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Artificial intelligence for SDG 4 of the 2030 agenda: Transforming education to achieve quality, equality, and inclusion

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CITATION

Arruda EP, Arruda DP. Artificial intelligence for SDG 4 of the 2030 agenda: Transforming education to achieve quality, equality, and inclusion. *Sustainable Economies*. 2024; 2(2): 34.
<https://doi.org/10.62617/se.v2i2.34>

ARTICLE INFO

Received: 18 February 2024
Accepted: 25 March 2024
Available online: 12 April 2024

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Abstract: The objective of this article is to discuss the possibility of using generative artificial intelligence (AI) to enhance teaching practices and pedagogical support to improve the quality of education provided to young people in elementary and secondary schooling. This issue is linked to the global perspective of a shortage of teachers, which directly affects Sustainable Development Goal 4 (SDG 4), concerning the enhancement of education quality as a target for global sustainable development. From this viewpoint, the potential use of AI may also relate to the improvement of educational quality and the reduction of social inequalities, yielding indirect effects on other sustainable development goals. As a method, we intend to conduct an extensive theoretical discussion addressing the challenges for teacher education and work worldwide, utilizing existing data from databases such as UNESCO, the UN, and the OECD, among others. In addition to data on teachers, we plan to analyze the potential for creating artificial intelligence based on existing ones but trained for the specific contexts of each country's educational system. The goal is to examine the potential for formatting artificial intelligence to provide pedagogical support for teachers, such as: grading of objective and discursive assessments; individualized intelligent tutoring; analysis of students' individual pedagogical development; preparation of individual student diagnoses; suggestions of specific pedagogical actions based on curricula and materials used; and all other pedagogical actions that support teachers in their educational journey. This work was funded by CAPES, CNPq, and FAPEMIG.

Keywords: artificial intelligence; education; sustainable development goal 4; teacher shortages; world

1. Introduction

The issue of teacher shortages is nothing new in academic discussions, at least in the last decade. Every year, UNESCO presents data showing that there is a global shortage of teachers, with a particular overload in poor countries located in sub-Saharan Africa and South Asia.

According to data from UNESCO [1], there is a shortage of more than forty-four million teachers worldwide if the need to universalise basic education by 2030 is to be met.

Lack of interest in the teaching profession and other factors have contributed to the shortage of these professionals. Since 2002, UNESCO has pointed to the need for long-term policies and improvements in teachers' working conditions and pay to tackle this challenge.

The explanations for the lack of teachers must be addressed and analysed in depth, considering not only salary aspects, but also effective working conditions, the available infrastructure, and the particularities inherent in teaching young people.

Data from Brazil shows that a teacher earns half the lowest salary offered to other professional categories with the same qualifications. According to UNESCO [1], only one in two countries pays primary school teachers as much or more than other professions requiring a similar level of qualifications. Europe and North America account for only three of the ten countries where the phenomenon is most prevalent. Many high-income nations pay upper secondary teachers seventy-five percent or less than they would in other occupations that are similar.

Although the problem is complex, there is a search for different solutions that have not yet found fully successful paths. It is worth emphasising that the lack of teachers has a direct impact on the United Nations' (UN) Sustainable Development Goal 4. It also has an impact on Goal 10, which is about reducing inequalities, because the failure to universalise basic education is directly related to countries' difficulties in generating wealth from the production of knowledge, as well as reducing the gap between those who earn more and those who earn less, thus increasing a country's socio-economic inequalities.

In general, it can be said that the improvement of SDG 4 enhances the achievement of all other sustainable development goals, since the quality of education involves increased productivity, social justice, equality, clean energy, and/or economic growth. Therefore, the focus on SDG 4 allows us to weave a global and interconnected reach for the remaining sustainable development goals [2].

The SDG 4 is a significant component of contemporary society capable of influencing all other social aspects [3]. For example, to eliminate unemployment, a skilled workforce is necessary, which is achievable through education. Moreover, to attain gender equality in all areas, the education of women is crucial so that they can acquire the same skills as men and have the same rights. SDG 4 aims to address all global issues that are directly or indirectly related to education and can be addressed through effective education for global citizens.

As a way of tackling the challenge related to teacher shortages and the quality of education, in the US context, Podolski [4] proposes measures such as increasing teacher salaries, greater social support from the federal government, and restructuring teachers' careers.

In his examination of the Brazilian context, André [5] identifies parallel challenges faced by educators. He asserts that, beyond the augmentation of salaries and the reformation of career structures, it is imperative to establish supportive policies focused on the induction and professional development of novice teachers. Such policies should not only bolster formal relationships but also fortify the teaching profession, ensuring that educators are well-prepared, connected, and empowered within their roles.

Cudowska [6] reached the same results in a wide-ranging study comparing several European countries. Low salaries, young people dropping out of training courses or the first few years of teaching, poor infrastructure conditions, and unattractive careers are among the findings of this comparative study. These results are remarkably close to those obtained by Ladd [7] when he analysed the situation in developed countries 16 years earlier.

According to UNESCO [8], among the strategies proposed to improve teaching conditions are the development of gender-sensitive policies to attract qualified

teaching candidates, the review and improvement of the quality of teacher training (both initial and continuing), and the development of a qualifications framework for teachers.

It is crucial to acknowledge that the successful implementation of Goal 4, which focuses on education and sustainable development, hinges directly or indirectly on the presence of a sufficient number of qualified teachers. This is because key objectives, such as the universalization of education, ensuring foundational knowledge in mathematics, achieving gender equality, and acquiring the essential knowledge to fulfil all other sustainable development goals, are linked to having a populace that has attained at least basic levels of educational development. Therefore, to turn these ambitions into reality, a robust and well-supported teaching workforce is fundamental.

And because this is a problem that has become chronic worldwide, there is no prospect of it being resolved in the short term. This is not only because of the difficulties observed but also because social challenges tend to increase as school education fails in society. When considering the sustainability goals proposed for 2030, it can be inferred that educational difficulties may make all the other goals unlikely to be achieved, since the level of education is an element strongly related to the population's adherence to sustainability policies.

Based on these gaps, we propose to analyse the possibilities for transformations in teachers' work, in the sense of incorporating artificial intelligence in a way that creates pedagogical support situations in their activities.

Hence, the focus should not be on the concept of creating "robot teachers," but rather on exploring how generative artificial intelligence (AI) can bolster the efficacy of educators. The aim is to provide support that allows teachers to enhance their professional performance, enabling them to streamline their workload and alleviate the pressures of their roles.

This is particularly vital in contexts where educators are overwhelmed by high student-to-teacher ratios due to teacher shortages. Generative AI offers a pathway to optimizing educational delivery, ensuring teachers can focus more on quality teaching and less on the burdens of overextended responsibilities.

We believe that the use of artificial intelligence as pedagogical support can reconfigure teaching work and create the conditions to reduce the impact of teacher shortages.

2. Method

The method used in this article is content analysis and the construction of a theoretical essay on the possibilities of artificial intelligence being incorporated into countries' educational policies to allow teaching activities to receive pedagogical and administrative support in the management of data and students.

From a methodological point of view, we conducted extensive research into the conditions of teacher shortages as well as references that propose to present the possibilities of artificial intelligence as an element of didactic-administrative support for teachers.

From a conceptual point of view, we consider artificial intelligence to be generative content creation models that help teachers provide didactic and

administrative support to their students. By didactic support, we mean help in preparing teaching materials, monitoring student learning, detecting learning difficulties, or creating strategies to reduce student difficulties. From an administrative point of view, we consider creating databases on students that allow for performance analyses, organising learning difficulties, organising school documents, personal and social information, and broad data analyses on classes.

3. Discussion and theoretical framework

In one of the classic books that deals conceptually with Artificial Intelligence (AI), Ertel [9] presents us with the dimensions and dilemmas of this technology, especially with regard to what is potentially being built around artificial intelligence, from the perspective of it being able to fulfil human actions that we are even better at, and from the perspective of programming adaptability, from which intelligent systems self-develop from the perspective of better developing the activities for which they were built.

Artificial intelligence involves dimensions based on algorithms and programming and ethical issues of the utmost importance to humanity, especially regarding machine decisions that directly impact life, health, social coexistence, and state structures.

Recent technological transformations, including the possibility of using generative artificial intelligence (GAI), have sparked discussions about the prospect of AI in teaching practices and problematise changes that may occur in the educational environment [10]. These changes concern the ways in which students begin to produce their educational content, as well as the ways in which teachers can conduct pedagogical activities with the support of AI.

According to Yu and Lu [11], the field of scientific management has witnessed the advantages of artificial intelligence and big data technologies. These advantages can also be applied to educational management. Monitoring the educational and academic process as well as quality dynamically can leverage the organisation, integration, recording, and development of intelligent systems for data mining and deep learning. It is also a technically reliable approach to managing academic and administrative matters in education.

Farrokhnia [12], in turn, states that AI can enable more efficient interactions between students and teachers, changing the way we research and create content. However, it must be considered that the concept of efficiency and interaction needs to be problematised, since we do not yet have concrete elements that allow us to make analyses about the strengthening of relationships between teachers and students mediated by artificial intelligence.

These competences not only lead to changes in the way teachers relate to technology but also open the door to broader changes in the educational context, relating to the assessment of learning, the development of intelligent tutoring, and adaptive teaching [13,14].

4. Research limitations

This research is theoretical, limiting the results of its analyses. In addition, it is noted that the theme of artificial intelligence is extremely recent, which makes the number of academic productions to support the arguments presented scarcer.

In addition, it is necessary, in a continuity of discussions, to promote greater dialogue between SDG 4 and the other SDGs and to analyze data that allows us to better understand the relationships between them, especially based on demonstrated empirical results.

5. Results

As highlighted by Edwards and Cheok [15], integrating AI into educational practices does not equate to creating “robot teachers.” Instead, these authors envision a scenario where educators can orchestrate and manage teaching activities characteristic of human instructors without necessarily being physically present.

They delve into the current utilization of robots within educational settings, serving as classroom aides, components of educational technology, and supports for teaching. The discussion extends to how, with the advancement of AI, robotics, and machine learning, robots could potentially outperform human teachers in specific areas such as expertise in subject matter and cost-effectiveness in maintenance. This perspective suggests a future where AI could complement or enhance the educational process, providing innovative solutions to the challenges faced by traditional teaching methods.

However, Edwards and Cheok [15] recognise that there are significant challenges to implementing robot teachers. These include the need for skills such as emotional intelligence, creativity, and communication, which are inherent characteristics of human teachers. In addition, the authors emphasise the need to consider social and demographic factors, such as culture and religion, when developing AI systems for education.

One of the strongest elements to consider is respect for the authority that the teacher exercises in the classroom. It is extremely easy to switch off an automated environment; you just press a button. This is different from the interaction between human students and teachers, as social, cultural, and authority relations discourage simple absence from the educational environment.

Celik et al. [16] state that AI offers teachers many opportunities to improve the planning, implementation, and evaluation of their teaching. In addition, teachers play various roles in the development of AI technology, acting as models for training AI algorithms and participating in AI development by checking the accuracy of automated AI assessment systems.

The role of the teacher as AI “trainer” is perhaps the one that generates the most discomfort because, as stated above, the lack of transparency about the codes and programmes, as well as the intentions of the large companies supplying AI, makes it unclear that the work of teachers is not being appropriated by the machines for a future situation of assimilation and teacher replacement, despite all the problems that such an action would incur.

However, political choices are not always based on scientific production, which is why these concerns are solid enough to be considered a risk to work, practices, and teaching itself in formal school contexts.

Although it is not a mathematical formula that contains a directly proportional relationship, numerous studies have shown that an increase in a country's educational levels makes it possible to reduce economic inequality, above all because better educational indices make it possible to obtain higher-paying jobs, as well as expanding the possibilities for a country's scientific and economic development [17–19].

When we look at the sustainability targets and indicators proposed for 2030, we realise that we are already just under six years away from meeting indicators that are still a long way from reality. It should be borne in mind that targets and commitments do not mean full fulfilment, but they are built collectively from a perspective that is the best possible reality for human improvement.

In the context of a shortage of millions of teachers, as we noted earlier, there will hardly be enough time to train so many teachers to guarantee universal access to primary and secondary education. This is because it takes a minimum of between three and six years, depending on the legislation of each country, for a teacher to be fully trained for primary and secondary education.

The data shows, however, that fewer and fewer young people want to become teachers, and those who enroll in courses drop out within the first few years, as noted above. Brazilian data from Inep [20] shows that even in areas where there are far more trained teachers than jobs, many choose not to work as teachers.

Gašević et al. [21] explore the ways in which we can enhance learning with the support of artificial intelligence. For the authors, the explainability of AI, educational assessment, and design help teachers better fulfil their teaching activities.

However, beyond these issues, which are presented as the most immediate answers to the educational gaps, we need to build paths that allow us to include artificial intelligence as an element that will minimise or allow an improvement in educational performance while countries fail to solve the shortage of teachers.

It is therefore not the best situation in which we should think of education as an element for reducing inequalities, but what is most readily available to us to reduce the development time of the poorest countries when compared to rich countries. The longer it takes to provide educational access, the greater social and economic inequalities become in local and international contexts.

6. Conclusions

Generative artificial intelligence software is still in the first wave of innovation, in the process of being perfected and learned. However, the results of using AI to produce texts, videos, and images are already impressive and are likely to become even better in terms of accurate responses in a short space of time.

This gives us important clues about the future that is opening for education and the construction of machine learning models that work to alleviate the shortage of teachers in countries—without, however, replacing them. This is a perspective in which A.I. becomes a source of teaching support for repetitive activities, for contexts

with too many students, and for individualised analyses that allow teachers to make pedagogical decisions that improve student performance.

What is more, we need to consider that this is not just a technical use of artificial intelligence in teaching. It is a cycle of transformation in teaching work, yet unmeasured, that will bring different actions and activities to teachers in their daily school lives.

In addition to the teaching activities previously learned in training courses, new activities emerge, such as learning how to use educational data generated by A.I. to improve school performance, how to develop individualised student monitoring based on the learning feedback provided by A.I., or even incorporating new teacher-student interaction strategies in contexts in which A.I. develops certain pedagogical interventions and frees up the teacher for other work, such as more in-depth analysis of a specific student's learning difficulties or collective difficulties with certain content.

The integration of artificial intelligence (AI) in education presents transformative potential to meet the United Nations' Sustainable Development Goals (SDGs) for 2030. AI has the potential to enhance educational accessibility for disadvantaged populations or those in remote areas. This can help reduce educational inequalities and promote gender equality in education, aligning with other sustainable development goals such as reduced inequalities (SDG 10) and gender equality (SDG 5).

Furthermore, AI systems can provide valuable insights from large educational datasets, enabling policymakers to make informed decisions to improve the quality and efficacy of educational systems. This can contribute to the construction of resilient and sustainable educational infrastructure, aligning with the goal of sustainable cities and communities (SDG 11).

By equipping students with skills in emerging technologies, AI-supported education can prepare the workforce for future challenges, promoting sustainable economic growth (SDG 8) and innovation and industrial infrastructure (SDG 9).

Therefore, we see an open future in which the use of artificial intelligence to help achieve SDG 4 could lead to improvements across all other goals through a positive dialogue in which the education provided to all becomes the best path to sustainable development.

Author contributions: Conceptualization, EPA; methodology, EPA and DPA; software, EPA; validation, EPA; formal analysis, EPA and DPA; investigation, EPA; resources, DPA; data curation, EPA; writing—original draft preparation, EPA and DPA; writing—review and editing, EPA; visualization, EPA; supervision, EPA; project administration, EPA; funding acquisition, EPA. All authors have read and agreed to the published version of the manuscript.

Funding: This work was funded by the Coordination for Personnel Improvement (CAPES), the National Council for Scientific and Technological Development (CNPq), and the Minas Gerais State Research Support Foundation (FAPEMIG).

Conflict of interest: The authors declare no conflict of interest.

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