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Technical Proficiency as the Strongest Predictor of AI Self-Efficacy: A Decision Tree Analysis of ChatGPT Literacy Among Romanian Educators

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Abstract: *The growing integration of generative artificial intelligence (AI) in education requires educators to develop not only operational competencies but also confidence in using AI tools effectively. The present study examined the predictive relationship between the multidimensional construct of ChatGPT literacy and AI self-efficacy among educators working in Romanian educational settings. A sample of 393 educators from Western Romania completed the ChatGPT Literacy Scale (and the AI Self-Efficacy subscale of the Meta AI Literacy Scale. Reliability analyses indicated good to excellent internal consistency across all literacy dimensions (α = .80–.95) and AI self-efficacy (α = .89). To model nonlinear and hierarchical relationships among predictors, a Decision Tree Regression approach was implemented in JASP. The five ChatGPT literacy dimensions, technical proficiency, critical evaluation, communication proficiency, ethical competence, and creative application, were entered as predictors of AI self-efficacy. The model explained 53.2% of the variance in AI self-efficacy (R^2 = .532), demonstrating moderate predictive performance (MSE = 0.517; RMSE = 0.719). Feature importance analysis revealed that technical proficiency was the strongest predictor (40.07%), followed by ethical competence (18.12%), critical evaluation (14.99%), communication proficiency (14.01%), and creative application (12.80%). The first and most informative split occurred on technical proficiency, highlighting its importance in shaping educators' perceived AI capability. These findings indicate that technical proficiency emerged as the strongest predictor of AI self-efficacy among educators. The results have implications for AI-focused professional development programmes, emphasising the importance of structured technical training alongside ethical and critical competencies.*

Keywords: ChatGPT literacy; AI self-efficacy; decision tree regression; educators; artificial intelligence in education.

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1. Introduction

The rapid adoption of generative artificial intelligence (AI), particularly large language models (LLMs) such as ChatGPT, is reshaping educational practice by transforming how educators access, generate, evaluate, and communicate knowledge. Beyond functioning as instructional support tools, AI systems increasingly act as cognitive partners, requiring educators to develop new forms of digital competence that integrate technical, critical, and ethical skills (Ciampa et al., 2023). Consequently, successful AI integration in education depends not only on the availability of technological tools but also on educators' confidence in using them effectively and responsibly.

Recent studies have identified ChatGPT literacy and AI self-efficacy as two closely related constructs supporting educators' adoption of generative AI. ChatGPT literacy encompasses the knowledge and competencies required to interact effectively with AI systems, whereas AI self-efficacy reflects educators' confidence in their ability to use these technologies successfully across educational contexts (Carolus et al., 2023; Lee & Park, 2024; Ma et al., 2024; Wang & Chuang, 2024). Previous research consistently indicates that higher levels of AI literacy are associated with greater AI self-efficacy, stronger technology acceptance, and more frequent AI use (Bewersdorff et al., 2025; Bergdahl & Sjöberg, 2025).

To investigate these relationships further, the present study employed Decision Tree Regression, an interpretable machine-learning approach capable of identifying hierarchical relationships, threshold effects, and nonlinear interactions among different dimensions of ChatGPT literacy. Unlike conventional regression techniques, decision trees provide transparent decision pathways that may offer practical insights for educational interventions and professional development programmes (Loh, 2011). Rather than estimating only average associations between variables, this approach allows the exploration of conditional and hierarchical relationships among predictors, thereby contributing to a more nuanced understanding of educators' AI self-efficacy.

Accordingly, the study investigated the predictive relationship between five dimensions of ChatGPT literacy, technical proficiency, critical evaluation, communication proficiency, creative application, and ethical competence, and AI self-efficacy among educators working in educational institutions in Western Romania.

The study addressed the following research question: *Which dimensions of ChatGPT literacy most strongly predict educators' AI self-efficacy, and how are these predictors hierarchically organized within a Decision Tree Regression model?*

2. Literature Review

The fast integration of generative artificial intelligence into educational settings has substantially expanded traditional understandings of digital literacy. Rather than simply extending existing technological competencies, tools such as ChatGPT require educators to develop new forms of interaction that combine technical, cognitive, critical, and ethical skills (Ciampa et al., 2023). Consequently, ChatGPT literacy has emerged as a multidimensional educational competence that supports effective, responsible, and pedagogically meaningful use of generative AI.

Ma et al. (2024) conceptualised ChatGPT literacy as a comprehensive construct encompassing technical proficiency, critical evaluation, communication proficiency, creative application, and ethical competence. Similarly, Lund et al. (2023) position ChatGPT literacy within broader technological literacy ecosystems, emphasising its close relationship with information literacy, data literacy, and privacy literacy. From this perspective, effective AI use requires educators not only to understand how generative AI systems function but also to critically evaluate their outputs and recognise their ethical implications.

Recent studies suggest that ChatGPT literacy extends beyond operational competence and may influence motivational outcomes such as academic confidence, engagement, and satisfaction (Lee & Park, 2023; Lee & Quan, 2024). Collectively, these findings suggest that ChatGPT literacy functions as both a cognitive and motivational resource that facilitates educators' and students' effective interaction with generative AI technologies.

Alongside the growing interest in AI literacy, increasing attention has been devoted to AI self-efficacy, defined as individuals' confidence in their ability to effectively use artificial intelligence systems across diverse tasks and contexts (Wang & Chuang, 2024). Rooted in Bandura's social cognitive theory, self-efficacy represents a central psychological determinant of technology adoption, influencing persistence, confidence, and willingness to engage with increasingly complex digital environments.

Previous research consistently demonstrated that AI self-efficacy is shaped by both technological competence and contextual factors. Montag et al. (2023) reported that trust in automated systems mediated the relationship between technology self-efficacy and AI acceptance, while Hong (2022) identified social status as an additional determinant of AI self-efficacy and intentions to use AI. These findings suggest that confidence in AI use develops through the interaction of individual competencies and contextual experiences rather than through technical knowledge alone.

Recent educational research further highlighted the close association between AI literacy and AI self-efficacy. Bewersdorff et al. (2025) found that AI literacy, attitudes, interest, and AI use jointly contributed to university students' AI self-efficacy. Similarly, Rodríguez-Ruiz et al. (2025) demonstrated significant relationships between AI use and self-regulatory characteristics such as self-control and self-esteem, whereas Bergdahl and Sjöberg (2025) showed that teachers' attitudes and perceptions towards AI are closely associated with their confidence in using these technologies within educational practice.

Collectively, these findings indicated that AI self-efficacy is a multidimensional psychological construct influenced by technological competence, attitudes, trust, and previous experience with AI. However, although previous studies have established significant associations between AI literacy and AI self-efficacy, relatively little attention has been devoted to understanding whether specific dimensions of AI literacy contribute equally to educators' confidence or whether their effects follow hierarchical and non-linear patterns.

Most previous studies examining the relationship between AI literacy and AI self-efficacy have relied on conventional statistical approaches, such as correlation analysis or multiple linear regression, to estimate average associations between predictors and outcomes. Although these methods provide valuable information regarding the relative contribution of predictors, they assume linear relationships and generally provide limited insight into potential threshold effects or hierarchical interactions among variables.

Decision Tree Regression offers an interpretable machine learning approach by recursively partitioning the data into increasingly homogeneous subgroups and generating transparent decision rules without requiring assumptions of normality, homoscedasticity, or linearity (Loh, 2011). Rather than estimating a single global regression equation, decision trees identify conditional pathways illustrating how predictors contribute across different competence levels. For educational research, this approach is particularly valuable because ChatGPT literacy represents a multidimensional construct whose components may contribute differently to educators' AI self-efficacy. Consequently, Decision Tree Regression enables the identification of hierarchical predictor structures and competence thresholds that may not be readily detected using conventional linear approaches. As with any interpretable machine learning method, its conclusions should remain theoretically grounded to avoid overinterpreting statistical patterns (Rad et al., 2025). Similar applications of machine-learning approaches in psychological research have demonstrated the utility of predictive models for identifying complex relationships among psychological variables (Delcea et al., 2023).

Despite the growing body of research on ChatGPT literacy and AI self-efficacy, several important knowledge gaps remain. Previous studies have generally examined AI literacy as a global construct, providing limited evidence regarding the relative contribution of its individual dimensions. Furthermore, most investigations have relied on conventional linear analytical approaches, leaving the hierarchical and non-linear relationships among ChatGPT literacy

dimensions largely unexplored. Finally, empirical evidence involving educators from Central and Eastern European educational contexts remains relatively limited.

To address these gaps, the present study applies Decision Tree Regression to investigate the hierarchical predictive relationships between five dimensions of ChatGPT literacy and AI self-efficacy among Romanian educators.

3. Methods

3.1. Participants

The study sample comprised 393 educators from Western Romania. Participants were recruited using a convenience sampling strategy through professional networks and institutional contacts. Data were collected using an online questionnaire administered via Google Forms, and participation was voluntary, anonymous, and based on informed consent. Data collection was conducted between January and March 2026.

Participants had a mean age of 40.50 years (SD = 11.15) and an average of 12.20 years of professional teaching experience (SD = 7.77), indicating a professionally experienced sample that included both early-career and experienced educators. Regarding gender distribution, 352 participants (89.6%) were female and 41 (10.4%) were male. Table 1 summarises the demographic characteristics of the study sample.

Table 1. Demographic characteristics of the study participants (N = 393)

Variable	**Value**
Variable	Value
Total N	393
Age (M)	40.50
Age (SD)	11.15
Work seniority (M, years)	12.20
Work seniority (SD)	7.77
Female	352 (89.6%)
Male	41 (10.4%)

Participation criteria required active employment in an educational institution at the time of data collection. No financial incentives were offered. Before completing the questionnaire, all participants gave informed consent to participate in the study.

3.2. Instruments

ChatGPT literacy was assessed using the ChatGPT Literacy Scale developed by Lee and Park (2024), a multidimensional instrument designed to evaluate competencies required for effective, critical, creative, and responsible interaction with generative AI systems. The scale comprises five theoretically grounded dimensions: technical proficiency, critical evaluation, communication proficiency, creative application, and ethical competence. Technical proficiency reflects the ability to formulate effective prompts, strategically refine inputs, and understand how ChatGPT generates responses (e.g., “I can formulate prompts that generate accurate responses from ChatGPT”). Internal consistency was good in the present sample (Cronbach's $\alpha = .80$).

Critical evaluation assesses the ability to evaluate the accuracy, credibility, and potential biases of AI-generated content (e.g., “I can recognise biases in ChatGPT’s answers”), demonstrating strong reliability ($\alpha = .88$).

Communication proficiency measures the ability to interact efficiently with ChatGPT by formulating clear and context-appropriate queries (e.g., “I know how to formulate effective questions for ChatGPT”). This subscale demonstrated excellent internal consistency ($\alpha = .95$).

Creative application evaluates the use of ChatGPT for idea generation, problem-solving, and creative tasks (e.g., "I can use ChatGPT to generate new ideas or solutions"), with excellent reliability ($\alpha = .94$).

Ethical competence measures awareness of responsible AI use, including ethical, legal, and privacy-related considerations (e.g., "I know how to use ChatGPT in an ethical manner"). Reliability was also excellent ($\alpha = .92$).

All items were rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating greater levels of ChatGPT literacy.

AI self-efficacy was measured using the AI Self-Efficacy subscale of the Meta AI Literacy Scale (MAILS) developed by Carolus et al. (2023). AI self-efficacy refers to individuals' confidence in their ability to successfully use AI systems across different tasks and contexts and is grounded in competency-based AI literacy models and psychological meta-competency frameworks (Carolus et al., 2023; Cetindamar et al., 2024; Dai et al., 2020). The subscale includes items such as "I can solve most problems related to using artificial intelligence on my own" and "I can handle demanding tasks when working with AI." Responses were recorded using the same five-point Likert scale (1 = strongly disagree, 5 = strongly agree), with higher scores indicating greater AI self-efficacy. The subscale demonstrated strong internal consistency in the present study (Cronbach's $\alpha = .89$).

Overall, the reliability coefficients indicate that all instruments demonstrated good to excellent internal consistency, supporting their suitability for assessing ChatGPT literacy and AI self-efficacy within the present sample.

3.3. Data Processing and Statistical Analysis

Data were screened and processed prior to analysis. Cases with incomplete responses were excluded using listwise deletion. Continuous variables were examined for normality, outliers, and distributional characteristics. Internal consistency was evaluated using Cronbach's alpha coefficients, whereas descriptive statistics (means and standard deviations) were computed for all study variables. All analyses were performed using JASP (Version 0.17.3.0). No cases contained missing values.

To investigate the predictive relationship between ChatGPT literacy dimensions and AI self-efficacy, Decision Tree Regression (Loh, 2011) was selected as the primary predictive modelling technique. This non-parametric machine learning approach was chosen because it can identify non-linear relationships, hierarchical predictor structures, and threshold effects without assuming normality, linearity, or homoscedasticity. Unlike conventional multiple linear regression, which estimates a single global relationship between predictors and the outcome, Decision Tree Regression recursively partitions the data into increasingly homogeneous subgroups, producing interpretable decision rules that facilitate the identification of conditional pathways among predictors. Given the multidimensional nature of ChatGPT literacy, this analytical approach was considered particularly appropriate for exploring how different literacy components jointly contribute to educators' AI self-efficacy.

Prior to model estimation, all continuous predictor variables were standardized (z-scores) to improve model stability and facilitate the interpretation of variable importance and split thresholds. Consequently, the split values reported in the decision tree represent standardized predictor scores rather than raw Likert-scale values.

The five ChatGPT literacy dimensions (Technical Proficiency, Critical Evaluation, Communication Proficiency, Creative Application, and Ethical Competence) were entered as predictor variables, whereas AI Self-Efficacy served as the dependent variable. The dataset was randomly divided into a training sample (80%) and an independent testing sample (20%). Predictive performance was evaluated using Mean Squared Error (MSE), Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE), and the coefficient of determination (R^2). Given that AI self-efficacy was measured on a bounded five-point Likert scale,

primary emphasis was placed on interpreting RMSE, MAE, and R^2, whereas MAPE was considered supplementary because percentage-based error indices may become inflated when observed values approach the lower end of bounded response scales.

4. Results

To examine whether ChatGPT literacy predicts educators' AI self-efficacy, a Decision Tree Regression model was estimated using AI self-efficacy as the dependent variable and the five ChatGPT literacy dimensions (technical proficiency, critical evaluation, communication proficiency, creative application, and ethical competence) as predictors.

The model was trained using 315 observations (80%) and validated on an independent test sample of 78 observations (20%). The complete Decision Tree model generated 50 decision splits and explained 53.2% of the variance in AI self-efficacy ($R^2 = .532$). Given the complexity of the full model, Figure 2 and Table 2 present only the most informative decision pathways and split rules.

Model performance was further characterised by MSE = 0.517, RMSE = 0.719, MAE = 0.602, and MAPE = 108.88%. Although the Mean Absolute Percentage Error appears numerically high, this metric is known to become inflated when the dependent variable is measured using a bounded Likert-type scale and includes values close to the lower end of the response range. Therefore, MAPE should be interpreted cautiously and considered alongside the absolute error indices (RMSE and MAE) and the explained variance (R^2), which provide a more informative assessment of predictive performance in the present context.

Feature importance analysis identified Technical Proficiency as the strongest predictor, accounting for 40.07% of the total relative importance. Ethical Competence contributed 18.12%, followed by Critical Evaluation (14.99%), Communication Proficiency (14.01%), and Creative Application (12.80%).

To facilitate the interpretation of the Decision Tree structure, Table 2 summarises the most informative decision split identified at each tree depth. For clarity, only the split yielding the greatest improvement in deviance at each level is presented, whereas the complete Decision Tree comprises 50 decision splits.

Table 2. Decision Tree Splits

	Obs. in Split	**Split Point**	**Improvement**
Technical proficiency	315	-0.243	0.338
Technical proficiency	108	-0.773	0.211
Ethical competence	61	-0.025	0.195
Technical proficiency	207	0.640	0.167
Creative application	126	0.557	0.047
Technical proficiency	81	1.700	0.174

Note. For clarity, only the split with the greatest improvement in deviance at each tree level is presented. The complete Decision Tree comprised 50 decision splits.

The first split occurred on Technical Proficiency (n = 315; split point = −0.243; improvement = 0.338), indicating that this variable produced the greatest reduction in prediction error and therefore constituted the first and most informative partition of the dataset. Subsequent splits on Technical Proficiency indicate that different levels of operational competence continued to contribute to the partitioning of the sample throughout the tree.

After the initial partition, Ethical Competence emerged as the next most informative predictor, followed by Creative Application, which provided additional discrimination among educators with comparable levels of technical proficiency. Together, these variables contributed to the hierarchical structure of the final Decision Tree model.

Figure 1 illustrates the relationship between observed and predicted AI self-efficacy scores in the independent test sample. Most observations are located close to the diagonal reference line,

indicating a moderate level of predictive accuracy that is consistent with the reported performance indices (R^2 = .532; RMSE = 0.719). Although prediction errors are visible at both lower and higher values of the response scale, no systematic pattern of overestimation or underestimation was observed.

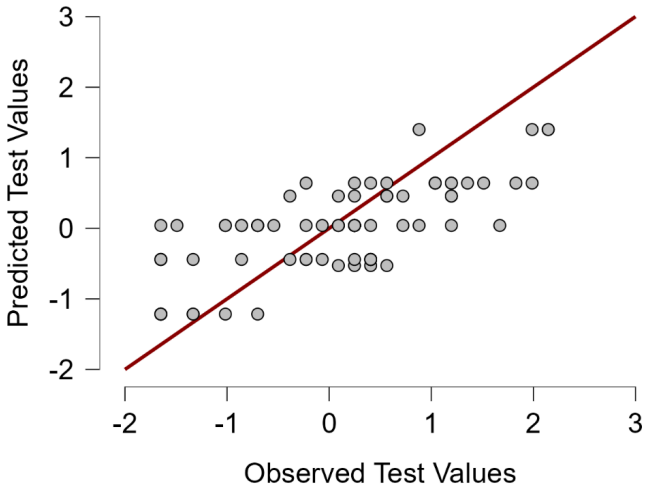

Figure 1. Predictive Performance Plot

Figure 1 visually illustrates the correspondence between observed and predicted AI self-efficacy scores in the independent test sample.

Figure 2 presents the Decision Tree Regression model used to predict AI self-efficacy from the five ChatGPT literacy dimensions. Technical Proficiency appears as the root node, indicating that it was the first variable selected to partition the dataset. Subsequent branches include Ethical Competence and Creative Application, reflecting their contribution to further partitioning the sample after accounting for technical proficiency.

As described in the statistical analysis section, the split values displayed in the tree correspond to standardised predictor scores (z-scores) rather than raw Likert-scale values. Consequently, negative split values do not represent negative levels of competence but correspond to standardised threshold values identified by the algorithm during recursive partitioning.

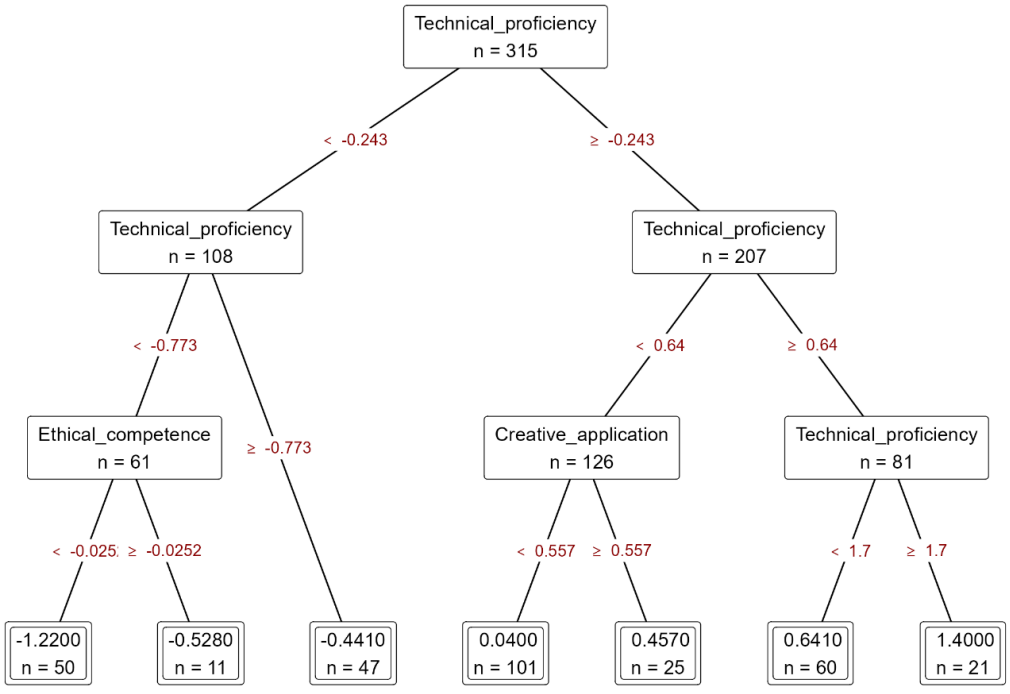

Figure 2. Decision Tree Plot

For clarity, Figure 2 presents only the upper levels of the Decision Tree, highlighting the most informative decision rules, whereas the complete model comprised 50 decision splits.

Overall, the Decision Tree illustrates a hierarchical partitioning of the sample, with Technical Proficiency defining the initial split and Ethical Competence and Creative Application contributing to subsequent partitions.

5. Discussion and Conclusions

The present study examined the relative contribution of five dimensions of ChatGPT literacy to educators' AI self-efficacy using a Decision Tree Regression approach. The findings indicate that Technical Proficiency emerged as the strongest predictor, whereas Ethical Competence and Creative Application provided additional explanatory value at successive decision levels. Together, these findings suggest that educators' confidence in using generative AI is supported by a hierarchical combination of technical, ethical, and creative competencies rather than by a single global literacy construct.

The prominent role of Technical Proficiency is consistent with contemporary conceptualisations of ChatGPT literacy, which position operational competence as the foundation for effective interaction with generative AI systems (Ciampa et al., 2023; Ma et al., 2024). Educators who can formulate effective prompts, refine AI-generated responses, and understand the basic functioning of ChatGPT are more likely to feel confident integrating these technologies into their professional practice. This interpretation is consistent with previous evidence demonstrating that AI literacy is one of the strongest contributors to AI self-efficacy (Bewersdorff et al., 2025), reinforcing the notion that competence and confidence develop in parallel as educators gain experience with AI-supported tasks. From the perspective of Bandura's social cognitive theory, technical competence may provide mastery experiences that strengthen educators' beliefs regarding their ability to successfully engage with AI technologies.

Beyond technical competence, Ethical Competence provided additional explanatory value, indicating that confidence in AI use is also associated with responsible decision-making, awareness of privacy and transparency issues, and adherence to principles of academic integrity. This finding supports previous research emphasizing that AI literacy should integrate ethical reasoning alongside technical competence (James & Filgo, 2023; Lund et al., 2023). Rather than functioning as an independent prerequisite, ethical competence may contribute to strengthening educators' confidence once a basic level of operational proficiency has been established.

Similarly, Creative Application contributed additional predictive value, suggesting that educators' confidence continues to develop as they move beyond routine operational use toward more innovative pedagogical applications of generative AI. The ability to employ ChatGPT for idea generation, instructional design, lesson planning, and problem-solving may reinforce educators' confidence in integrating AI into authentic educational contexts. This interpretation is consistent with Huang et al. (2023), who reported that meaningful educational applications of generative AI promote critical AI literacy and more effective engagement with AI-supported learning.

An important contribution of the present study lies in the analytical approach used to investigate these relationships. Whereas previous studies have predominantly relied on correlation analyses or multiple linear regression, Decision Tree Regression enabled the identification of hierarchical predictor structures and competence thresholds that may be more difficult to detect using conventional linear models. Rather than assuming identical relationships across all educators, the decision tree identified conditional pathways illustrating how different dimensions of ChatGPT literacy contribute sequentially to AI self-efficacy. Accordingly, the value of the present approach lies not in replacing conventional statistical techniques but in complementing them through an interpretable machine learning framework capable of generating practically meaningful educational profiles. These findings should not be interpreted as evidence that Decision Tree Regression is

inherently superior to traditional regression models; rather, they demonstrate its complementary value for identifying hierarchical and conditional relationships among predictors.

From a practical perspective, the findings may suggest that teacher professional development programs could benefit from adopting a staged approach to AI competence development. Initial training may prioritise technical proficiency, including prompt design, effective interaction strategies, and understanding the operational principles of generative AI systems. Ethical competence should be integrated throughout the training process to promote responsible AI use, while more advanced stages may emphasise creative pedagogical applications that support teaching, assessment, and instructional design.

Several limitations should be acknowledged. First, participants were recruited using a convenience sampling strategy, limiting the generalisability of the findings beyond educators from Western Romania. Second, the predominance of female participants reflects the demographic profile of the educational workforce but may nevertheless limit sample representativeness. Third, the cross-sectional design precludes causal inference. Fourth, all variables were measured using self-report instruments, making the findings susceptible to common-method variance and response bias. An additional limitation is that educational level and institutional type were not assessed, preventing subgroup analyses across different educational settings and limiting the understanding of potential differences between educational sectors. Finally, although Decision Tree Regression provides highly interpretable predictive models, tree-based algorithms may be sensitive to sampling variability. Future studies should therefore replicate these findings using probability-based sampling, external validation datasets, and complementary predictive modelling approaches.

Future research should examine whether the hierarchical structure identified in the present study remains stable across different educational systems, cultural contexts, and professional groups. Longitudinal research would be particularly valuable for investigating how educators' AI self-efficacy evolves over time and whether improvements in technical proficiency facilitate the subsequent development of ethical competence and creative AI use.

Future predictive models should also incorporate contextual variables such as institutional support, previous AI experience, digital competence, access to professional development opportunities, and attitudes toward artificial intelligence, all of which have previously been associated with AI adoption and AI self-efficacy (Bergdahl & Sjöberg, 2025; Bewersdorff et al., 2025; Montag et al., 2023).

In conclusion, the present study indicates that Technical Proficiency emerged as the strongest predictor of educators' AI self-efficacy, while Ethical Competence and Creative Application provide additional explanatory value within a hierarchical predictive structure. By applying an interpretable machine learning approach, the study extends previous research beyond conventional linear analyses and offers a more nuanced understanding of how different dimensions of ChatGPT literacy jointly contribute to educators' confidence in using generative AI. These findings may inform the development of evidence-informed professional development programmes aimed at promoting effective, responsible, and pedagogically meaningful AI integration in education.

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