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Pygmalion effect and artificial intelligence: educational transformation and ethical challenges

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Abstract

This article presents a critical analysis of the impact of artificial intelligence on education, emphasizing its capacity to optimize processes by personalizing experiences and data processing in real time. Additionally, the relation between artificial intelligence and the "Pygmalion effect" was considered, a phenomenon by which expectations influence student performance. Considering that this technological tool, by providing personalized feedback in real time, can inform these expectations, influencing academic performance and student-teacher interaction, reflections on its use are made by raising ethical challenges such as privacy, algorithmic biases, and unequal access to technology, which can increase existing gaps. The importance of training for use of artificial intelligence and the need for an ethical approach to avoid inequalities and discrimination are stressed.

Keywords: Algorithms. Artificial intelligence. Ethics. Bioethics. Education. Education professional.

Resumo

Efeito Pigmalião e inteligência artificial: transformação educacional e desafios éticos

Apresenta-se uma análise crítica sobre o impacto da inteligência artificial na educação, com ênfase em sua capacidade de otimizar o processo por meio da personalização de experiências e do processamento de dados em tempo real. Além disso, considera-se a relação entre a inteligência artificial e o "efeito Pigmaleão", fenômeno pelo qual as expectativas influenciam o desempenho dos estudantes. Considerando que essa ferramenta tecnológica, ao fornecer feedback personalizado em tempo real, pode moldar essas expectativas, influenciando tanto o desempenho acadêmico quanto a interação com os docentes, refletimos sobre seu uso ao propor desafios éticos como a privacidade, os vieses algorítmicos e o acesso desigual à tecnologia, que podem aumentar as brechas existentes. Destaca-se a importância da formação para o uso da inteligência artificial e a necessidade de uma abordagem ética para evitar desigualdades e discriminação.

Palavras-chave: Algoritmos. Inteligência artificial. Ética. Bioética. Educação. Ensino superior.

Resumen

Efecto Pigmalión e inteligencia artificial: transformación educativa y desafíos éticos

Se presenta un análisis crítico sobre el impacto de la inteligencia artificial en la educación, con énfasis en su capacidad para optimizar el proceso mediante la personalización de experiencias y el procesamiento de datos en tiempo real. Adicionalmente, se considera la relación entre la inteligencia artificial y el "efecto Pigmalión", fenómeno por el cual las expectativas influyen en el rendimiento de los estudiantes. Considerando que esta herramienta tecnológica, al proporcionar retroalimentación personalizada en tiempo real, puede moldear dichas expectativas influenciando tanto el rendimiento académico como la interacción con los docentes, reflexionamos acerca de su uso al plantear desafíos éticos como la privacidad, los sesgos algorítmicos y el acceso desigual a la tecnología, que podrían aumentar las brechas existentes. Se subraya la importancia de la formación para el uso de la inteligencia artificial y la necesidad de un enfoque ético para evitar desigualdades y discriminación.

Palabras clave: Algoritmos. Inteligencia artificial. Ética. Bioética. Educación. Educación superior.

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Bioethics arose as a field of knowledge in the 1970s, after the publication of the book *Bioethics: a bridge to the future*, by Van R. Potter. The author argued that biological facts should respect and be in harmony with human values. Founded on this seminal work, Bioethics was disseminated and consolidated as an ethics applied to the analysis of human experiences and situations related to the lives of human beings, non-human animals and the environment [1].

In the last fifty years, several bioethics-related theoretical currents have arisen to address the scientific and technological advances that are now part of contemporary times. These theoretical currents include the theory of principles [2]—the first and best known theory—and critical theories—developed by researchers who sought to advance discussions and expand bioethical reflection [3]—including the ethics of responsibility [4].

In this context, Hans Jonas argues for the existence of a private responsibility and a public responsibility, which enables emphasizing that scientific knowledge and new technologies provide, on the one hand, benefits and, on the other hand, risks to humanity. Accordingly, the unpredictable, irreversible and, often, irreparable consequences require ethical reflection on the potential damages and risks that the application of the technologies entails, even when they can also contribute toward new ways of thinking and developing knowledge [4]. Hence the relevance of the bioethical analysis of the use of artificial intelligence (AI) in education.

AI is defined as a branch of computer science focused on the development of algorithms and systems that emulate human intelligence based on machine learning [5]. In recent years, the incorporation of AI into various areas of everyday life and academia has significantly transformed how people interact with technology, thus requiring analysis of the potential benefits and limitations related to the use of AI tools.

In the book *Artificial Intelligence: A Modern Approach* [6], AI is described as a set of tools that has the purpose of documented digital reception of context and that, in its generative action, performs actions that minimize the possibilities of conceptual or procedural errors to achieve the success of the planned goal. This has provided numerous opportunities to try to optimize the teaching-learning process, due to the multiplicity of tools geared toward students' interaction with more sophisticated information, containing large volumes of data. These data are compiled into visual, theoretical, and auditory products that personalize the teaching experience and guide information for groups with learning disabilities or difficulties.

However, the so-called "generative" AIs create conversational content that is very close to that of humans, which is impacting the lives of students at school and university levels by reducing their critical capacity in responses or by having in these tools conversations that respond to the concerns of young students [7].

However, one of the recent advances of these technologies is related to their capacity to influence student expectation and performance, consistently with the "Pygmalion effect" [8]. The classic example is bank panic [9], in which, with a mistaken perception of risk of bankruptcy, people withdraw all their money and, finally, the bank ends up failing.

The field of education sees the occurrence of a similar phenomenon: it is called "self-fulfilling prophecy" or "self-fulfilled prophecy," since expectations can influence teacher behavior and impact students, given their relationship [10]. Therefore, AI could function as a factor that reinforces the "Pygmalion effect," creating systems that adapt to the individual needs of students and leading to high-performance expectations based on data, along with personalized follow-up.

At the same time, open artificial intelligence (open AI) provides educational resources for the creation of interactive classes or tutorials, which are already applied in several schools in the United States. This situation poses a challenge for teachers in the digital transformation of education, raising discussions on all the ethical implications of its use with the risk of not protecting the privacy and security of students [9,10].

In this context, AI can play a key role in providing accurate, personalized and real-time feedback, in addition to fostering an environment in which expectations can be managed consciously and

strategically. As educational platforms continue to evolve, it will be possible to see an opportunity to boost student academic performance, not only by optimizing learning trajectories, but also by creating positive expectations based on a deep and personalized data analysis, based on experiences obtained by humans, and not by AI.

More than 600 companies are developing AI to solve learning problems, which enables education to be more inclusive, effective and attractive and seek to leverage information that empowers students to meet the requirements of the international labor market, including virtual reality, in addition to the creation of educational bots [11].

Considering that the use of AI has become widespread both in the workplace and in education, it is important to reflect on the relation between AI and the Pygmalion effect; this is essential to undertake the ethical commitment associated with the use of AI in this area, through a responsible and safe approach that avoids reinforcing pre-existing biases and inequalities, and their negative effects.

Education

Application of artificial intelligence

Education is the paramount mainstay for driving the advancement of society, which, combined with technological innovation, should contribute toward informing the present and future in an ethical and responsible manner. In this regard, within universities, AI development has been studied as an object of research and as a tool to enhance the teaching-learning process.

In turn, virtual learning environments (VLE) are defined as techniques and activities conducted in a timeless space, without physical presence and mediated by the internet, which provide a diversity of means and resources to support education [12].

This synchronous or asynchronous space must be characterized by enabling flexibility, interactivity, autonomy and inclusion. Teachers should customize learning plans and individualize activities for the various types of students who attend their classrooms, with the aim of improving their learning, becoming mediators of the process and not assigning the virtual function to the learner's free will [13]. Therefore, we can consider as notable aspects of VLEs:

a. Personalization of learning: favors more inclusive teaching at different levels, adapting educational materials and teaching to the individual needs of each student, adjusting difficulty levels to the pace and content according to the student's skills and progress;

b. Automation of administrative tools: facilitates the process of correcting tests or organizing resources, allowing teachers to focus more on teaching and interacting with students;

c. Tracing of performance patterns: helps teachers trace students at risk to adapt their pedagogical strategies immediately, which facilitates *feedback* for continuous evaluation processes;

d. Automated tutorials: facilitate the answering of questions and the clarification of doubts of students in real time through systems and algorithms that complement traditional teaching and provide support at times outside of school hours.

The learning plans will include the promotion of technological skills for students and teachers, whose level of mastery will represent an improvement in educational skills, bringing them closer to the technological context of the students' future work and building digital teaching capacity.

The proposal is the intrinsic requirement of human-centered AI, in which the teacher is not replaced with digital tools, but rather that they contribute toward personalized and effective education, fostering the students' critical thinking and development of socio-emotional skills, and encouraging autonomous and self-managed learning [14].

These resources and their applicability are possible due to the digital educational footprint (DEF), that is, the data recorded through the interaction between students and teachers in the different activities scheduled for the teaching-learning process, and the large amount of data generated and recorded in the VLE, which enables their analysis through data mining techniques that,

due to the large volume of information collected, can be statistically treated [15].

Over the past five years, AI has evolved from being solely a research topic in the academic setting to becoming a prominent topic in public discourse, and its influence can be seen in various aspects of daily life in many countries. However, as there are continual and rapid AI technology advances, they pose numerous risks, challenges, and concerns as to their social and ethical implications. Thus, in the case of an important area for the development of nations, such as education, the application of AI will depend on accessibility, coverage, training, and the current cultural, socioeconomic and regulatory characteristics in each country [16].

Association between AI and the Pygmalion effect

The Hellenistic "Pygmalion effect," which proposes the existence of a process of change in personal behavior, based on the beliefs or expectations of another person, is applicable in education when one person can be influenced by another through the performance of the first, that is, that student performance will be better the greater the expectation about the person or subject to be addressed [17,18].

This effect, which influences interpersonal relationships in which the intended result is expected, can be applied to the use of generative AI, a technology that presents idyllic situations in information, which are idealizable by students and according to the teacher's learning plan. The latter can lead to reinforced positive results, or to negative results based on the beliefs and expectations of the teacher in relation to each student.

The work *Pigmalión en la escuela* [19] states that the occurrence of this effect requires three aspects: 1) firmly believing in a fact; 2) expecting it to happen; and 3) following it with messages that encourage its realization.

In the context of AI-mediated education, the "Pygmalion effect" acquires new dimensions: technological tools personalize learning by providing feedback based on the students' prior performance, thereby creating algorithmic expectations that inform their educational trajectory.

Based on that, there arises the question as to how these expectations—whether human or automated—can impact student cognitive and emotional development in an increasingly digital environment and whether this feedback is based solely on student performance or on information collected by AI on the web or on the average performance of the learning group.

In this sense, an AI system would be designed to adjust its recommendations and approaches, enhancing the aspects that are relevant for each student and fostering a supportive environment. In the second case, there would be a climate of distrust in the face of feedback based on "false expectations" not detectable by human instrumentators or verifiers, altering the perception of the reality of the object under study.

It can then be hypothesized that, in the case of generative AI, it is essential to consider how the pre-programmed expectations and data used to train models can create a "Pygmalion effect," which shows the importance of identifying programming algorithms to avoid biases in input and output information, ensuring that injustices or inequalities are not perpetuated. It is also important to include teacher expectations to influence student performance along with AI algorithms, which can reflect and amplify pre-existing biases, affecting the individuals or groups that interact with them [20].

If an AI system is designed or trained with biased data, it can categorize students based on their demographic, economic, or prior performance characteristics, perpetuating expectations that influence their success. Therefore, if AI predicts that a student will perform poorly, it may reduce the quantity or quality of educational resources allocated to that student, thereby reinforcing the predicted low performance.

On the other hand, AI platforms can provide the possibility of creating customized profiles; thus, it is possible to adjust tasks or activities designed according to the student's times, based

on their progress and performance. While this can be positive, it is important to consider that it can also lead to limiting expectations for those students with low performance, for whom AI can suggest simpler study materials, preventing them from overcoming greater academic challenges.

In educational environments, AI is a tool that assists teachers, and it is essential to consider their expectations in relation to students, which can be enhanced and, in many cases, modulated by the data and recommendations provided by the technological tool, prioritizing human interactions as mediators.

In turn, if used appropriately, AI can also strengthen the positive "Pygmalion effect," as a well-designed system can trace areas for improvement and opportunities for growth, in addition to providing students with constructive, personalized feedback that motivates them and raises expectations regarding their performance. By personalizing learning based on each student's potential, AI can help create a more optimistic and encouraging educational environment, similar to a teacher's positive expectations to inspire better outcomes [21].

Thus, AI in conjunction with teachers can promote learning by considering the students' zone of proximal development (ZPD), more effectively structuring what they need to learn based on current competencies [22,23]. However, these tools can lead to uses and abuses that in turn can lead to concrete damages, such as segregation, exclusion, labeling, etc.

The impact of expectations is not limited to academic performance, but also encompasses psychological, social, and emotional development. And its implications can be reflected in people's life projects.

Ethical challenges posed by AI in education

The use of AI in education raises ethical concerns, such as the privacy of student data, the risk of algorithmic biases, and transparency in evaluation processes. In addition, unequal access to technology can increase the educational gap, especially in regions with economic and social deficiencies.

Regarding the advancement and integration of AI into education, a series of ethical dilemmas arise that require analysis based on established bioethical frameworks, such as the principles of autonomy, beneficence, non-maleficence and justice, which provide a perspective to assess the risks and responsibilities involved [2]. At the same time, approaches such as those proposed on the basis of bioethics of solidarity enable broadening the reflection to the social, structural and collective dimensions of justice in educational contexts marked by profound inequalities [24,25].

Therefore, ethics should not be limited to individual relationships, but should also consider the social structures that produce vulnerability and exclusion. Therefore, in the educational field, this implies recognizing that fair access to and ethical use of AI are not only a matter of technical issues or individual decisions, but also of collective responsibility, social justice and inclusive public policies [25]. Therefore, it is essential to adopt approaches from a plural, sensitive and contextualized bioethical perspective, which considers and respects the real educational contexts and the specific living conditions of those involved.

In the scope of the principle of autonomy, dilemmas that could arise between education and ethics could stem from recording classes without student consent or in a coercive manner, which also causes maleficence due to the possibility of producing high levels of anxiety or feelings of persecution in students. Accordingly, the principle of beneficence should be pursued using recordings, data analysis and plagiarism prevention as tools that promote the education of students, and that give them greater possibilities of incorporating knowledge in an equitable manner, ensuring equal access to these technologies [26].

The ethical debate around the use of AI is indispensable to ensure and facilitate proper implementation; therefore, it is necessary to adopt a collaborative and multidisciplinary approach to ensure the responsible and fair use of this type of technology [1].

On the other hand, the United Nations Educational, Scientific and Cultural Organization (UNESCO) [26], in the scope of the Beijing Consensus framework, fosters the training of those responsible for the formulation of educational policies in the area of AI, stating in general terms that it is imperative to promote dialogue between the various actors involved in each educational process, with the purpose of building collaborative and collective proposals that establish the ethical principles guiding the development and use of AI tools.

Similarly, the document [26] encourages AI developers to ensure ethical use, reflecting and respecting human values and principles, so AI can be a socially and individually beneficial tool, without compromising the fundamental ideals of humanity.

The ethical implications must be recognized to coordinate the concrete actions of the actors involved in the teaching-learning process, contributing to the development of proposals that are formulated according to ethical principles that guide the use of technological resources, specifically AI.

There is no doubt that AI is a powerful tool to foster an educational environment where the "Pygmalion effect" benefits are leveraged, providing continuous feedback that can adapt to individual needs. Additionally, AI can help create more realistic and motivating expectations for students, improving their academic performance and promoting personal development, provided that the generative algorithmic programming does not provide information created by itself in its own self-learning system.

A recent systematic review on AI found that the algorithms most likely to be biased and error-prone were trained with "enriched" data packets distancing them from reality. This affects truth and veracity, guarantee of academic quality [27]. Considering that learning and teaching are human responsibilities and that AI-based tools can provide multiple benefits, it is clear that they cannot replace the ability to learn or teach. The true richness of learning can result from combining AI competencies with human attributes such as creativity, empathy, and critical judgment [12].

Consistently, teachers could promote learning by using AI as a tool for assessing the students' knowledge and skills, and in turn analyze the proposals that the intelligence produces to adapt them to each of the learning roadmaps [18,19].

Another study suggests that one of the major challenges of the 21st century is to reflect on how to create conditions in which technology is at the service of human beings, without sacrificing the value of face-to-face interaction, of community and dialogue, or affecting effective social and educational practices. This challenge invites to reflection in learning communities, including the university setting, providing spaces for approximation that enable thinking in a multidimensional and intersectoral manner, with the participation of teachers and students [28].

Final considerations

It is essential to train teachers in the use of AI to strengthen their critical thinking in relation to the results of this tool. This implies developing skills to assess the accuracy, relevance, and potential biases of AI, and integrate it ethically and effectively into the classroom. By understanding its limitations, teachers can develop educational activities that boost learning and foster critical thinking in their students. Studies confirm that this training is fundamental to leverage AI, minimizing risks and promoting its responsible use in education [29].

On the other hand, there is a need for collective and collaborative learning with continuous dialogues [5], which promote the required joint reflection on the ethical implications of the use of AI in education, such as data privacy, the risk of algorithmic biases and transparency in evaluation processes. Similarly, it is essential and indispensable to consider inequalities in access to technological resources, as these gaps can widen and deepen in regions that are deficient in resources and accessibility.

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Paula Romina Putallaz and Patricia Sorokin were responsible for drafting the original draft, as well as writing, reviewing, and editing the manuscript. Lucas Gago-Galvagno, Eduardo Alfredo Duro and Dirce Bellezi Guilhem participated in the conceptualization, data curation and writing, review and editing of the manuscript. Myrna Marti and Ida Cristina Gubert contributed to the conceptualization, formal analysis, writing, review and editing of the manuscript. Roberto García Sánchez and Elizabeth Benites Estupiñan worked on the conceptualization, methodology, writing, review and editing of the manuscript. In addition, Patricia Sorokin assumed overall supervision of the work.

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