

## AI IN ECONOMICS AND FINANCE EDUCATION: INNOVATIONS, CHALLENGES AND FUTURE DIRECTIONS

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### Abstract

The integration of Artificial Intelligence (AI) into economics and finance teaching represents a transformative shift in pedagogical strategies, offering opportunities to enhance learning outcomes and institutional efficiency. This study explores the applications of AI tools, such as generative models and big data analytics, and personalized learning. By synthesizing empirical findings from multiple case studies and qualitative analyses, this research identifies key innovations, including automated content generation, adaptive learning platforms, and AI-driven assessment systems. These tools enable educators to address diverse student needs, streamline repetitive tasks, and foster critical thinking through real-world scenario simulations. However, the adoption of AI also presents significant challenges, such as algorithmic biases, data privacy concerns, and the risk of overreliance on technology diminishing human interaction. The study highlights the necessity of continuous teacher training to effectively integrate AI into pedagogical practices while maintaining ethical standards. Furthermore, institutional support, through updated infrastructure, interdisciplinary collaboration, and policy frameworks, is critical to overcoming barriers like technological inequity and resistance to change. The research employs a mixed-methods approach, combining literature reviews, surveys of educators, and practical implementations of AI tools in classroom settings. Results indicate an increase in AI adoption among educators when supported by structured training programs, alongside improved student engagement in complex topics like financial modeling and economic policy analysis. Case studies from universities in Mexico illustrate how AI can democratize access to advanced resources while fostering global competencies in students. In conclusion, AI serves as a complementary force in education, enhancing, not replacing, the role of educators. Strategic implementation, grounded in ethical considerations and pedagogical goals, can bridge gaps in traditional teaching methods and prepare students for a digitized economy. This study advocates for balanced innovation, emphasizing collaborative efforts between academia, policymakers, and technology providers to create sustainable, inclusive educational ecosystems.

**Keywords:** *Artificial intelligence, economics education, financial literacy, adaptive learning, ethical challenges.*

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### 1. Artificial Intelligence in teaching economics and finance

Artificial intelligence (AI) is dramatically transforming the way economics and finance are taught. Tools like generative models, such as ChatGPT, adaptive learning platforms like Coursera, and real-time stock market simulators, such as CapTrader are leading this change (Shiller, 2025). These technologies enable personalized content and precise market analysis, making advanced educational resources more accessible to everyone.

This study arises from the critical need to analyze this duality. On one hand, tools like ChatGPT and stock market simulators have shown to increase student engagement in complex topics such as financial model analysis and economic policies. On the other hand, highly volatile and stressful financial phenomena reveal the limits of automation in uncertain contexts, where human judgment remains indispensable (Kasneci *et al.*, 2023).

This tension between technical capabilities and human limitations extends to classrooms: while universities with advanced infrastructure implement interactive simulations, others lack even the connectivity to access updated financial data. The relevance of this research lies in the debate over case studies, showing how hybrid strategies that combine adaptive AI with specialized tutoring can be effective, while also identifying risks such as reduced interaction between teachers and students.

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Additionally, the performance of machine learning models in predicting currency crises surpasses traditional methods. Studies from Meese and Rogoff (1983) to Bluwstein *et al.* (2020) show that techniques like neural networks and ensemble combining (Sermpinis *et al.*, 2019) better capture volatility in emerging markets. However, challenges remain algorithms do not fully incorporate factors such as international capital flows (Rey, 2015) or global monetary policies (Miranda-Agrippino and Rey, 2020), and their effectiveness varies across market regimes.

This work not only aims to document these dynamics but also to propose pathways for responsible integration. The collected evidence suggests that the success of AI depends on regulatory frameworks with algorithmic transparency and investment in inclusive infrastructure. By articulating findings, this study aims to contribute to the debate on how technological innovation and educational equity can prepare for a digital economy without sacrificing human interaction, critical thinking, and social justice.

## 2. AI in teaching economics and finance: Asymmetries, ethical challenges and tensions

The integration of AI in teaching economics and finance unfolds in a global context marked by significant technological disparities and ethical tensions. In Mexico, this duality is evident: while institutions like Tecnológico de Monterrey invest over \$2 million in specialized laboratories (Tec Review, 2023), 23% of rural areas lack internet access, and only 34% of their inhabitants have connectivity compared to 68% in urban areas (INEGI, 2023). This gap limits educational initiatives, such as the virtual reality investment simulators developed by Universidad Veracruzana, whose potential contrasts with the low mastery of basic financial concepts among university students, even in urban institutions.

In the financial sector, tools like Bloomberg Terminal allow real-time market modeling, revolutionizing teaching methods. However, their adoption coexists with structural barriers: platforms like Kueski exhibit algorithmic biases that discriminate against women in marginalized municipalities (CONEVAL, 2023). Globally, 67% of financial institutions report vulnerabilities to cyberattacks linked to AI systems (IBM Security, 2022), highlighting systemic risks that transcend borders.

Financial automation in the face of volatile phenomena challenges the assumptions of rationality in neoclassical models and underscores the need for human oversight, even in highly technical environments. These phenomena support the thesis of Kay and King (2020) on market uncertainty, where narratives surpass the predictive capacity of purely quantitative models.

Moreover, the adoption of generative AI faces unprecedented pedagogical challenges. At UNAM, 38% of economics students use ChatGPT, but only 12% of the faculty are trained to integrate it critically (UNAM, 2023). UNESCO establishes three pillars for the ethical development of AI in education: universal access, permanent human supervision, and continuous impact assessment (Vázquez, 2021).

Interventions in schools, combining adaptive AI with specialized tutoring, improve outcomes, demonstrating that technology acts as an amplifier rather than a substitute for educational processes (Lara *et al.*, 2024). However, risks such as a 67% reduction in interactions between teachers and students are identified (ANUIES, 2023). These findings emerge from a mixed-methods design that combines:

The equitable implementation of AI in economic and financial education requires balancing four key dimensions:

1. Inclusive Infrastructure: Projects should prioritize not only connectivity but also access to devices and teacher training, bridging gaps between elite institutions and marginalized communities.
2. Algorithmic Transparency: Develop regulatory frameworks to audit biases and enforce ethical standards in the use of sensitive data.
3. Hybrid Pedagogy: Combine AI tools with specialized tutoring.
4. Global Collaboration: Promote partnerships between academia, industry, and governments to harmonize policies that balance innovation and stability.

This framework not only validates the transformative potential of AI but also outlines critical pathways for its responsible adoption, where technology enhances rather than replaces human capabilities in training future economists and financiers.

## 3. Pedagogical, technological and ethical integration of AI in teaching

The implementation of AI in teaching economics and finance is based on three interdependent theoretical pillars that combine technological innovation, pedagogical principles, and ethical standards. These pillars address the challenges and opportunities, providing a conceptual framework to analyze its impact on higher education.

- **Pedagogical Dimension: Adaptive Learning**

The adaptive learning theory of Moloi and Marwala (2020) supports the design of platforms like CapTrader, which personalize content according to the individual progress of students. This approach aligns with constructivist principles, where tools like interactive simulations allow students to experiment with abstract economic concepts, such as modeling fiscal policies in Python. Platforms like iTalk2Learn integrate curriculum domain models and pedagogical strategies, achieving a 27% improvement in conceptual retention by applying the growth mindset theory of Dweck (2006).

- **Technological Dimension: Generative Models and Automation**

Generative models and big data analysis are redefining educational methods. Systems like FearNot! (Vannini *et al.*, 2011) use virtual agents to simulate complex social interactions, while neuroeducation (Howard-Jones, 2014) validates how gamification with uncertain rewards increases intrinsic motivation. However, these advances contrast with theoretical limitations in economics: while the neoclassical approach of Samuelson (1947) assumes rationality and efficient markets, behavioral economics by Hens and Riege (2016) shows that 95% of financial decisions are based on subjective perceptions. This theoretical conflict explains phenomena like the 2010 Flash Crash (Kay and King, 2020), where algorithms amplified stock market crashes, highlighting that AI cannot handle radical uncertainty without human intervention.

- **Ethical Dimension: Biases, Privacy, and Governance**

Ethics emerges as a critical axis. Studies like those by Hernández *et al.* (2023) reveal how algorithms on platforms replicate discriminatory biases, while financial institutions report cyberattacks. These issues require regulatory frameworks, incorporating algorithmic audits and transparency protocols to mitigate risks such as plagiarism with ChatGPT. Digital literacy becomes essential to balance generative tools with human judgment, especially in contexts where AI does not replace contextual rationality.

#### 4. Practical applications in financial markets

Machine learning models illustrate the theoretical-practical duality of AI. Techniques such as Random Forest and Gradient Boosting (Bluwstein *et al.*, 2020) outperform traditional methods in predicting currency crises. However, their effectiveness varies according to market regimes and does not fully incorporate macroeconomic factors such as international capital flows (Rey, 2015) or global monetary policies (Miranda-Agrippino and Rey, 2020). These limitations reinforce the need for hybrid approaches that combine AI with qualitative analysis.

AI emerges as a complementary tool, whose success depends on balancing its democratizing potential with the mitigation of ethical and structural risks. This theoretical framework increased student participation, resistance to change in outdated institutions, and also outlines a critical path for responsible implementations:

- Pedagogical Innovation: Integrate interactive simulations with active methodologies.
- Technological Governance: Policies for algorithmic transparency and data protection.
- Systemic Equity: Prioritize infrastructure in marginalized areas and continuous teacher training.

By linking educational theories, technological advances, and ethical principles, this framework provides the foundation for developing inclusive educational ecosystems, where AI enhances, without replacing, human capabilities in training economists and financiers for a digitized world.

#### 5. Evaluation of the impact of AI in teaching economics and finance

The study was based on a mixed-methods approach, qualitative and quantitative, designed to evaluate the impact of AI in teaching economics and finance, with an emphasis on contexts marked by technological and socioeconomic disparities. The design proposal allowed for the integration of empirical and theoretical perspectives, addressing three critical dimensions: pedagogical (effectiveness of tools like stock market simulators), technological (performance of predictive models like Random Forest and Gradient Boosting), and ethical (identification of algorithmic biases and cybersecurity risks). The choice of the mixed-methods approach was justified by the need to contrast quantitative data with qualitative perceptions, especially in environments where infrastructure and access to resources vary significantly.

Data from studies with stratified samples were used to ensure representativeness. In the educational field, 637 participants (teachers and students) from institutions in Mexico were selected based on their technological level. In the financial sector, 215 Mexican professionals involved in AI implementation were included. The instruments used included Likert scale surveys to measure perceptions of the effectiveness of tools like ChatGPT, digital competence tests evaluating skills on platforms like CapTrader, and analysis of technical reports.

In the quantitative component, robust regressions (Majjate *et al.*, 2024) were applied to quantify teacher adoption associated with AI training. In the qualitative component, a thematic analysis of open-ended survey responses was conducted, identifying recurring narratives such as the perception that “AI reduces human interaction.” Additionally, case studies of hybrid projects in rural Mexican areas (Lara *et al.*, 2024) were reviewed, triangulating these findings with quantitative data to ensure consistency.

Ethical criteria included replicability through open repositories, such as public data from INEGI, and informed consent from participants to detect biases in tools like ChatGPT. However, the study faced limitations, such as potential selection bias by prioritizing institutions with basic technological access, and reliance on secondary data that may not reflect recent updates in digital divides.

## 6. Interpretation of findings

The results revealed a dual landscape. Generative tools and interactive simulators increased student engagement in complex topics, such as financial model analysis and economic policies, fulfilling the goal of “promoting critical thinking” through simulations. The learning and prediction capabilities of machine learning models support the idea of AI’s potential to “prepare students for a digitized economy.”

Structural and Ethical Challenges:

- **Technological Gaps:** Lack of internet access limits initiatives like the virtual reality simulators, reflecting “resistance to change in institutions with outdated infrastructure.”
- **Operational Risks:** The constant risk of cyberattacks on financial and educational institutions that compromise user data.

## 7. Pedagogical tensions

- Excessive automation reduced teacher-student interactions by 67% (ANUIES, 2023).
- Only 12% of the economics faculty at UNAM are trained to critically integrate tools like generative models (UNAM, 2023), highlighting the need for “continuous teacher training.”

Based on the findings, strategic implementation pathways are proposed:

1. **Hybrid Pedagogy:** Combine adaptive AI with human tutoring, replicating the approach of “personalized learning.”
2. **Ethical Governance:** Develop regulatory frameworks with algorithmic transparency to mitigate biases and protect sensitive data.
3. **Technological Inclusion:** Prioritize projects that provide connectivity, access to devices, and teacher training, bridging gaps between institutions.
4. **Global Collaboration:** Promote partnerships between academia, industry, and governments, realizing multisectoral collaboration.

## 8. Conclusions

AI is established as a transformative tool in economic and financial education, demonstrating its ability to improve learning outcomes and institutional efficiency. The findings validate that tools like generative models and stock market simulators increase student engagement when accompanied by structured teacher training, fulfilling the goal of optimizing pedagogical processes through AI. However, risks are confirmed: excessive automation reduces human interactions, and technological gaps limit its democratic reach.

While AI democratizes advanced resources such as simulations with real data, financial platforms replicate biases, highlighting “ethical challenges.” On the other hand, machine learning models improve financial predictions, though the need for supervision in the face of uncertainty is emphasized. Additionally, partnerships between universities and the private sector should translate into multidisciplinary audits and adaptive frameworks that prepare students for a digitized economy without sacrificing human interaction.

Longitudinal studies are required to evaluate medium-term impacts that measure not only statistical accuracy but also effects on critical thinking. This responds to the call for creating “sustainable and inclusive educational ecosystems,” where AI enhances rather than replaces human capabilities.

The responsible implementation of AI in education is not merely a technical challenge but a social one. We emphasize that its success depends on prioritizing equity, ethics, and global collaboration, ensuring that technology serves as a bridge rather than a barrier to a more just and digitally competent society.

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