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Economics of education: a conceptual analysis of the foundations and challenges in the age of AI

Economía de la educación: un análisis conceptual de los fundamentos y desafíos en la era de la IA

Economia da educação: uma análise conceitual dos fundamentos e desafios na era da IA

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Abstract

This study was conducted considering the theme of the economics of education and, above all, focusing on a trend such as artificial intelligence (AI). This theme, which in the research is driven by the economics of education, is grounded in the conceptual foundations of the field. Its main objective is to construct an updated diagnosis of the relationships between education, economic growth, and technological transformations. Therefore, the methodology employed was a conceptual analysis that documented and compared studies on the most recognized themes, such as access and equity, quality and learning results, financing, governance, accountability, technology, and digital transformation. Among the conclusions, the most significant was the need for public decision-making in a context of accelerated technological change, fiscal challenges, and growing learning gaps. The report proposes

public policy pathways to maximize the social return on investment in education, safeguard equity, and guide responsible AI use. Thus, one of the findings was that, due to inequalities in Latin America and Mexico, gaps still exist in the aforementioned areas, and that, especially given the multidisciplinary nature of the economics of education, it is crucial to conduct research from diverse fields of knowledge.

Keywords: economics of education, human capital, educational policy, AI in education.

Resumen

Este estudio se realizó considerando el tema de la economía de la educación y, sobre todo, centrándose en una tendencia como la inteligencia artificial (IA). Este tema, que pudo explorarse en la investigación debido a la amplitud del campo de la economía de la educación, ofrece una síntesis analítica de los fundamentos conceptuales del área. Su objetivo principal es construir un diagnóstico actualizado de las relaciones entre educación, crecimiento económico y transformaciones tecnológicas. Por lo tanto, la metodología empleada fue un análisis conceptual que documentó y comparó estudios sobre los temas más reconocidos, tales como acceso y equidad, calidad y resultados de aprendizaje, financiamiento, gobernanza, rendición de cuentas, tecnología y transformación digital. Entre las conclusiones, una de las más significativas fue la necesidad de una toma de decisiones pública en un contexto de cambios tecnológicos acelerados, desafíos fiscales y crecientes brechas de aprendizaje. El informe propone vías de política pública para maximizar el retorno social de la inversión en educación, salvaguardar la equidad y orientar el uso responsable de la IA. Así, una de las conclusiones fue que, debido a las desigualdades en América Latina y México, aún existen brechas en las áreas mencionadas y que, especialmente dada la naturaleza multidisciplinaria de la economía de la educación, es crucial realizar investigaciones desde diversos campos del conocimiento.

Palabras clave: economía de la educación, capital humano, política educativa, IA en la educación

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Resumo

Este estudo foi conduzido considerando o tema da economia da educação e, sobretudo, com foco em uma tendência como a inteligência artificial (IA). Este tema, que pôde ser explorado na pesquisa devido à vastidão do campo da economia da educação, oferece uma síntese analítica dos fundamentos conceituais da área. Seu principal objetivo é construir um diagnóstico atualizado das relações entre educação, crescimento econômico e transformações tecnológicas. Portanto, a metodologia empregada foi uma análise conceitual que documentou e comparou estudos sobre os temas mais reconhecidos, como acesso e equidade, qualidade e resultados de aprendizagem, financiamento, governança, prestação de contas, tecnologia e transformação digital. Entre as conclusões, uma das mais significativas foi a necessidade de tomada de decisão pública em um contexto de mudanças tecnológicas aceleradas, desafios fiscais e crescentes lacunas de aprendizagem. O relatório propõe caminhos de políticas públicas para maximizar o retorno social do investimento em educação, salvaguardar a equidade e orientar o uso responsável da IA. Assim, uma das constatações foi que, devido às desigualdades na América Latina e no México, ainda existem lacunas nas áreas mencionadas e que, especialmente dada a natureza multidisciplinar da economia da educação, é crucial realizar pesquisas a partir de diversos campos do conhecimento.

Palavras-chave: economia da educação, capital humano, política educacional, IA na educação.

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Introduction

The authors Leyva and Cárdenas (2002) analyze the economics of education, where societies invest and regulate in order, at a macro level, to promote economic growth, and, at an individual level, Hanushek and Woessmann (2015) First, it generates human capital that, in the long term, increases productivity and improves people's quality of life, mainly in the economic dimension. Second, it benefits the social environment by fostering social mobility, cohesion, etc. Today, this function is especially relevant in promoting the use of technology and innovation in education (Hanushek and Woessmann, 2015).

Over the past two decades, increases in schooling levels have not been sufficient to address persistent inequalities or close the learning gaps that limit the transformative potential of education. This is due to differences in educational systems across the world.

Therefore, not everyone has access to education, and even if they do. (World Bank and UNESCO, 2024).

In the current context, recognize that the world faced the COVID-19 pandemic, 2020 results of which showed a decline in student performance, particularly in mathematics and reading comprehension. Various studies and reports have shown that performance by socioeconomic level has become alarmingly unequal. Consequently, researchers have renewed the debate on the economics of education from a global perspective, addressing aspects such as educational coverage rates, quality, and equity across different educational levels. The health crisis negatively influenced people at all educational stages, disrupting learning trajectories. Paradoxically, it also accelerated debates on resilience, digitalization, and new teaching methods, as well as the integration of artificial intelligence (AI) into education (OECD, 2023).

At the same time, the emergence of AI and automation is transforming skill demand and redefining the structure of educational systems. These changes have significant implications for productivity and income distribution—not only among teachers but also among students in the education sector (Acemoglu, 2024; OECD, 2024a; and UNESCO, 2023a). Technology now shapes our daily lives; however, it also compels individuals to further develop cognitive, socio-emotional, and digital competencies.

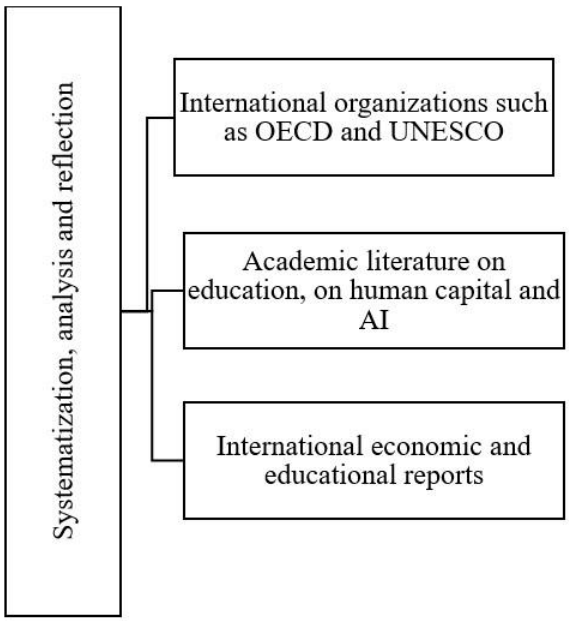
Countries' ability to adapt to these technological and AI transformations will be a decisive factor for both economic competitiveness and social equity in the digital age. This research presents an updated map of public action and applied research, structured along three axes: the first focuses on the foundations and analytical dimensions of the economics of education; the second, the experiences and lessons learned from educational policies; and the third, current findings in the context of technological disruption and artificial intelligence (IA). Finally, conclusions and strategic public policy proposals are presented from an educational economics perspective.

Methodology

This research uses primary and secondary sources, including academic literature, institutional reports, statistics, and international policy documents. This research used sources obtained from as Google Scholar, ERIC, Redalyc, Universidad Autonoma De México (UNAM) Library, Elsevier, and ResearchGate. The study aims to develop an updated diagnosis of the links between education, economic growth, and technological transformations (University of Toronto, 2025).

The method consisted of a conceptual analysis that involved a critical and comparative exercise to identify consensuses, tensions, and gaps in knowledge production between 2015 and 2024. With special attention to the post-pandemic period and emerging literature on artificial intelligence (AI) and education. Figure 1 below shows the methodology, which systematizes research from international organizations such as the OECD and UNESCO, as well as from the aforementioned repositories of literature on education, human capital, and AI, and draws on international reports on economics and education. This was done to provide a broad overview for in-depth, thereby framing an analytical framework for the documents examined in this research (Expósito and González, 2017).

Figure 1. Methodology.



Source: Authors' own elaboration.

Inclusion criteria: documents from primary and secondary sources of international organizations, such as the OECD and UNESCO; literature on education, human capital, and AI; and reports on economics and education. Exclusion criteria: documents that are not from primary and secondary sources, and reports on economics and education.

Recent OECD and UNESCO Production

In recent years, the OECD and UNESCO have produced documents addressing educational equity, digitalization, and sustainability as central pillars of the international agenda (OECD, 2024a; UNESCO, 2023a). A systematic review of these reports shows convergence on the need to consider education as a key element of each country's economic and social development, as well as the urgent need to use and adapt technology across all educational levels. Among the common findings were the urgency of reducing digital exclusion, of addressing the diversity of educational contexts with technology, and of investing in teachers as mediators of change in the development of skills and competencies in the use of AI in teaching-learning processes (Bolaño and Duarte, 2024).

Academic Literature on Education, Human Capital, and Artificial Intelligence (AI)

In the first section on primary and secondary sources, this study reviews the foundational literature on the economics of education, focusing on works that link investment in human capital to sustained economic growth. Hanushek and Woessmann (2015) document how the development of human capital and its production in higher education institutions promote, in various ways, productivity, competitiveness, and social and individual well-being.

Considering these perspectives, the scope of existing studies, particularly in academia, and their influence on human capital development. They also reveal current limitations, highlighting the need to address various aspects, including measurable and non-measurable competencies (such as cognitive, social, and leadership skills), technical and operational skills, and the appropriate use of human capital in each area of specialization. All these elements underscore the value of the economics of education and technology as an essential emerging field for national and global development.

In the second section of emerging literature on artificial intelligence (AI), this research examines the macroeconomic and educational impacts of AI and automation. While many discussions emphasize AI's potential, significant limitations remain. For example, recent studies by Acemoglu (2024) and the OECD (2024b) warn that the rapid expansion of AI is reshaping skill demands and creating both opportunities for productivity and risks of

labor polarization. However, few analyses address the conceptual boundaries of intelligence itself in AI, so researchers must clearly define them to avoid overestimating its usefulness and to better understand its limitations.

From an educational perspective, it enables the personalization of the teaching and learning process and, therefore, optimizes educational management at both the institutional and classroom levels. Other important issues raised include ethical dilemmas related to fairness, privacy, and algorithmic bias (UNESCO, 2023a). The results of this review of such documents show that, while most currently view AI's transformative potential favorably, significant gaps remain in the assessment of AI. Therefore, in the educational sphere, it remains necessary to reformulate and integrate not only AI but also other technologies into curricula, and to measure their impact across different geographical contexts to understand their socioeconomic implications.

The review strategy prioritized studies and program evaluations that provide both quantitative and qualitative evidence. The research also included educational, economic, and technological policy documents, as well as applied studies from international organizations, to support the study. The study emphasizes the period 2015–2024, with particular attention to the post-pandemic years, published in a more continuous form, and introduces new studies with updated data on virtual learning, educational expenditures, and digitization.

Furthermore, the study considers the emerging field of AI and education, which combines economic, educational, and technological analyses to anticipate future scenarios. This critical review maps the economics of education and connects it to previous research that scholars have enriched by addressing previously invisible challenges emerging from the global health crisis and the ongoing technological revolution.

International Economic and Educational Reports

This section analyzed the results of comparative learning assessments, particularly the OECD's PISA 2022 (2022). The results reveal historic declines in mathematics and reading comprehension, primarily due to the COVID-19 pandemic. More importantly, achievement gaps between students from different socioeconomic backgrounds widened, confirming that the crisis did not affect all populations equally but had a drastic impact on the most vulnerable. These reports highlight global results and offer a realistic perspective, enabling us not only to obtain complex data but also to analyze and evaluate it and to develop country-specific policies on educational resilience, digitalization, and recovery strategies.

Finally, the sources are reports on education finance, including the Education Finance Watch (World Bank and UNESCO, 2024). These documents highlight the fragility of education financing systems in the post-pandemic era, where fiscal pressures and budget constraints have limited governments' capacity to sustain increases.

Evidence indicates that, despite increased enrollment, spending per student in many middle-income countries remains insufficient to guarantee quality education, reduce equity gaps, and provide students with the necessary tools to integrate into the labor market in today's global context. These documents allow us to observe new trends in policy instruments, foster partnerships between public and private organizations and universities, and explore financing mechanisms for digital tools and for teacher and student training, with a particular emphasis on artificial intelligence.

Results

From an economic perspective, human capital theory has been studied and developed since the mid-20th century as one of the most influential conceptual pillars for explaining the relationship between education and economic development (Valencia, 2005). Other arguments focus on education for better labor market integration, and on productivity translating into higher individual wages, as well as stronger skills in mathematical reasoning and socio-emotional skills such as motivation, collaboration, and creativity. These benefits are not only manifested in higher incomes, occupational mobility, and job stability, but in social benefits ranging from technological innovation to civic cohesion and the strengthening of democracy (Medina and Ochoa, 2025).

However, current literature suggests an emerging consensus: simply extending schooling, measured in years of education, does not suffice. Instead, what truly determines results is the learning that students actually acquire, which the workforce currently requires, depending on the field. Comparative research shows that the accumulation of practical skills strongly correlates with sustained long-term economic growth.

In Latin America and Mexico, there is a limited scientific output on the economics of education. That is why this research seeks to open up an academic area that has been little explored by researchers in the region (Mungaray, Pimienta, and Ocegueda, 2023). This shift in focus, emphasizing the quantity of education rather than the quality of learning, has profound implications. First, it demands a rethink of traditional metrics for evaluating educational policies: simply recording school enrollment or graduation rates is no longer

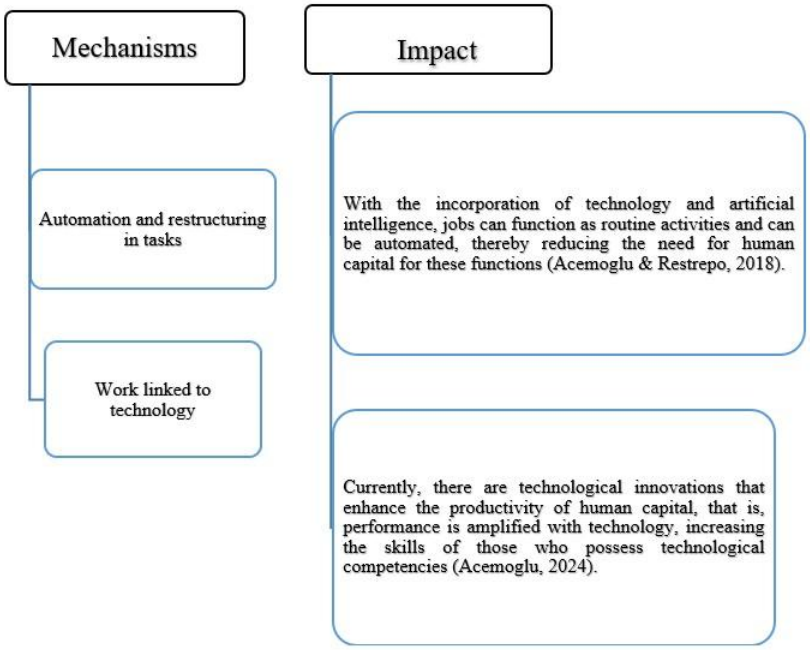
sufficient; it is now necessary to assess specific, transferable skills. Second, it requires integrating human capital theory with other approaches in contemporary economics, such as globalization and technological change.

For example, in behavioral economics, researchers have studied how families and students make educational decisions under conditions of incomplete information. They are influenced; they lack clarity about the importance of attending school. In addition, the level of economic resources of each family or individual. Aspects such as a lack of awareness of the long-term benefits of education and the influence of social norms condition school trajectories and explain phenomena such as early school leaving, which affect both personal and social levels.

Furthermore, public economics provides a normative and analytical framework for discussing education financing in different contexts worldwide, as well as the positive aspects of learning and the equitable distribution of resources. This aspect deserves further investigation. The nature of education, both public and private, justifies public intervention through subsidies, redistribution, and regulatory frameworks that balance efficiency with equity.

Likewise, Figure 2 main mechanisms of technology for analyzing the competitive structure of school systems, particularly in contexts where public and private schools coexist. One future objective would be to regulate the design of competitive mechanisms, promote incentives for quality, and address barriers to entry for new providers. These essential issues link economic analysis with educational governance. Within this conceptual framework, technological disruption emerges as a factor that radically transforms the dynamics of human capital. Recent research has identified two central mechanisms through which technology impacts labor markets and, consequently, redefines educational requirements and the new approaches that educational institutions at all levels must adopt. (Acemoglu y Restrepo, 2018).

Figure 2. Main mechanisms of technology.



Source: Authors' own elaboration

The ultimate impact of technological disruption depends on the balance between the displacement of previous functions or activities by technology and the creation of new tasks. The automation process focuses on eliminating routine tasks, leading to the creation of new sectors or roles within companies across industries. Sadly, this can significantly widen inequalities worldwide. Therefore, it is important to integrate technology into all education systems to prepare the population to take on advanced tasks in fields such as creative problem-solving, complex information management, innovation, and digital ethics. This has effects that can translate into greater aggregate productivity and increased employment opportunities for graduates of technology-focused education systems.

Consequently, human capital theory remains essential, but it needs to be updated and integrated with behavioral economics, public economics, industrial organization, and the theory of technological change. The capacity of education systems to generate intellectual capital and develop skills that complement automation will be a determining factor in economic growth and social equity in the 21st century.

Critical Dimensions of the Economics of Education in the Contemporary Context

The current agenda for the economics of education must be viewed from a multidimensional perspective that articulates access, equity, quality, financing, governance, and technological innovation. Each of the following axes offers both progress and persistent

challenges, and together they constitute the framework for action for sustainable and effective educational policies in the 21st century. Therefore, this research addresses the following:

a) Access and equity. - In recent decades, significant progress has been made in educational coverage, with increased enrollment in primary and secondary education in much of the world. However, universal access does not automatically translate into equity. Inequality gaps persist related to socioeconomic status, gender, geographic location, and migration status, among other factors. For example, children from poor households, rural communities, displaced families, or ethnic minorities face structural barriers that affect their educational results. One particularly revealing indicator is "learning poverty," which measures the proportion of children unable to understand a simple text by age 10. The World Bank (2024) reports that this deficiency affects a considerable proportion of children in low- and middle-income countries, with marked variations across regions, including Latin America and Mexico. This reality means that millions of students advance to the next grade without consolidating basic reading skills, which negatively impacts their subsequent learning and leaves them consistently behind.

Equity, understood as the capacity to guarantee effective educational opportunities regardless of social origin, also requires specific and inclusive policies. Governments and educational institutions provide support, such as scholarships, tutoring, socio-emotional services, and food programs, to equalize opportunities and compensate for structural disadvantages. However, inadequate strategies for distributing these resources often prevent those who truly need them from accessing this support. In the absence of such policies, education systems continue to reproduce, and even amplify, intergenerational inequalities in Latin American countries and Mexico (Arango, Sosa, and Valdés, 2022).

b) Quality and Learning results. - The quality dimension is currently relevant. The PISA 2022 report (OECD, 2023) documents unprecedented declines in areas such as mathematics and reading, which statistical results attribute to the educational conditions resulting from the pandemic. These setbacks were not uniform; variations were observed across countries, socioeconomic levels, and genders, reinforcing the need for context-specific interventions. The literature identifies several cost-effective strategies for recovering and strengthening learning. These include explicit pedagogical practices with clear objectives and continuous teacher feedback, as well as self-assessment; effective time spent on tasks, which reduces interruptions and maximizes the pedagogical use of school time; and personalized programs that have demonstrated a significant impact on post-pandemic learning recovery.

c) Financing, efficiency, and accountability. The sustainability of any education policy depends on adequate and well-managed funding, as noted in the Education Finance Watch 2024 report (World Bank, 2024) and (UNESCO, 2024), which highlights the fiscal pressures many countries faced after the pandemic, marked by debt burdens, inflation, and competition with other priority sectors. In this context, it is crucial to protect and redirect spending toward interventions with greater educational impact. Educational efficiency requires not only more resources but also better implementation, depending on the country, as well as robust information systems that allow for monitoring the allocation and results of public education spending.

The OECD (2024a), in its Education at a Glance report, also emphasizes the close relationship between educational attainment and employment, while warning about the persistence of gender gaps and labor market segmentation, even among individuals with similar credentials. Accountability thus becomes a key element: governance systems based on transparent budgets and accountability mechanisms are essential to ensure that educational funding translates into tangible improvements in learning and equity.

d) Governance and School Choice. - The quality of education systems depends largely on their institutional architecture, which includes curricula, assessment systems, teacher career paths, and school choice mechanisms. These dimensions determine student achievement and the distribution of educational opportunities. The literature contains research and data on school vouchers and co-payment systems, which have shown mixed results. Studies such as those by Angrist et al. (2006) and Epple et al. (2017) show that, in specific contexts, school vouchers can improve retention and completion rates, especially when accompanied by explicit conditionality and transparency mechanisms. However, it is also observed that, without inclusion regulations, these programs can deepen school segregation and disproportionately benefit families with greater cultural capital. This implies that governance must strike a balance between promoting families' autonomy and choices while avoiding fragmentation of the system, deepening inequalities, and, above all, failing to address structural vulnerability.

e) Technology, artificial intelligence, and digital transformation. In the 21st century, digital transformation has become a crosscutting theme in education policies. However, international evidence underscores that technology is a means, not an end: its impact depends on pedagogical design, teacher training, and available infrastructure (UNESCO, 2023b).

Experiences with digitization have shown limited effects when not accompanied by pedagogical innovation or teacher training.

The emergence of artificial intelligence (AI) opens new possibilities for education, including personalized learning through adaptive systems that adjust content to the student's pace; automated formative assessment, which provides immediate feedback and early diagnosis of weaknesses; and administrative optimization, which reduces bureaucratic burdens and frees up teachers' time for teaching. However, significant risks also arise, such as algorithmic biases that perpetuate inequalities, risks to privacy and data protection, excessive cognitive dependence, and a widening digital divide between those who have access to these tools and those who are excluded (UNESCO, 2023a; OECD, 2024b). Therefore, integrating AI into education requires ethical and regulatory frameworks. As well as strategic investments in infrastructure and digital literacy, to avoid perpetuating exclusion among those who lack access to technology.

An analysis of these five dimensions reveals ongoing tensions among coverage, quality, equity, segmentation, limited funding, growing demands, technological innovation, and the risks of exclusion. The economics of education, in this context, should not be limited to studying individual returns to schooling but must become an interdisciplinary field that articulates social justice, economic efficiency, and technological sustainability.

Evidence and Contemporary Challenges in Financing Policies, Governance, and Technology in Education

The economics of education has documented multiple funding and organizational mechanisms aimed at expanding access, improving quality, and ensuring equity. These include vouchers, subsidies, and co-payments in different countries; equity-focused funding; limited transparency in scholarship disclosure and governance structures; and, more recently, the incorporation of artificial intelligence (AI) as a tool to support teaching and learning. Analyzing these dimensions reveals both their transformative potential and associated risks, especially in contexts with fiscal constraints, persistent inequalities, and accelerated technological disruption.

Conceptual reviews show that the effects of these instruments are heterogeneous. Epple et al. (2017) note that in limited programs with conditionality and some transparency mechanisms, small to moderate impacts on academic performance and graduation rates have been observed. However, when these policies are implemented on a large scale without

regulations on quality and inclusion, the results tend to be diffuse or ambiguous, and may even increase school segregation.

A prime example is the PACES program in Colombia, which allocated vouchers through a random lottery. This experimental evaluation, conducted by Angrist et al. (2006), demonstrated that beneficiaries were more likely to complete secondary education and that there were some positive long-term effects on income and labor force participation. Researchers have widely cited this example as evidence of vouchers' potential when policymakers design them with clear allocation rules and implement them in relatively robust institutional contexts.

Conversely, co-payment and selection schemes, common in systems with high private sector participation, can deepen school segmentation. When schools use selective mechanisms without inclusion regulations—for example, entrance exams, interviews, or high tuition fees—access tends to be concentrated among families with greater economic and cultural capital. The literature suggests that mitigating these risks requires measures such as blind admissions without socioeconomic bias, transparency in information, and the availability of compensatory scholarship funds (Ministry of Education, 2025).

Contemporary education policy holds that governments must protect funding, distribute it progressively, and direct it toward equity. The Education Finance Watch 2024 report by the World Bank and UNESCO (2024) emphasizes that, amid global fiscal pressures, countries must safeguard basic spending per student and avoid cuts that disproportionately affect the most vulnerable populations.

Furthermore, it is necessary to expand progressive funding schemes that provide greater resources to underserved territories, rural areas, or highly marginalized communities. Evidence shows that differentiated allocation, combined with accountability systems, can reduce learning gaps and educational opportunities. Efficient spending requires prioritizing interventions with a high cost-benefit ratio. Educators and policymakers have implemented key strategies, including intensive tutoring for at-risk students, meaningful professional development for teachers, high-quality curriculum-aligned educational materials accessible across contexts, and extended instructional time. These investments improve learning results and help reduce intergenerational inequality (Fuentes, 2021).

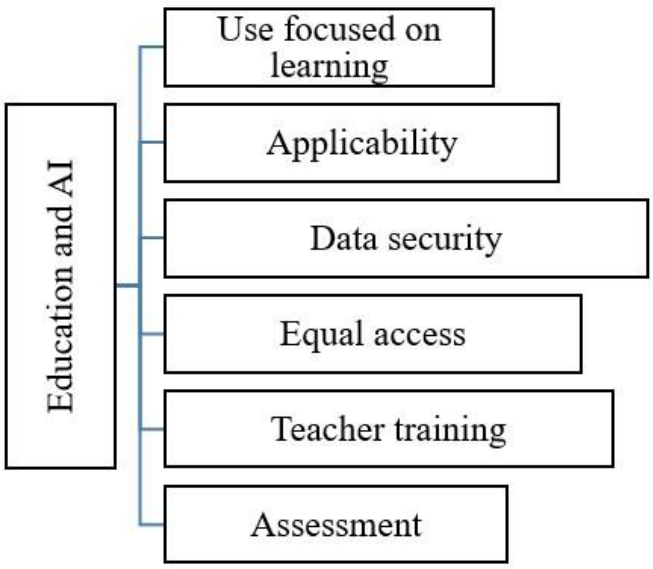
On the other hand, educational governance constitutes the institutional framework that defines how policymakers design, implement, and evaluate educational policies. A key element is the existence of formative and summative assessment systems that monitor school

performance and guide improvement decisions. The public use of results, along with safeguards that prevent the stigmatization of schools and communities, can foster transparency and accountability. However, assessment policies must also translate into continuous improvement processes rather than functioning only as sanctions.

School staff often face administrative overload because authorities require them to report redundant indicators, reducing the time they can dedicate to pedagogical work. The literature emphasizes that governance systems should be designed based on the principles of simplification and relevance, allowing schools to focus their energy on teaching and learning rather than on excessive administrative burdens, which currently constitute one of the most pressing problems facing teachers at all educational levels.

Regarding the integration of artificial intelligence (AI) into education, expectations have been raised about its transformative potential, but so too have warnings about ethical, pedagogical, and equity risks. UNESCO (2023a), in its Guide for Generative AI in Education and Research, and the OECD (2024b), in adapting its AI principles to the educational field, propose a framework based on seven pillars, as illustrated in Figure 3. These include: learning-focused use, applicability, data security, equal access, teacher training, and evaluation; these entail a process at any educational level.

Figure 3. Pillars of artificial intelligence in education.



Source: Authors' own elaboration.

In operational terms, artificial intelligence (AI) offers significant potential for automated formative feedback, assisting teachers in planning and various activities. It can produce learning analytics to generate early warnings of lags and provide conversational tutors. However, it can never replace human teaching.

However, there are also significant risks, such as algorithmic biases that reproduce content errors and student dependency on AI operational, which having negative results by not demonstrating their knowledge or skills. Mitigating these risks involves responsible use policies, human verification of results, and an instructional design that encourages critical reasoning and authentic learning. However, above all, it is important to explain to students that AI is a tool.

An analysis of these dimensions reveals that educational policies must balance innovation, regulation, efficiency, equity, autonomy, and accountability. Vouchers and subsidies show potential in regulated contexts; progressive financing guarantees educational justice; governance allows for improvement without bureaucratization; and AI, properly managed, can become a powerful tool for learning.

The economics of education, therefore, faces the challenge of providing analytical frameworks and research to guide these decisions. In the case of educational reforms, beyond their technical design and the validity of their rationale, they are developed in a complex political space where budget disputes, union interests, and territorial dynamics converge.

In this sense, the field of political economics of education emphasizes that changes in public policy are not linear processes, but rather negotiations between actors with asymmetric power resources (Ibarra & Mercado, 2014). Ministries of education must confront the resistance or negotiation of teacher unions, which in many countries are highly mobilized actors, and harmonize reforms with subnational governments, which often have direct responsibilities for school management, teacher hiring, and spending.

Cost-effective interventions with strong research support, such as intensive tutoring, guided practice, teacher training programs, and extended school days, Its impact is minimal or non-existent if institutional capacities do not support its implementation (Pritchett, 2013). Weak administrative frameworks, a lack of pedagogical leadership in schools, and unclear incentives for teachers and principals constitute the so-called bottlenecks that erode the transformative potential of education policy. In this sense, the evidence reinforces the idea that the problem with education policy lies not so much in defining what to do, but in how to do it sustainably and at scale.

In societies with high administrative decentralization, such as Mexico, Brazil, and India, implementation challenges are exacerbated by regional capacity gaps: local governments with lower technical and fiscal capacity face difficulties in implementing national reforms, thereby reproducing territorial inequalities (World Bank, 2022). The incorporation of artificial intelligence and digital technologies into education amplifies this complexity. Unlike traditional reforms focused on curriculum or funding, the AI era demands strong cross-sector coordination.

The integration of these tools is not limited to the purchase of devices or platforms; rather, it requires the convergence of sectors such as education, science and technology, telecommunications, and data protection. System interoperability, universal connectivity, ethical standards for data use, and the regulation of private technology providers become essential conditions, without which innovation risks exacerbating inequalities and vulnerabilities (UNESCO, 2023a; OECD, 2024b).

Thus, the challenge of implementation in the age of AI transcends the school setting and extends to the entire institutional ecosystem. Creating governance frameworks that align educational agendas with those of technological innovation, while simultaneously protecting the rights of students and teachers, is fundamental to ensuring that reforms are not biased by special interests or limited to unrelated pilot projects. Only through this process can ensure that AI becomes a complement that expands learning opportunities, rather than a factor that further fragments access to quality education. In short, in the age of AI, the success of an education policy will depend less on its formulation in official documents and more on its ability to bring together sectors, stakeholders, and regions around a project of inclusive and equitable transformation for all those involved in education.

As a final point drawn from the results, some Latin American countries have achieved significant improvements in the quality of primary and secondary education, as demonstrated by learning results, and have experienced higher growth and productivity rates than those that simply increased formal schooling without improving learning (OECD, 2024a). However, these countries still need to improve their positive results. Therefore, developing new skills technical, operational and soft skills is essential to making a difference, as evidenced in both international documents and national and international literature.

Discussion

The discussions in this section cover the different points found in this research, which are as follows: fostered reflection on the role of the economics of education in the contemporary context, It offers an overview of the complexity that education systems face in the 21st century. Traditionally, this discipline has provided a solid framework for analyzing how investment in human capital directly influences productivity and individual income, thereby driving economic growth. However, its relevance extends beyond the strictly economic: education also acts as a generator of social capital, intergenerational mobility, becoming an instrument of social transformation fostering technological innovation in Latin America.

However, recent research indicates that schooling does not guarantee effective results in terms of quality or equity. The COVID-19 pandemic particularly in Latin America, the significant gaps in the use and integration of AI in education, demonstrating that universal access does not automatically translate into meaningful learning. This suggests that education systems require effective mechanisms transferable learning through evidence-based pedagogical strategies, intensive mentoring, and strengthened teacher professional development. , especially in Latin America, and specifically in Mexico, there are significant social, economic, and educational inequalities.

Nevertheless, some educational institutions, since the emergence of Artificial Intelligence (AI) and technological automation, the aim is to increase the demand for advanced cognitive and digital skills.

Therefore, it is necessary to redefine employability profiles and to encourage educators and decision-makers to rethink curricula, funding models, and educational governance structures, considering the implications for teachers who lack technological skills from an economics-of-education perspective.

From this perspective, researchers in the economics of education seek to connect approaches from human capital theory, public economics, behavioral economics, and industrial organization, also integrating the technological dimension as a factor that can amplify both opportunities and inequalities (Torres and Cobo, 2017).

In this context, the effectiveness of educational policies depends not only on the design of cost-effective interventions, but also on institutional capacity and intersectoral coordination among education, science, technology, and regulation.

Education, conceived as a public good, requires an approach that combines social justice, economic efficiency, and technological sustainability, promoting ethical implementation that maximizes the benefits of digital innovation and minimizes the risks of exclusion or segregation.

Finally, the results of this emphasize that the economics of education must evolve into an interdisciplinary and forward-looking field, capable of generating comprehensive diagnoses, coordinating evidence with inclusive policies, and designing adaptive strategies that respond to accelerated technological transformations, persistent inequalities, and the learning demands of the 21st century. It is a possible alternative to ensure that education fulfills its dual function of promoting economic and social development while forming competent and critical citizens capable of participating in complex and technologically advanced societies (Ochoa, 2024).

Conclusions

The economics of education It has been a fundamental approach on human capital to become a multidimensional analytical discipline capable of addressing the complex challenges of social equity and technological disruption in the 21st century. Investment in education influences productivity and economic development. However, the analysis indicates that simply expanding school enrollment is insufficient to guarantee equitable and quality results, a reality that the COVID-19 pandemic exposed and exacerbated, as evidenced by the reports various in documents, and the academic articles reviewed for this paper.

The research identified a change of perspective: education systems prioritize the quality and measurement of transferable skills as part of educational assessment. Effective strategies—such as intensive mentoring and teacher training for the pedagogical use of technology and AI—help reduce learning gaps and educational poverty in low- and middle-income countries (World Bank, 2024).

The emergence of artificial intelligence (AI) is redefining skills requirements and driving a review of curricula and educational governance. AI has transformative potential to personalize learning and optimize processes; however, it also carries significant risks, such as algorithmic bias, digital exclusion, and the widening of inequalities. Therefore, the integration of AI requires the adoption of ethical and regulatory frameworks, such as those proposed by UNESCO (2023a) and the OECD (2024b), which protect the rights of students and teachers.

Research carried out, in the Latin American and Mexican context; indicate that the effectiveness of educational reforms depends as much on their technical design as on their political and institutional implementation. In the age of AI, the success of educational policies will depend on their ability to ensure that technology serves as a complement that expands learning opportunities rather than widening inequality gaps. Ultimately, the economics of education must evolve to guide public decisions toward a balance between efficiency, equity, and technological sustainability, ensuring that education fulfills its dual role of fostering economic development and social justice, and, above all, it involves economic aspects, which are not explicitly addressed in educational topics.

Future lines of research

Future research should explore work multidisciplinary collaboration among economics, administration, and education generate research robust data and involve key stakeholders—administrators, teachers, parents, and students. At the same time, expand research on IA and teacher professional development to producek nowledge and disseminate findings that contribute positively to society and the economics of education.

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