COMPUTATIONAL SIMULATIONS AS REPRESENTATIONS OF REALITY: PHILOSOPHICAL ANALYSIS AND IMPLICATIONS FOR ARTIFICIAL INTELLIGENCE

SIMULAÇÕES COMPUTACIONAIS COMO REPRESENTAÇÕES DA REALIDADE: ANÁLISE FILOSÓFICA E IMPLICAÇÕES PARA A INTELIGÊNCIA ARTIFICIAL

SIMULACIONES COMPUTACIONALES COMO REPRESENTACIONES DE LA REALIDAD: ANÁLISIS FILOSÓFICO E IMPLICACIONES PARA LA INTELIGENCIA ARTIFICIAL

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ABSTRACT
The use of computational simulations has become central in various scientific and technological fields. In addition to enabling the modeling of complex systems and the prediction of behaviors, simulations feed reinforcement learning algorithms, digital twins, and interactive prototypes. However, when these simulations are employed to represent or recreate reality, philosophical problems arise concerning the nature of representation, the difference between appearance and reality, and the limits of knowledge. This theoretically exploratory article critically examines computational simulations as representations of reality, articulating classical and contemporary philosophical traditions. In light of authors such as Plato, Aristotle, Kant, Descartes, Baudrillard, Heidegger, Putnam, Bostrom, Winsberg, Turing, Searle, and others, it analyzes the relationship between imitation and original, the distinction between phenomenon and thing-in-itself, the role of signs in the construction of reality, skeptical hypotheses, and the crisis of representation in the age of technology. The text then discusses implications for artificial intelligence (AI), especially in the context of learning algorithms and digital twins. It reflects that simulations are not mere copies, but constructions mediated by theories, signs, and technology, requiring epistemological and ethical reflection on their use in AI.

Keywords: Computational Simulations. Representation of Reality. Philosophy of Technology. Artificial Intelligence. Digital Twins.

RESUMO
O uso de simulações computacionais tornou se central em diversos campos científicos e tecnológicos. Além de viabilizarem a modelagem de sistemas complexos e a predição de comportamentos, as simulações alimentam algoritmos de aprendizagem por reforço, gêmeos digitais e protótipos interativos. Contudo, quando essas simulações são empregadas para representar ou recriar a realidade, emergem problemas filosóficos relativos à natureza da representação, à diferença entre aparência e realidade e aos limites

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do conhecimento. Este artigo, de natureza teórico exploratória, examina criticamente as simulações computacionais como representações da realidade, articulando tradições filosóficas clássicas e contemporâneas. À luz de autores como Platão, Aristóteles, Kant, Descartes, Baudrillard, Heidegger, Putnam, Bostrom, Winsberg, Turing, Searle e outros, analisa se a relação entre imitação e original, a distinção entre fenômeno e coisa em si, o papel dos signos na construção da realidade, as hipóteses céticas e a crise da representação na era da técnica. Em seguida, o texto discute implicações para a inteligência artificial (IA), especialmente no contexto de algoritmos de aprendizagem e gêmeos digitais. Reflete-se que simulações não são meras cópias, mas construções mediadas por teorias, signos e tecnologia, exigindo reflexão epistemológica e ética sobre seu uso em IA.

Palavras-chave: Simulações Computacionais. Representação da Realidade. Filosofia da Tecnologia. Inteligência Artificial. Gêmeos Digitais.

RESUMEN
El uso de simulaciones computacionales se ha vuelto central en diversos campos científicos y tecnológicos. Además de posibilitar la modelización de sistemas complejos y la predicción de comportamientos, las simulaciones alimentan algoritmos de aprendizaje por refuerzo, gemelos digitales y prototipos interactivos. Sin embargo, cuando estas simulaciones se emplean para representar o recrear la realidad, surgen problemas filosóficos relacionados con la naturaleza de la representación, la diferencia entre apariencia y realidad y los límites del conocimiento. Este artículo, de carácter teórico-exploratorio, examina críticamente las simulaciones computacionales como representaciones de la realidad, articulando tradiciones filosóficas clásicas y contemporáneas. A la luz de autores como Platón, Aristóteles, Kant, Descartes, Baudrillard, Heidegger, Putnam, Bostrom, Winsberg, Turing, Searle y otros, se analiza la relación entre imitación y original, la distinción entre fenómeno y cosa en sí, el papel de los signos en la construcción de la realidad, las hipótesis escépticas y la crisis de la representación en la era de la técnica. A continuación, el texto discute las implicaciones para la inteligencia artificial (IA), especialmente en el contexto de los algoritmos de aprendizaje y los gemelos digitales. Se reflexiona que las simulaciones no son meras copias, sino construcciones mediadas por teorías, signos y tecnología, lo que exige una reflexión epistemológica y ética sobre su uso en la IA.

Palabras clave: Simulaciones Computacionales. Representación de la Realidad. Filosofía de la Tecnología. Inteligencia Artificial. Gemelos Digitales.

1 INTRODUCTION

The advancement of computational technologies has allowed the creation of mathematical models capable of simulating natural phenomena, social processes, and complex technical systems. In the fields of data science, physics, and biology, simulations replace or complement experiments, allowing to "test" theories and project future scenarios (Winsberg, 2009, 2010). In the area of artificial intelligence, simulations are used to train reinforcement learning algorithms, as they allow agents to perform millions of interactions in virtual environments, saving resources and avoiding risks in real contexts (Simwell, 2021). Companies and governments implement digital twins, virtual replicas of machines, cities, or processes, in order to monitor and optimize systems in real time (Simio, 2023). The popularity of the "metaverse" and the success of virtual reality platforms highlight a cultural trend of interaction in simulated worlds. Despite this centrality, the philosophical literature warns of risks and ambiguities. For centuries, philosophers have reflected on the difference between image and reality, as well as on the limits of knowledge obtained through representations. Plato (2006) described art as "imitation of imitation" and, in the famous allegory of the cave, prisoners rely on shadows projected on the wall, ignoring that they are only copies of real objects (Plato, 2006). Aristotle (1973), although accepting mimesis, maintains that poetry does not imitate particular events, but what can occur according to the laws of verisimilitude and necessity (Aristotle, 1973). The philosopher Kant (2001, 2011) distinguished the world as a phenomenon, that which appears according to the filters of space and time of sensibility, of the noumene, the "thing in itself", inaccessible to experience (Kant, 2001, 2011). For Heidegger (2001, 2014), modernity has reduced the world to an image: reality is established as a calculated image, so that the world "exists in an image" and becomes manipulable by technique (Heidegger, 2001). In addition to these classic analyses, contemporary thinkers draw attention to the implications of the new techniques. Jean Baudrillard diagnoses an era of simulacra in which copies have no originals and the real is replaced by hyperreality (Baudrillard, 1981). Hilary Putnam (1981) uses the "brain in a vat" thought experiment to argue that we cannot prove that we are not immersed in a computer-controlled simulation, although he considers such a hypothesis to be incoherent under certain semantic assumptions (Putnam, 1981, 1988, 1990). Nick Bostrom formulates the *simulation argument* by suggesting that, given the computational capacity of advanced societies, we are likely to live in an ancestral simulation (Bostrom, 2003). In the philosophy of science, Eric Winsberg shows that simulations are not mere experimental tools, as they require epistemological justifications and validation criteria that are different from physical experiments (Winsberg, 2009, 2010). John Searle, in turn, argues that computers can manipulate symbols without understanding their meaning, as illustrated by the *Chinese fourth* (Searle, 1980, 2006). These discussions indicate that the use of computer simulations evokes ontological, epistemological and ethical issues that go beyond technique. This research aims to examine, in the light of these traditions, to what extent computer simulations can be considered representations of reality. The work is exploratory and theoretical, based on a bibliographic review of classic and contemporary works. It seeks to articulate concepts of imitation, representation, sign, appearance, reality and technology, to then discuss the implications for artificial intelligence and in the end, considerations are presented that highlight the need for critical reflection on the development and use of simulations in AI and science.

2 THEORETICAL FRAMEWORK

2.1 IMITATION AND REPRESENTATION IN THE CLASSICAL TRADITION

The analysis of computer simulations as representations of reality requires recovering the long philosophical tradition that discussed the relationship between imitation and original. Plato (2006) argues that works of art imitate sensible objects, which, in turn, are imperfect imitations of ideal forms, so that art is *three times far from the truth* because it imitates particular things and not the idea of the thing (Plato, 2006). This vision appears metaphorically in the allegory of the cave: prisoners see only shadows projected on the wall and take them for reality (Plato, 2006). In the same perspective, computer simulations can be seen as shadows of mathematical models that seek to get closer to real phenomena. Thus, Platonic criticism warns of the risk of confusing representation with reality, a recurring phenomenon in credulity in virtual worlds. Aristotle (1973) proposes a revision of this critique. Although he agrees that art is *mimesis* (imitation), he states that the poet's craft does not consist in narrating facts that have occurred, but in representing what can happen according to verisimilitude and necessity (Aristotle, 1973, 1988). Poetry tends to represent the universal, not the particular (Aristotle, 1973, 1988), when watching a tragedy, we learn something about the human being in general. Such a view opens space to recognize the cognitive value of simulations, which allow exploring possibilities and variations of systems, extrapolating the particular. However, Aristotle (1973, 1988) insists that *mimesis* must remain credible, which implies criteria for evaluating the fidelity of the simulation to the behavior of the world.

2.2 APPEARANCE, KNOWLEDGE AND REALITY

During modernity, reflection on the relationship between appearance and reality intensified. Descartes (1999), when starting the *Metaphysical Meditations*, decides to put everything in doubt. He considers that his senses can deceive him and hypothesizes an *evil genius* who could manipulate him in all things. To reinforce the doubt, imagine that perhaps you are dreaming and that all perceptions are illusions. The Cartesian goal is to find indubitable truths, but the thought experiment suggests an uneasiness about the reliability of representations. If the mind can be deceived, how can we believe that a simulation adequately portrays reality? Immanuel Kant (2001, 2011) reacts to the polarizations between empiricism and rationalism, proposing a synthesis. For the philosopher, we know the world only as a phenomenon, that is, as it is organized by *the a priori forms* of sensibility, space and time, and by the categories of understanding. Space and time are not properties of objects, but filters added by the mind, without them, we would not perceive anything. Therefore, there is a reality in itself (*noumeno*) that we cannot know directly. Consequently, validation criteria must recognize this limitation: simulations approximate observed phenomena, but do not capture the essence of things.

2.3 SEMIOLOGY AND CONSTRUCTION OF MEANING

Another fundamental contribution to understanding representations comes from semiology. Chandler (2017, p. 22) states that *we think only of signs*, anything can become a sign if it is interpreted as such. Ferdinand de Saussure, as cited by Chandler (2017), in turn, describes the linguistic sign as composed of a signifier (the sound or visual form) and a signified (the concept). The association between signifier and signified is arbitrary and depends on social conventions. Simulations, as sets of images, codes and *outputs*, function as signs whose interpretation gives meaning to the data. This means that the status of *reality* attributed to a simulation depends on the intersubjective agreement about its correspondence with the modeled phenomenon. If users interpret the *outputs* as reliable representations, the simulation acquires epistemological power; if not, it loses credibility. Jean Baudrillard radicalizes this view by arguing that the era of postmodernity is dominated by simulacra: representations that have no original. He describes four stages of the image: first, it reflects a reality, then it masks and denaturalizes reality, then it masks the absence of reality, and finally it becomes pure *simulacra* unrelated to the real. In the *hyperreal*, representation replaces the real in such a way that distinction becomes useless. The popularity of virtual worlds, social networks, and digital twins can be seen as a manifestation of this phenomenon: individuals interact with images that do not refer to an original, building identities and strategies based on simulated data. If simulations take the place of reality, the question about their fidelity becomes less relevant than the analysis of their social and psychological effects. Baudrillard (1991) relates these phases of the image to the concept of *hyperreal*, emphasizing that representations dispense with the original and establish a logic of simulacra.

2.4 PHILOSOPHY OF TECHNIQUE: FROM THE WORLD AS IMAGE TO FRAME

Heidegger (2001, 2014) emphasizes that modernity conceives the world as a calculated and manipulable image, and Anders (1956) observes that reality comes into existence as an incessant chain of images. Martin Heidegger (2014), in his essay *The Age of the Worldimage*, examines the relationship between technique and representation. For him, modernity is characterized by the conception of the world as an image: it is not only a matter of creating images of the world, but of converting the world itself into an image. Reality comes to be defined by calculated and manipulated images, and "knowing the world as an image" becomes the rule. The philosopher observes that the essence of technique is not instrumental; Modern technology reveals the world as a "reserve of resources" and imposes a calculating way of thinking. Anders comments that the world exists as an image, a chain of images that covers the real incessantly. From this point of view, computer simulations are not simple tools, but expressions of a way of being in which the real is produced and controlled by representation. Heidegger (2014) identifies consequences of this phenomenon: thought becomes calculating, technical acceleration imprints speed to processes, masses and gigantism subordinate singularity, and subjectivism and objectivism are intertwined in technical domination. The "frame" (*Gestell*) organizes all entities as available for use. Modern technology, by reducing the world to a manipulable image, reinforces the separation between subject and object, making man the master of a calculated reality and, at the same time, the object of control systems. To understand the status of simulations in AI, one must consider this horizon: they are part of the mode of production of the world as an image and of the technical organization of reality.

2.5 SIMULATION, KNOWLEDGE AND PHILOSOPHY OF SCIENCE

In the contemporary field, the philosophy of science discusses the epistemological status of simulations. Eric Winsberg (2009, 2010) notes that they have emerged as tools to investigate complex systems, such as climate or cosmological models, that cannot be studied directly. However, simulations differ from physical experiments. While experiments are based on direct manipulation of natural systems, simulations operate on mathematical representations and depend on processes of discretization, parameterization, and computational implementation. Winsberg (2009, 2010) distinguishes verification, the process of ensuring that the computational code correctly implements the model, validation, evaluation of how well the model represents the physical system. This distinction shows that the epistemic value of simulation results not only from its predictive capacity, but from the theoretical and empirical justification of the models employed. Frigg and Reiss maintain that simulations do not have a single epistemology; they are part of a broader scientific practice and lack specific criteria of justification. Winsberg (2009, 2010) also discusses the debate over whether simulations are analogous to experiments. Some defend the "identity thesis", according to which simulations are experiments run on models, and that, therefore, experimental epistemology applies to them. Others, such as Parker, propose a pragmatic approach, suggesting that validation methods can combine elements of empirical testing and statistical analysis. For the purposes of this article, it is important to highlight that simulation does not replace empirical research, but complements it, and that its results should be interpreted in the light of underlying models and hypotheses. When employed for AI, simulations constitute artificial environments that may or may not reflect the real world.

2.6 SKEPTICAL HYPOTHESES: BRAINS IN VATS AND SIMULATED UNIVERSES

Questions of reality and simulation take on metaphysical contours in the thought experiments of Putnam (1981, 1988, 1990) and Bostrom (2003, 2018). Hilary Putnam (1981) proposes to imagine that all human beings are brains in a vat connected to a computer that produces sensory experiences. The "brains" believe they live in a real world, but all they perceive is manipulation. Putnam (1981) argues that this hypothesis is self-contradictory because, if the linguistic terms refer to the *inputs* produced by the simulation, the phrase "we are brains in a vat" could not be true in the reference system. Despite this semantic critique, the experiment reveals the concern that our perceptions can be controlled by advanced computer systems, an idea that resurfaces in science fiction narratives and debates about virtual reality. Nick Bostrom (2003, 2018) develops the simulation argument, formulating a trichotomy: (1) the probability that advanced civilizations will become extinct before reaching a "posthuman" stage is high; (2) the probability that posthumans are not interested in running many "ancestral simulations" is high; or (3) we are almost certainly living in a simulation. The philosopher maintains that if future computational capabilities allow the creation of simulated universes containing conscious beings, and if there is interest in doing so, the number of simulated beings will outnumber the original beings. The conclusion is that "there is a significant possibility that we are in a simulation," and that the hypothesis cannot be easily ruled out. This line of thought, although speculative, reinforces the need to question the relationship between simulations and reality, including in the daily use of computer models.

2.7 TURING TEST, COMPUTATIONALISM, AND ARTIFICIAL CONSCIOUSNESS

In the early 1950s, Alan Turing proposed a pragmatic criterion for evaluating machine intelligence. The "Turing test", formerly called the "imitation game", consists of a human evaluator talking to a machine and a human without knowing which is which. If the evaluator is unable to distinguish, within a given time, who the machine is, it is considered to demonstrate intelligent behavior. Turing replaces the question "Do machines think?" with "Can machines imitate human language indistinguishably?" The test influences the development of AI and gives rise to debates about whether the ability to generate believable responses is enough to attribute intelligence. Hilary Putnam (1981, 1988, 1990), initially an advocate of "computationalism", later criticized the view that the mind is a computer program. In an argument known as "multiple realization," he asserts that any physical system can be interpreted as implementing a finite state machine, which would trivialize the notion of computation, requiring additional criteria to distinguish truly computational systems. In a similar vein, John Searle (1980, 2006) argues, in the "Chinese room" thought experiment, that a computer can manipulate symbols and provide correct answers without understanding their meaning. In the example, a person who does not know Chinese follows a set of rules to correlate questions in Chinese to answers in English; To observers, it seems that she understands the language, but internally nothing is understood. For Searle (1980, 2006), syntactic manipulation is not enough to generate semantics, therefore, simulations of cognitive processes are not equivalent to conscious experience. These arguments suggest conceptual limits to mind and consciousness simulations.

2.8 SIMULATION AND ARTIFICIAL INTELLIGENCE: REINFORCEMENT AND DIGITAL TWINS

With the rise of *reinforcement learning* (RL), simulations have become essential components of algorithm training. Unlike supervised methods, in which models learn from labeled data, RL requires an agent to explore an environment and receive rewards or punishments according to their actions. To conduct thousands or millions of experiments without physical risk, simulations that emulate the environment are used. A case study from the company Simwell notes that simulation provides a controlled and risk-free environment for testing strategies, and is indispensable for RL because it allows for repeatable testing and collecting performance metrics. In these simulations, the agent evaluates different policies and adjusts their behavior, later, the policies can be implemented in the real world, reducing costs and risks. Another technological trend is the use of digital twins. A digital twin is a virtual replica of a physical object, built from sensor data, mathematical models, and AI algorithms. The *Simio* report highlights that digital twins originated in the aerospace sector, when NASA used simulators to replicate flight conditions, and that the concept was formalized by Michael Grieves in the early 2000s. Today, digital twins incorporate AI to perform predictive analytics, optimization, and predictive maintenance, allowing systems to be monitored and adjusted in real-time. The integration between AI and digital twins results in "smart twins" that learn from data and evolve over time. However, such technology reinforces Baudrillard's concern: the virtual replica can become more real than the object, influencing decisions based on calculated projections. Researchers are also investigating the use of real images to generate photorealistic simulations. A 2024 paper from the University of Washington reports on the development of the RialTo and URDFormer systems, which build digital twins of buildings or environments from smartphone scans or internet images. These simulations allow you to train robots quickly and cost-effectively, allowing them to adapt to real-world conditions. The goal is to democratize the use of detailed simulations, reducing the *gap* between virtual models and the physical world. Despite the benefits, the ability to create reliable simulations from available data also raises ethical questions about privacy and surveillance.

3 METHODOLOGY

This study is characterized by a qualitative approach of a theoretical-exploratory nature, based on systematic bibliographic research and documentary analysis (Gil, 2019). The investigation adopts the hermeneutic-dialectical method to understand the complex relationships between computer simulations and representations of reality, articulating classical and contemporary philosophical traditions with current technological implications (Minayo, 2014). The methodological design followed the assumptions of exploratory research, which aims to provide greater familiarity with the problem, making it more explicit and allowing the construction of hypotheses (Gil, 2019). According to Marconi and Lakatos (2017), exploratory research increases the researcher's knowledge of the facts, allowing for a more accurate formulation of problems and the creation of new hypotheses. This approach proved to be adequate given the multidisciplinary nature of the theme, which requires the articulation of philosophical, epistemological and technological knowledge. The collection of primary data was based on a systematic review of the literature, conducted by consulting the main academic databases. The bibliographic survey followed criteria of thematic relevance and academic quality, prioritizing reference works in the field of philosophy, epistemology, and philosophy of science (Severino, 2017). The search strategies included the descriptors: "computer simulations", "representation of reality", "philosophy of technology", "artificial intelligence", "epistemology of simulations", combined with Boolean operators. The time frame ranged from fundamental classic works to more recent contemporary publications, ensuring the historical breadth necessary for the proposed analysis (Severino, 2017). The theoretical *corpus* was made up of primary and secondary sources, including: (i) classical philosophical texts by Plato, Aristotle, Descartes, Kant and Heidegger; (ii) contemporary works of philosophy of science and epistemology, especially by Winsberg, Putnam, Searle and Bostrom; (iii) specialized literature on artificial intelligence and computer simulations; and (iv) technical papers and case studies on practical applications of AI simulations.

4 ANALYSIS AND DISCUSSIONS

The theoretical foundation presented outlines multiple perspectives on the relationship between simulation and reality. The tradition of Plato (2006) and Aristotle (1973, 1988) shows that imitation can both distance from the truth and allow the learning of universals. In computer simulations, the Platonic concern is manifested in the risk of taking models for reality, especially when technical verisimilitude masks simplifications. An example of this are climatic or epidemiological models that, although indispensable, do not capture all the variables of the real system. The Aristotelian reading, on the other hand, inspires a constructive use: simulations are spaces to explore possibilities and general laws, as long as the difference between possibility and fact is recognized. In AI, reinforcement learning algorithms learn from a model of the world, but transfer to the physical world requires care to avoid illusions of control. Kant (2001, 2011) and phenomenologists remind us that our experience is always mediated by cognitive structures and a *priori* forms. Simulations, as products of our sensitivity and understanding, carry these structures, including prejudices and biases. Spatiotemporal "shapes" and logical categories are programmed into the models and algorithms. Thus, the validation of simulations needs to go beyond numerical fitting, it must consider whether the models incorporate questionable assumptions. For example, facial recognition systems trained on unbalanced data sets can perpetuate discrimination, demonstrating that the statistical representation of the world becomes a form of co-production of reality. When mapping urban environments to create digital twins, it is crucial to reflect on which perspectives are privileged and which are invisible. The semiotic apparatus focuses on interpretation. As Peirce observes, nothing is a sign unless it is interpreted as such. The validity of a simulation depends, therefore, on the interpretive community that recognizes it as faithful or useful. Acceptance of the results of a climate model, for example, requires consensus among scientists on the methods and parameters. In everyday interactions, people accept the veracity of simulations when they trust the institution or technology that produces them, hence the importance of transparency and communicability of models. The dissociation between signifier and signified observed by Saussure warns that representations can slide and produce divergent interpretations. In AI, interfaces that show simplified visualizations can suggest accuracy where there is uncertainty. Baudrillard's hyperreal warns that the avalanche of simulations can displace the real: graphs and indicators of a digital twin can determine urban decisions, even if people's experience in physical space is different. Heidegger's (2001, 2014) philosophy of technique expands the analysis by situating simulations in the context of a technically armed world. Simulations participate in the logic of "frame": they transform entities into calculable and manipulable objects, favoring a dominant posture in relation to the world. The expansion of networks of sensors, algorithms and digital twins induces a vision in which all dimensions of life, health, education, mobility, are quantified and translated into data. The "world as image" implies that the real only exists when represented and calculated. However, this technical perspective needs to be balanced by a reflection on what escapes calculation. In education, for example, simulators can help learn mathematics or physics, but they do not replace the living experience of dealing with students' mistakes, doubts, and singularities. The risk is that the class becomes a mechanical reproduction of models, erasing the dialogical and creative dimension of teaching. Winsberg

(2009, 2010) shows that simulations require verification and validation processes that are different from experiments. This applies directly to AI. In reinforcement learning, the simulator code must be checked for correct model implementation, and the results must be validated by comparing simulated behaviors with empirical data. The validity of a digital twin depends on the continuous updating of the data and the fidelity of the equations used. When it comes to replicating complex social phenomena, such as human interactions in virtual environments, validation becomes even more challenging. The absence of clear criteria can lead to overconfidence in simulation or, on the contrary, to its rejection by skeptics. The skeptical thought experiments of Putnam (1981, 1988, 1990) and Bostrom (2003, 2018) invite us to reflect on levels of simulation. If reality itself could be a simulation, the distinction between "real" and "virtual" would lose meaning. Regardless of the plausibility of this hypothesis, it points to the power of technology to alter the experience. In AI, virtual environments created to train robots, such as *RialTo* and *URDFormer*, show that we can produce worlds so believable that agents generalize well to the physical world. However, if the data used to build these simulations reflect only part of social reality, we can perpetuate inequalities. The brain in a vat reminds us that by blindly trusting the *outputs* of automated systems, we can lose the ability to distinguish between representation and direct experience. The Turing test and the critiques of computationalism highlight the conceptual limits of simulations. Although machines are capable of passing modern variants of the test, this does not imply that they understand or have consciousness. Searle (1980, 2006) argues that syntactic manipulation of symbols does not generate semantics. This debate has implications for AI: conversational simulators based on large language models (LLMs) can generate coherent texts, but this does not guarantee understanding. In the educational context, it is important not to confuse a *chatbot's ability* to answer questions with a real understanding of the content or the needs of the students. Finally, the use of simulations in AI brings both benefits and challenges. Reinforcement learning in simulated environments accelerates the development of autonomous agents. Digital twins allow you to optimize industrial and urban processes, and the creation of photorealistic simulations based on images democratizes access to complex virtual environments. However, these technologies are consumed in a context of *hyperconnectivity* and data economy that involves issues of privacy, security, digital exclusion and sustainability. The power to represent and predict brings with it ethical responsibilities: who sets the parameters of the models? Who benefits from the simulations and who is excluded? How to prevent simulations from becoming mechanisms of social control? These questions should guide the development and application of simulations in the field of AI and beyond.

5 FINAL CONSIDERATIONS

The objective of this article was to investigate computer simulations as representations of reality, articulating a philosophical analysis with implications for artificial intelligence. The review of classical authors, from Plato to Heidegger, showed that the relationship between image and reality is problematic and full of nuances. Plato (2006) warns that images can take us away from the truth, while Aristotle (1973) recognizes their heuristic value. Kant (2001, 2011) and phenomenologists remind us that all representation is conditioned by our cognitive structures, Heidegger (2001, 2014) denounces that technology transforms the world into a calculable image, and Baudrillard announces the era of simulacra, in which the distinction between original and copy dissolves. The contemporary philosophy of science, represented by Winsberg (2009, 2010), reinforces that simulations require their own criteria for verification and validation, and that they do not replace experimentation, although they complement it. Thought experiments by Putnam (1981, 1988, 1990) and Bostrom (2003, 2018) expand the reflection on the ontological status of simulated reality, while Searle (1980, 2006) and Putnam (1981, 1988, 1990) criticize the reduction of the mind to computation. In the field of artificial intelligence, simulations play fundamental roles: they enable reinforcement learning, support digital twins, and provide environments for robot testing. These uses demonstrate that simulations are powerful modeling and forecasting tools. However, the evidence and arguments discussed suggest caution. It is necessary to recognize that every simulation is built from models and assumptions, therefore, it is not the world, but a representation that can hide or distort aspects of reality. Confidence in the results of algorithms trained in simulations should be proportional to the transparency of the models and the empirical validity of the data. From a pedagogical point of view, simulations can enrich teaching, but never replace the living experience of learning. And, in the ethical sphere, the use of data and images to build simulations must respect individual and collective rights. Computer simulations are representations that, at the same time, reflect and construct realities. Its growing adoption in science and AI invites a permanent dialogue between technique and philosophy. Only an analysis that considers the ontological, epistemological and ethical foundations will be able to guide a responsible and emancipatory use of these technologies. The contributions of this study to society and academia are multiple. For academia, the work offers a philosophical foundation for understanding the epistemological status of computer simulations, bridging a gap between classical philosophy and contemporary debates on technology and artificial intelligence. The articulation between distinct philosophical traditions provides a conceptual basis that can guide future research in the philosophy of technology, the epistemology of simulations, and the ethics of AI. For society, the study warns about the risks of confusing computational representations with reality, an issue that is increasingly relevant in a context of proliferation of digital twins, metaverses, and automated decision-making systems. The proposed critical reflection can support public policies and corporate practices that seek the responsible use of simulations, especially in sensitive areas such as health, education, public safety, and urban planning. In addition, by showing that simulations carry theoretical assumptions and biases, the work contributes to the debate on algorithmic transparency and social justice, central themes in the contemporary agenda of technological governance. As for the limitations of the research, it is recognized that the study has an eminently theoretical and exploratory character, not contemplating empirical analyses of specific cases of application of computer simulations in AI contexts. Although the literature review has covered relevant classical and contemporary authors, the literature on the philosophy of simulation is vast and constantly expanding, so that other philosophical perspectives could enrich the analysis. In addition, the article did not develop a specific methodological protocol for epistemological and ethical evaluation of simulations, limiting itself to identifying general conceptual issues. Finally, the discussion on digital twins and reinforcement learning drew on secondary sources and available technical literature, without direct access to proprietary implementations or primary data from companies developing these technologies. It is recommended, for future studies, to carry out empirical research that analyzes concrete cases of use of simulations in AI projects, examining how philosophical assumptions manifest themselves in the practice of modeling and validation. It would be productive to develop operational criteria, inspired by the philosophy of science, to assess the epistemological adequacy of simulations employed in critical contexts, such as public health or social policies. It is also suggested to investigate, from an interdisciplinary perspective, the psychosocial impacts of immersion in simulated environments, articulating philosophy, psychology and sociology. Studies on the relationship between simulations and algorithmic biases, analyzing how simplifications and *design* choices perpetuate inequalities, constitute an urgent research agenda. It is recommended to develop *specific ethical frameworks* for the use of digital twins and AI training environments considering privacy, consent, and transparency concerns, in dialogue with emerging regulations on artificial intelligence.

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