

Artificial intelligence and education: Theoretical-conceptual and methodological framework and critical reflections

Beatriz Fainholc ^{1*} 

¹ CEDIPROE Center, Universidad Nacional de La Plata, La Plata, ARGENTINA

*Corresponding Author: bfainhol@gmail.com

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ABSTRACT

The world changed amidst unknowns. It can be understood as a mutation, or an attack on traditional styles of governance and management, institutional offerings, academic research spaces, production of software artificial intelligence (AI), and the processes of learning and teaching in general. This contribution aims to review the theoretical and methodological support that have inspired the explanations of the relationship between AI and education. The challenge is to reconfigure the theoretical-conceptual and methodological frameworks of interpretation of these phenomena towards others more relevant according to the digital spaces and their crisis. Also, adding the deployment of AI as a background factor that transforms all social processes. The design of AI in the scenario of a digital ecology is based on the technical-instrumental rationality of reductionist economic explanation for thinking, feeling and acting. The complex dimensions of human reality in general and the pedagogical reality in particular, physical and virtual, require a more comprehensive, systemic-holistic and recursive paradigm and their theoretical and methodological perspectives. Also, relational, hermeneutic and rhizomatic explanations. The evolution of AI sets the background for some current and possible directions for an unknown future. More with the consideration of the disruptive challenges of AI toward overcoming its political-economic and military decisions which influences on it. The conclusions and recommendations included indicate the tentativeness of scientific-technological concepts and the need for considering a critic appropriate educational technology, an interdisciplinary studies and continuous relearning in the face of the uncertain hyper-industrialized scenarios of AI in education.

Keywords: theoretical methodological frameworks, artificial intelligence, education, critics, recommendations

INTRODUCTION

The world has changed in the midst of convulsions and unknowns. It can be understood as a mutation, or an attack on traditional styles of governance and management, from institutional offerings, academic research, production of artificial intelligence (AI), and so, the processes of learning and teaching.

Technology is surprising and frightening at the same time, with its rapid and pervasive, disruptive and paradoxical advances.

The aim of this contribution is to study the general and generative AI (GenAI), in order to consider different theoretical-methodological foundations that could be conceived and support the AI design, and some explanations about its impact on physical, virtual and hybrid educational programs.

It encourages the commitment of the educational institutional administrators, professors, teachers, students,

educational community and society as a whole, to recognize the subjacent lines to construct the bases of teaching and learning proposals. Nowadays through the transversality of AI in every space of the daily life which articulates/merges the human being with the technological non-human (Braidotti, 2019).

The AI represents this digital era and is presented by the paradigm of automatic algorithms, in general proprietary software, supported by a linear and binary epistemological system. However, there are also critics that seek to transit to another paradigm. This contribution calls it critic appropriate educational technology, with a wide understanding about the person, life and a world cosmovision to improve education, as well as the development of people through AI.

There are theoretical-conceptual and methodological frameworks that AI holds, which try to review the conception of the design, development and practice of AI software solutions for the teaching and learning processes, and teacher training, especially for virtual environments, and particularly for higher education, but not fully defined yet.

In order to study the relationship between AI and education, the hermeneutics theory recognizes an interpretative dialogical relationship between people and machines, which, in an interactive conversation, “think to each other”. It seeks, achieves (or not) an intention consensus.

In this context, an effort to explain the predominance of AI ChatGPT is necessary. The generative pre-training transformer software, from an educational perspective, should consider alternative proposals.

But it is a poor approach only to apply Metric equivalents for all non-metric units, because other principles and strategies, which are based on critics of the instrumental rationality, while the communicative sense (Habermas, 1985), is an approach more pertinent to study the theoretical and methodological frameworks. These discussions are implicit in their dynamic of the phenomena named before, and it needed to be considered.

DISCUSSION

The scientific-technological-pedagogical frameworks convoked by virtual educational environments are presented as a “to go over again” from the known to place unprecedented digital issues, such as the vertiginous development of AI.

Considering that any model works well when it is known or what is expected in a given field of knowledge, but that breaks down when the complexity of this knowledge increases, or when the context is convulsed, it shows real problems of diverse types, especially with the uncertainties of AI: then it is necessary to “go over again”, to put it simply.

As a result of conflicting and disputed ideas, of the social-historical evolution of human existence, society and culture, many attempts are made to revise what is known. With AI, which is not new, it is expected an overcoming of the unidirectionality and automation of machines and software, and their still existing underlying technical-instrumental rationality.

THEORETICAL AND METHODOLOGICAL FRAMEWORKS

The philosophical-epistemological reflection connected with the humanities has long held that technology is not value-neutral (Feenberg, 2002) and it suggests reviewing the design of technological mediations—which are not only technological— and which are especially evident today with the algorithms of AI software: that needs to drive them through an alternative focus.

It means going into the field of their design: by introducing or removing some components in that field, where the learning is modelled/modulated in different directions, and reciprocally shapes the society: this occurs basically through interaction proposed by its design but not only through the design itself. Today the circuit of networks and high flow of screens, also intervenes to build knowledge.

The enormous digital penetration of AI algorithms sets up a new relationship of the category’s emotion–body, brain–

mind, and human intelligence–AI and others, all of them overlapping, complementing, fulfilling, and/or substituting diverse inputs. They drive a revision of models, theories and principles, as well, which show enormous epistemological, ontological, pedagogical and ethical consequences for education.

It means a new sensorium that tries to rescue, even though the AI software design and sources are very irresolute, the sensitivity and the social-emotional variables linked to the cognitive, the hidden of implicit knowledge, the interpersonal, the intertextuality, and others, which are “in progress” in their study and practice.

At the same time AI is leading an opposite paradigm of thought, understanding and action, registered in the digital/post-digital context. It’s important to know that the post-digital condition does not describe a life after digital, but rather, to explore the consequences of the digital age of computers.

It’s one of today’s grand challenges in science, education, arts, and various other areas of human interests and their technological relationship and virtual scenarios.

These named concepts still do not present a more stable interpretation, because the reality is uncertain and obscure, and the comprehensive arrangement of variables is very volatile: it requires academic scientific-technological studies and specialized interdisciplinary research toward new paradigms.

The Foundations of Artificial Intelligence

The academic scientific-technological-educational studies specialized in an interdisciplinary research toward new paradigms, needed to be clarified concerning the foundations of AI.

1. Complexity and systemic-holistic approach, embedded in fractal and autopoietic paradigms, sustained and still sustains an epistemological turn to understand the social, cultural and educational phenomena and processes, that in their evolution, involve the huge proliferation and distribution of ideas and mechanisms now made possible by interconnectivity, networks and AI.
2. Cultural historical structural approach (Davidov, 1996; Leont’ev, 1978; Luria, 1976; Vygotsky, 2017) that sets a concrete explanation of the change in the perspective of history, influencing the personal, group and institutional levels. At this context, it is rescuable, among others, the idea of the generation of subjectivity provided by an intersubjectivity of a practical reciprocal interaction with actions mediated by all kinds of artifacts, during the socialization/education. Today this can be extended to the role of mediation and media: AI software and algorithms in the informal, formal and non-formal education.
3. The actor-network (Latour, 2007) breakdown the assumptions about the building of knowledge, subjectivity, etc. It wonders about how the natural, social, cultural, technical and environmental factors are added, and in its combination, are networked, associated, persisted, declined and/or mutated: a

transferable explanation to the human being thinking that nothing is accepted by oneself, but it is the effect of interactions in networks and nodes, which is also taken up the connectivism leaning theory (Siemens, 2005, 2006). In other words, they are processes and products of mutual action, which transpose and transform as a whole, the current merger of the human and non-human.

4. Hermeneutics (Gadamer, 1989) provide a valuable contribution to the study of the relation between AI and education. However, hermeneutics recognizes the dialogic feature of humans and machines which, in conversation (Turkle, 2017), “think to each other” seeking/arriving (or not) to an intentional communication and consensus.

This input shares diverse kinds of AI, such the current GPT, and the controversial DeepSeek, today.

By the way, hermeneutics recognizes the events of teaching–physical and virtual–in dialogue, where knowledge is shared by meanings which are traced, in an encounter that has the structure of a text, an image, discourse, to be understood and re-interpreted.

This consideration can be transposed to the dialogic events of a virtual teaching with the conversational GenAI, or others.

5. The rhizome. Rhizomatic thinking (Deleuze & Guattari 1976) is supported by digital networks: it breaks down systematic knowledge of a linear nature because there are no points or positions, as it is found in a programmatic context. Neither it is presented in a structure but rather in the format of a tree, a root: there are only lines “that diverge” in branches.

In a rhizomatic learning and teaching system, there are little guides: the students negotiate a non-pre-formatted curriculum. They create and share tools to produce content, exploit learning networks, etc. They think things in the “between” and establish creative, imaginative connections by determining their own learning objectives, and others of the group.

By the way, in terms of the educational models that emerge from the above-mentioned conceptual frameworks, they should also have to be re-considered in the light of the times of the AI. In this way, some models are as follows:

- a. Behaviorism (Skinner, 1953, 1974) taken up by the linear design of software, based on the historical programmed instruction.
- b. Cognitivism (Ausubel, 1968), whose salient contribution focuses on the semantic organization of content that is subsumed in a supra-structured and sub-structured hierarchy of concepts, which gives clarity and relevance to learning. It rescues previous concepts and experiences to anchor the new ones.
- c. Socio-constructivism (Piaget, 1950) argues that learning is an internal evolutionary epistemological-symbolic process of people (although it refers to children, it can be generalized

to other ages), which takes place through interaction with the environment: the resources and spaces introduced stimulate inter-learning with “significant others” (Mead, 1934) in specific contexts.

- d. Connectivism (Siemens, 2005, 2006) explains the changing dynamics of the adaptive circulation of complex information based on the socio-political power forces and needs of learners, using software tools to create and connect nodes as data sources in diverse knowledge networks. They will be connected when the dialogues are re-signified during the learning process.

Artificial Intelligence

Previously it was interesting to conceptualize (human) intelligence as the readiness to know, analyze and understand issues and tools that are presented, as useful (or not) to solve problems, to make alternative and convenient decisions, to choose a particular behavior. Also, it is the ability to establish relationships between different ideas and data to get more understanding, comprehension, and appealing to an unprecedented relationship of variables.

The AI is the discipline based on computer science, data science and the tele-communication infrastructure of programmed network connections, invented/driven by the powerful automatic software of (the proprietary software) deep learning, machine learning, and others, like the open code DeepSeek.

The work of AI represents the 4th industrial revolution, where logico-mathematical, engineering, systems analysis, economic-financial sphere of international business, industrial productivity, etc., converge in the digital/post-digital culture (Jandrić et al., 2018), for the design, production, cross-cutting application of algorithms that intervene in the majority of physical and virtual social relations and processes. In this context the contribution of AI-ChatGPT4 (soon the 5, 6) and the free DeepSeek conversational, are in boom, today.

It is a field of computer science that focuses on creating systems and programs capable of performing tasks that normally require human intelligence. Although its significant advancements in recent years, there are still certain tasks for which the general AI is not well suited.

Beyond thinking that devoid of the assumption that the introduction of AI and algorithms without the ethical criteria of prudence and caution, may increase the deceptive search for perfection and truth, we have to pay attention on the interactive digital technologies in order to understand more the modelling role of them in the educational profiles.

Also, the generalization of automatic artifacts and software may dismantle general human intelligence and emotional intelligence. It may also lead to a misunderstanding and non-awareness of the significance of implicit knowledge, metacognition, bias, etc., in the production of knowledge during learning.

Features of Artificial Intelligence

1. Exponential and exceptional deployment of presence that is multiplied by processed data, trained by large

language models (LLMs), neural networks, etc., based on learned conditional probabilities that then cut across all social spheres.

2. Standardization of a vast mass of information, converted into highly structured guidelines that normalize, equalize and homogenize its organization, and routinize it. With a stereotyped step, the designers produce objects, services, etc., to resemble a repeating pattern of performances: playing the role of autonomous robots (Lanier, 2010). They are systems capable of recognizing, understanding, and making decisions based on complex data with skills simulating human ones.

3. Automation of tasks and processes that have an impact on the increase of operational efficiency and/or on the improvement of the performance of the sectors where it is implemented, within an institution, social organization, etc. Today, it impregnates the designs of the software that results as a hinge in form and contents, communicative interface and mediating interrelation, such rein of transmission of the information, with other users and machines in an effective way according to the objectives proposed.

By reproducing, storing and distributing the flow of information generated, selected, updated and made possible by the networks, the “viralization” of the algorithmical information.

4. Deep learning software (Deep Learning), the heart of artificial neural networks, like another software produced abroad the USA, simulates the functioning of the human brain. It bets on improving the ability to learn complex skills, without human intervention, to make decisions, with great success in the areas where it is applied, without ignoring possible risks.
5. The high human-non-human interaction, developed and facilitated by interfaces and networks, optimize user experiences, expresses intellectual behaviors through a binary language, that captures images, audios, animations, and others, not only produced and recorded by people but also autonomously, by machines and robots, which lowers their costs.
6. The explosion of algorithms and their design underlying AI reveals an imaginative mind that creates useful courses of action to specific projects, such as the virtual learning environment platform for remote and highly interactive training of students.

Artificial Intelligence and Its Design

The main role of the design proposed for AI algorithms and interfaces, today appears to be a crosscutting one in all sciences, which, in an interdisciplinary way, is involved in the construction of knowledge.

Design is the art of projecting all kinds of objects, today digital, for a particular program. For example: the design of a house or the experimental design of research, a curricular design, or the design of algorithms for a conversation with the ChatGPT or others.

The design as a project sets speculative scenarios by helping to reflect on the society, the possible futures and

opportunities thinking imaginatively, an improvement of the conditions of being in the world.

However, the design of software, AI algorithms, beyond the fact that it can be open source, corresponds more to fixed forms of construction and circulation of information, than to a description of the reality that is always vulnerable to verification and questioning.

Risks and Limitations

1. Subordination to a digital technological-political totalitarianism. Any kind of AI as an infocratic reticular system (Han, 2018) answers to a surveillance society (Zuboff, 2019). It is imposed globally without authentic representativity, except by the “I like it” through the hyper-connectivity.
2. The GenAI GPT, with the LLM models (as Gemini, Copilot, Llama, etc.), DeepSeek, etc., work by worksistical patterns. So it doesn’t understand the meaning (by now). Although it enriches human intelligence, by the (pseudo) possibility of a (mythical) intelligent “conversational” context, it can’t always be pedagogical. It is considered as an encounter with many applications that can be used in the educational field, but not more than that, also, by now.

The AIG with a great computer power requires more and more sophisticated equipment. The decision makers and the programmers who designs and develops the software are part of a scenario of a digital audio-visual ecology which in general, do not consider (or do not want to consider) other macro-contexts with severe consequences: high energy costs and energetic consumption, carbon emissions, a lot of water to refrigerate the systems, electronic waste abandoned for many years, all of these provoke terrible environmental disasters, and so on.

Latin America and the countries of the south of the world can’t assume that, definitively, by now.

So as, all of the subagent conceptions of the design of the software-AI, should be redefined according to specific socio-cultural contexts, historical time and space, and in pedagogical terms, referred to the objectives of the programs and the pedagogical generative activities to be achieved (Broussard, 2016).

3. The context of the technocene and transhumanism dystopically appeals to nanotechnology and robotics, which already implants augmented technology in humans, clones embryos, even though defying mortality (Kurzweil, 2005).

These indissoluble ideas of people’s lives subvert their privacy. This is brought down by the automatic production and distribution of data, that is food for the networks.

This consequence of that operation makes control and regulation mechanisms, which generally is carried out by the linguistic codes (Austin, 1811; Derrida, 1998) and computer tools. Beyond the symbolic binary code of algorithms, their discourse is “authoritative” - also considered “authoritative” (Bakhtin, 1986), which

appears as hyper-normalizing, immutable and self-referential.

It produces a discard of the subcultures where the daily lives of individuals and groups are standardized (Postman, 1996). This negation imposed by the AI, volatilizes the human condition that overlies the ethical coordinates, and distorts the contexts, and in this way, the democracy (Feenberg, 2002). The opposite framework is based on the concept of a critic appropriate educational technology (including all kinds of technologies) which takes care of the human condition, its development and improvement, as well.

4. The iterative rationality sustained by simple logical-mathematic algorithms generates more or less accurate results, which do not always solve definite problems, because the comprehension and understanding of the human condition are not always necessarily the same.
5. The enormous production of data, which can be classified, categorized and interpreted in a biased way, of supposedly by a positive instrumentation of AI, it can introduces "hallucinate": errors and misinterpretations of the estimated calculations or prediction of trends, etc., which could lead to erroneous conclusions.

Rather than predicting, they guess the future without real support to ensure effective, situated, strategic decision making.

Validation measures to ensure that AI operates with transparency and accuracy would fortify ethics to respect the truth, to prevent false data, and gaining public trust in technology and in particular, in AI in teaching and learning.

6. Deep learning software, the core of artificial neural networks, by simulating the functioning of the human brain, aims to improve the ability to learn complex skills, without human intervention, to make decisions in a very, very fast way, with great success in the areas where it is applied, without overlooking possible risks. But to get tones of information in a very, very fast way, it doesn't mean to get the best decisions.

As we can see, there are flaws, deviations, and folds, that AI and its derivatives didn't solve problems so easily. They don't depend only on technology. but mainly on the conception of life, the social and cultural aims, the profile of the groups, etc., which adopt (or not) the approved lines of governance, the values underlying the existing policies to be considered, supposedly toward caring for the people.

An Educational Look to Artificial Intelligence

It means to answer, "which is the real application of AI with a genuine impact on education".

To study the relationship between AI and learning is interesting to recall historically, to Papert (1994) who claimed that machines cannot give an opinion, or be self-critical, to develop self-steam, etc., as a human being can get.

On the contrary, Simon (2019) proposed that "symbol manipulation" is the essence of both human and artificial

intelligence and thus, a symbol system as a sufficient means for general intelligent actions.

The education sphere, reconverted as virtual with the Internet, networks, AI, applications, and so forth, does not remain on the margin of technology; on the contrary, it has to reckon the dominant role of the added algorithms.

However, the current expression of A.I. implies different phenomena and process. In general, it is claimed that it causes/will cause unknown consequences to be produced (maybe not) in the person who thinks, learns and understands (if they was well leached and he/she can do it...) the functioning of society, culture and diverse dimensions, in the digital world, as a whole.

Consequently, it is necessary to review the concept of conventional teaching and learning that goes beyond AI Deep Learning for enhancing human intelligence, called "intelligence augmentation". This is too little, as it does not consider a genuine "deep learning" (Perkins, 2003) inscribed on the "pedagogy of understanding" (Gardner, 1993). In this way, it is expected to remove the obscurity of these proposals.

The pedagogical coherence, of a pertinent application and discussion of how profitable and/or risky the AI ChatGPT and derivatives are, should be contextualized in specific pedagogical spaces (physical, virtual, and hybrid) to be socially useful and productive. The search has to continue seriously.

Designing methodological strategies for developing the "soft, invisible, or mental" technologies-linked to the high mind functions, have to be included in the design of the software.

That are connected to live real educational experiences (Dewey, 1916, 1938), mediated through diverse scientific-technological and didactic activities based on observation, exploration, anticipation, transdisciplinary experimentation, metacognition, self/hetero and co-monitoring, critic evaluation, research "in", "by", and "for" the educational action (Schön, 1987).

The research of action, in action, for action, by the action (Schön, 1987) should explain and interpret the poorly studied evolution of the design, development and implementation of AI in general and in education. In this case, to react to the decay in general, of the educational levels and to analyze whether AI contributes to the improvement or worsens of the aggravated contemporary learning and teaching processes that involve educational problems.

CONCLUSION

The objectives of this contribution have pointed out the most relevant theoretical-conceptual and methodological frameworks about the state of the art of GenAI and its educational relationship. Without doubt, it shows the need to continue the research for present and future actions.

1. The social criteria of relevance and pertinence of culture and society are central to be considered as well as the quantitative criteria of effectiveness and efficiency of informatic sciences, especially for the purposes of strategic planning, decision making, investments, etc.

2. A qualitative approach for the articulation of the criteria of socio-political-cultural and emotional relevance anchored in the lives of each person, contextualized in a culture, is the most neglected (for now) of the AI with the unthinkable consequences from the educational point of view.
3. The high level of human-non-human interaction, developed and facilitated by interfaces, networks, AI, etc., are systems designed to optimize experiences, which are not always so, but are the result of automatized processes and products of exchanges that are not “neutral” that translate, transfer and transform materials and services.
4. Interaction process, in general, makes the survival of people where they socialize, communicate, and recreate information, etc., through programmed algorithms, although they can’t achieve good results of interaction and to be a great help for learning: they still can’t include the interpretative problems of such interaction, as the emotional ones.
5. Technological interactivity, where AI plays a central role, Fainholc (1999, 2024, 2025) encourages a digital transmission, which appears in the production and distribution of content, although not so generalized, if we remember the prevailing social exclusion in many countries.
6. An interdisciplinary/transdisciplinary perspective (Nicolescu, 2013) proposes an intersection of AI and their derivations (software, formats, networks, etc.) to the interior of the designing and processing of the information. That should articulate the contributions of humanities, social sciences, cultural and political studies, life science and others, beyond the data sciences, big data, algorithms, etc., that operate using deep learning, machine learning, and other software, today.

All these fields and others are the basis for the designs that create and build spaces and channels for the social interaction, which link, complement, re-negotiate and make possible, by a technological-pedagogical interactivity, the production of epistemological changes. These pillars could/can reconceptualize the AI in favor of a holistic and reticular systemic understanding to generate knowledge, and to be applied in the educational programs and projects.

Finally

There are doubts and mysteries, uncertainties and fears in the face of local and global dystopian realities, and about the relationship between AI and education.

Understanding the possible repercussions of just building advanced robots, and not considering their impacts on education, means overlooking philosophical-epistemological and ethical, conceptual and methodological issues of AI, which would be unwise.

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