increase in job vacancies worldwide across all economic sectors where AI-relevant skills are becoming necessary. Also, in the spirit of the "future argument," the Enquete Commission "Artificial Intelligence - Social Responsibility and Economic, Social and Ecological Potentials" of the German Bundestag stated in its final report 2020 that digital knowledge, including AI-related skills, is becoming an "indispensable key competence" for participation in our entire society. For this reason, "the German education system should be rapidly geared" to teaching digital skills (including how algorithms and self-learning systems work) from "the very beginning and across all educational pathways" (Deutscher Bundestag, 2020, pp. 182-183).¹

The think tank network "Global Solutions Initiative" also emphasizes the importance of AI education in childhood to teach career-enhancing skills early on. In a post on the network's website, Timis and Sonak (2021) argue: "Early childhood education sets the stage for future academic success, a meaningful career, and a happy, fulfilling life. These formative years are essential for creating an environment where children learn the foundational skills necessary to be successful in the 21st century."

Touretzky et al. (2019) advocate for teaching children as much as possible about AI so they can later become programmers in the industry: "Our hope for undergraduates is to prepare them for a bright future in the computing industry, or spur them on to graduate studies." (Touretzky et al., 2019, p. 9795). In their 2016 paper, Kandlhofer and others recommend AI education from kindergarten to university to give children better career opportunities at an early age. They state: "Sound knowledge about AI and the principles of computer science will be of vast importance for future careers in science and engineering." (Kandlhofer et al., 2016, p. 61905) Elsewhere, Kandlhofer et al. write: "Profound knowledge about Artificial Intelligence (AI) will become increasingly important for careers in science and engineering" (EAAI, 2016, p. 4126). The paper (2018) in which they introduce the EDLRIS project begins with a similar rationale: "Artificial Intelligence (AI) plays an increasingly important role in our daily life. In the near future, jobs will largely be related to AI as it is the basis for upcoming disruptive technologies." (Kandlhofer & Steinbauer, 2018, p. 7954)

The second prevalent argument in the literature for including AI in K-12 education is the "AI ubiquity" argument. This argument posits that AI is now being applied universally and is shaping the 21st century. Consequently, it is imperative that AI be included in school curricula. Numerous examples in the literature reinforce this argument, illustrating its widespread acceptance and application. Florio-Hansen (2020), for example, speaks of the fact that new electronic technologies play an increasingly dominant role in the present. Accordingly, it is not enough to introduce pupils to the use of digital media. Rather, it is about training skills that will count in the future (Florio-Hansen 2020, p. 10). Cantú-Ortiz et al. (2020) see schools as having a duty to train students in AI. "The need to develop software capable of learning from data to handle moving devices such as autonomous vehicles and robots, performing surgeries, planning city traffic, or company

1 All quotes have been translated from the original German.

production through interactive design and manufacturing of new products, demands professionals with new capacities. These problems are ubiquitous in society and demand solutions for training specialists, something contemplated by the interdisciplinary fields of AI and society in general." (Cantú-Ortiz et al., 2020, p. 1159) Van Brummelen and Phoebe Lin argue that it is important to learn about AI as "children interact more with AI technologies". Therefore, "it is critical that they are able to recognize AI, understand how AI algorithms work, use those algorithms to solve problems meaningful to them, and evaluate the impact of AI technologies on society" (Van Brummelen & Lin, 2020, p. 2). Seegerer et al. (2019, p. 325) note that there is likely no other informatics topic that dominates current news coverage as much as AI. AI finds application in many areas. Therefore, the authors conclude, the topic of AI is also becoming relevant for schools and needs to be included in curricula. For Kandlhofer et al., it can be seen that AI and Robotics have a significant impact on our society and our everyday life. For this reason, the acquisition of competencies in the field of AI means learning "key skills for the 21st century" (Steinbauer et al., 2021, p. 127). A study by Bellas and others (2023) aims to develop and implement a tailored AI curriculum for high school education in Europe. The authors also rely on the ubiquity argument and implicitly on the future argument: "There are two key needs in this scope: to prepare all young citizens better understand how AI works for living in a world increasingly impacted by it, and to train more of them for studying AI in higher education." (Bellas et al., 2023, p. 400)

Inevitably, when we prompted OpenAI's (2021) GPT-3 with the question "why should we teach AI in schools?" we got the following response: "There are two main reasons for doing so. First, we are living in an age of great technological disruption, with artificial intelligence and machine learning at the forefront. It is crucial that students understand the implications of these technologies, as well as the societal and ethical questions that they raise. And second, there is a huge demand for AI skills among industry employers." Newer versions of ChatGPT provide more detailed answers, though they mostly prioritize future and ubiquity arguments (ChatGPT, personal communication, March 31, 2025).

Critical analysis of the arguments

One reason why these two types of arguments are so dominant could be that they align well with the human capital theory of education promoted by organizations such as PISA and the OECD (Keeley, 2007). Both arguments are rooted in an instrumental understanding of education, focusing on pragmatic outcomes like employment prospects and technological literacy. However, it is precisely because these arguments are so dominant that they are rarely questioned. At first glance, the future and ubiquity arguments for AI in schools seem convincing. Few would dispute the importance of preparing children to understand their world and secure well-paid jobs. However, the overemphasis on the instrumental aspects overshadows other valuable educational principles. This overemphasis suggests that value-rational arguments, which focus on the ethical, cultural, and personal development aspects of education, are somehow secondary. We argue, however, that the value oriented considerations should take first priority when justifying curricular decisions.

There are three main points of criticism that we want to clarify here. The first point concerns the formal weaknesses or triviality of both the future and ubiquity arguments. The second point addresses the pedagogical implications of these arguments, namely how their assumptions implicitly shape the practice of learning and teaching by prioritizing extrinsic factors. Consequently, intrinsic and achievement motivations are given lower priority. Our third criticism stems from techno-ethical considerations: The arguments are based on a too narrow, instrumental conception of artificial intelligence, ignoring a broader, more human-centric approach. However, adopting a broader definition of AI can help formulate a better rationale for why AI should be included as a necessary subject in school curricula.

We begin with argumentation-theoretical considerations. The ubiquity argument simplifies to: AI is everywhere. Therefore, AI should be taught in schools. It is easy to see that such an argument is fallacious. The fallacy is called the is-ought fallacy, first popularized by David Hume (1739/2011). One cannot infer with necessity an 'ought' from an 'is'. Thus, one cannot conclude from the fact that AI exists everywhere that AI should be taught in schools.

Weizenbaum (2001) points this out, albeit somewhat modified but still related to computers: "It is often said that the computer is everywhere today, and young people need to know what they are up against in the world. That is why it is necessary for schools to teach about computers. But there are other things that are all over our world that we just don't feel like we need to take time in school to teach about." (Weizenbaum 2001, p. 80).² As Weizenbaum objects, the plain fact that computers are everywhere is not yet sufficient for learning about them in school. Electric motors, for example, are also everywhere, but that fact alone does not make them a central subject in school.

Nevertheless, why does the ubiquity argument still seem convincing? Arguments have an implicit material conditional of the form "if A, then B". In the ubiquity argument, the implicit conditional suggests that if young people are taught about AI in schools, they will better understand the AI-driven technological world around them. Assuming the quality of teaching is sufficient, it follows that children will have a better grasp of technology when they learn about it in school. Hardly anyone would dispute the validity of this conditional.

So, what makes the argument fallacious? The issue lies in the fact that for a normative conclusion to hold, at least one of the premises must also be normative. To render the argument coherent, we must replace the descriptive proposition "AI is ubiquitous" with a normative proposition, such as "Children should understand today's AI-driven world." With this adjustment, we arrive at a coherent rationale for why AI should be taught in schools.

From a logical perspective, the argument now appears valid. However, what becomes apparent is the triviality of the argument: the triviality stems from the normative premise being stated without further elaboration on its rationale. To rescue the argument from

2 This quote has been translated from the original German.

triviality, we need to address second-order questions such as "Why do we need to understand the AI-driven world?" or "Why should we know how AI works?". Answering these questions requires deeper justifications that need to be anchored in value-based rationality. For instance, understanding the AI-driven world may be crucial to prevent discrimination by machines, or knowing about AI might be necessary to democratize its use. These more profound arguments are indeed utilized in the literature to justify AI as a school subject. (Kandlhofer & Steinbauer, 2021; Timis & Sonak, 2021). Nevertheless, despite its trivial nature, the ubiquity argument remains much more widespread.

Another problem with the ubiquity argument is that it misses what is significant and unique about AI. As Weizenbaum (2001, p. 83) argues, the mere fact that computers are everywhere is not sufficient justification for learning about them in school. The ubiquity argument for teaching AI could be applied to any other technical application. Using Weizenbaum's example: Electric motors are ubiquitous, and while it certainly makes sense to learn about them in school, the argument for their inclusion in the classroom hardly revolves around their ubiquitous nature. Instead, we teach about electric motors to understand phenomena like electromagnetic induction or electromagnetism in general. Further exploration of the "why" question reveals that the inclusion of electric motors in the curriculum is rooted in human fascination with the laws of physics and our drive to pursue questions and solve problems. The same rationale applies to AI. We should learn about AI not because it is used everywhere, but because, like any other formal science, it raises interesting problems and is based on abstract principles and mathematical constructs. The practical applicability of AI, while important, is, in fact, secondary to its educational value. What comes first is the fascination with epistemological questions and formal creativity.

The future argument also leads to a trivial conclusion, but in some ways it is even more problematic. It contends that the future job market will demand AI expertise, necessitating AI training in schools today. Again, the argument gains intuitive appeal from a conditional premise: if we teach AI in schools, many will be equipped to work with it in the future. While this is true—if AI is effectively taught, students are likely to develop these skills—the critical issue lies in the underlying normative assumption. The future argument presupposes that all individuals will require AI skills in the future, either for employment or to interact with AI systems. However, even if we accept this premise, a question posed by Weizenbaum (2001, p. 81) remains pertinent: "On what level of explanation?" Specifically, how in-depth must AI education be to meet future needs? Looking twenty-five years ahead, it becomes difficult to determine this with any certainty.

Moreover, defining the necessary AI skills remains challenging. While it is practical to base these skills on contemporary practices (cf. Touretzky et al., 2019), the evolution of AI illustrates the difficulty in forecasting the discipline's trajectory. For instance, if an AI curriculum had been developed in the early 2000s, it likely would not have emphasized artificial neural networks, which are now predominant in the field. Similarly, due to their uncertainties and lack of trustworthiness, generative models may eventually be replaced by other approaches that are still unknown today (cf. Marcus, 2024). Thus, we contend that justifying AI curricula based on vague future projections is problematic. Instead,

the rationale for integrating AI into educational settings should arise from a broader human drive towards scientific and creative pursuits.

Here, the second point of our critique becomes evident. We emphasize once again that our argument is not against teaching AI in schools. On the contrary, we advocate for AI education that is engaging and motivating. However, both the future and ubiquity arguments overlook the importance of the quality of pedagogical practices. Relying solely on instrumental reasoning to justify curricula can lead to insufficient teaching methodologies.

For practitioners, both students and teachers, the question of "Why do I need to learn this?" or "Why do I need to teach this?" is central. The answers to these questions should foster motivation that encourages deep engagement with challenging subjects. However, when answers are primarily instrumental, they tend to promote extrinsic motivation, which is a means-to-an-end approach. Here, the goal lies outside the task itself, leading individuals to pursue activities not for enjoyment but for external rewards (Locke & Schattke, 2019; Rheinberg & Engeser, 2018). This type of motivation, while effective in some contexts, may not inspire the excellence and profound intellectual engagement essential for mastering a subject.

Translated to the realm of AI education, this means that we might often learn and teach about AI solely to achieve goals that ultimately have little to do with AI itself. Commonly, the rationale provided for learning about AI is to secure well-paying jobs in the future or to effectively utilize and understand the AI-driven services and products that permeate our lives. However, these reasons do not touch upon the aspects of AI that are intrinsically motivating. While extrinsic motivation undeniably plays a role in our decisions, for instance, understanding a recommendation algorithm is useful when navigating online shopping or streaming platforms, it does not foster a in-depth engagement with AI. On the other hand, intrinsic motivation, which arises from an inherent interest in or enjoyment of the activity itself, proves to be a more powerful force. This type of motivation encourages a profound exploration of AI, such as delving into machine learning out of sheer fascination rather than merely practical necessity.

Intrinsic motivation describes that we like or want to do an activity for its own sake. The pleasure and enjoyment lie in the experience. Meyer (2011), for example, argues that education should be understood as a "value in itself" (Meyer, 2011, p. 11) insofar as it provides a good or valuable experience. Valuable experiences can have different qualities. They can be "joyful, enriching, intense, comic or meaningful" (2011, p. 57), which in turn can be ascribed to their "intrinsic value" (2011, p. 54).³

Engaging with artificial intelligence certainly provides intrinsic value. AI naturally evokes curiosity and stimulates imagination. AI has been intertwined with the narratives of science fiction and technological mythologies from the beginning (Hudson et al., 2021). This inherent fascination often inspires individuals to explore the field further, perhaps by delving into an AI textbook. Moreover, the process of writing a program and observing its execution by a machine might offer unique intellectual satisfaction. Captivating could be the experience of training a model and watching it successfully or some-

3 All quotes have been translated from the original German.

times unsuccessfully recognize images. Such engagement with machine learning can be rewarding, as it challenges and fulfills intellectual curiosity. In summary, it can be said that exploring programming and AI often evokes a sense of curiosity and wonder. In the foreword of *Mindstorms*, Seymour Papert (1993), a key figure in the history of AI education, describes such a feeling of wonder in his childhood when playing with gears:

"I found particular pleasure in such systems as the differential gear, which does not follow a simple linear chain of causality since the motion in the transmission shaft can be distributed in many different ways to the two wheels depending on what resistance they encounter. I remember quite vividly my excitement at discovering that a system could be lawful and completely comprehensible without being rigidly deterministic.

I believe that working with differentials did more for my mathematical development than anything I was taught in elementary school." (Papert, 1993, p. xxviii)

The focus on both the future and ubiquity arguments within the debate on AI in education often overshadows the equally significant role of intrinsic motivation. This may stem from a prevailing belief that learning activities pursued solely for pleasure, interest, or curiosity are less efficient. However, such a perspective underestimates the impact of wonder and intrinsic motivation. Frank C. Keil (2022) defines wonder as a universal, native quest for understanding, driven by an exploratory impulse that deeply engages children in learning through their innate interest in mechanistic explanations. Modern developmental psychology posits that scientific inquiry is deeply rooted in intrinsic motivations similar to those driving early learning and play activities (Gopnik, 2012).

Consequently, it is plausible to argue that scientific and technological advancements are more often fueled by serendipity, playful exploration, and meaningful experiences rather than purely utilitarian aims. However, as Rushkoff (2023) and Suarez-Villa (2012) argue, creativity and playfulness have increasingly been utilized by corporate interests, turning what was once a field for authentic innovation into a marketplace where creativity is commodified and driven by profit, rather than by the intrinsic value of exploration and discovery. Thus, when advocating for AI education in schools, it is even more crucial to aim for intrinsic factors and a value-oriented approach. The rationale for teaching AI should emphasize how it promotes creativity, playfulness, and exploration—but for its own sake. This perspective can enhance pedagogical practices by encouraging teachers to not only employ 'hands-on' and 'problem-based' learning methods but also to help students view their creative outputs not as *means to an end* — rather, as expressions of themselves.

Our third point of criticism stems from techno-ethical considerations, which assess the moral and ethical implications of technology in society. The ubiquity and future arguments predominantly view AI instrumentally, as merely a *means to an end*. This perspective, however, tends to obscure AI's true educational potential. Rather than focusing solely on technical proficiency, AI's deeper connection to human capacities—such as speech, discourse, logic, causal understanding, theory of mind, and moral judgment—should be emphasized. Today's AI approaches can be explained through simple philosophical analogies (Larson, 2021). Rule-based systems align with logical reasoning and symbolic representation, echoing ideas found in Leibniz's *characteristica universalis* and Frege's *Begriffsschrift* (1879). In contrast, machine learning algorithms, such as decision trees, Bayesian models, and artificial neural networks, correspond to empiricist epistemology. Deep learning, for instance, resonates with Locke's notion that sensory data imprint the mind with primitive ideas, which then evolve through complex, multi-layered conditioning processes, much like those envisioned in behaviorism and cybernetics. Overall, current AI methodologies represent epistemological attempts in modeling specific aspects of thinking and learning.

However, human capacity goes far beyond data processing or logical deduction. Strong doubts persist regarding the creation of a machine capable of "contemplating the whole domain of human thought." (Weizenbaum, 1976, p. 203). Human thought is much more—it is sapient. This sapience includes states that remain almost completely unexplored in the field of AI, precisely because AI focuses solely on application and tends to ignore fundamental questions. Engaging with fundamental questions requires wonder and the ability to recognize one's own ignorance. These cognitive states of ambiguity and vagueness are an inherent element of science, often referred to as the "context of discovery," characterized by states of "vague puzzlement" (Belnap & Steel, 1976, p. 11) or "p-predicament" (Bromberger, 1992, p. 4). Human reason and learning, or sapience, is marked by the capacity to ask questions and intuitively discern problems-the ability to inquire and learn autonomously. This is precisely the ability that schooling should aim to nurture and support. Unfortunately, the instrumental view, both in AI and education, prioritizes solving specific technical problems over cultivating these uniquely human capacities. From an engineering standpoint, designing applications for specific tasks is understandable. Yet, from a deeper scientific-theoretical perspective, it neglects what constitutes the true richness of the human mind: its sapience, which lies in asking questions and being fascinated by the thing-in-itself.

The prioritization of human values is crucial not only in AI education but also in AI development itself. When attempting to understand and develop human-level intelligence, such efforts should not be confined to the instrumental approach of AI, which often reduces human capacities to the limits of existing technical methodologies. Therefore, from an ethical standpoint, definitions of artificial intelligence must consistently emphasize human autonomy and capacities. As highlighted by Misselhorn (2021, p. 133), AI research should regard individuals not just as isolated entities but as social beings embedded within a network of values. Failing to adopt this perspective risks reifying human beings, essentially reducing them to mere components of technological processes. This reification not only objectifies individuals but also fails to capture the full potential and ethical implications of AI as a scientific discipline.

In a broader sense, AI grapples with core questions also central to fields such as epistemology, cognitive psychology, cognitive anthropology, and neuroscience. AI not only parallels these disciplines but also equips them with innovative tools and methods. It is precisely this connection to human learning processes that provides an important answer to the question of why we should teach AI in schools. Seymour Papert held exactly this view. Papert, an AI professor at MIT like Weizenbaum, was fascinated by the potential of psychological models to describe human intelligence and how these insights could enhance AI research. This approach motivated Papert to work with Jean Piaget (1930). From him, Papert adapted the image of children as "builders of their own intellectual structures." (Papert, 1993, p. 7). According to Piaget's theory, children differentiate their cognitive structures during development via hands-on experimentation with objects. This idea eventually led Papert to develop the "Turtle", a drawing robot that children could program. Papert reflects this as a remarkable departure from the traditional understanding of education: "The child, even at preschool ages, is in control: The child programs the computer." (Papert, 1993, p. 19)

Papert's "constructionism" builds on Piaget's "constructivism" and extends it. Learning is not only the result of the learner's interaction with people and objects in their environment (as posited by Piaget's constructivism) but also the result of the learner's engagement in constructing something that is of personal interest (Valente & Blikstein, 2019). Papert's ideas are continued today at MIT by the Lifelong Kindergarten Group (Resnick & Robinson, 2018), and are also influential in the Maker Movement and its makerspaces (Hatch, 2013). Their learning concepts align with the modernist idea of education. Learners are not mere recipients but agents and makers of their learning processes. This pedagogical approach incorporates key aspects from modern educational theories, notably Dewey's (1986), such as problem orientation ("problem-solving") and the aspect of active participation ("hands-on", "learning by doing"), and also draws on insights from educational thinkers like Paolo Freire (2021), Célestin Freinet (1993), and Maria Montessori (1965) (Valente & Blikstein, 2019).

Weizenbaum (2001, p. 90) highlights Papert's example as someone who believed that children should be perceived as agents from an early age. Understanding Papert's critique of instructionism and his advocacy for constructionism is crucial within the framework of value-rationality. Central to this educational philosophy is the concept of children having agency, being able to act independently and make their own decisions as active learners. In this model, computer science and AI are not merely subjects to be transferred to children; instead, they are fields where children actively contribute, creating visible artifacts from their own motivation.

Value rationality in education is based on distinct expectations regarding its outcomes. Rather than focusing solely on vague job descriptions or practical skills, it prioritizes values such as creativity, curiosity, intellectual joy, knowledge, and social experience. This view corresponds to what Weizenbaum means by reversing the question: instead of asking what the role of the computer is in school, it is first necessary to ask what education should achieve in the first place.

The value-based argumentation also supports the other side of the AI-school interaction. Not only do students benefit from AI as a scientific field. AI research might also benefit from a holistic approach that teaches not only skills but also encourages reflection and critical thinking. In our view, Papert's idea that learning about AI could inspire children to think about their thinking provides an insightful answer to why we should teach AI in schools. If we teach AI in the context of philosophy and cognitive science, we gain valuable knowledge about human thinking and learning. In studying the mind, AI's contribution lies in its ability to manifest certain cognitive functions through formal structures, making abstract concepts about thought processes concrete and tangible. For Papert, AI, therefore, has qualities that make it particularly suitable as a topic for school teaching. Papert (1993) says this clearly:

"In order to make a machine capable of learning, we have to probe deeply into the nature of learning. And from this kind of research comes the broader definition of artificial intelligence: that of cognitive science." (Papert, 1993, p. 157)

As Papert suggests, when children play with computers and build computer programs and robots in the same way they build LEGO houses and sandcastles, they are constructing their own cognitive structures and reflecting on them. Thus, the reason to teach AI is that children "can think more concretely about mental processes" (Papert, 1993, p. 158). Papert's case for teaching AI in schools is value-oriented. The values expressed by Papert (1993) are represented by creativity, reflection, self-conscious thinking, the feeling of self-efficacy, and intellectual collaboration. Exercising these human capacities provides value *in itself*.

Better Arguments

According to Weizenbaum (2001, p. 88), we should first ask, what is education supposed to do in the first place? What are the priorities in terms of what education should do? A proper answer to these questions might be that education is supposed to nourish our ability to think autonomously. If it is true that learning about AI supports this goal by fostering creative and critical thinking, then AI should indeed be taught in schools. However, adopting a perspective based on value rationality reveals that other valuable practices in school curricula also promote metacognition, critical thinking, and creativity. Notably, these include engaging in philosophical inquiry, reading and analyzing complex argumentative texts, and applying scientific methods and logic in the pursuit of knowledge (Lipman, 1988). Therefore, teaching AI should not be seen as the only way to encourage children to think about thinking. Nevertheless, AI occupies an interesting niche for education in its broader definition. Its interdisciplinary approach, integrating elements from ethics, logic, and computational thinking, can be particularly valuable in one's learning biography. Thus, while AI is only one of many valuable topics in education, its distinctive contribution to fostering metacognition and creativity makes it worth considering for integration into curricula.

How AI as a scientific field can have this role will become more evident when we take a closer look at the definitions of AI and its connections to other fields. On a fundamental level, AI can be defined as automated problem-solving (Newell & Simon, 1963; Turing, 1950). When we teach AI in schools, we will teach the art of problem-solving as it is presented in logical puzzles or board games like chess and Go. Engaging in such games at different levels of difficulty has an intrinsic value and shows us formal rules of thinking.

On a more advanced level, AI involves automated decision-making and pattern recognition. To effectively understand AI, one needs knowledge of various complex concepts, including logic and proof theory, probability theory, Bayesian inference, information theory, and other statistical aspects. Elements of these are already incorporated into the math and physics curricula. One significant potential of integrating AI as scientific field in schools is that these mathematical foundations can be taught by demonstrating how they relate to our cognitive processes—and, more importantly, by highlighting areas where they fail to explain human cognition.

Moreover, AI makes it exciting to look at cognitive processes even from the perspective where our thinking has limitations because of our biases, prejudices, and, generally, our bounded rationality. As Papert said, AI should be understood as cognitive science and, as such, has congruencies with the philosophy of science, anthropology, and developmental psychology (Gopnik, 2017; Tenenbaum et al., 2011). If AI is taught in schools as the science of the differences between human learning and machine learning, AI could become a crucial component of a curriculum focused on thinking skills, encouraging students to explore and understand the complexities of their own cognitive processes.

Besides their theoretical aspects, AI and computer science are also very practical and hands-on. AI involves building robots and smart gadgets. As many initiatives demonstrate, teaching AI in schools often includes tinkering with electronics and constructing meaningful artifacts (cf. Scheidt & Pulver, 2019). In this respect, working with AI holds intrinsic value as a craft.

Ultimately, our understanding of AI should be even broader. Technology cannot be considered in isolation from the socio-technical conditions under which it is developed and used. If we view human autonomy and social responsibility as central goals of education, then teaching AI in schools also involves teaching about democracy, human solidarity, and civil liberties. This approach aims to solve complex social problems through human agency and interaction, rather than relying solely on distant technologies. Precisely because AI research strives to model human thought processes, it should also be seen as an interdisciplinary field involving psychology, ethics, and sociology.

Conclusion

In this essay, we have argued that the two arguments commonly favored in the literature, the 'future argument' and the 'ubiquity argument', warrant criticism. Both arguments tend to be fallacious, elicit criticism from a pedagogical perspective, and are limited to a narrow notion of artificial intelligence. The rationale for AI in schools should be more profound, as humans are also more complex and much more multi-layered in their whole being (Misselhorn, 2021, pp. 133-134). We have proposed value-based reasoning that aims at prioritizing human autonomy. AI as an academic field is inherently interdisciplinary, encompassing not only mathematics and computer science but also touching upon social and cognitive sciences. The diverse approaches could provide an opportunity for teachers and students to critically examine society's values and the role of technology. Ultimately, AI should not be seen as a tool for economic exploitation, but as an intriguing topic in its own right, offering new perspectives on mathematics and formal thinking. The value of AI as a school subject follows from this perspective. In our view,

Papert's idea that learning about AI helps us to think about thinking provides an interesting answer to why we should teach AI in schools.

AI itself raises a broad range of ethical questions. Technology cannot be considered in isolation from the socio-technical conditions under which it is developed. Why should we educate our children about AI, and what objectives are we aiming to achieve? Regardless of our answers, we should prioritize value rationality in finding them. For some, enduring the prioritization of value rationality is challenging. For instance, Weizenbaum reports the 'tension' experienced when terms like 'ethics' and 'one should' are introduced in scientific discourse (Weizenbaum, 1976, p. 264). However, a deeper exploration of AI from the perspectives of the humanities and cognitive science could transform our thinking about not only educational practices but also about society at large. To conclude, we reflect on a thought from Joseph Weizenbaum: when asked whether it was feasible to develop computer software that could be effectively implemented in schools, he responded by questioning whether we could design a school system where computer software can be effectively integrated (Weizenbaum, 2001, p. 95). This prompts a more pressing consideration: Are we capable of building a society in which AI can be implemented reasonably?

References

- Bellas, F., Guerreiro-Santalla, S., Naya, M., & Duro, R. J. (2023). AI Curriculum for European High Schools: An Embedded Intelligence Approach. *International Journal of Artificial Intelligence in Education*, 33(2), 399–426. DOI: 10.1007/ s40593-022-00315-0
- Belnap, N. D., & Steel, T. B. (1976). The Logic of Questions and Answers. Yale University Press.
- Bromberger, S. (1992). On What We Know We Don't Know. Explanation, Theory, Linguistics, and How questions Shape Them. The University of Chicago Press.
- Burgsteiner, H., Kandlhofer, M., & Steinbauer, G. (2016). IRobot: Teaching the Basics of Artificial Intelligence in High Schools. *Proceedings of the AAAI Conference on Artificial Intelligence*, 30(1), Article 1. https://ojs.aaai.org/index.php/AAAI/ article/view/9864
- Cantú-Ortiz, F. J., Galeano Sánchez, N., Garrido, L., Terashima-Marin, H., & Brena, R. F. (2020). An artificial intelligence educational strategy for the digital transformation. *International Journal on Interactive Design and Manufacturing* (*IJIDeM*), 14(4), 1195–1209. DOI: 10.1007/s12008-020-00702-8
- Deutscher Bundestag. (2020). Bericht der Enquete-Kommission Künstliche Intelligenz

 Gesellschaftliche Verantwortung und wirtschaftliche, soziale und ökologische Potenziale (Drucksache 19/23700). Deutscher Bundestag. https://www.bundestag. de/webarchiv/Ausschuesse/ausschuesse19/weitere_gremien/enquete_ki.
- Dewey, J. (1986). Experience and education. The Educational Forum, 50, 241–252.
- EDLRIS. (2021). EDLRIS European Driving License for Robots and Intelligent Systems. Accessed 7. Sep 2022, https://edlris.ist.tugraz.at/

- Florio-Hansen, I. D. (2020). Digitalisierung, Künstliche Intelligenz und Robotik: Eine Einführung für Schule und Unterricht. UTB.
- Frege, G. (1879). Begriffsschrift, eine der arithmetischen nachgebildete Formelsprache des reinen Denkens. Verlag von Louis Nebert.
- Freinet, C. (1993). Education Through Work: A Model for Child-Centered Learning (J. Sivell, Trans.; 2nd ed.). Edwin Mellen Press Ltd.
- Freire, P. (2021). Pädagogik der Autonomie: Notwendiges Wissen für die Bildungspraxis (P. Schreiner, N. Mette, D. Oesselmann, & D. Kinkelbur, Ed.; I. Tamm, Trans.; 1st ed.). Waxmann Lehrbuch.
- Gopnik, A. (2012). Scientific Thinking in Young Children: Theoretical Advances, Empirical Research, and Policy Implications. *Science*, 337(6102), 1623–1627. DOI: 10.1126/science.1223416
- Gopnik, A. (2017). Making AI More Human. Scientific American, 316(6), 60-65.
- Hatch, M. (2013). Maker Movement Manifesto: Rules for Innovation in the New World of Crafters, Hackers, and Tinkerers. McGraw-Hill Education.
- Hudson, A. D., Finn, E., & Wylie, R. (2021). What can science fiction tell us about the future of artificial intelligence policy? *AI & SOCIETY*. DOI: 10.1007/s00146-021-01273-2
- Hume, D. (1739/2011). A Treatise Of Human Nature: Volume 1: Texts (The Clarendon Edition Of The Works Of David Hume): Texts: A Critical Edition (D. F. Norton & M. J. Norton, Ed.). Oxford University Press.
- Kandlhofer, M., & Steinbauer, G. (2018). A Driving License for Intelligent Systems. The Eighth AAAI Symposium on Educational Advances in Artificial Intelligence 2018 (EAAI-18). DOI: 10.1609/aaai.v32i1.11399
- Kandlhofer, M., & Steinbauer, G. (2021). AI K–12 Education Service. KI Künstliche Intelligenz. DOI: 10.1007/s13218-021-00715-9
- Keeley, B. (2007). OECD Insights Human Capital: How what you know shapes your life (1st, ed.). OECD Publishing.
- Keil, F. C. (2022). Wonder. Childhood and the Lifelong Love of Science. The MIT Press.
- Larson, Erik J. (2021). *The myth of artificial intelligence: Why computers can't think the way we do.* Harvard University Press.
- Lipman, M. (1988). Philosophy goes to School. Temple University Press
- Locke, E. A., & Schattke, K. (2019). Intrinsic and extrinsic motivation: Time for expansion and clarification. *Motivation Science*, 5(4), 277–290. DOI: 10.1037/ mot0000116
- Marcus, G. F. (2024). *Taming Silicon Valley: How we can ensure that AI works for us*. The MIT Press.
- Meyer, K. (2011). Bildung. Grundthemen der Philosophie. Walter De Gruyter.
- Misselhorn, C. (2021). Künstliche Intelligenz und Empathie. Vom Leben mit Emotionserkennung, Sexrobotern & Co. Reclam, Philipp, jun. GmbH, Verlag.
- Montessori, M. (1965). Spontaneous activity in education. Schocken.
- Newell, A., & Simon, H. A. (1963). Computers in Psychology. In D. Luce (Ed.), Handbook of Mathematical Psychology (361–428). John Wiley & Sons.
- OpenAI (2021). Accessed 7 Sep 2022 https://openai.com/api/

- Papert, S. (1993). *Mindstorms: Children, Computers, And Powerful Ideas* (Subsequent Edition). Basic Books.
- Piaget, J. (1930). The Child's Conception Of Physical Causality. Kegan Paul, Trench, Trubner & Co. LTD. http://archive.org/details/in.ernet.dli.2015.75334
- Resnick, M., & Robinson, K. (2018). Lifelong Kindergarten: Cultivating Creativity through Projects, Passion, Peers, and Play (Reprint Edition). MIT Press.
- Rheinberg, F., & Engeser, S. (2018). Intrinsic Motivation and Flow. In J. Heckhausen & H. Heckhausen (Ed.), *Motivation and Action* (579–622). Springer International Publishing. DOI: 10.1007/978-3-319-65094-4_14
- Rushkoff, D. (2023). *Survival of the richest: Escape fantasies of the tech billionaires*. W. W. Norton & Company.
- Scheidt, A., & Pulver, T. (2019). Any-Cubes: A Children's Toy for Learning AI. Proceedings of Mensch Und Computer 2019, 893–895. DOI: 10.1145/3340764. 3345375
- Seegerer, S., Lindner, A., & Romeike, R. (2019). AI Unplugged Wir ziehen Künstlicher Intelligenz den Stecker. Gesellschaft für Informatik. DOI: 10.18420/ infos2019-c18
- Squicciarini, M., & Nachtigall, H. (2021). Demand for AI skills in jobs: Evidence from online job postings. OECD. DOI: 10.1787/3ed32d94-en
- Steinbauer, G., Kandlhofer, M., Chklovski, T., Heintz, F., & Koenig, S. (2021). A Differentiated Discussion About AI Education K-12. KI - Künstliche Intelligenz, 35(2), 131–137. DOI: 10.1007/s13218-021-00724-8
- Strauß, S. (2021). Deep Automation Bias: How to Tackle a Wicked Problem of AI? Big Data and Cognitive Computing, 5(2), 18. DOI: 10.3390/bdcc5020018
- Suarez-Villa, L. (2012). Technocapitalism: A Critical Perspective on Technological Innovation and Corporatism. Temple University Press.
- Tenenbaum, J. B., Kemp, C., Griffiths, T. L., & Goodman, N. D. (2011). How to Grow a Mind: Statistics, Structure, and Abstraction. *Science*, 331, 1279–1285. DOI: 10. 1126/science.1192788
- Timis, D., & Sonak, A. (2021, Juni 24). Building AI Skills for the Future of Work. How do we address the AI skills gap in the long-term? *Young Global Changers Blog*. https: //www.global-solutions-initiative.org/young-global-changers-blog/skills-for-thefuture-of-work/
- Touretzky, D., Gardner-McCune, C., Martin, F., & Seehorn, D. (2019). Envisioning AI for K-12: What Should Every Child Know about AI? *Proceedings of the AAAI Conference on Artificial Intelligence*, 33(01), 9795–9799. DOI: 10.1609/aaai. v33i01.33019795
- Turing, A. M. (1950). Computing Machinery and Intelligence. *Mind*, 59(236), 433-460.
- Valente, J. A., & Blikstein, P. (2019). Maker Education: Where Is the Knowledge Construction? *Constructivist Foundations*, 14(3), 252–262.
- Van Brummelen, J., & Lin, P. (2020). Engaging Teachers to Co-Design Integrated AI Curriculum for K-12 Classrooms. arXiv:2009.11100 [physics]. http://arxiv.org/ abs/2009.11100

- Weber, M. (1904). Die "Objektivität" sozialwissenschaftlicher und sozialpolitischer Erkenntnis. Archiv für Sozialwissenschaft und Sozialpolitik, 19(1), 22–87.
- Weber, M. (1978). Economy and Society. An Outline of Interpretative Sociology (G. Roth & C. Wittich, Ed.). University of California Press.
- Weizenbaum, J. (1976). Computer Power and Human Reason: From Judgement to Calculation. W. H. Freeman.
- Weizenbaum, J. (1985). Weizenbaum examines computers and society. *The Tech*, *105*(16), 2.
- Weizenbaum, J. (2001). Computermacht und Gesellschaft: Freie Reden (G. Wendt & F. Klug, Ed.; 4th edition). Suhrkamp Verlag.