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School dropout in Latin America: factors, impact of artificial intelligence, and prevention strategies

Deserción escolar en América Latina: factores, impacto de la inteligencia artificial y estrategias de prevención

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ABSTRACT

School dropout in Latin America affects approximately 37 % of adolescents, with a significant percentage abandoning education even before completing primary school, which has led to a perception of the phenomenon's inevitability. Nevertheless, data science and artificial intelligence (AI) are transforming this perspective by enabling the proactive prediction and prevention of school abandonment. Early Warning Systems (EWS) utilize algorithms to analyze academic and socioeconomic variables, identifying at-risk students with high accuracy and generating intervention recommendations. Despite technological advancements, emotional support, mentorship, and curriculum flexibility are irreplaceable human strategies that complement technological solutions. However, the implementation of AI in education entails ethical challenges such as data privacy, the digital divide, and the need for constant human oversight to prevent the exacerbation of inequalities. This review article analyzes the factors influencing dropout, explores the impact of AI on its prevention, and discusses the relevance of human strategies, as well as the ethical challenges associated with technological implementation, concluding that school dropout is an approachable challenge through a comprehensive approach.

Keywords: School Dropout; Artificial Intelligence; Education; Latin America; Prevention; Early Warning Systems.

RESUMEN

La deserción escolar en América Latina afecta aproximadamente al 37 % de los adolescentes, con un porcentaje significativo abandonando incluso antes de completar la educación primaria, lo que ha llevado a una percepción de inevitabilidad del fenómeno. No obstante, la ciencia de datos y la inteligencia artificial (IA) están transformando esta perspectiva al permitir la predicción y prevención proactiva del abandono escolar. Los Sistemas de Alerta Temprana (SAT) utilizan algoritmos para analizar variables académicas y socioeconómicas, identificando estudiantes en riesgo con alta precisión y generando recomendaciones de intervención. A pesar de los avances tecnológicos, el acompañamiento emocional, la mentoría y la flexibilidad curricular son estrategias humanas insustituibles que complementan las soluciones tecnológicas. Sin embargo, la implementación de la IA en la educación conlleva desafíos éticos como la privacidad de datos, la brecha digital y la necesidad de supervisión humana constante para evitar la exacerbación de desigualdades. Este artículo de revisión analiza los factores que inciden en la deserción, explora el impacto de la IA en su prevención y discute la relevancia de las estrategias humanas, así como los desafíos éticos asociados a la implementación tecnológica, concluyendo que la deserción escolar es un desafío abordable mediante un enfoque integral.

Palabras clave: Deserción Escolar; Inteligencia Artificial; Educación; América Latina; Prevención; Sistemas de Alerta Temprana.

INTRODUCTION

Currently, school dropout is a persistent and multifactorial challenge that significantly impacts educational and socioeconomic development in Latin America. Approximately 37 % of adolescents in the region drop out of school during the school year, and half of them do so before completing primary education. These alarming figures have led many to consider this phenomenon practically inevitable, especially in contexts with limited resources. In Mexico, for example, only 38 % of young people who enter university manage to graduate.

During the COVID-19 pandemic, the situation worsened, with Colombia's Ministry of National Education reporting that 102 880 children dropped out of the education system, representing 1,1 % of students from preschool to high school. In addition, a Dane survey found that 4,5 % of students did not continue with virtual classes. This problem has perpetuated the idea that dropout is an inherent phenomenon in the education system.

However, new technologies and data-driven approaches are radically changing this deterministic view, demonstrating that school dropout is not only preventable but also predictable. Therefore, this article aims to analyze the factors that influence school dropout in Latin America, explore the impact of artificial intelligence on its prevention, and discuss the relevance of human strategies, as well as the ethical challenges associated with technological implementation in the educational field.

DEVELOPMENT

This literature review is based on a critical analysis of relevant studies and reports on school dropout, the application of artificial intelligence in education, and intervention strategies. Databases and sources such as Scopus, Latindex, Dialnet, DOAJ, SciELO, Web of Science, PubMed, Google Scholar, DOI, Redalyc, and CIRC were consulted. Priority was given to literature addressing the Latin American context, as well as empirical studies and reviews that provided quantitative and qualitative data on the phenomenon of dropout and innovations in its prevention.

School dropout in Latin America: a historical perspective and current figures

Historically, school dropout has been perceived as an inevitable phenomenon in the region, a conception rooted in the socioeconomic and structural dynamics of education systems. The lack of effective strategies to combat it, along with persistently high figures, has reinforced this perception. The Economic Commission for Latin America and the Caribbean (ECLAC) reports that approximately 37 % of Latin American adolescents aged 15-19 drop out of school during the school year. According to the Inter-American Development Bank, only one in two adolescents in the region completes secondary school.

In addition, of the 117 million Latin American children and young people, 22,1 million are outside the education system or at risk of dropping out. In Mexico, the dropout rate in upper secondary education was 8,7 % during the 2022-2023 school year, although more than 35 % of students who enroll in upper secondary education do not graduate. The uninterrupted closure of schools in Latin America and the Caribbean during the pandemic, with an average of 153 days of in-person classes lost, exacerbated the problem, leaving approximately 86 million children out of the classroom.

The causes of school dropout are multifaceted and its consequences profound. Among the most decisive factors are:

- Economic: Lack of resources is one of the leading causes. In low-income countries, less than two-thirds of girls finish primary school.
- Family: Related to household chores, pregnancy, and motherhood. Problems in the family environment, such as domestic violence and lack of emotional support, contribute significantly to dropout rates. The pressure to help with household chores particularly affects girls.
- Motivational: Lack of interest among young people and parents.
- Academic: Poor performance and behavioral problems. Educational backwardness and failure increase the probability of dropping out by 2,47 times. Academic difficulty leads to frustration and demotivation.
- Institutional: Failure to adapt to student needs.
- Social: Substance abuse and the influence of bad friends also play an essential role.

Dropout rates vary significantly according to educational level. In Mexico, the rates are: 0,3 % in primary school, 2,7 % in secondary school, 8,7 % in upper secondary school, and 6 % in higher education. Critical moments are usually changes in educational level, particularly in first grade and sixth grade. In terms of gender differences, the dropout rate in upper secondary education was 12,1 % for men and 8,4 % for women, resulting in a 3,7 percentage-point gap. Between 2019 and 2022, 1 million men dropped out of school (5,2 % of total enrollment), compared with 500,000 women (3,4 %). For two out of five women, lack of resources, marriage, or pregnancy is the primary constraint. In contrast, for one-third of men, the need to find work or a lack of skills are the main obstacles.

Artificial intelligence as a predictive and preventive tool

However, data science and artificial intelligence (AI) are transforming the approach to school dropout by enabling proactive prediction and prevention. In contrast to traditional statistical models, which are based on assumptions that can become obsolete, machine learning techniques have a predictive application based on objective data, allowing them to adapt to new data. In Mexico, a case study at a private university showed that metrics and visualization for analyzing patterns can reveal characteristics that better predict institutional school dropout.

Early Warning Systems (EWS) are computer tools that process daily school data to identify students at risk of dropping out. Unlike traditional methods that analyze causes after dropout, these systems generate preventive alerts at the beginning of the academic year. The process works through algorithms that analyze variables such as absences, grades, educational history, and socioeconomic factors.

This allows the creation of a "traffic light" that classifies students by risk level and generates reports for teachers and administrators with specific intervention recommendations. In successful applications, artificial intelligence has detected 95 % of students who would eventually drop out, with grade predictions that deviate by only 0,9 points out of 10. A data science-based system developed by the University of Barcelona allows "relevant information hidden in student academic data" to be extracted to "help tutors offer their students personalized and proactive guidance."

In Argentina, the provinces of Mendoza and Entre Ríos have implemented SAT with support from the Inter-American Development Bank. The Mendoza system uses machine learning to analyze historical data and create a predictive risk map. In 2023, this system identified 4,300

students in Mendoza at high risk of dropping out, who subsequently stayed in school. Similarly, in Wisconsin, United States, the Dropout Early Warning System (DEWS) has been in operation since 2012 and has proven particularly effective with minority students and those with English as a second language.

These AI-based systems offer significant advantages over conventional approaches. First, they allow for proactive intervention before dropout occurs. In addition, they can process larger volumes of information and detect patterns that would go unnoticed by a teacher. They also facilitate the customization of educational strategies tailored to the specific needs of each student. A study conducted in China found that using artificial intelligence to identify at-risk students had a positive impact on school retention. Finally, they optimize resource allocation, allowing educational institutions to focus their efforts on students who need them most.

Complementary human strategies in dropout prevention

Despite technological advances, it is crucial to recognize that human strategies and personalized support remain fundamental pillars in comprehensive school dropout prevention. Emotional and psychological problems often impact academic performance and school retention. Studies indicate that 73 % of students have felt the need to ask for help with their physical and mental well-being, yet 40 % never did. Professional psychological counseling is essential for young people who face discrimination, bullying, or exclusion, factors directly linked to school dropout. Adequate emotional support develops social-emotional skills that translate into better academic performance, access to higher education, and reduced risk behaviors.

School mentoring and tutoring models have proven highly effective. Mentoring, a development process based on a relationship between two people in which mentors share knowledge and expertise, can come from trained teachers, older students (peer mentoring), or external professionals. Psychopedagogical tutoring functions as a personalized support process during training, facilitating the monitoring of academic and personal factors that could affect the educational trajectory.

On the other hand, curricular flexibility is crucial when students must balance studies, work, and family responsibilities. Offering modalities such as online courses, flexible schedules, and adjustments to academic workload significantly increases retention rates. Curricular adaptations, understood as modifications made by the teacher to address specific needs, ensure a more equitable and personalized education. As a result, students can follow educational paths suited to their particular circumstances without being forced to abandon their studies.

Ethical challenges and limitations of artificial intelligence in education

However, the implementation of artificial intelligence in education is not without challenges, particularly regarding the ethical implications and limitations of unsupervised deployment. The collection and use of personal data in educational settings through AI raises serious privacy concerns. It must be ensured that sensitive student information is protected, even when interacting with technologies such as ChatGPT. UNESCO recommends setting an age limit of 13 for the use of AI tools in classrooms and requiring teachers to receive specific training. It also warns that schools must be safe in both their digital and physical environments. A study reveals that 83 % of parents are concerned about how their children use school technology.

The digital divide is one of the biggest obstacles to the equitable implementation of AI systems. In Colombia, 79 % of rural educational institutions lack internet access, and almost 60 % lack computer rooms. This reality contrasts sharply with urban areas, where only 9,3 %

lack internet access. In Latin America and the Caribbean, at least 77 million people lack access to high-quality internet in rural areas. Globally, approximately 826 million students lack basic access to a computer at home, and 706 million lack internet access at home.

Human oversight is essential for the ethical and safe operation of educational AI systems. Experts agree that AI can perpetuate or even exacerbate existing inequalities in the education system, for example, if algorithms are biased or if students with limited access to technology are left behind. UNESCO therefore emphasizes that teachers should guide the use of AI in classrooms, ensuring it aligns with educational objectives and ethical standards. From a legal perspective, human oversight helps define responsibility in the event of errors, ensure regulatory compliance, and protect fundamental rights.

DISCUSSION

The integration of artificial intelligence in the fight against school dropout represents a significant advance, marking a departure from the traditional view of inevitability. Early warning systems, such as those implemented in Argentina and the United States, demonstrate the ability to predict dropout with high accuracy, enabling proactive interventions that traditional methods did not facilitate. This transforms dropout from a fatality to a challenge that can be addressed through advanced technological tools and evidence-based preventive approaches.

However, the success of these tools does not detract from the need for human intervention. Evidence suggests that emotional and psychological support, mentoring and tutoring programs, and curricular flexibility are essential components for ensuring school retention and addressing aspects that technology alone cannot cover. Indeed, the balance between technological innovation and people-centered strategies is the most promising approach to addressing the complexity of dropout.

The discussion must also address the critical ethical implications of AI in education. Massive data collection and the potential digital divide can exacerbate existing inequalities and compromise student privacy if not managed rigorously. Therefore, constant human oversight and the development of robust ethical frameworks are indispensable to ensure that AI is a tool for inclusion and equity, rather than a factor of exclusion.

CONCLUSIONS

In conclusion, a comprehensive review of the literature shows that school dropout in Latin America, although alarming, should not be considered an inevitable and unchangeable fate. New technologies, particularly artificial intelligence through early warning systems, offer powerful tools to predict and prevent school dropout with surprising accuracy. These mechanisms not only identify students at risk but also allow for proactive interventions before dropout occurs. Successful experiences in countries such as Argentina and the United States confirm their effectiveness, especially when implemented ethically and responsibly.

However, it should be emphasized that technology alone will not solve this complex problem. Emotional support, mentoring programs, and curricular flexibility are essential to ensuring school retention, providing comprehensive support that complements technological solutions. The balance between technological innovation and people-centered strategies represents the most promising approach to addressing this challenge.

Ultimately, ethical challenges related to data privacy, the digital divide, and the need for constant human supervision require careful attention. The implementation of AI-based solutions

must take these aspects into account to avoid deepening existing inequalities and ensure that technology is a force for educational equity. School dropout, although complex, can be significantly reduced through comprehensive approaches that combine advanced technology with effective human strategies, thus transforming what once seemed inevitable into a perfectly manageable challenge.

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