

## FINANCIAL CONSIDERATIONS OF AI ADOPTION IN HIGHER EDUCATION

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**Branimir Kalaš**

University of Novi Sad, Faculty of Economics in Subotica, Republic of Serbia

E-mail: [branimir.kalas@ef.uns.ac.rs](mailto:branimir.kalas@ef.uns.ac.rs)

**Ines Đokić**

University of Novi Sad, Faculty of Economics in Subotica, Republic of Serbia

### ABSTRACT

The integration of Artificial Intelligence (AI) in higher education institutions has rapidly expanded, transforming teaching, learning, and administrative processes. While much research has focused on pedagogical benefits, comparatively less attention has been paid to the financial dimensions of AI adoption. This paper examines the costs, funding strategies, and cost–benefit considerations associated with implementing AI in higher education. Drawing on evidence from frontier AI models, case studies, and literature on institutional financing, it highlights the substantial investments required in infrastructure, software, cloud services, and specialized personnel. The study further explores innovative funding mechanisms, including outcome-based financing, public grants, philanthropy, and partnerships with industry, which support sustainable AI deployment. Findings emphasize that strategic planning, continuous cost management, and alignment of investments with measurable educational outcomes are essential to ensure both financial sustainability and long-term institutional value.

**Keywords:** AI, Higher education, Financial aspect, Cost-benefit analysis

### INTRODUCTION

The integration of artificial intelligence into higher education institutions has intensified in recent years, reshaping teaching, research, and administrative practices. The rapid advancement of AI has emerged as a key force in reshaping educational systems, especially within higher education (Mosha et al., 2026). Within education, fundamental AI tools like Machine Learning (ML), Natural Language Processing (NLP), and generative AI are increasingly applied to enrich teaching, learning, and institutional management. While much research emphasizes pedagogical innovation and learning outcomes, comparatively less attention has been paid to the financial foundations necessary for sustainable AI implementation. As AI becomes embedded in institutional operations, issues such as funding models, cost structures, and long-term return on investment have become central to strategic planning (Bearman et al., 2023; Jia et al., 2024).

Implementing AI requires significant initial and ongoing investments. Institutions must allocate resources for digital infrastructure, cloud computing, cybersecurity, data management, and technical support (Moscardini et al., 2020). Beyond technology, effective adoption also demands investment in staff training, organizational restructuring, and governance mechanisms to ensure ethical and responsible use (Shrivastava, 2023).

Funding approaches vary across contexts. Public universities frequently depend on government grants and national digitalization initiatives, whereas private institutions may rely on tuition revenues, philanthropic funding, and partnerships with industry (Alexander et al., 2019). Collaboration with technology companies has become increasingly prominent, enabling shared development of AI solutions while reducing immediate financial burdens. However, such arrangements may introduce concerns related to long-term costs, vendor dependence, and data governance. The aim of this paper is

to examine the financial aspects of AI integration in higher education, analyze the cost–benefit balance of different AI tools, and provide insights into sustainable funding strategies that ensure long-term institutional viability and educational effectiveness. To achieve this, the paper first analyzes the financial implications of AI adoption, highlighting major cost drivers and potential returns on investment before exploring funding strategies and sustainable implementation models.

## **COST-BENEFIT ANALYSIS OF AI IN HIGHER EDUCATION**

Implementing AI in higher education involves significant financial commitments, and understanding the cost–benefit landscape is crucial for informed decision-making. The analysis of frontier AI models shows that the amortized compute cost for training has grown by approximately 2.4× per year (90% CI: 2.0×–2.9×) since 2016, and the total development costs for selected models such as GPT-3, OPT-175B, GPT-4, and Gemini Ultra exceed \$100 million, with R&D staff accounting for 29–49% of the total (Cottier, 2025). AI accelerator chips and server components also represent substantial portions of the budget, while energy consumption and cluster-level interconnect contribute additional costs, highlighting the magnitude of investment required even before deployment in higher education.

The KI:connect.nrw case study demonstrates that financing generative AI in higher education requires structured cost management mechanisms and transparent budget allocation. Instead of relying on fixed per-user licenses, a token-based billing model was implemented to ensure that costs reflect actual usage, although this approach demands continuous monitoring and sophisticated tracking systems. The experience at RWTH Aachen University further shows that without predefined usage limits and active cost control, expenditures can quickly exceed allocated budgets, highlighting the importance of ongoing financial oversight and adaptive spending controls (Decker & Dittrich, 2025).

A primary financial risk in AI adoption is not the cost of technology itself, but ineffective implementation. U.S. K–12 districts spent \$35 billion on educational technology in 2020 with minimal improvement and many unused software licenses. Outcome-based financing, which ties vendor payments to student progress and allocates funds for professional development and technical support, ensures that investments generate measurable educational gains and sustainable AI use (Dallas, 2025).

The study of Rahmawati et al. (2026) suggests that combining traditional funding sources, such as public grants and philanthropy, with innovative mechanisms like venture capital, social impact bonds, and subscription models, while aligning investments with measurable educational outcomes, is essential for ensuring scalable and financially viable AI integration. Structured financial planning, including usage-based billing, outcome-oriented financing, and diversified funding sources, can mitigate the risks of overspending while aligning AI initiatives with measurable educational outcomes (Rahmawati et al., 2026). While cost-benefit analysis provides insight into potential gains and risks, understanding the broader financial landscape, including operational and maintenance expenses, is essential for sustainable AI integration in higher education.

## **FINANCIAL ASPECTS OF AI IN HIGHER EDUCATION**

The financial challenges associated with AI go beyond initial setup. Acquiring the required hardware, programs, and staff expertise demands considerable capital, while the ongoing upkeep of intelligent systems creates a lasting drain on institutional budgets (Alenezi & Faisal, 2020). According to Alenezi (2023), the level of financial dedication plays a crucial role in whether AI integration can be maintained over time.

To ensure sustainability, institutions must budget for both initial needs such as training and hardware, and ongoing expenses, including software updates, maintenance, and cloud services. This long-term planning transforms AI from experimental adoption into enduring integration (Al-Zahrani & Alasmari, 2025).

Integrating AI into education management requires substantial upfront investment in specialized hardware and software infrastructure, although declining technology costs have gradually improved accessibility (Brown, 2018). Effective adoption further depends on significant financial allocation for staff training, as equipping educators and administrators with the necessary competencies is essential for maximizing the long-term value of AI systems (Ananyi & Nwosu, 2023a).

Integrating AI in educational institutions entails significant financial commitments, including upfront investments in AI software, hardware, and personalized learning platforms, as well as ongoing operational costs related to administrative automation, data analytics, and efficiency-enhancing tools (Ananyi & Somieari-Pepple, 2023). Institutions that strategically allocate funding across technology acquisition, staff development, and operational oversight are more likely to achieve positive outcomes from AI investments (Ananyi & Somieari-Pepple, 2023). These expenditures must be weighed against potential long-term returns such as increased student retention, improved academic performance, reduced administrative overhead, and qualitative benefits like enhanced student satisfaction and institutional competitiveness.

By combining upfront investments in infrastructure, ongoing operational support, and performance-oriented funding strategies, higher education institutions can harness the pedagogical and administrative benefits of AI while maintaining financial prudence and resilience (Rahmawati et al., 2026; Dallas, 2025). Adopting flexible financing models, including subscription-based or outcome-based approaches, can mitigate financial risk while aligning AI use with measurable educational improvements. Combining these strategies enables institutions to manage the substantial costs of AI integration while ensuring that the benefits justify the investment. Such a comprehensive approach ensures that AI initiatives not only deliver pedagogical and administrative improvements but also remain financially viable over the long term.

## **CONCLUSION**

The implementation of AI in higher education presents both significant opportunities and financial challenges. Successful integration requires careful planning, not only for technology acquisition but also for ongoing operational costs, staff training, and governance mechanisms. Institutions must consider both initial and long-term expenditures to ensure that AI solutions are effectively maintained and deliver value. Structured financial planning, including usage-based billing, outcome-oriented financing, and diversified funding sources, can mitigate the risks of overspending while aligning AI initiatives with measurable educational outcomes. Strategic allocation of resources across infrastructure, personnel, and operational support ensures that investments generate tangible benefits, such as improved student retention, enhanced learning experiences, and streamlined administrative processes.

Long-term sustainability also depends on institutional capacity to monitor and adapt expenditures over time, integrating AI into daily operations without compromising financial stability. By combining innovative funding strategies with careful cost management and continuous oversight, higher education institutions can harness the potential of AI to enhance teaching, learning, and administration, while maintaining financial prudence and resilience. Ultimately, the success of AI integration depends on balancing technological innovation with strategic financial stewardship to achieve lasting institutional and educational benefits.

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