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ARTICLE

REFLECTIONS ON ARTIFICIAL INTELLIGENCE IN THE LIGHT OF THE FOUNDATIONS OF VOCATIONAL EDUCATION [1;2]

EDUARDO ANDRÉ MOSSIN[1]
ORCID: https://orcid.org/0000-0001-5144-518X
<emossin@ifsp.edu.br>
GISELLE ALVES MARTINS[2]
ORCID: https://orcid.org/0000-0003-1711-4031
<gisellealvesmartins@gmail.com>
RIAMA COELHO GOUVEIA[1]
ORCID: https://orcid.org/0000-0002-4100-891X
<riama@ifsp.edu.br>
RODRIGO PALUCCI PANTONI[1]
ORCID: https://orcid.org/0000-0001-8644-7118
<rpantoni@ifsp.edu.br>

1 Instituto Federal de Educação Ciência e Tecnologia de São Paulo. Sertãozinho, SP, Brasil.
2 Universidade de São Paulo, Ribeirão Preto, SP, Brasil.

ABSTRACT: Contemporary society faces a significant challenge in integrating Artificial Intelligence with vocational training. This type of education has historically been marked by the duality between technical training for workers and humanistic training for the elite. In this context, the idea of Vocational Education arises, which seeks to integrate vocational training with human training, with the aim of omnilateral training. Its foundations include work as an educational principle, interdisciplinarity, research as a pedagogical principle, the integration of work, science, technology, and culture, and the inseparability between education and social practice. Faced with the complexity intrinsically linked to Artificial Intelligence, a strictly technical training, hallmark of vocational education in Brazil, is not capable of preparing workers to face the challenges of this new reality. In this context, the article highlights the importance of comprehensive training and seeks to stimulate reflection on the relationships and impacts of Artificial Intelligence on the production system, the educational process, and society. Methodologically, the study develops an analysis of the interconnections between the foundations of Vocational Education and Artificial Intelligence, addressing aspects such as work, human rights, research, authorship, and interdisciplinarity. The conclusions indicate that this new scenario requires a critical and reflective approach that considers both its transformative potential and the associated risks. The study emphasizes the need for training that goes beyond mere technical instrumentation, preparing individuals to understand and deal with the social, ethical and cultural implications of Artificial Intelligence.
Keywords: artificial intelligence, professional and technological education, work, technology.

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REFLEXÕES SOBRE A INTELIGÊNCIA ARTIFICIAL À LUZ DOS FUNDAMENTOS DA EDUCAÇÃO PROFISSIONAL E TECNOLÓGICA

RESUMO: A sociedade contemporânea enfrenta um desafio significativo na integração da Inteligência Artificial com a formação profissional. Esta modalidade de educação é marcada historicamente pela dualidade entre a formação técnica voltada para trabalhadores e a formação humanística destinada às elites. Neste contexto surge a ideia de uma Educação Profissional e Tecnológica que busca integrar a formação profissional com a formação humana, tendo como objetivo a formação omnilateral. Seus fundamentos incluem o trabalho como princípio educativo, a interdisciplinaridade, a pesquisa como princípio pedagógico, a integração entre trabalho, ciência, tecnologia e cultura, e a indissociabilidade entre educação e prática social. Diante da complexidade intrinsecamente ligada à Inteligência Artificial, uma formação estritamente técnica, marca da educação profissional no Brasil, não é capaz de preparar o trabalhador para enfrentar os desafios dessa nova realidade. Neste contexto, o artigo destaca a importância de uma formação integral e busca estimular reflexões sobre as relações, impactos da Inteligência Artificial no sistema produtivo, no processo educativo e na sociedade. Metodologicamente, o estudo desenvolve uma análise das interconexões entre os fundamentos da Educação Profissional e Tecnológica e a Inteligência Artificial, abordando aspectos como trabalho, direitos humanos, pesquisa, autoria e interdisciplinaridade. As conclusões indicam que este novo cenário requer uma abordagem crítica e reflexiva, que considere tanto seu potencial transformador quanto os riscos associados. O estudo enfatiza a necessidade de uma formação que supere a mera instrumentalização técnica, preparando os indivíduos para compreender e lidar com as implicações sociais, éticas e culturais da Inteligência Artificial
Palavras-chave: inteligência artificial, educação profissional e tecnológica, trabalho, tecnologia.

REFLEXIONES SOBRE LA INTELIGENCIA ARTIFICIAL A LA LUZ DE LOS FUNDAMENTOS DE LA EDUCACIÓN PROFESIONAL Y TECNOLÓGICA

RESUMEN: La sociedad contemporánea se enfrenta al importante reto de integrar la Inteligencia Artificial con la formación profesional. Este tipo de educación se ha caracterizado históricamente por la dualidad entre formación técnica para los trabajadores y formación humanística para las élites. En este contexto, surge la idea de Educación Profesional y Tecnológica que pretende integrar la formación profesional con la formación humana, con el objetivo de una formación omnilateral. Sus fundamentos incluyen el trabajo como principio educativo, la interdisciplinariedad, la investigación como principio pedagógico, la integración del trabajo, la ciencia, la tecnología y la cultura, y la inseparabilidad entre educación y práctica social. Frente a la complejidad intrínsecamente vinculada a la Inteligencia Artificial, la formación estrictamente técnica, que es el sello distintivo de la educación profesional en Brasil, es incapaz de preparar a los trabajadores para hacer frente a los desafíos de esta nueva realidad. En este contexto, el artículo enfatiza la importancia de la formación integral y busca estimular la reflexión sobre las relaciones e impactos de la Inteligencia Artificial en el sistema productivo, en el proceso educativo y en la sociedad. Metodológicamente, el estudio desarrolla un análisis de las interconexiones entre los fundamentos de la Formación Profesional y Tecnológica y la Inteligencia Artificial, abordando aspectos como el trabajo, los derechos humanos, la investigación, la autoría y la interdisciplinariedad. Las conclusiones indican que este nuevo escenario requiere un enfoque crítico y reflexivo que considere tanto su potencial transformador como los riesgos asociados. El estudio subraya la necesidad de una formación que vaya más allá de la mera instrumentalización técnica, preparando a los individuos para comprender y tratar las implicaciones sociales, éticas y culturales de la Inteligencia Artificial.
Palabras clave: inteligencia artificial, educación profesional y tecnológica, trabajo, tecnología.

INTRODUCTION

Vocational education has historically been related to the training of workers in different sectors of production. It is marked by disputes between different conceptions of the educational process (Frigotto, 2012). In recent decades, it has come to be called EPT- *Educação Profissional e Tecnológica*, and has been defined as an "educational modality that permeates all levels of national education, integrated with other modalities of education and the dimensions of work, science, culture and technology" (Brasil, 2021, art. 2, our translation). EPT courses and programs can be developed as: i) Professional Qualification, at different levels, including worker training; ii) Secondary Vocational Education, integrated or not with High School, in Basic Education; and iii) Technological Professional Education, undergraduate and postgraduate, including professional master's and doctorate degrees.

In a society divided between those who own capital and those who own the labor force, with conflicting interests, education is situated within the class struggle (Saviani, 2013). In other words, the configuration of power dynamics in society is reflected in and directly influences educational concepts and practices, generating an educational duality. This duality, throughout Brazil's history, has intensified in high school, with the existence of a type of education aimed at the elite, which prioritized a broad and humanistic education, and an education for the working class, often limited to technical and practical aspects for immediate professionalization. Education focused only on technical aspects is not sufficient for an education that enables to overcome the fragmentation of knowledge and contemplate the multiple dimensions of students' lives (Kuenzer, 2007a).

In this context, EPT, committed to comprehensive human development, aims to overcome the educational and social division of labor by offering an education that integrates all dimensions of existence, for the omnilateral development of students (Ramos, 2014). Omnilateral development occurs "in all aspects of human life – physical, intellectual, aesthetic, moral and for work, integrating general education and vocational education" Ciavatta (2014, p. 191, our translation). This means that EPT seeks to include both education focused on the technical and practical aspects of the world of work and broad, humanistic intellectual education. This proposal has been materialized through Integrated High School, which contains general and technical training subjects in a single curriculum, especially in the Federal Institutes of Science and Technology Education (*Institutos Federais de Educação Ciência e Tecnologia*), which aim to offer this type of education as a priority. Therefore, Federal Institutes are spaces that seek to overcome the historical duality between education for the elite and education for the working class, promoting an education not only preparing for work, but the full development of the individual.

In addition to comprehensive and omnilateral human development and curricular integration, the foundations of EPT include work as an educational principle, the integration of work, science, technology and culture, interdisciplinarity, research as a pedagogical principle and the inseparability of education and social practice (Brazil, 2021). Thus, in a society in which technological advances are incorporated and transform the production system, agents of the educational process need to reflect on the relationships between technology, education and the world of work. Considering technological innovations in other spheres of social life such as communication and art, education actors also need to analyze the impacts of technologies on their relationships with science and culture.

Artificial Intelligence (AI) is one of the technologies able to promote major transformations in different aspects, significantly influencing the future of society. In simple terms, AI is a field of computing focused on the development of systems that imitate human intelligence. AI involves several technologies and methods, allowing machines to perform complex tasks such as pattern recognition and decision-making. In one of its aspects, AI allows systems to learn from data and experience, without relying on predefined rules (Tiwari, Tiwari, and Tiwari, 2018).

The multiple relationships between AI and the foundations of EPT raise several questions. These reflections are fundamental for a critical analysis of the educational process. Therefore, this article aims to bring reflections on the relationships, impacts and consequences of AI in the productive system, in the educational process and in society in general in the context of EPT. The discussions will address the interconnections between the foundations of EPT and AI, with emphasis on the political, social,

economic and ethical issues related to AI; the use of AI in research; the interdisciplinarity of AI, among other relevant aspects.

The following paragraphs of this introductory section will provide a detailed description of the proposal, establishing the basis for the analysis of the themes in the subsequent chapters. It is important to note that this article does not seek to exhaust the discussions on the issues raised but rather to stimulate reflections on the impacts of AI in the educational field and particularly in EPT. Additionally, the following paragraphs preliminarily outline the main themes to be investigated and describe the structure of the article.

The first section of the article introduces some basic concepts and general reflections on AI. Before starting specific discussions on each topic, it is important to introduce some basic elements about AI, which are necessary to understand the subsequent discussions. Specific tools will not be mentioned, but rather a general overview of the technology, since the speed of change and the emergence of new AI could make these parts of the text obsolete quickly.

The text deals specifically with issues related to work, AI and EPT since one of the foundations of EPT is work as an educational principle. The impact of AI on the world of work is a concern for many current authors (Schwab, 2016; Harari, 2018; Nazareno; Schiff, 2021; Cramarenco; Burcă-Voicu; Dabija, 2023; Markelius et al., 2024). These impacts are not limited to the issue of jobs but include economic and labor relations, especially the training of workers (Kuenzer, 2000; Kuenzer, 2007b; Frigotto, 2012). Thus, a discussion on the transformations in the world of work brought about by the use of AI and the relationship established between these changes in the world of work and vocational education is presented in the section "Work, AI and Vocational Education".

It is worth highlighting that the numerous possible applications for AI play a crucial role in structuring new social dynamics, not only in terms of the economy and work, but also in political, cultural and scientific aspects. Since one of the foundations of EPT is the integration between work, science, technology, culture and the inseparability of education and social practice, some topics reflecting on the interconnections between AI and human development processes, from the perspective of EPT, are presented in the section "AI and Human Development". Considering the complexity of the topic, this section is subdivided into three parts: "Human Rights, Ethnic-Racial and Gender Equality", "Research and Authorship" and "Interdisciplinarity".

The subsection "Human Rights, Ethnic-Racial and Gender Equality" addresses an aspect relevant to the topic, referring to the ethical issues that arise with AI. It emphasizes on the biases that can be introduced into systems by the data sets used and the choices made by their developers, resulting in discrimination; the complexity of some types of AI, in which decision factors are inaccessible to human verification or correction, raising concerns about explainability and transparency; issues related to the right to individual privacy and data security; the possibility that AI algorithms reinforce pre-existing beliefs based on users' interests, which can restrict access to new ideas, among others (Liu; Roehl; Mukherjee, 2021). The necessary inseparability between education and social practice supported by EPT requires a training process that allows for a broad and critical view of all these issues.

In the subsection "Research and authorship", the basis of EPT on research as a pedagogical principle involves the impact that AI brings to the field of research. AI is inserted into the context of research, whether in the form of research for a simple school task that can be done on ChatGPT, or in the form of work by complex AI systems in simulating the action of new drugs. This participation of AI in research raises a set of copyright and intellectual property issues.

Finally, the subsection "Interdisciplinarity" discusses the interdisciplinary nature of AI, both in its scientific and technological principles, which involve knowledge from different areas of knowledge, and in its application possibilities in EPT. The affirmation of this intrinsic and applied interdisciplinarity does not in any way exclude the specificities of each area of knowledge, which is reflected in the different sections, which deal particularly with some topics of interest. In this context, this subsection addresses the interdisciplinary aspect of AI regarding its relationship with the foundations of EPT, although in many previous moments of the text the intersections between the different aspects of AI are evident.

Thus, this study contributes to the professional practice of EPT by providing fundamental reflections on the intersections between AI and the guiding principles of EPT. By critically analyzing the

relationships between AI, work, research, human rights, and interdisciplinarity, the study provides support for EPT professionals to rethink their pedagogical practices and develop educational strategies that contemplate the challenges and opportunities brought by this technology. The research innovates in the field of literature on AI by examining this technology from the specific perspective of EPT, highlighting how its impacts manifest in an educational context that seeks the omnilateral training of students and the mitigation of the historical duality existing in vocational education.

ARTIFICIAL INTELLIGENCE: GENERAL ASPECTS

This section begins with some basic and fundamental definitions for understanding AI. A broad understanding of all the scientific and technological concepts related to the functioning of AIs is a complex task, which requires advanced knowledge of computing, data science, among others beyond the scope of this article. However, since one of the objectives of EPT is to provide students with the necessary foundations for a critical analysis of technology, all EPT agents need to understand some basic aspects regarding AIs.

AI, pioneered by John McCarthy, is the field of computing dedicated to developing systems capable of imitating human intelligence. This scientific branch focuses on creating machines that can process information and respond to stimuli in a similar way to the human brain. AI acts as a broad field in computing, encompassing various technologies and methods for developing intelligent systems. Its scope ranges from basic algorithms to sophisticated learning techniques, allowing machines to perform complex tasks such as pattern recognition, decision-making and problem-solving - capabilities traditionally associated with human cognition. Machine Learning (ML), a branch of AI, allows computer systems to learn from data, examples and experience, instead of following pre-programmed rules. Through ML, computers can improve their performance on specific tasks over time, using techniques such as Linear Regression, Decision Trees, Random Forest and Artificial Neural Networks to identify patterns and make decisions based on data. Deep Learning (DL) is a specialized subdivision of ML that uses Artificial Neural Networks with multiple layers to process data in its raw form. This technique has proven to be particularly effective in tasks such as natural language processing, speech recognition, image recognition, among others, surpassing human performance in many cases. The relationship between these concepts can be understood as hierarchical: DL is a specific type of ML, which in turn is a branch of AI (Tiwari, Tiwari, and Tiwari, 2018).

Based on these definitions, the use of large databases for the learning process as the central characteristic of the AIs stands out in this article. This characteristic is essential, as it entails a series of challenges and controversies associated with the topic. This is because such databases are created by human beings, reflecting a wide range of existing social issues. Thus, AIs can reproduce and amplify problems such as biases, inequalities and discrimination in social structures, which makes it necessary to critically examine the impacts of these technologies.

AI has been expanded its capabilities with the emergence of new approaches and techniques. Although the concept of AI was pioneered by John McCarthy in 1956, the exponential development of this technology is a relatively recent phenomenon, driven mainly by advances in processing capacity, availability of large volumes of data and the evolution of techniques such as Machine Learning and Deep Learning. In this scenario of technological evolution, generative AIs have emerged as one of the most significant innovations in the field, standing out for their ability to create new and original content from existing data. We can highlight the public launch of ChatGPT in November 2022, which constitutes a milestone in the evolution of AI systems, not only by allowing access to a natural language processing technology previously restricted to specialized environments, but also by demonstrating an unprecedented advance in the ability of AI systems to understand, process and generate content in natural language in a contextually appropriate and semantically coherent way. This technological shift represents a significant break with previous models, establishing new parameters for human-machine interaction and causing profound transformations in contemporary social, educational and professional dynamics.

In the current historical-economic context, characterized by rapid technological transformations and growing demands for automation and information processing, these tools gain special relevance due to their ability to generate content, process natural language and perform complex tasks that were previously exclusively human. This technological evolution not only responds to the needs of an increasingly digitalized world but also raises important questions about the future of work, education and social relations, especially considering that these technologies are trained with data that can reflect and amplify existing social issues, such as biases and inequalities.

Among generative AIs, this text has two approaches related to the topics covered: Large Language Models (LLM) and Generative Adversarial Networks (GAN). LLMs, such as ChatGPT, Claude.ai, Gemini, among others, are designed to understand and generate human language in a coherent way, based on large volumes of text and allowing the performance of tasks such as automatic translation, text generation and even interactive dialogues. These AIs are based on a specific type of Artificial Neural Network architecture known as Transformer. The operation of LLMs involves a complex text generation process. When a stimulus is given (prompt with a command), it is initially divided into smaller units called tokens, which are inserted into the model. The model then uses statistical patterns to predict the most likely sequence of words or phrases that would form a coherent response to the stimulus. These patterns are based on large volumes of text extracted from various sources, such as the internet. In other words, the model learns from data from sources that are not necessarily reliable. The model evaluates the probability of specific words or phrases occurring in the given context and, based on this analysis, generates the response word by word, repeating the process until a complete response is formed. In an attempt to avoid offensive or harmful results during this generation, filters known as guardrails are applied. In addition, after the text is generated, the response is post-processed to ensure greater readability, including adjustments such as formatting and punctuation, and the introduction of initial words that are typical in human responses, such as "certainly" or "of course" (Unesco, 2024).

Generative AIs for images and music generally use Generative Adversarial Networks. GANs consist of two components: the "generator," which creates images or music from a command, and the "discriminator", which tries to distinguish between the generated content and the real one. The generator adjusts its parameters based on the results of the discriminator, repeating the process until the generated images or music become increasingly realistic. For example, a GAN trained on landscape photographs can generate images that are almost indistinguishable from real photos, and one trained on popular music can create new compositions with the same structure. These models are trained using images from often unknown sources, which can lead to problems related to the quality and authenticity of the generated content. Since images and music are extracted from vast databases, often without strict control over the sources, it is possible that the generated content may contain inaccuracies or distortions, compromising its reliability. Furthermore, because these AIs are trained on databases of human-generated images, they inevitably reflect the biases present in that data. For example, an AI generating images may reproduce stereotypes or prejudices present in the images used to train it, such as the predominance of certain ethnicities, leading to results that do not fairly and evenly represent human diversity. Therefore, it is crucial to be aware of the biases and limitations of these models, especially when using them in sensitive or high-impact social contexts (UNESCO, 2024).

Regardless of the type of generative AI that teachers or students choose, it is essential to understand the appropriate techniques for inputting data into these systems, a process called prompt engineering. This practice is essential to ensuring that effective results are achieved with generative AI. While using these technologies may seem straightforward, the task of formulating commands that achieve the desired outcome often requires adjustments and refinements to prompts. Prompt engineering involves applying specific techniques to create commands that more accurately align with the user's intent, including using clear and direct language, illustrative examples, providing relevant context, and performing iterations. It is equally important that commands are ethical and avoid generating inappropriate or harmful results. In addition, it is essential to critically evaluate the results provided by AI, as they may be flawed or produce inaccurate information. Rigorous performance assessment, with the adoption of specific metrics for each type of task, becomes a crucial step before large-scale implementation of generative AI tools, especially in high-risk contexts (Unesco, 2024).

Although generative AIs bring transformative innovations, the focus of the article, as already presented in the introduction, is to provoke reflection on the challenges and problems that these technologies can bring about in the context of EPT. By exploring the potential of these AIs, the article also seeks to highlight the ethical, social and educational issues that arise with their advancement, such as the automation of tasks, the issue of authorship and the impact on professional training, questioning how these technologies can affect the preparation of students for a future increasingly influenced by them.

In this context, after an initial presentation on AIs, the text continues with the first general reflections on the use of generative AIs. In this way, the reflection proposed by Crawford (2022) is presented, which discusses the nature and impacts of AI technologies. According to the author, AI is neither artificial nor intelligent. The author highlights that AI is composed of natural resources, human labor, infrastructure, fuel, stories, logistics, and classifications. AI systems are not autonomous, rational, or able to discern anything without extensive and intensive computational training, using large volumes of data or pre-established rules and rewards. As we know it, AI carries a wide range of economic, political, cultural, and historical structures. Thus, AI systems both reflect and produce social relations and understandings of the world. This broader view of AI aligns with the perspective, in EPT, that the educational process is established at the interface between work, science, culture, and technology and that the educational process is not separate from social practice.

Another important aspect to be highlighted is the meaning of the information generated by AI. Current tools are prone to "hallucinations", generating texts that may not make sense or be untrue, but are presented in a way that appears to be reliable. Amorim (2024) states that the texts used in AI training do not have intrinsic meaning for the model and the texts generated by it only make sense when interpreted by humans. Therefore, for the proper use of the material generated by AI, prior knowledge of the subject and the ability to critically analyze the textual content are essential.

Also, AIs depend on large-scale physical and technological infrastructure for its training and operation. Due to the investment required to build AI on a large scale, AI systems are ultimately developed to serve the interests of the ruling classes. Human knowledge is behind the texts generated by AIs, built over centuries and stored digitally, constituting the raw material used by large technology companies called Big Tech. Thus, this topic requires a reflection beyond knowledge about Artificial Neural Networks and statistical pattern recognition. We must reflect on what is being optimized and for whom. AI is an instrument of power. AI is fundamentally political.

In this context, Crawford (2022) states that whoever masters AI technology will master the power to define how the world is measured and interpreted. The author says that the perspectives underlying the field of AI do not emerge independently but are shaped by a specific set of beliefs and worldviews. Crawford (2022) also highlights that the main architects of AI are a restricted and homogeneous group of individuals, concentrated in a few cities, working in an industry that currently holds the greatest wealth in the world. When analyzing these aspects, there is an even greater tendency for concentration of power and an increase in social inequalities. After all, this concentration of resources increases and perpetuates the existing imbalances in society, favoring those with greater access to technology and capital.

There is also the issue of responsibility for what is generated by AI. The example of Amorim (2024) cites that ChatGPT wrongly accused a teacher of sexual harassment. If the accusation had been made by one person, such an episode would be considered slanderous and false. Since it was an AI that generated the accusation, the fact was classified only as a "hallucination". Analyzing the problem, the author states that a machine cannot hallucinate, since it acts according to models and algorithms implemented by humans. As machine learning models become more complex, the responses of intelligent systems become increasingly unpredictable. Amorim (2024) also states that examples like this illustrate the far-reaching consequences that can arise when immature technologies are released to the public for practical testing, with almost no regulation.

Together with this responsibility, the wide use of AI in society raises concerns about regulating the development and use of this technology. The large-scale application of AI requires large investments, putting pressure on business leaders to launch products quickly, hindering to reconcile short-term financial returns with the precautions needed to deal with potentially destructive technologies. Therefore, it is urgent to propose standards that regulate technologies at a national and/or global level.

At the time of writing this text, only the European Union has approved an AI regulation in the world. They became the first to establish rules for the use of AI and tend to influence the rest of the planet. Guillot (2024) reports that the main concern of the European Parliament is to ensure that AI systems used in the European Union are safe, transparent, traceable, non-discriminatory, and environmentally sustainable. The regulation also provides that AI systems must be monitored by humans, rather than operating in a fully automated manner, to avoid negative consequences. Guillot (2024) also reports that the regulation establishes obligations for AI providers and users, and these obligations depend on the level of AI risk. The author presents these risk levels and the types of applications that fit into the respective levels. For example, we can mention the "social score" application, which classifies people based on behavior, socioeconomic status, and personal characteristics. This application is classified as "unacceptable risk".

Although this is the first regulation in the world, several documents guide the use of AI. When analyzed, they often present similar concerns and guidelines. Corrêa et al. (2023) developed a study that sought to determine whether there is a global consensus on the ethical principles that should govern the use of AI and contribute to future regulations. To this end, the authors analyzed 200 governance policies and ethical guidelines for AI, published by public agencies, academic institutions, private companies, and civil society organizations around the world. The authors identified several recurring principles in policies and guidelines, such as transparency, explainability, auditability, reliability, security, trustworthiness, justice, equity, non-discrimination, privacy, accountability, responsibility, freedom, autonomy, democratic values, technological sovereignty, diversity, inclusion, pluralism, accessibility, beneficence, non-maleficence, dignity, human rights, cooperation, fair competition, open source, human-centeredness, alignment, sustainability, labor rights, truthfulness, intellectual property, children's and adolescents' rights.

When all these aspects are analyzed, the scope of the topic becomes clear. Thus, the importance of this issue being prioritized in the EPT environment is highlighted, reinforcing Crawford's (2022) consideration that states that AI systems are embedded in the social, cultural, political, and economic worlds, shaped by human beings and institutions that determine what they do and how they do it. Therefore, the history of vocational education in Brazil reveals a persistent dichotomy. On the one hand, a broad and humanistic education for the dominant classes. On the other hand, a technical and pragmatic education for workers. This division reflects and maintains historical social inequalities. Therefore, it is essential to understand that an exclusively technical education, focused only on the development of practical skills, is insufficient to provide an education to deal with the multidisciplinary complexity in AI systems.

From this perspective, it is essential to reflect on an education that promotes a conception and pedagogical practices to train critical individuals, capable of driving profound and urgent transformations in reality (Oliveira; Dias, 2022). In other words, it is necessary to conceive of an omnilateral education that favors the integral development of the human being, ensuring everyone the right to receive a complete education, which enables a real reading of the world and allows civic action, politically integrated into society (Ciavatta, 2008).

Therefore, Oliveira and Frigotto (2021) state that "these principles signal a school that forms man in his totality and integrality, based on a broad vision of the world. Professional and technological training implies training for work as a manifestation of autonomy, emancipation, and creation" (Oliveira; Frigotto, 2021, our translation).

WORK, AI AND VOCATIONAL EDUCATION

The history of humanity is marked by major changes in how humans produce food, shelter, and all kinds of material goods, that is, in the world of work. Technological development is one of the drivers of these transformations. Changes in production processes and work follow and promote transformations in relationships between people and how new generations are educated, preparing them for work. This section, which begins with the presentation of the conception adopted for work and education, discusses the changes in production processes and the world of work throughout history and their influence on educational processes, so that it is possible to understand the subsequent discussion

on the impacts of AI on the contemporary production system and world of work, as well as its reflections on the educational system.

Work, as the action of man on nature transforming it according to his needs and transforming himself in the process, is considered a characteristic of human beings (Frigotto, 2012). Education can be defined as the appropriation, by new generations, of socially and historically constructed knowledge and culture. When it comes to acquiring knowledge more directly related to the production of goods, it is characterized as Vocational Education (Ramos, 2012).

In primitive societies, where human beings collectively produced their existence, without differentiation in the principles of work, the education of new generations and work were inseparable actions and in an essentially similar way for all the social group members (Saviani, 2007). Since society was structured into classes, whether free men and slaves or feudal lords and vassals, work has been differentiated, characterized as intellectual work, carried out by the dominant class, and manual work, carried out by the dominated class. Following the differentiation of work, education has also been divided: a humanistic education for the dominant class and an education aimed at learning techniques for manual work, for the dominated class (Saviani, 2007; Kuenzer, 2000).

Science, in industrialized capitalist society and representing intellectual work, was materialized in the production process through technological development. As a result, it became necessary to provide workers with qualifications that involved specific knowledge "directly determined by the needs of the production process" (Saviani, 2007, p. 159, our translation). That means, in addition to practical knowledge, a certain limited intellectual training (Ramos, 2012). In this context, educational duality is characterized by the general education schools for the ruling class and professional training schools for workers, giving rise to Vocational Education systems (Kuenzer, 2007a). These schools are initially intended for marginalized populations and aim to meet the demands of the labor market, training professionals to work in industry, commerce, and the service sector. They are structured based on a restricted educational process, which aims to train workers to reproduce procedures, privileging memorization and repetition, without intellectual depth (Kuenzer, 2007b).

Technological advances in the second half of the 20th century, especially in microelectronics, promoted new transformations in the production process and, consequently, in the world of work. Capitalism transitioned to a flexible accumulation system, based on the flexibility of products, consumption, trade, and work processes. Automation processes applied to industrial production reduced the need for human labor and began to require workers who could operate constantly developing technologies or solve problems generated by complex technological systems (Kuenzer, 2007b). Thus, "The traditional worker, who used his hands and strength to work, is no longer fit to perform his activities as a citizen-man of the polis, subject and object of rights, and as a worker" (Kuenzer, 2000, p.36, our translation). At this point, the transformation introduced by microelectronics and automation, in production and work, begins the process reinforced by the subsequent incorporation of AI into society.

To prepare workers for the new reality, education must train flexible professionals who can keep up with the advances generated by the rapid development of Science and Technology applied to the production system. The role of education becomes the "development of skills that allow lifelong learning" (Kuenzer, 2007b, p.1159, our translation). Thus, at least in theory, the educational process in the flexible accumulation system is aligned with the idea of a general and technological education for all, which allows the appropriation of the different scientific knowledge that structures the manifest forms of work. However, when considering that work is a social and collective practice, the evidence of structural duality becomes clear. With the sharp reduction in jobs that effectively require general and technological training, the need for workers with low qualifications and high turnover grows (Kuenzer, 2007b). Education is once again structured to meet two demands: on the one hand, initial preparatory training complemented by advanced scientific-technological and socio-historical training; on the other hand, general preparation and streamlined training focused on specific occupations in production chains (Kuenzer, 2007b).

At the beginning of this century, new social transformations are being observed, marked by "a growing and increasingly radical rupture, by capital, of controls on its maximum greed and a new scientific-technical basis in production (digital-molecular) and in its management processes" (Frigotto,

2012, p. 67, our translation). The advancement of technology and the application of AI in different spheres of life: economic, political, scientific, productive, personal, among others is probably the most significant aspect of this transformation: "We know that machine learning and robotics will change almost all forms of work - from yogurt production to yoga teaching" (Harari, 2018, p. 40, our translation).

The use of AI in production processes generate great benefits in terms of efficiency and precision, while reducing not only the need for manual labor by human beings, as occurred in electromechanical and microelectronic automation processes, but part of the intellectual tasks of workers also begin to be transferred to machines (Harari, 2018): "the work of several different professionals may be partially or completely automated, namely, lawyers, financial analysts, doctors, journalists, accountants, insurance brokers or librarians" (Schwab, 2016, p. 39, our translation).

With the advancement of Computer Science, associated with the development of life sciences (Genetics, Neuroscience, etc.), AI systems are and will be increasingly capable of identifying natural, social, and individual behavior patterns and making decisions regarding traffic, investments, or medical diagnoses more efficiently than human beings. In addition, computers are easily connected to networks, allowing constant sharing of information and updates (laws, new diseases or new medicines), transforming individual decisions, such as those of a driver at an intersection, into networked decisions, made by an algorithm that controls a set of autonomous cars (Harari, 2018). Therefore, AI will be increasingly present in the world of work, both in industrial processes and the service sector, previously occupied essentially by human beings.

Several studies seek to assess the impacts of AI on the production system regarding the reduction of human labor. Markelius et al. (2024), for example, state that the activities taken over by AI in companies can absorb 60 to 70% of workers' time. Schwab (2016) indicates that up to 47% of jobs in the United States are at risk in the coming decades. Nazareno and Schiff (2021) mention several studies on the subject that point to the risk of human labor being replaced by more than 50% in the United States, around 44% in the countries of the Organization for Economic Cooperation and Development (OECD), and a global decline in the workforce of up to 14%.

In addition to job losses, the increased presence of AI in production processes can affect multiple dimensions of the production process, from job requirements, through task design and execution, to assessment techniques. As a consequence, the well-being and mental and physical health of workers will be affected in freedom, autonomy, sense of meaning, satisfaction, constant updating, external monitoring, interpersonal relationships, and insecurity (Markelius et al., 2024; Nazareno; Schiff, 2021; Cramarenco; Burcă-Voicu; Dabija, 2023).

All the transformation processes in the world of work that have occurred throughout history have led to job losses and the creation of new ones, as well as changes in workers' lifestyles. Currently, there is a significant acceleration and radicalization of transformations compared to what occurred previously, generating a reduction in job vacancies combined with a strong polarization of work. On the one hand, a small number of positions require high cognitive/intellectual capacity and on the other hand, a greater number of occupations do not require qualifications (Schwab, 2016).

The polarization in work, caused by the presence of AI in the production system, in turn refers to the duality of the educational process, as seen with the development of electronics and automation. In the words of Kuenzer:

> The more scientific and technological development advances, the more it introduces a contradiction in the relationship between worker education and the production process: the more practical activities are simplified in the making, the more complex they become in management and maintenance, as a result of the scientific development they encompass (Kuenzer, 2000, p. 35).

This means that for most workers who will perform activities related to the simple operation of AI systems or do not need a high level of qualification, educational training can be greatly simplified, focused on developing manual skills and some basic knowledge to deal with technological interfaces, which are increasingly simple to use. For example, drivers working for apps, an activity that has been growing in recent years. Such work requires more physical skills (driving the vehicle) than intellectual

skills, since the most complex operations are performed by an intelligent algorithm that selects passengers, makes charges and payments, establishes the route of the trip, etc. The training of such workers does not require long or highly qualified school processes.

At the other end, we can find highly skilled occupations that involve the generation, updating, and maintenance of intelligent systems. These occupations require highly complex cognitive operations, developed through long-term educational training that must include the appropriation of multiple scientific principles constructed by human beings throughout history and their application in the development of modern technologies. In the case of AI, in addition to a solid basic education that effectively allows the understanding of scientific principles and the development of complex intellectual skills, the necessary training involves advanced specific knowledge of mathematics and computer science, as well as economic, ethical, and social issues related to the application of these systems, as explained in this article.

Something that has been happening in education in Brazil in recent years allows us to glimpse reflections of this duality, including in the regulations related to EPT, the focus of this study. The scientific literature that discusses the foundations of Vocational Education focuses on the perspective of work as an educational principle, research as a pedagogical principle, the omnilateral, polytechnic, comprehensive training of students, and the search for curricular integration, aiming for a single type of training for all young people. This foundation even permeates the EPT guidelines (Brazil, 2021), but its provisions also dialogue with a more market-based perspective of work, when they indicate that this educational modality is intended for the "coherent construction of training itineraries, to prepare for the exercise of operational, technical and technological professions" or that its function is to "contribute to the employability of graduates" (Brazil, 2021). When the objective of the educational process is to prepare for operational and technical professions or to "employ", scientific principles and general humanistic training are not necessary, limiting the future professional's prospects for action to low-skilled positions, far from the understanding and development of highly technological systems inserted in the world of work.

Educational duality is also evident when the resolution that defines the guidelines for EPT provides that it can occur in two very distinct ways, responding to the different forms of work that characterize the current production process. One of the forms is EPT articulated with basic or higher education, that is, general and scientific training articulated with professional training, which occurs, for example, in technical courses integrated with high school, lasting 3 to 4 years. This modality can effectively include training that enables students to understand and deal with technologies such as AI. The other is the "different forms of continuing education, in institutions accredited to offer it or in the workplace" (Brazil, 2021); Although continuing education is important for the improvement and updating of workers, and can be carried out seriously and scientifically in educational institutions, the lack of specification regarding accredited institutions and the standards for this training to take place, including in the workplace, opens the possibility for the existence of low-level, short-term qualifications, without involving scientific bases, responding superficially to the rapid changes in low-skilled jobs in the production chain.

The elements brought to the discussion suggest that AI systems are and should continue to significantly transform the world of work at high speed. The changes promoted may generate economic and social impacts that have not yet been fully assessed, as well as direct impacts on the educational process of training workers. In this sense, the reinforcement of the historically constructed educational duality emerged. On the one hand, it offers basic training to a majority of workers who will only operate systems that involve AI, restricting their professional prospects, and on the other, highly qualified training to a small number of people effectively capable of understanding all the implications of the presence of AI in society. An alternative would be the provision of an education that seeks the comprehensive and omnilateral training of all students, as intended by the premises of Vocational Education.

AI AND HUMAN FORMATION

Some other topics of intersection between AI and EPT deserve special attention, in addition to the general aspects involving the expansion of the development and use of AI in contemporary society and the impacts that technology has on the production system and the training process of workers. This section will discuss the relationships between AI and human training, both regarding social issues and elements of academic research and interdisciplinarity. To facilitate understanding, the topics have been divided into subsections, addressing one of the topics already mentioned in the introduction to this article and relating them to EPT.

Human Rights, Ethnic-Racial and Gender Equality

Machine learning technologies absorb patterns and assumptions prevalent in the data they use. As such, they can reinforce and even exacerbate existing biases and systemic inequalities, such as issues related to gender, ethnicity, people with disabilities, or individuals from minority backgrounds. As in human contexts, it is possible to minimize these biases through ethical practices, data adjustments, and more inclusive algorithm developments.

Given the wide range of sectors using AI applications, the negative impacts result in individual and, potentially, collective violations of human rights. These negative impacts of AI can influence the distribution of social benefits, decisions on whether to provide credit to customers, employee recruitment processes, criminal justice procedures, immigration and border control, policing and targeted advertising, among others, affecting social justice in ways that alter the relationship and trust between citizens and government (Council of Europe, 2023).

In this context, EPT occupies a prominent position since, within the perspective of comprehensive education, it aims at the development of social aspects linked to critical citizenship. A citizen who has an education that addresses these issues will be able to analyze the results of these AIs, propose new solutions, and fight for actions that mitigate this social problem. On the other hand, a superficial education, focused exclusively on meeting the immediate demands of the job market, tends to restrict individuals' capacity for critical analysis, making it difficult for them to understand the complexities involved in AI. This limited approach can produce technically qualified the unprepared workers to deal with the ethical, social, and political dilemmas that these technologies imply, deepening inequalities and reducing the capacity for social transformation through education.

Araújo and Frigotto (2015) point out that the commitment to social transformation should be the central objective of an integrated education project. Therefore, designing an education that considers the various dimensions of individuals' lives is a constant challenge for Integrated High School and Technical Education, which must go beyond simple professional training and contribute to a more inclusive and fair society.

Therefore, the Federal Institutes of Education, Science, and Technology stand out as a concrete example in EPT. These institutes implement a series of actions ranging from continuing teacher training to the creation of centers and committees dedicated to the study and development of initiatives that aim to intensify awareness and combat prejudice and discrimination, promoting a more inclusive and equitable educational environment (Fioravanti; Brancher; Moreira, 2020). Examples include NAPNE (Support Center for People with Specific Educational Needs-*Núcleo de Apoio às Pessoas com Necessidades Educacionais Específicas*), NEABI (Center for Afro-Brazilian and Indigenous Studies-*Núcleo de Estudos Afro-brasileiros e Indígenas*), NUGS (Center for Studies on Gender and Sexuality-*Núcleo de Estudos sobre Gênero e Sexualidade*) and the Committee for the Promotion of Human Rights, Ethnic-Racial and Gender Equality. In a context in which AI can propagate various types of prejudice, these actions are essential for the comprehensive education of students, promoting an education that not only transmits technical knowledge but also ethical and social values. The discussions on racial and gender issues stand out among the topics addressed by the aforementioned committees, which have generated broad mobilization in the face of the problems caused by AI in these areas. For example, Wilson, Hoffman and Morgenstern (2019) demonstrated that standard models for object detection, trained with conventional datasets, are more accurate for lighter skin tones than for darker ones.

One example that gained considerable attention is related to the former Twitter, now X, which used an algorithm that automatically crops images to prevent them from taking up too much space in the feed. However, users discovered that the feature was automatically focused on white faces (Yee; Tantipongpipat; Mishra, 2021). Another famous case that cannot be overlooked is the documentary Coded Bias (Kantayya, 2020), which exposes the racial bias in AI algorithms. The film highlights how these algorithms can perpetuate discrimination and social injustice, with concrete examples of how people with darker skin face difficulties in facial recognition systems. The protagonist Joy Buolamwini investigates and denounces this issue, highlighting the importance of promoting ethical changes in the development and use of AI-based technologies.

Another study by Buolamwini and Gebru (2018) analyzed 3 commercial gender classification systems and found that darker-skinned women were the most misclassified group (with error rates as high as 34.7%). The maximum error rate for lighter-skinned men was 0.8%. The authors state that significant differences in the accuracy of gender categorization of darker women, lighter women, darker men, and lighter men across gender classification systems require immediate attention.

Specific issues related to gender are also exposed in this new context of AI. "If she's in the kitchen, she's a woman." This is the title of the article written by Salas (2017), which states that there are more images of women cooking than men and, therefore, systems start recognizing people in the kitchen as women. According to Wassermann (2024), the article by Moreno (2023) highlights that the most important global personalities behind AI are men. The author also states that in Brazil, according to LinkedIn, 25% of people working in AI were women in 2022. In this problematic and complex environment, the solution presented for algorithm bias, in most cases, is to adjust the databases and the training of AIs. However, this solution has also generated problems. It is worth highlighting a reflection carried out by Amaral (2024), who cites examples of results generated by AIs from prompts that ask for a drawing of a medieval king of England and generate black people with long dreadlocks, Native Americans with headdresses, or a woman with a Hindu appearance. Other examples were also cited, such as ethnically diverse Vikings and black Nazi soldiers. In addition, the author states that users reported that the algorithm refused to create images with specific ethnicities.

In 2015, Amaral (2024) also highlights that Google labeled an image of black people as "gorillas" and the solution implemented was not to label anything as a gorilla or monkey to avoid this type of problem. The author reinforces that, as much as it is desirable to avoid algorithmic bias, AIs have this bias due to the information used in their training and that forcibly masking these results may not be the best way. The ideal would be to change social reality, and one of the ways to do this is to develop critical and reflective skills to address social and technological issues through education.

Several initiatives have emerged to try to encourage the presence of underrepresented groups in AI such as Black in AI, Queer in AI, Latinx in AI, Women in Machine Learning, Women in AI, {Dis}Ability in AI, Indigenous in AI, among others (Wassermann, 2024).

In this context, UNESCO (2022) and other institutions state that throughout the life cycle of AI systems, it is essential to ensure respect, protection, and promotion of diversity and inclusion following international law, including human rights laws. This can be achieved by promoting the active participation of all people or groups, regardless of color, gender, race, age, religion, political opinion, ancestry, language, disability, nationality, ethnic or social origin, economic, social or birth status, or any other factor.

Research and authorship

This section highlights the importance of research in the comprehensive education of students. Demo (2007) states that research is part of the educational process, helping students acquire critical and creative knowledge. Freire (1996) highlights the importance of research throughout the pedagogical process, contributing to forming a critical conscience in students. In EPT, several initiatives seek to introduce research to students, mainly in Integrated High School, with emphasis on Scientific Initiation. According to Bridi (2010), these initiatives work throughout the curricular structure on pedagogical

aspects relevant to understanding scientific methods as training beyond a set of techniques to organize, treat, or analyze data.

Based on the conception of research as a pedagogical principle, as a fundamental element of the conceptual premises of EPT, the implementation and execution of Scientific Initiation projects play a key role in the comprehensive and meaningful education of students, constituting a mediating element between theory and practice in the educational process. Furthermore, the research in institutions that develop EPT, mainly in Integrated Secondary Education, presents a difference from other educational institutions, at the same level, since it preferably covers applied issues linked to the world of work.

In the specific context of EPT in Brazil, the Federal Institutes of Education, Science and Technology, as institutions that materialize the State policy for the expansion and internalization of EPT, have a significant portion of their scientific production consolidated through Scientific Initiation programs. Such programs, based on the inseparability of teaching, research and extension, provide students with concrete opportunities for developing investigative skills, maturing critical-reflective thinking and appropriating technical-scientific knowledge, through the articulation between theoretical foundations and practical experiences in authentic scientific research scenarios, thus contributing to their omnilateral and emancipatory education within the scope of EPT. This enables them to become autonomous, critical, and reflective citizens, capable of seeking answers to questions that involve both their reality and the needs of their communities. Through critical analysis and comparison of data and information, students actively contribute to the generation of new knowledge that meets the demands of their community, while reflecting on their contribution to building a more just and egalitarian society. By developing autonomy in the search for and interpretation of data, individuals become more aware of their role in society, enhancing their creativity and critical capacity. Therefore, research plays a crucial role in this process, allowing research learning to happen virtually, aligned with the principles of EPT. In this scenario, teachers who supervise research projects directly contribute to the practical training of students, especially in high school, preparing them not only for continuing their studies, especially in higher education, but also for their insertion in the world of work, to contribute to a more inclusive and equitable society (Araujo, Menin and Dias, 2024).

A research project allows the student to learn about research through scientific methodologies, deepen their knowledge about the research topic by analyzing data and information, learning to work in a group, and develop intellectual autonomy, among other activities. The supervisor, on the other hand, understands the importance of developing the students' knowledge through guidance, assimilating concepts of organization and responsibility through monitoring the activities carried out, in addition to contributing to the student's human and scientific development, inserting them into the universe of science and work (Bridi, 2010). The aspect of interdisciplinarity that a research project generally provides, by articulating various types of knowledge, is also important.

Scientific research also involves several responsibilities and ethical issues that must be taught to students. In addition to Scientific Initiation, the research methodologies in EPT applied in Integrative Project reports or Course Conclusion Papers, and even in routine research activities taught by teachers to students in the classrooms, are also examples that introduce students to scientific areas.

In this context, all courses must assume responsibility for the ongoing scientific and ethical education of students. Thus, autonomy and authorship are fundamental skills in the education of students. Thus, these skills must be taught to students not only in specific disciplines related to scientific methodologies, but also by all teachers who have contact with students.

Problems related to copyright, for example, have gained prominence in this historical moment of growth in the use of AIs. Although this type of problem is quite old, it has worsened with the growth of AIs, especially text generators.

One of the main discussions is plagiarism. To make matters worse, a series of erroneous statements have been observed on social media suggesting that generative AIs always produce original texts and do not commit plagiarism. Marques (2023) highlights that some researchers analyzed the ability of models such as OpenAI's ChatGPT to produce plagiarism-free content: 210,000 texts generated by GPT-2 were investigated, seeking to identify three types of plagiarism: literal copying, paraphrasing, and use of ideas without credit. The research revealed that all of these types of plagiarism were present, and

that the incidence of plagiarism increased proportionally to the number of parameters used in training the model (Marques, 2023).

According to Kirkpatrick (2001), plagiarism occurs when someone presents someone else's work as their own. Within an intellectual community, ideas are freely shared, and much research depends on citing the work of others. Ethical writers acknowledge their sources by making clear references to the material used, while plagiarists fail to mention these sources, committing plagiarism. The absence of clear references is plagiarism, revealing information and ideas that the author could not have developed alone. Although both honest writers and plagiarists use the work of others, the difference lies in how they acknowledge these sources.

Some other issues still need to be debated in the EPT, such as how much a student should use AI, since tools that promise to detect plagiarism present a series of false positives. Gao et al. (2023) submitted a set of texts developed by humans and AI to human reviewers to indicate whether or not the texts were developed by AI. The reviewers correctly identified 68% of the generated abstracts as being generated by ChatGPT, but incorrectly identified 14% of the human-generated abstracts as being generated by AI. These results highlight the complexity involved in defining and even accusing a researcher of using AI.

In such a complex context, several authors have suggested that the use of AI should not be prohibited, but researchers should be instructed on its ethical use. That ethical training should be provided to current and future researchers. Peters (2023) states that one of the reasons why students commit plagiarism is the lack of knowledge or skills necessary to avoid it. Therefore, to eliminate plagiarism, it is essential to help students develop their reading, writing, and information referencing skills, further reinforcing the need for comprehensive training defended by the conceptual bases of EPT.

Khedkar (2023) discusses how AI tools can improve writing, data analysis, literature review, and research planning. The study highlights AI as a supporting mechanism for research processes while maintaining human creativity and critical thinking.

Another recurring question is whether an AI can be a co-author of a research study. In this context, article 15 of Law 9,610/98, which establishes the rules for intellectual rights, defines the rules for characterizing co-authorship. In this sense, "anyone who simply assisted the author in the production of the literary, artistic or scientific work, reviewing it, updating it, as well as supervising or directing its editing or presentation by any means, is not considered a co-author" (our translation). In other words, it would not be appropriate to include ChatGPT as the author of a research study. In a research and innovation environment, a researcher should not use AI as a tool to generate complete texts or even parts of articles to be used in full. Such an attitude would bring a great risk of plagiarism to the author. After all, Generative AIs obtain their texts from ideas available on the internet and do not inform the origin of these ideas. In this context, this research understands that AIs should be used only as auxiliary tools in the process of writing academic texts. Buriak et al. (2023) stated that the strengths of ChatGPT, when focused on research, are: "being used effectively to improve the title, abstract and conclusion of your manuscript and to adapt the parameters of the journal to its scope or readership".

Finally, one of the principles of science is honesty. Conducting research requires deepening concepts and this only happens with a lot of study. Producing science is not merely reproducing knowledge, it is advancing, seeking new ideas, thoughts that can innovate, create hypotheses, and new formulas for the development of humanity.

Interdisciplinarity

Some necessary conceptualizations must first be made to understand the broad relationship between studies on AI and Interdisciplinarity in the EPT environment.

Over the years, the concept of Interdisciplinarity has undergone some modifications, historically and socially constructed, based on educational, work, and epistemological scenarios, seeking to respond to the fragmentation of knowledge (Pereira, 2008). According to Pombo (2005), Interdisciplinarity can be considered an attempt to break with the stagnant nature of disciplines, promoting communication, articulation, and interaction between disciplines in favor of a common goal.

Severo (2016) defends interdisciplinarity as a mechanism for designing a pedagogical approach that considers possibilities for student training to overcome the limits imposed by the traditional classroom. For Gadotti (2009), interdisciplinarity is a theoretical methodological approach in education that seeks to overcome problems related to the compartmentalization of knowledge. Within the EPT scenario, Interdisciplinarity is a pedagogical practice, clarifying that interdisciplinary projects are important in the teaching and learning process when they involve research as a pedagogical principle (Demo, 2007). Frigotto (2008) presents Interdisciplinarity as a necessity and a problem within the limits of the subject who seeks to build knowledge of a given social, complex, and historical reality.

Given the complexity of the concepts of Interdisciplinarity, a consensus is reached regarding the need for actions aimed at an Education that follows the precepts of an omnilateral training, valuing the development of the multiple capacities of students and, allowing educators to rethink their pedagogical practices for teaching that is compatible with the digital reality and interconnection between different knowledge (Bessa, et al., 2020).

Thus, designing curricula for Comprehensive and Integrative Education, as prescribed by EPT, is a challenging process. It needs to be constantly expanded and enriched, revealing its regulatory nature, in which it is necessary to make explicit, explain, justify, and evaluate the decisions made (Sancristán, 2013) to prepare students not only for the world of work but for life in society. In this sense, Ramos (2010) warns that integration needs to happen beyond the simple sum of curricula. It is necessary to adopt "teaching and learning processes, general and specific knowledge, culture and work, humanism and technology" (Ramos, 2010, p. 52, our translation).

In this sense, the use of technologies in EPT is characterized as an interdisciplinary means of bringing students, teachers and schools closer to a digital society, enabling more meaningful learning by familiarizing students with technological resources that can be used in other contexts and realities (Santos; Ribas; Oliveira, 2017), especially in the world of work. For Santos and Souza (2019), when information technologies (ICT) are offered to students responsibly and appropriately by teachers who have received specific training in ICT approaches, they can ensure an increase in the dynamism of teaching and learning processes, with innovative potential, tending to result in quality education.

AIs are considered the most attractive interdisciplinary technologies in recent years. Within the scope of EPT, in addition to the use of AI by students in their daily activities, often without adequate guidance from teachers, it is possible to cite some examples in which AI appears in an interdisciplinary way in EPT courses.

Using ChatGPT as a support tool in the interdisciplinary project developments, carried out by Bandeira and Aquino (2023), is a very interesting example. In this experience report, the authors affirm the positive reception and enthusiasm of students when using ChatGPT, "recognizing its potential to improve the productivity of meetings, propose fun activities, and assist in research related to the topics discussed in the conversation circles" (Bandeira; Aquino, 2023, p.5, our translation).

Another recent example of the use of AI in the context of EPT is the development of avatars that translate/interpret Libras as technological educational resources for accessibility and inclusion aimed at deaf and hard-of-hearing students (Freitas; Dos Santos, 2024). The authors consider these tools valuable and of great potential for the area and emphasize that "innovative technologies and applications are still under development and it is necessary to carry out more research to expand their potential and mitigate limitations" (Freitas; Dos Santos, 2024, p.25, our translation).

Thus, when establishing a parallel between the use of AI in EPT, it is possible to see that both are fundamentally interdisciplinary. When observing the principles of construction of EPT, where Interdisciplinarity is characterized as one of its conceptual bases, when analyzing the teaching and learning methodologies addressed in Education, Science and Technology institutions, and when reflecting on the social insertion and comprehensive training of individuals for the world of work in these institutions, it is possible to perceive an intrinsic connection between the various disciplines involved, bringing a clear philosophical and practical articulation between EPT, AI and Interdisciplinarity.

Finally, it is understood that I) when analyzing in greater depth the construction of integrated curricula in EPT, it is noted the need for an interdisciplinary approach on the part of decision-makers and teachers, to provide students with an omnilateral education and, II) when verifying the need for

continuous curricular improvement to adapt to the realities (including digital) in which we live, AI is seen not only as an option in this training process, but as a means by which it will intrinsically be considered in an interdisciplinary way to achieve the curricular integration guided by EPT. This means that it is not only common interdisciplinary characteristics that bring EPT and AI together, but rather the inherent articulation between an educational modality and a methodological modality for integrative and meaningful learning.

FINAL CONSIDERATIONS

Technological development in general, especially in AI systems, is a concrete reality that appears in contemporary society, regardless of the divergent opinions that may exist on the subject. On one hand, it is not difficult to imagine or find in the literature the potential of AIs to benefit humanity, other species, and the environment. On the other hand, there are discussions, including this text, highlighting issues related to the importance of a critical analysis of the social role and impacts on human development that may arise from the incorporation of AIs into the productive system and life as a whole.

This article sought to reflect, within the context of EPT, on the relationships, impacts, and consequences of AI in the production system, in the educational process, and in society in general. This objective was achieved through an analysis of the interconnections between AI and the foundations of EPT. This can be evidenced through the discussions presented on the transformations in the world of work caused by AI and their implications for professional training, the reflections on ethical issues such as algorithmic biases and human rights, the analysis of the impacts of AI on research and authorship, and the examination of the interdisciplinary nature of this technology. All the aforementioned aspects make up the conceptual bases of EPT, such as the inseparability of education and social practice, interdisciplinarity, and research as a pedagogical principle. The discussions demonstrated both the transformative potential of AI for the integration of work, science, technology, and culture, as well as the challenges and risks that need to be considered so that its incorporation into EPT effectively contributes to the omnilateral training of students.

After our reflections, it is possible to state that the relationship between AI and EPT requires a deeper look at crucial aspects for the development of the area. This includes the understanding of how AI can act as a facilitator or obstacle in overcoming the historical duality between technical and humanistic training in EPT, as well as the understanding of the processes of preparation of the institutions that develop EPT, such as the Federal Institutes, to incorporate teaching about AI into their integrated curricula. It is also essential to investigate the mechanisms that ensure that the incorporation of AI into EPT does not intensify the social division of labor, but effectively contributes to omnilateral training, as well as to examine the specific role of AI in the integration of labor, science, technology, and culture, fundamental elements of EPT.

The history of vocational education in Brazil reveals a persistent duality, in which training limited to technical and pragmatic aspects was historically aimed at workers, while more comprehensive and humanistic training was reserved for the ruling classes. This model of technical education, focused only on learning specific skills, does not prepare individuals to deal with the complex challenges posed by emerging technologies, such as AI. By focusing only on instrumental skills, it neglects the critical and reflective training necessary to understand the social, ethical, and cultural implications of AI. Thus, education restricted to technical aspects does not prepare citizens to face the multidimensional issues involving AI, becoming insufficient in the face of the needs of an increasingly complex and technologically advanced society.

It is also possible to state that the expansion of the use of AI and the transfer of autonomy to such systems, if not done responsibly and ethically, could cause several harms to vulnerable populations, low-skilled workers, and minority groups, or even lead to decisions that generate major negative social impacts. Such technologies must be implemented in an economic and social system aimed at meeting human needs and protecting the planetary systems that sustain life, and not the accumulation of capital.

The path to the critical and effective use of AIs involves the training of current and new generations and, therefore, the educational process. In EPT, in particular, which focuses on comprehensive human development and overcoming the social division of labor, discussions and

reflections involving the entire school community are needed, on both scientific and technological issues, and the different political, social, economic, psychological, and ethical aspects involved in AI.

It is important to clarify that this text, in addition to presenting some topics that relate to AI and EPT, sought to draw attention to the degree of complexity and possible problems that may be faced with the escalation of this type of technology, highlighting the importance of polytechnic or omnilateral training.

The growth of AI systems in a society still full of injustices requires interdisciplinary and integrated training, in which a global understanding of technology is sought from different points of view that are interrelated to compose the concrete reality experienced.

Deepening this theme in EPT opens up avenues for several future research projects. Among them, case studies in Federal Institutes and other institutions that implement Integrated Secondary Education stand out, as well as investigations into the perceptions of the academic community regarding the use of AI in the teaching-learning process. We also recommend that integrated curricular proposals that incorporate AI be developed and evaluated, respecting the principles of omnilateral training, in addition to comparative analyses of international models of AI integration in vocational education. Other fields of research include the impact of this technology on the different modalities of EPT, such as integrated technical courses, subsequent courses, and technological undergraduate courses, and the potential of AI in reducing educational inequalities in this context. These studies are essential to deepen reflections on the role of AI in EPT and to guide pedagogical practices that integrate technological innovation and comprehensive human development.

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Author 3 – Participation in research, conceptualization and analysis, writing of the manuscript, and review.
Author 4 – Participation in research, conceptualization and analysis, writing of the manuscript, and review.

DECLARATION OF CONFLICT OF INTEREST

The authors declare that there is no conflict of interest with this article.