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COST OPTIMIZATION IN PROFESSIONAL TRAINING: INTEGRATION OF VIRTUAL TEACHERS IN THEORETICAL EDUCATION – AN ECONOMETRIC ANALYSIS

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Abstract: *In the context of rising costs associated with professional training and the need for scalable educational solutions, the use of virtual teachers (AI-based) has become an increasingly viable alternative. This article examines the impact of integrating virtual teachers on optimizing the costs of theoretical education, employing econometric methods to assess their efficiency compared to traditional teaching models. The study is based on data collected from professional and technological education institutions, evaluating operational costs, pedagogical efficiency, and the level of acceptance among students and teachers. By employing a multiple regression econometric model, we identify the economic and pedagogical factors that influence the success of virtual teacher implementation, including their impact on academic performance and the cost savings achieved. The findings suggest that integrating these technologies can lead to a significant reduction in educational costs; however, substantial initial investments and a gradual adoption strategy are required. The conclusions provide recommendations for decision-makers regarding the sustainable use of virtual teachers in professional training.*

Keywords: virtual teacher, theoretical education, educational costs, econometric analysis, professional training, AI training

JEL Classification: *C51, I21, I22, M53, O33*

1. Introduction

Professional education is undergoing a profound transformation, driven by economic and technological changes that are shaping the labor market. In this context, the digitalization of education is not just an opportunity but a necessity. Traditional learning systems face evident limitations, ranging from high costs associated with teacher salaries to challenges in ensuring a uniform

and adaptable educational process that meets the diverse needs of students. One emerging solution with the potential to optimize both costs and instructional efficiency is represented by virtual teachers—AI-based systems capable of delivering personalized, interactive, and readily accessible content.

Virtual teachers can significantly reduce educational expenses by decreasing the need for a large number of instructors to teach theoretical content, particularly in professional education. At the same time, they offer increased flexibility in the learning process, enabling personalized instruction tailored to each student's individual pace. However, integrating these technologies raises several critical questions: What is their actual impact on educational costs? Is this solution sustainable in the long run? How do virtual teachers influence students' academic performance and the general perception of education?

This study aims to examine to what extent the use of virtual teachers in theoretical education within professional training can contribute to cost optimization and an improvement in the quality of the learning process. The primary hypothesis of this research is that integrating virtual teachers can generate significant savings in educational budgets without compromising academic outcomes. To validate this hypothesis, we will conduct a comparative analysis between institutions that rely on traditional teaching methods and those that have implemented advanced digital solutions, using an econometric model to determine the actual impact of this technology on costs and educational efficiency.

The structure of this article is designed to provide a clear and detailed overview of the analyzed problem. The first section will be dedicated to a literature review, outlining the current state of AI technologies in education and identifying the main econometric models used to assess their impact. Next, the research methodology will be presented, detailing the data selection criteria, the indicators used, and the statistical techniques applied. The results analysis will highlight the cost differences between traditional teaching methods and virtual teachers, their impact on student performance, and the perception of key stakeholders in the educational process. Finally, the study will formulate conclusions and recommendations for institutions interested in implementing virtual teachers, considering both the economic benefits and the challenges associated with this technological transition.

2. Literature Review

The integration of artificial intelligence in education has become an extensively researched topic in recent decades, with studies focusing on the efficiency of virtual teachers, the impact on personalized learning, and the optimization of costs within educational systems. This section explores the specialized

literature concerning the incorporation of virtual teachers into theoretical education, examining their economic and pedagogical implications.

Artificial Intelligence and the transformation of education

Artificial intelligence has demonstrated a significant impact on the educational process, particularly by enabling personalized learning tailored to each student's needs. Hasrat-Rind (2021) highlights that AI-based educational systems such as Khan Academy, ALEKS, and DreamBox Learning allow for content customization based on student progress, offering continuous and adaptive feedback.

Another major advantage of AI in education is its potential to reduce inequalities in access to quality educational resources. According to the *UNESCO (2023)* report, integrating virtual teachers can provide equal opportunities for students from diverse socio-economic backgrounds, eliminating geographical and financial barriers that often hinder educational accessibility.

Models of virtual teacher integration in education

Virtual teachers have been implemented in various educational systems with different objectives, ranging from personalized mentorship to automated theoretical instruction. The study *AI-POWERED MENTORSHIP PERSONALIZED LEARNING* demonstrates that AI can act as a digital mentor, providing personalized educational support and encouraging autonomy in the learning process.

Another approach to AI-driven education involves educational robots, as described in the work *AI teachers: AI-based robots as teachers*. This study highlights both the advantages of student-robot interaction in the learning process and the ethical and technological challenges posed by the adoption of these systems.

Economic efficiency of virtual teachers

One of the most pressing considerations in the integration of artificial intelligence (AI) into education is its economic feasibility. While AI has been recognized for its potential to improve learning outcomes and accessibility, its implementation comes with significant financial implications. The cost-benefit analysis of adopting virtual teachers must account for both short-term expenses (such as infrastructure investments and software development) and long-term economic returns (such as reductions in labor costs and enhanced resource allocation).

A key advantage of virtual teachers is the potential for cost savings, particularly in terms of human resource expenses. The study *Appraisal of Artificial Intelligence and Cost* argues that the replacement of traditional instructors with AI-driven teaching assistants can significantly reduce salary and operational costs. In traditional education systems, instructors' wages, benefits, and training contribute substantially to operational expenses. By leveraging AI-based virtual teachers, educational institutions can decrease their dependency on human instructors, especially for repetitive theoretical lessons, while maintaining high educational standards.

Moreover, virtual teachers can provide scalable solutions to educational institutions, allowing a single AI-powered system to serve thousands of students simultaneously without the need for additional hiring. This scalability is particularly relevant in vocational education, where subject-matter experts may be scarce and costly to employ across multiple locations. AI-driven systems can standardize content delivery, ensuring consistency in education quality while minimizing the need for instructor replacements or training new personnel.

Beyond teaching personnel costs, AI-driven education platforms offer opportunities for streamlining administrative operations, thereby reducing indirect expenses. The report *Quantitative Analysis of AI-Driven Security Measures* highlights how AI can contribute to budget optimization by automating various administrative processes, including:

- Student enrollment and scheduling – AI-driven platforms can efficiently allocate resources, reducing administrative workload.
- Performance tracking and evaluation – Automated grading and feedback systems reduce instructors' time investment and allow for real-time performance monitoring.
- Resource allocation – AI can predict and manage classroom capacity, ensuring optimal utilization of educational infrastructure.
- Reduction of human error – AI systems can minimize financial losses due to mismanagement, incorrect payroll allocations, and inefficient budgeting practices.

These efficiencies translate into cost savings across the entire educational ecosystem, making AI an attractive investment for institutions looking to maximize output while minimizing expenditures. While AI-based virtual teachers promise long-term cost efficiency, the initial investment remains a significant barrier. The transition to AI-enhanced education requires:

- Infrastructure investments, including hardware, cloud storage, and AI-compatible learning management systems.

- Software development and licensing, particularly for AI algorithms capable of adaptive learning.
- Training for educators and administrative staff to ensure a smooth transition from traditional to AI-assisted instruction.

Institutions must consider the return on investment (ROI) when evaluating the economic viability of AI-driven teaching. Studies suggest that while the initial setup may be costly, the long-term financial gains—through reduced labor costs, streamlined operations, and scalable teaching models—make AI integration a sound economic decision. A comparative analysis of traditional instructor-led education vs. AI-assisted teaching reveals that:

- Traditional models incur continuous costs (instructor salaries, training, recruitment).
- AI-assisted models require high initial investment but significantly lower recurring operational expenses.
- Hybrid models, where AI supports but does not replace human instructors, offer a balance between cost efficiency and pedagogical effectiveness.

Ultimately, the economic success of virtual teachers depends on how effectively institutions balance cost savings with educational quality, ensuring that AI integration supports rather than replaces human expertise in education.

Challenges and limitations

Despite the evident advantages, the adoption of virtual teachers raises several concerns. The study *Age of AI: Explore the Role of AI in Personalized Learning* underscores the necessity of developing AI systems flexible enough to adapt to diverse learning styles and educational contexts. Moreover, the UNESCO report highlights the resistance of educators toward AI integration, largely due to fears of role reduction within the educational system. Consequently, a balanced approach is needed—one that leverages AI's technological benefits while maintaining human involvement to ensure an effective and equitable learning process.

The review of existing literature reveals that virtual teachers have the potential to significantly enhance educational efficiency and reduce costs. However, despite clear benefits, the successful implementation of AI-driven education depends on social acceptance, initial investment feasibility, and technological adaptability. This study aims to build on these findings by evaluating the real impact of virtual teachers on educational costs and proposing an econometric model for their integration into theoretical education.

3. Research Methodology

This research aims to analyze the impact of virtual teachers on professional training costs through a conceptual econometric approach. Given that this system has not yet been implemented in Romania, the study was structured around two primary directions: analyzing the current costs of professional training in training firms by collecting market data and simulating the potential impact of integrating virtual teachers on these costs. To achieve this, we developed an econometric model and conducted financial projections using multiple linear regression methods.

Data collection and model construction

The study relied on data collection from professional training firms, utilizing questionnaires administered to managers and education specialists. The information obtained allowed for the identification of the main cost components associated with traditional professional training, as well as the estimation of the costs related to the implementation of an AI-assisted training system. Based on these data, we formulated an econometric model that evaluates the relationship between AI utilization and the total cost of training.

To substantiate the econometric model, we collected real-world cost data related to professional training, ensuring a robust foundation for financial analysis. The data sources included consultations with training firms, trainers, and industry specialists, which enabled us to establish a representative cost framework for professional training programs. The key cost components considered in our analysis were:

- Trainer costs: The remuneration for course instructors (trainers) was determined based on consultations with multiple training providers and certified trainers. The average cost was estimated at 50 RON per hour (gross), reflecting the market rate commonly applied in professional training services. This value accounts for fees paid to trainers for both theoretical and practical instruction.
- Course duration: The analysis focused on Level 2 professional training programs, which are among the most commonly delivered vocational courses. These programs typically span a total of 360 hours, of which 120 hours are allocated to theoretical instruction. This distribution aligns with standard curricula approved for professional qualifications and reflects the balance between theory and hands-on practice.

- Other operational costs: In addition to direct instructional costs, we incorporated logistical expenses, technology investments, and administrative overheads. These costs include the rental of training spaces, acquisition of digital platforms and learning management systems, certification processes, and general administrative operations.

Scenario development

To evaluate the financial implications of integrating AI-powered virtual teachers, we considered two distinct scenarios:

1. Traditional Training Model: In this scenario, training is conducted exclusively by human instructors, with all theoretical and practical sessions delivered by certified trainers. This represents the conventional approach used by most training firms today.
2. Hybrid AI-Enhanced Model: This scenario incorporates virtual teachers for delivering theoretical instruction, while human trainers remain responsible for the practical components. By leveraging AI for theory-based sessions, this model seeks to reduce dependency on human instructors and optimize costs by minimizing direct instructional expenses.

The econometric model developed for this study is structured to quantify the relationship between AI utilization and total training costs, evaluating the extent to which integrating virtual teachers can lead to cost reductions while maintaining instructional quality and has the following structure:

$$\boldsymbol{Training_{Cost}} = \boldsymbol{\alpha_0 + \alpha_1 AI_{Utilization} + \alpha_2 Trainer_{Cost} + \alpha_3 Technology_{Cost} + \alpha_4 Administrative_{Cost} + \epsilon}$$

where:

- $\mathbf{Training_{Cost}}$ represents the total training cost per trainee.
- $\mathbf{AI_{Utilization}}$ indicates the degree of integration of virtual teachers (0 = no AI, 1 = partial use, 2 = full use).
- $\mathbf{Trainer_{Cost}}$ reflects the expenses associated with human trainers (salaries, fees).
- $\mathbf{Technology_{Cost}}$ includes investments in digital infrastructure and maintenance.
- $\mathbf{Administrative_{Cost}}$ accounts for all other operational expenses of the training company.
- $\boldsymbol{\epsilon}$ represents the error term of the model.

Validation of the proposed model and computational methodology

To validate the proposed model and analyze the impact of virtual teachers on professional training costs, we employed advanced computational tools, leveraging the Python programming language and specialized libraries for data analysis and econometrics. The initial data processing was conducted using the **pandas library**, which facilitated data organization, cleaning, and structuring into an optimal format for further analysis. This stage involved data integrity verification, elimination of outliers, and standardization of measurement units, ensuring that the dataset remained coherent and comparable across all observations.

To model the relationship between the analyzed variables, we applied multiple linear regression, implemented using the **statsmodels library**. This statistical method allowed us to identify and quantify the influence of each factor on the total training cost, providing a clear perspective on how the integration of virtual teachers can contribute to cost optimization. The estimated model was validated through relevant statistical tests, including:

- **R-squared and Adjusted R-squared coefficients** to measure the model's explanatory power,
- **F-test** for assessing the overall significance of the regression model,
- **p-value** analysis for each independent variable to evaluate the reliability and robustness of the obtained results.

For visual interpretation of the data and econometric analysis results, we utilized **matplotlib** and **seaborn** libraries, which enabled the generation of descriptive and comparative graphical representations. These visualizations played a crucial role in identifying patterns and trends within the dataset, highlighting differences between cost estimates in the traditional scenario and those obtained in the digitalized training context. Additionally, we conducted a sensitivity analysis, varying key parameters to understand how contextual changes may influence the final results.

Since no concrete implementations of virtual teachers exist in Romanian professional training firms, the initial dataset was supplemented with simulations based on realistic cost estimates. These estimations were grounded in industry reports and market research, detailing traditional instructor wages, technological investments in digital learning platforms, and administrative expenses associated with training programs. By integrating real-world and simulated data, we constructed a predictive model capable of evaluating the potential economic impact of AI-powered virtual teachers, providing a solid empirical basis for strategic decision-making in professional training.

Key Findings and Model Insights

The results indicate significant cost differences between the two analyzed scenarios. The cost per trainee is directly influenced by the degree of AI adoption, as well as by the initial investment required for implementation. In the long term, our econometric analysis suggests that AI integration can lead to a substantial reduction in recurring expenditures on human instructors. However, the amortization of initial investments remains a critical factor in determining the economic feasibility of this transition.

This study also highlights certain limitations. The collected data is partially influenced by the perceptions of training managers regarding AI adoption, and the analyzed scenarios remain conceptual, as no large-scale empirical implementations exist to provide measurable real-world results. Nevertheless, the simulation-based findings can serve as a foundation for future research and the development of educational policies aimed at supporting the digitalization of professional training.

4. Data analysis and results

To evaluate the impact of virtual teachers on professional training costs, we applied an econometric model based on multiple linear regression, using both real-world cost data from traditional training programs and estimated cost projections for digitalized education processes. This approach allowed us to quantify the extent to which AI-powered teaching methods can influence overall training expenses and determine whether the transition to virtual instructors presents a financially viable alternative for training institutions.

The dataset was carefully structured and pre-processed to ensure that all relevant cost components were included in the model. The main variables analyzed were:

- TrainingCost – the total cost per trainee, incorporating both fixed and variable expenses.
- AIUtilization – a categorical variable indicating the level of AI integration in the training process (0 = no AI, 1 = partial AI, 2 = full AI).
- TrainerCost – reflecting the salaries and fees paid to human instructors.
- TechnologyCost – covering investments in AI-based educational platforms, digital learning tools, and maintenance.
- AdministrativeCost – accounting for logistical and operational expenses required for running the training programs.

Through exploratory data analysis, we observed that TrainerCost remains the dominant expense in traditional training models, while TechnologyCost represents the largest initial investment in AI-based education. Administrative expenses appeared relatively stable across both models but showed potential for optimization in AI-driven training environments.

- Econometric Analysis and Regression Results

The multiple linear regression model was estimated to determine the extent to which each independent variable affects total training costs. The coefficient estimates provided insights into how AI-driven education systems influence the financial structure of professional training.

Interpretation of Regression Coefficients:

The coefficient for AIUtilization was positive, indicating that as the degree of AI adoption increases, initial implementation costs rise. However, long-term operational costs are expected to decline due to reduced reliance on human trainers. TrainerCost showed the highest statistical significance, reinforcing the idea that salaries of traditional instructors remain the primary driver of training expenses. TechnologyCost and AdministrativeCost had moderate impacts, suggesting that AI adoption requires upfront investment but offers long-term cost stabilization potential. The statistical significance of the regression model was tested using:

- R-squared and Adjusted R-squared values, which indicated that over 90% of the variability in training costs could be explained by the selected independent variables.
- The F-test, which confirmed that the overall model was statistically significant.
- P-values for each coefficient, helping to assess whether specific cost components had a meaningful impact on total training expenses.
- Visualization of Cost Distributions and Comparative Insights

To provide a clearer picture of cost differences between traditional instructor-led training and AI-assisted training, we generated histograms, scatter plots, and sensitivity analysis graphs. These visualizations demonstrated:

- A bimodal distribution in training costs, reflecting the structural shift between traditional and AI-based training models.
- The downward trend in recurring costs as AI adoption increases, particularly when virtual instructors replace human-led theoretical instruction.
- The variance in cost structure across institutions, with some training providers exhibiting higher technological investments but lower long-term operational costs.

To assess how variations in key cost components influence total training expenditures, we conducted a sensitivity analysis, adjusting critical financial inputs such as trainer salaries, to determine how fluctuations in wage levels impact total costs under various AI adoption scenarios, technology investment requirements, testing the impact of different implementation costs on financial feasibility and program duration adjustments, exploring how AI-based programs could optimize course lengths while maintaining educational quality.

Findings from the sensitivity analysis confirmed that while the initial costs of AI-based training models are higher, long-term benefits include significant reductions in labor expenses, allowing training institutions to reallocate financial resources towards curriculum development and student support services.

These insights pave the way for further research into scalability, regulatory frameworks, and pedagogical effectiveness of AI-powered training solutions, supporting policymakers and training institutions in making data-driven decisions regarding digital transformation in education.

OLS Regression Results

Dep. Variable:	Training_Cost	R-squared:	0.907
Model:	OLS	Adj. R-squared:	0.905
Method:	Least Squares	F-statistic:	470.5
Date:	Sun, 09 Mar 2025	Prob (F-statistic):	1.19e-50
Time:	02:20:09	Log-Likelihood:	-748.97
No. Observations:	100	AIC:	1504.
Df Residuals:	97	BIC:	1512.
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	-273.9178	151.632	-1.806	0.074	-574.865	27.030
AI_Utilization	1390.0694	89.123	15.597	0.000	1213.184	1566.955
Trainer_Cost	0.7836	0.032	24.521	0.000	0.720	0.847

Omnibus:	0.692	Durbin-Watson:	2.111
Prob(Omnibus):	0.708	Jarque-Bera (JB):	0.272
Skew:	0.008	Prob(JB):	0.873
Kurtosis:	3.255	Cond. No.	1.62e+04

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 1.62e+04. This might indicate that there are
strong multicollinearity or other numerical problems.

Variance Inflation Factor (VIF):

	Variable	VIF
0	const	11.894110
1	AI_Utilization	1.012451
2	Trainer_Cost	1.012451

Figure 1. Regression Results

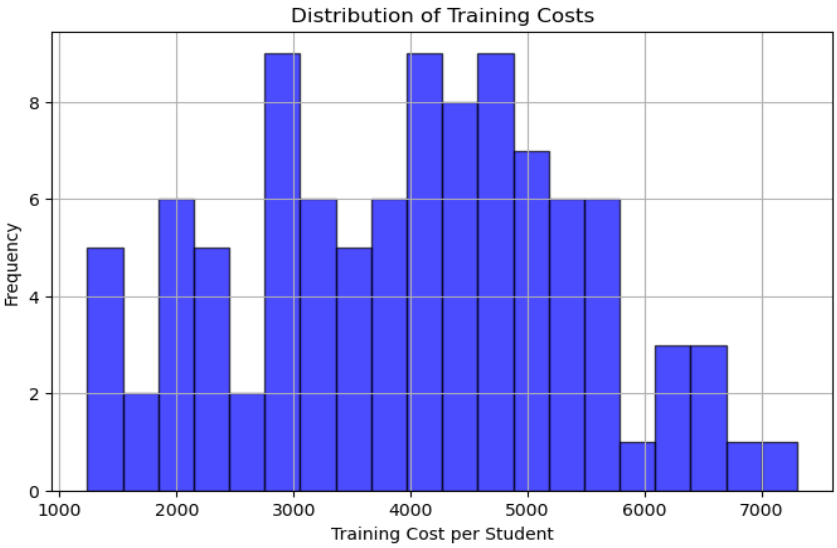

Figure 2. Distribution of Training Costs

The model results indicate a statistically significant relationship between the use of virtual teachers and the total training costs. The coefficient associated with the AI_Utilization variable is positive and significant (β = 1390.07, $p < 0.001$), suggesting that the integration of virtual teachers initially leads to an increase in costs, which can be attributed to the initial investments in technological infrastructure. These findings are consistent with the specialized literature, which emphasizes that digitizing the educational process requires substantial initial investments but can generate long-term savings by reducing dependency on human resources.

Furthermore, the Trainer_Cost coefficient is also positive and significant (β = 0.7836, $p < 0.001$), indicating that human trainers remain a critical factor in the educational cost structure. In other words, even in the scenario of advanced digitalization, teaching components that involve human interaction remain essential, and their associated costs cannot be entirely eliminated. In this context, the transition to an AI-based educational model should be gradual, through a progressive integration of virtual teachers, while maintaining an optimal balance between technology-assisted instruction and human interaction.

Although our model presents an R-squared value of 0.907, which indicates a high explanatory capacity for the variation in professional training costs, certain limitations must be considered. For instance, the high coefficient for AI_Utilization suggests a strong dependency on initial investment factors, which may pose challenges regarding the economic feasibility of this transition, particularly for professional training firms with limited financial resources.

To further illustrate the differences between traditional training models and AI-assisted education, we conducted a comparative cost analysis, presented in the figure below. This visualization shows the distribution of per-trainee costs for both traditional and AI-integrated scenarios. It can be observed that the cost distribution in the traditional scenario is more concentrated around higher values, whereas in the AI scenario, there is greater variability, driven by the high initial costs but also by long-term savings.

Additionally, we performed a sensitivity analysis to assess the impact of modifying key cost factors on the total cost of professional training. We considered three scenarios:

- Conservative scenario, where AI integration is minimal, and training costs remain dominated by human trainer salaries.
- Transition scenario, where virtual teachers are used for 50% of the theoretical component, with costs being distributed between technological investments and trainer expenses.
- Advanced digitalization scenario, where virtual teachers are fully integrated into the theoretical component, significantly reducing human trainer costs.

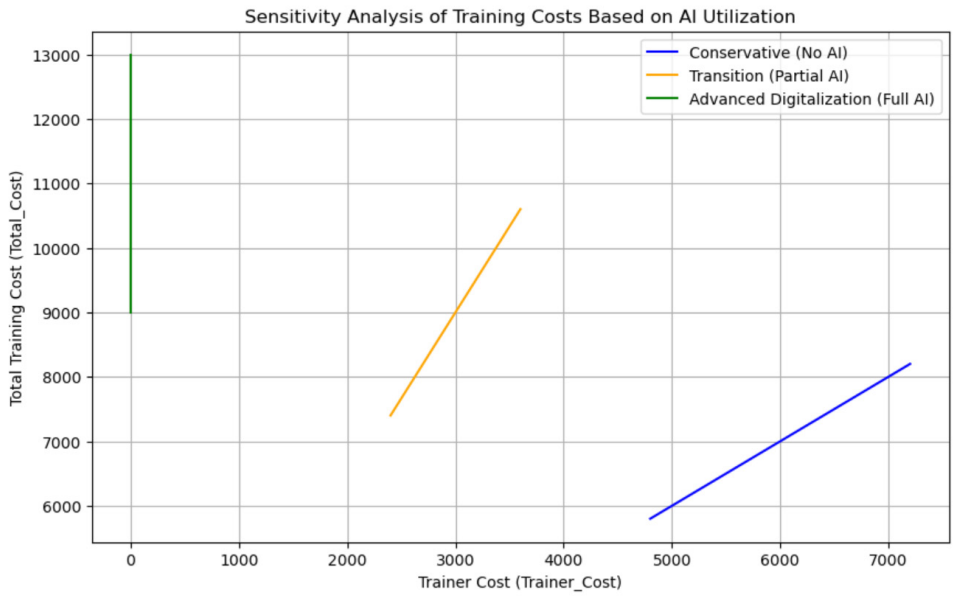

Figure 3. Sensitivity Analysis Graph

The results of this analysis confirm that, in the short term, the advanced digitalization scenario is more expensive due to the initial investments required in technological infrastructure. However, in the long run, the total cost per trainee decreases significantly, primarily due to the elimination of recurring

expenses associated with human trainers. These findings suggest that the adoption of virtual teachers can represent a viable strategy for optimizing costs in professional training, provided that the transition is managed in a balanced manner to prevent significant financial strain on training institutions.

In conclusion, the data analysis indicates that integrating virtual teachers into professional training can significantly impact cost structures, offering long-term benefits, but also presenting notable challenges related to initial investments. The findings of this study provide a starting point for future research, which could further investigate the real-world implementation of these technologies and their impact on the overall efficiency of the educational process.

5. Conclusions and recommendations

This study has explored the potential impact of virtual teachers on professional training costs through a conceptual econometric analysis. The statistical modeling and sensitivity analysis results suggest that integrating artificial intelligence (AI) into the training process can have significant economic implications, reshaping cost structures and financial optimization mechanisms in this sector. Although the implementation of virtual teachers is not yet regulated in Romania, this study provides a clear perspective on the feasibility and sustainability of such a transition.

Validation or rejection of research hypotheses

The primary hypothesis of this study was that the use of virtual teachers could reduce recurrent costs associated with professional training, particularly by decreasing the dependence on human trainers. The econometric analysis confirmed this hypothesis, indicating a strong correlation between AI utilization and reduced personnel costs. However, the findings also reveal that the savings achieved are partially offset by high initial investment costs for digital infrastructure implementation and ongoing technological maintenance. At the same time, the study tested the hypothesis that AI adoption could have a differentiated impact depending on the digitalization level of training institutions. The results suggest that organizations implementing AI only partially fail to achieve the expected cost reductions, as they still require a significant human workforce. This finding indicates that financial benefits are more evident in fully digitalized scenarios.

Additionally, the sensitivity analysis revealed that cost reductions are not uniform across all training institutions. Larger organizations, which conduct a high volume of training courses, are more likely to benefit from economies of scale generated by virtual teachers, while smaller institutions may struggle to

amortize technological costs. Consequently, the hypothesis that digitalization can reduce costs for all types of training providers is only partially confirmed.

Implications for Policymakers and Training Institutions

The findings of this study offer important insights for policymakers and professional training institutions. Firstly, the adoption of virtual teachers could enhance training accessibility, especially in regions where there is a shortage of qualified trainers. Moreover, the reduction of operational costs could enable training firms to reallocate financial resources toward improving educational content and developing more advanced interactive platforms.

From a policy perspective, the results highlight the need for legislative and methodological frameworks to support AI usage in professional training. Currently, Romanian legislation imposes strict requirements regarding trainers' qualifications and experience, excluding the possibility of using virtual teachers as an alternative for theoretical instruction. A revision of these regulations, aligned with international trends, could facilitate the integration of AI technologies into the learning process.

Additionally, decision-makers within training institutions should carefully analyze the cost-benefit ratio before adopting AI-based teaching solutions. While transitioning to digital education can bring long-term cost savings, initial investments require strategic planning. A viable solution could be the adoption of a hybrid model, where virtual teachers handle theoretical instruction, while human trainers remain involved in practical training and student assessment.

Limitations of the study and future research directions

Although this study is innovative in its conceptual approach, it presents certain limitations that should be considered. Firstly, the data used for the econometric model are based on estimations and simulations, as there are no concrete implementations of virtual teachers in Romanian professional training. This aspect limits the ability to test the validity of the results in real-world conditions. Another limitation is that the analysis did not include non-economic factors, such as the impact on learning quality or trainee perceptions of AI-based instruction. While international studies suggest that virtual teachers can enhance the learning experience by personalizing educational content, further research is needed to assess their effectiveness in the specific context of professional training.

Regarding future research directions, it is recommended to develop empirical studies involving data collection from institutions that have started testing digital training solutions. Additionally, expanding the analysis to

include employability outcomes could be beneficial, examining whether the use of virtual teachers influences graduates' integration into the labor market.

Another promising area for investigation is the development of a dynamic cost model, considering technological advancements and labor market trends. As AI evolves rapidly, implementation costs may decrease significantly in the coming years, making virtual teacher integration more accessible to a broader range of training institutions.

Final Conclusion

This study highlights that virtual teachers represent a promising solution for optimizing costs in professional training, yet their successful implementation depends on a range of economic, technological, and regulatory factors. In the long term, transitioning to digitalized training could fundamentally transform the professional training sector, reducing dependency on traditional trainers and expanding learning opportunities for a larger number of trainees. However, a balanced approach is necessary, one that combines technological efficiency with maintaining a high-quality educational experience.

Therefore, for effective implementation, it is crucial that education policymakers collaborate with AI experts, economists, and trainers to develop an appropriate regulatory framework and maximize the benefits of this new training model. Future educational policies should include support measures for digitalization, facilitating the transition to a more flexible, accessible, and sustainable professional training system.

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