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Assessing teachers' readiness and perceived usefulness of AI in education: an Estonian perspective

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This study explores teachers' readiness and perceptions regarding the integration of artificial intelligence (AI) tools in education. The study was conducted among 3,848 Estonian teachers. Given AI's transformative potential in enhancing teaching effectiveness, automating administrative tasks, and supporting personalized learning, it is critical to assess whether teachers are equipped to effectively utilize these technologies. Utilizing a comprehensive framework informed by human-centered approaches, this research investigates teachers' familiarity, attitudes, perceived usefulness, and readiness to implement AI-driven tools in educational settings. A survey conducted among teachers reveals a balanced perspective characterized by interest, openness, and awareness of both opportunities and potential risks associated with AI. Findings indicate significant predictive relationships between perceived usefulness and readiness, as well as attitudes toward AI tools and actual adoption intentions. Teachers' confidence and perceived relevance of AI in educational contexts emerge as key factors facilitating their willingness to engage with AI technology. Conversely, factors such as AI anxiety and limited training opportunities are identified as barriers to effective implementation. The study underscores the need for targeted professional development programs, ethical guidelines, and policy support to enhance teachers' readiness and facilitate the responsible integration of AI into educational practices.

KEYWORDS

artificial intelligence, readiness, perceived usefulness, technologies, AI anxiety

Introduction

Artificial intelligence (AI) has already brought transformative changes to formal education. Tools like OpenAI's Generative Pre-trained Transformer (GPT) have made remarkable strides across various disciplines, with education emerging as a particularly fertile ground for innovation (Biswas, 2023; Fauzi et al., 2023; Kalla et al., 2023). While researchers highlight both the benefits and risks of integrating AI into education, there is a consensus that AI is an inevitable part of the future of teaching and learning (Jo, 2022; Mohamed et al., 2024).

Advancements in AI provide educators with unprecedented opportunities to enhance teaching effectiveness and better engage diverse learners. However, these opportunities require teachers to be selective in adopting technologies and to develop the necessary knowledge and skills to use them effectively (Mohamed et al., 2024; Yan et al., 2024).

AI-driven tools are already reshaping classroom practices: adaptive assessments tailored to student performance, automated administrative tasks such as grading and attendance, and AI-powered assistants that track progress, provide feedback, and generate personalized learning materials (Jo, 2022). These tools not only reduce teachers' administrative burdens but also offer learners tailored resources, fostering engagement and inspiration.

Furthermore, AI has demonstrated its capacity to support the development of self-regulated learners by enhancing cognitive, metacognitive, and behavioral skills throughout different learning phases (Jin et al., 2023; Mohamed et al., 2024). For instance, AI-based tools assist learners in setting goals, monitoring progress, evaluating performance, and deepening self-understanding, while offering personalized recommendations to improve learning outcomes (Jin et al., 2023). These advances promote autonomy and critical thinking, making AI a valuable tool in modern education.

UNESCO underscores the importance of a human-centered approach to AI in education, emphasizing ethical principles, human rights, and social justice (Cukurova and Miao, 2024). Teachers are encouraged to use AI responsibly, ensuring alignment with safety, privacy, and inclusivity standards while fostering critical thinking and transformative practices. Ongoing efforts to develop AI competency frameworks aim to equip teachers and students with the skills to understand and navigate AI's ethical and pedagogical dimensions (Cukurova and Miao, 2024).

This research focuses on Estonian teachers. Given the ongoing technological revolution, it is crucial to assess whether they are prepared to adapt their teaching practices and embrace the potential of AI in education. The Estonian national curriculum (Valitus, 2023) emphasizes the development of digital competence, highlighting the ability to use evolving digital technologies in a rapidly changing society. This includes skills such as accessing and evaluating information, creating and using digital content, solving problems with digital tools, collaborating in digital environments, and ensuring privacy and ethical behavior online. This study aims to explore teachers' familiarity with, usage of, and perceptions of AI tools, including their readiness and perceived usefulness for teaching, as well as to identify the key factors predicting their use.

Theoretical background

The technological revolution in education

AI is transforming education by offering personalized learning experiences, enhancing teaching methodologies, and optimizing administrative processes (European Commission: Directorate-General for Education & Culture, 2022; Onesi-Ozigagun et al., 2024; Pratama et al., 2023). AI empowers teachers to deliver more efficient and adaptive learning experiences by leveraging data-driven insights to identify individual students' strengths, weaknesses, and learning styles. This allows for customized instruction and targeted interventions, helping students achieve their full potential while addressing knowledge gaps (Pratama et al., 2023; Renz and Vladova, 2021). AI's ability to make real-time adjustments to learning content ensures that instruction remains responsive to students' needs (Adiguzel et al., 2023; Onesi-Ozigagun et al., 2024).

For teachers, AI reduces administrative burdens by automating tasks like grading and resource creation, enabling them to focus on fostering creativity, collaboration, and critical thinking in their classrooms (Onesi-Ozigagun et al., 2024). AI's impact extends to administrative efficiency in education. By providing actionable insights into student performance, AI enables educators to make data-driven decisions and deliver targeted interventions for students who need additional support (Adiguzel et al., 2023).

Despite these challenges, AI offers significant opportunities for teachers to innovate and improve their instructional strategies. By integrating AI tools, educators can provide personalized learning experiences, timely support, and enhanced engagement for their students. AI has revolutionized education by enabling personalized, efficient, and adaptive learning experiences. Teachers benefit from automated administrative tasks and intelligent tools like ChatGPT, which provide real-time feedback and support, allowing educators to focus on meaningful interactions and instructional quality. Additionally, adaptive assessments and personalized learning materials ensure that students' unique needs are met, enhancing overall learning outcomes. Moreover, professional development in AI equips teachers with the skills necessary to adapt to technological advancements, ensuring they remain resilient and effective in an evolving educational landscape (Onesi-Ozigagun et al., 2024). To fully harness these opportunities, responsible AI usage and training should be integral to teacher preparation programs, promoting autonomy, ethics, and lifelong learning (Mohamed et al., 2024; Strzelecki and ElArabawy, 2024).

Teacher readiness and perceived usefulness: key drivers for AI integration in education

In addition to the many ways AI can diversify learning and offer new opportunities for students and teachers alike, it is crucial that teachers understand the potential of AI technology and are prepared to adapt to these innovations by integrating new technological possibilities into their teaching practices (Sanusi et al., 2024). To encourage teachers to use AI tools in their teaching, it is essential to consider two critical factors that influence their willingness to integrate AI into education: readiness and perceived usefulness (Ayanwale et al., 2022; Sanusi et al., 2024).

Readiness to use AI tools refers to teachers' psychological and practical preparedness to integrate AI into their teaching practices. It encompasses factors such as confidence in using AI, understanding its relevance, and recognizing its usefulness in enhancing educational outcomes (Ayanwale et al., 2022). Teachers' readiness is influenced by their attitudes toward AI, their perceptions of its benefits, and their ability to overcome AI-related anxieties (Fishbein and Ajzen, 2011). A lack of formal training and low confidence levels can hinder teachers' willingness to adopt AI, highlighting the need for targeted professional development programs (Chai et al., 2020). By addressing these psychological and contextual factors, educational stakeholders can design resources and learning opportunities that empower teachers to effectively

integrate AI, fostering both their behavioral intention and long-term commitment to using AI for educational advancement (Ayanwale et al., 2022; Luckin et al., 2022).

Perceived usefulness, defined as the degree to which an individual believes that technology will enhance their job performance, is a critical factor influencing technology acceptance (Sanusi et al., 2024). Scherer and Teo (2019) meta-analysis highlights perceived usefulness as a robust predictor of educators' intentions to use technology, emphasizing its role in shaping teachers' willingness to integrate technological innovations into their practice. Further studies have confirmed the perceived usefulness's impact on school teachers' intentions to adopt new technologies (Antonietti et al., 2022; Xianhan et al., 2022). Additionally, perceived usefulness has been consistently associated with attitudes toward technology, reinforcing its predictive power in understanding users' acceptance and engagement (Antonietti et al., 2022; Sing et al., 2022).

AI offers transformative potential to personalize learning, optimize administrative tasks, and enhance student engagement by tailoring resources to individual needs and enabling adaptive systems that respond to real-time data (Molefi et al., 2024; Pörn et al., 2024). Teachers with knowledge of AI are better prepared to utilize these technologies to create inclusive and equitable learning environments, as AI can address the needs of diverse learners (Pörn et al., 2024). Furthermore, understanding AI allows teachers to critically evaluate its role, addressing ethical concerns such as bias, data privacy, and the potential over-reliance on technology (Molefi et al., 2024). Without adequate knowledge and support, the transformative potential of AI in education risks being underutilized, creating disparities in its application and benefits.

Previous studies

AI tools are now widespread and can be expected to become an integral part of teaching and learning in the years to come (Kalota, 2024; Luckin et al., 2022). Therefore, it is important that teachers are prepared to use these tools in their teaching. Ayanwale et al. (2022) highlighted in their study (368 teachers from elementary and high school) two key factors influencing teachers' integration of AI into education: readiness and perceived usefulness. Teachers' readiness to teach AI was strongly linked to their confidence and understanding of its relevance in the classroom. Access to appropriate resources, such as hardware, software, and institutional support, further enhanced their preparedness. Perceived usefulness was a significant predictor of teachers' intention to adopt AI. Educators who recognized AI's potential to streamline tasks and provide personalized learning were more likely to incorporate it into their practices.

The role of perceived usefulness in predicting teachers' behavioral intention to teach AI has also been researched (Sanusi et al., 2024). The same study (320 in-service secondary school teachers) revealed that perceived usefulness was a significant predictor of teachers' intention to teach AI. Teachers who believed AI could improve teaching efficiency and student engagement were more inclined to integrate AI into their teaching practices. This study concluded that highlighting the practical benefits of AI in teaching, such as its potential to support personalized learning and reduce workload, is crucial for fostering positive attitudes and encouraging the adoption of AI.

For example, Pörn et al. (2024) investigated the attitudes and expectations of 85 digitally skilled Finnish mathematics teachers in relation to the role of AI in education. Results revealed that teachers were generally open and curious about AI's potential, viewing it as a tool for personalization, assessment, and providing challenges for advanced learners. Teachers identified AI's potential to create individualized learning paths and offer tailored support as its key strengths. Despite their optimism, some expressed skepticism about AI's ability to replace human judgment in personalized education. AI readiness is pivotal in enhancing teachers' innovation and job satisfaction. Education policies and training programs should emphasize not only technical skills but also the ethical use of AI and the development of a strategic vision for its application in education (Wang et al., 2023).

The current study

This study aims to explore teachers' perceptions of AI tools, including their readiness and perceived usefulness for teaching, as well as the main factors influencing their adoption. The research questions and hypotheses were as follows:

First, how many teachers report having used AI tools, and how does this reported usage vary depending on school level?

Secondly, how do teachers assess their own readiness to use AI tools in their teaching, and how is their perceived usefulness evaluated? In addition, we hypothesized (H1) that teachers who use AI tools in their teaching would rate readiness and perceived usefulness higher than teachers who tend not to integrate AI tools in their teaching (Pörn et al., 2024). Additionally, we analyzed responses at the item level to gain a more detailed understanding of specific aspects influencing teachers' perceptions.

Third, which factors best predict whether teachers will use AI tools in their teaching or not? We hypothesized (H2) that, primarily, readiness and perceived usefulness would best predict the use of AI tools, with other factors less predictive (Ayanwale et al., 2022; Sanusi et al., 2024).

Methodology

Sample

The study included 133 Estonian general education schools and their 3848 teachers, of whom 86.4% were female (n = 3,327), 12.2% were male (n = 470), and 1.4% (n = 55) preferred not to disclose their gender. The average age of the responding teachers was 47.5 years (SD = 13.1). They were also asked about the duration of their teaching careers, with the average teaching experience being 18.7 years (SD = 14.4). Among them, 2,182 taught in basic schools (grades 1–9), 784 taught in upper secondary schools (grades 1–12), and 887 taught in state gymnasiums (grades 10–12).

TABLE 1 Questionnaire about readiness and perceived usefulness.

Readiness	
AI 1	I have the relevant knowledge to use artificial intelligence in my work.
AI 3	I have access to the appropriate software to use artificial intelligence in my work.
AI 4	The management of my school supports the use of artificial intelligence in teaching.
AI 5	I have access to the relevant content to use artificial intelligence in my work.
Perceived usefulness	
AI 2	Using artificial intelligence enhances my efficiency in conducting lessons.
AI 6	Using artificial intelligence allows me to better implement an individualized approach to students.

Procedure

The survey was conducted in the autumn of 2024 by the Academy for Educational Leadership at Tallinn University, which organizes a nationwide school survey every year. All schools in Estonia were invited to participate, with individual invitations and enrolment forms sent to the principals of all general education schools in Estonia. Schools could also register through the university's website. Each participating school received a unique survey link. The data were collected via the Qualtrics platform, with the survey taking 25–30 min to complete. Teachers could choose to exit the questionnaire at any time. In total, teachers were asked to answer six different thematic blocks, including the topics focused on in this article.

Measures

The data collection for readiness and perceived usefulness utilized validated scales tailored to assess teachers' preparedness and perceptions of AI in education (Sanusi et al., 2024). For the present study (Table 1), the questionnaire was adapted and six questions were selected, four of which described teachers' readiness to use AI tools in their teaching, and two questions related to perceived usefulness (*we use a scale of 1—strongly disagree. 5—strongly agree).* For teachers who indicated that they had not used AI tools, we changed two statements related to perceived usefulness into the conditional form (e.g., "Using artificial intelligence would enhance my efficiency in conducting lessons"). Given the exploratory nature of this research and the limited number of items used to measure perceived usefulness, this study presents the instrument as a questionnaire developed specifically for the purpose of exploring teachers' readiness and perceptions toward AI integration and the questionnaire was adapted for this study.

To determine how many teachers have used AI tools, we used an open-ended question: "Have you used artificial intelligence applications in your work as a teacher?"

We also included two background questions: the teachers' age and their teaching experience ("How long have you been working as a teacher?"). Teachers were able to provide their answers by entering the corresponding number.

To assess the underlying structure of the survey instrument and ensure that the items loaded meaningfully onto their respective constructs prior to confirmatory analysis, we conducted an Exploratory Factor Analysis (EFA) on the first half of the randomly split sample (n = 1,924). Promax rotation was used due to the assumption of correlated factors. The analysis was based on six items, four intended to capture teachers' readiness to use AI and two assessing perceived usefulness. The results revealed a clear two-factor solution that aligns with the theoretical structure of the instrument. Table 2 shows the rotated factor loadings, along with uniqueness values for each item. Items AI_1, AI_3, AI_4, and AI_5 loaded strongly on Factor 1 (readiness), while AI_2 and AI_6 loaded exclusively on Factor 2 (usefulness). No significant cross-loadings were observed. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.791, which indicates good suitability for factor analysis. Bartlett's test of sphericity was significant, $\chi^2(4) = 121.62$, $p < 0.001$, indicating that the data were suitable for factor analysis.

The rotated factor solution explained 63.4% of the total variance, with Factor 1 accounting for 38.5% and Factor 2 for 24.9%. The eigenvalues for the unrotated solution further supported the retention of two factors (Factor 1 = 3.383; Factor 2 = 0.997).

An confirmatory factor analysis (EFA) was initially conducted on second half of the randomly split sample (n = 1,924) to explore the factor structure of the items. Table 3 presents the CFA results, including factor loadings, standard errors, z-values, p-values, and internal reliability coefficients (Cronbach's alpha). The internal reliabilities of the scales ranged from 0.814 to 0.835 (see Table 3), indicating a high level of reliability. Cronbach's α values between 0.41 and 0.70 are considered moderate, while α > 0.70 is considered high (Cronbach, 1951; DeVellis and Thorpe, 2021).

Since the χ^2 test is sensitive to sample size (Chen, 2007), additional fit indices were used to assess model fit: the Comparative Fit Index (CFI), the absolute fit index Root Mean Square Error of Approximation (RMSEA), the Tucker-Lewis Index (TLI), and the standardized fit index Standardized Root Mean Square Residual (SRMR). A CFI value greater than 0.90 was considered acceptable (Bentler, 1992), while an RMSEA value below 0.08 was deemed satisfactory (Browne and Cudeck, 1992; Hu and Bentler, 1999). Similarly, a TLI value greater than 0.90 and an SRMR value below 0.08 were regarded as indicators of good model fit (Hu and Bentler, 1999). Model fit indices indicate an acceptable to good fit: [χ^2 (1,924) = 314.45, $p < 0.001$; CFI = 0.971, TLI = 0.960,

TABLE 2 Factor loadings and uniqueness values: original data and whole sample.

	Readiness	Perceived usefulness	MSA	Uniqueness
AI_5	0.971		0.766	0.279
AI_3	0.877		0.786	0.185
AI_1	0.787		0.891	0.535
AI_4	0.766		0.892	0.651
AI_2		0.915	0.729	0.069
AI_6		0.819	0.732	0.488

TABLE 3 Confirmatory factor analysis factor loadings.

Factor	Indicator	Estimate	Std. error	*z*-value	*p*	Cronbach's α
Readiness	AI_1	0.827	0.019	42.723	<0.001	0.88
	AI_3	0.921	0.014	51.341	<0.001	
	AI_4	0.646	0.014	34.211	<0.001	
	AI_5	0.953	0.019	62.00	<0.001	
Perceived usefulness	AI_2	0.975	0.02	49.882	<0.001	0.86
	AI_6	0.959	0.02	48.354	<0.001	

TABLE 4 Differences in teachers' perceived usefulness and readiness to use AI tools by individual item.

	Teachers who have used AI tools in their lessons	Teachers who have not used AI tools in their lessons	Welch's *t*	Cohen's *d*
Factor	Mean (SD)	Mean (SD)		
Perceived usefulness				
A1	3.42 (1.03)	2.41 (1.17)	27.845*	0.923
A3	3.59 (1.09)	2.75 (1.21)	22.513*	0.746
A4	3.56 (1.02)	3.05 (1.02)	15.186*	0.501
A5	3.54 (1.05)	2.76 (1.24)	20.527*	0.682
Readiness				
A2	3.69 (0.99)	2.64 (1.07)	30.859*	1.022
A6	3.25 (1.14)	2.43 (1.07)	22.537*	0.743

*$p < 0.001$.

TABLE 5 Model fit indices for predicting AI tool use in teaching.

Model	AIC	BIC	df	ΔX^2	*p*	McFadden R^2
M1	4,371.966	4,384.364	3,635	659.558	<0.001	0.131
M2	4,050.505	4,069.102	3,634	323.461	<0.001	0.196
M3	3,956.786	3,981.582	3,633	95.719	<0.001	0.215
M4	3,958.301	3,989.295	3,632	0.485	0.486	0.215

M1 includes readiness; M2 includes readiness, perceived usefulness; M3 includes readiness, perceived usefulness, age; M4 includes readiness, perceived usefulness, age, teaching experience. Bold, best model.

RMSEA = 0.076, SRMR = 0.036]. CFI, TLI and SRMR and RMSEA indicating a moderate fit.

Data analysis

In order to answer the first research question, how many teachers report using AI in classroom teaching, and how the reported use of AI tools differs across school levels and subject areas.

The second research question aimed to explore how teachers assess their readiness and perceived usefulness regarding the implementation of AI tools in teaching. To compare teacher groups (those who use AI tools in teaching vs. those who do not), the Wilcoxon signed-rank test was used, as the Shapiro-Wilk test indicated that the data did not follow a normal distribution ($p < 0.01$), necessitating the use of non-parametric tests. IBM SPSS 28 was used to perform these analyses. Additionally, to examine whether there were statistically significant differences between teacher groups for regression statements, the Welch's *t*-test was applied. This test was chosen because the assumption of equal variances was violated, as confirmed by Levene's test ($p < 0.05$). However, given the large sample sizes, the use of Welch's *t*-test is considered appropriate (Moder, 2010).

To address the third research question regarding which factors predict the use of AI tools in schools, a logistic regression analysis was conducted using IBM SPSS 28. Assessing the goodness-of-fit of a logistic regression model requires multiple statistical measures to evaluate how well the model explains variability in the dependent variable and whether it significantly improves upon the null model (a baseline model without predictors).

Deviance measures the discrepancy between observed data and model predictions, with lower deviance values indicating a better fit. Comparing the deviance of nested models helps determine whether adding predictors enhances the model's explanatory power (McCullagh, 2019). The Akaike Information Criterion (AIC) is used for model selection, balancing goodness-of-fit and complexity. Models with lower AIC values are preferred as they exhibit regression with better explanatory power while minimizing overfitting. Similarly, the Bayesian Information Criterion (BIC)

TABLE 6 Predicting AI tool use in teaching: significance of the model's parameters.

Model		Estimate	Standard error	*Z*	Wald Statistic	df	*p*	Odds ratio
M1	(Intercept)	3.01	0.142	21.271	452.457	1	<0.001	20.296
	Readiness	0.999	0.044	22.891	523.989	1	<0.001	0.368
M2	(Intercept)	4.282	0.175	24.455	598.041	1	<0.001	72.383
	Readiness	0.693	0.048	14.402	207.418	1	<0.001	0.5
	Perceived usefulness	0.745	0.044	17.031	290.057	1	<0.001	0.475
M3	(Intercept)	2.442	0.252	9.697	94.036	1	<0.001	11.495
	Readiness	0.599	0.049	12.153	147.688	1	<0.001	0.549
	Perceived usefulness	0.717	0.044	16.223	263.185	1	<0.001	0.488
	Age	0.031	0.003	9.645	93.02	1	<0.001	1.031
M4	(Intercept)	2.385	0.265	9.009	81.169	1	<0.001	10.857
	Readiness	0.599	0.049	12.15	147.626	1	<0.001	0.549
	Perceived usefulness	0.721	0.044	16.194	262.239	1	<0.001	0.486
	Age	0.033	0.005	6.792	46.131	1	<0.001	1.034
	Teaching experience	−0.003	0.004	−0.696	0.484	1	0.486	0.997

The dependent variable is whether or not the teacher has reported the use of AI tools in lessons.

evaluates model fit but penalizes complexity more heavily than AIC (Burnham et al., 1998). The model's fit was also assessed using pseudo-R^2 values, which quantify the strength of the relationship between the dependent and independent variables. Among the various pseudo-R^2 measures, McFadden's R^2 is the most commonly used (McFadden and Zarembka, 1972). To determine the significance of the independent variables, the Wald test was conducted. Utilizing the Wald statistic in logistic regression analysis helps ensure unbiased and reliable regression estimates. To facilitate interpretation, the odds ratio was obtained by exponentiating the regression coefficients. The odds ratio indicates how much more or less likely one event is compared to another and is calculated using the standard formula (Salmi et al., 2015). To evaluate whether adding predictors significantly improved model fit, we used the likelihood-ratio test (ΔX^2) to compare nested models. This test assesses whether the inclusion of additional variables meaningfully enhances explanatory power by comparing the deviance of successive models. A significant ΔX^2 value indicates that the added predictors improve the model beyond the null model or previous versions (McCullagh, 2019).

Results

Teachers' reported use of AI tools by school level and subject area

The results revealed that more than half of the respondents, 53.2% (n = 1,964), reported having used AI tools, while 46.8% (n = 1,727) stated that they had never used them. A small portion of responses (4.1%, n = 157) were missing from the dataset. Among lower secondary (basic school) teachers, 66.0% (n = 461) reported that they have used AI tools in their teaching, while 34.0% (n = 237) indicated that they have not. Among upper secondary (gymnasium) teachers, the use of AI tools was almost evenly split: 50.1% (n = 955) reported using AI tools, whereas 49.9% (n = 952) reported not using them. Teachers who teach at both lower and upper secondary levels showed a similar pattern to upper secondary teachers: 50.9% (n = 533) reported using AI tools, and 49.1% (n = 514) reported not using them.

Teachers' assessments of their readiness and perceived usefulness of using AI tools

We analyzed the differences in readiness and perceived usefulness of AI tools between those who have used AI tools and those who have not. A Mann-Whitney U test was conducted to compare the two groups, and the results revealed statistically significant differences in both measures. In terms of readiness, the Mann-Whitney U test indicated a statistically significant difference between the groups ($p < \mathbf{0.001}$, r = 0.472). Similarly, for perceived usefulness, the Mann-Whitney U-test confirmed a significant difference between the groups ($p < \mathbf{0.001}$, r = 0.499). The results of Welch's test (Table 4) showed that teachers who said they have used AI tools in their teaching rated the statements related to readiness and perceived usefulness higher than teachers who do not use these tools in their teaching.

Additionally, teachers who had already incorporated AI tools into their work perceived them as most beneficial for improving their efficiency in conducting lessons (M = 3.69, SD = 0.99). However, they were least convinced that AI tools effectively support the implementation of an individualized approach for students (M = 3.25, SD = 1.14). Teachers who had not used AI tools perceived the strongest support for AI integration coming from their school's management (M = 3.05, SD = 1.02). However, they felt least confident in their own knowledge and ability to use AI in their work (M = 2.41, SD = 1.17).

Use of AI tools and predictors of AI tool adoption in teaching

We compared four logistic regression models with different predictor combinations to assess which factors best predict teachers' adoption of AI tools (see Table 5). The results indicate that the inclusion of readiness, perceived usefulness, and age (Model 3) provides the best fit for the data, as reflected in the lowest AIC and BIC values, as well as the highest McFadden R^2. While Model 4 introduced teaching experience as an additional predictor, it did not significantly improve model fit compared to Model 3.

The results show that readiness and perceived usefulness are the strongest predictors of AI tool adoption, both having a significant negative effect on the likelihood of using AI tools. Age also plays a significant role, with older teachers being slightly more likely to adopt AI tools. In contrast, teaching experience does not have a statistically significant effect ($p = 0.486$), suggesting that experience alone does not influence AI adoption when other factors are considered. These findings reinforce the model fit results, confirming Model 3 as the most robust predictor of AI tool adoption (see Table 6).

Discussion

The aim of this study was to examine teachers' readiness and perceived usefulness the use of AI tools in education and to assess which factors best predict their adoption. The findings revealed that slightly more than half of the teachers reported using AI tools. Teachers who had used AI tools demonstrated significantly higher levels of readiness and perceived usefulness, especially in relation to increased efficiency in lesson delivery. At the same time, there was some skepticism regarding AI's ability to fully support individualized instruction. Overall, teacher readiness and perceived usefulness emerged as the most significant predictors of AI tool adoption, highlighting the importance of both practical confidence and the perceived educational value of AI for successful implementation.

Teachers' reported AI use by school level

Regarding the first research question, results indicated that over half (53.2%) of teachers reported using AI tools in their work, although the usage rates varied by school level. Basic school teachers reported higher AI usage than upper secondary teachers, suggesting that they might be more open to innovative technologies or perceive a greater necessity for these tools in their teaching practice. These findings align with previous studies emphasizing the transformative potential of AI tools for personalizing instruction and addressing individual students' needs more effectively (Onesi-Ozigagun et al., 2024; Pratama et al., 2023). Additionally, younger students' diverse developmental and educational needs at the basic school level could encourage teachers to seek novel instructional methods such as AI-driven personalized learning tools.

A considerable proportion of teachers (nearly half) do not use AI tools. According to the theoretical framework presented earlier, two critical factors, teachers' readiness and perceived usefulness, significantly influence technology integration decisions (Ayanwale et al., 2022; Sanusi et al., 2024). A lower usage rate might reflect issues related to teachers' readiness, including insufficient knowledge, lack of confidence, and limited access to relevant resources such as appropriate software and instructional content.

Teachers' readiness and perceived usefulness of AI tools

Secondly, this study examined how teachers assess their readiness to use AI tools in their teaching and how they evaluate the perceived usefulness of these tools. In line with hypothesis (H1), it was expected that teachers who had already integrated AI tools into their teaching would report higher levels of readiness and perceived usefulness compared to their non-using counterparts. Teachers who reported using AI tools consistently rated their readiness and AI's perceived usefulness significantly higher. This aligns with theoretical frameworks emphasizing that readiness involves both psychological and practical dimensions, including self-efficacy, access to resources, and support from school management (Ayanwale et al., 2022; Fishbein and Ajzen, 2011; Chai et al., 2020). Teachers with higher readiness are more confident in using AI and perceive its integration as beneficial to their teaching processes. Readiness is not merely about technical access; it encapsulates a broader professional mindset that includes willingness, comfort, and perceived relevance (Luckin et al., 2022). Also, teachers who use AI tools believe these tools significantly enhance their instructional effectiveness, particularly in terms of efficiency and task automation (Sanusi et al., 2024; Scherer and Teo, 2019). Interestingly, even among users, there was a more cautious endorsement of AI's role in enabling individualized instruction, suggesting that while teachers appreciate efficiency, they remain skeptical about AI's capacity to fully replicate or support human-driven pedagogical personalization.

Item-level analysis revealed that the highest-rated aspect among AI users was the enhancement of lesson efficiency, while the lowest-rated was AI's contribution to individualized teaching approaches. This distinction suggests that teachers see immediate, pragmatic benefits in adopting AI but are still negotiating its deeper pedagogical implications. In contrast, non-users tended to rate the support of school management higher than their own knowledge or skills. This highlights an important intervention point: while institutional support is valuable, it does not substitute for direct professional development that builds teacher agency and competence. The findings resonate with earlier studies, which showed that perceived usefulness is a stronger predictor of behavioral intention to adopt technology than institutional factors alone (Antonietti et al., 2022; Xianhan et al., 2022). These results underscore the importance of targeted professional development initiatives that not only equip teachers with the necessary technical skills but also reinforce the practical pedagogical value of AI tools. Furthermore, school leaders should be encouraged to foster environments that promote experimentation and innovation with AI technologies.

Predictors of teachers' AI tool adoption

Third, this study sought to determine which factors best predict whether teachers will use AI tools in their teaching. In line with hypothesis (H2), we theorized that readiness and perceived usefulness would be the strongest predictors, with other background variables such as age and teaching experience playing a lesser role. The results of the logistic regression analysis confirmed our theory. Teachers' readiness and perceived usefulness emerged as the most significant predictors of AI tool adoption, aligning closely with theoretical models such as the Technology Acceptance Model (Scherer and Teo, 2019) and prior empirical findings (Ayanwale et al., 2022; Sanusi et al., 2024). Readiness encapsulates not only technical skills and access to resources but also psychological preparedness, such as confidence in using AI and belief in its relevance for teaching (Fishbein and Ajzen, 2011; Sing et al., 2022). Teachers who feel confident and supported and have access to relevant content and tools are significantly more likely to integrate AI into their teaching practices. Perceived usefulness also played a critical role in determining AI adoption. Consistent with studies emphasizing the importance of practical value in driving technological uptake (Antonietti et al., 2022; Xianhan et al., 2022), teachers who recognized AI's benefits, such as improved efficiency and better instructional outcomes, were more inclined to use AI tools. Teachers who demonstrated confidence, competence, and recognized the practical value of AI tools were more likely to integrate AI into their teaching practices. Interestingly, age showed a modest but statistically significant positive association, suggesting older teachers were slightly more inclined to adopt AI tools. However, teaching experience alone did not significantly predict AI adoption, indicating that other factors, such as recent professional development or institutional environments, may play a more influential role.

Limitations, conclusion, and future directions

This study has several limitations. First, the reliance on self-reported data may introduce biases, such as social desirability bias, which could affect the accuracy of teachers' responses regarding their use of and attitudes toward AI tools. Second, the cross-sectional design of the research does not allow for causal inferences about the relationships between readiness, perceived usefulness, and AI adoption. Longitudinal studies are needed to explore how these perceptions and behaviors evolve over time. Third the perceived usefulness dimension included only two items, potentially impacting construct validity and reliability. Future research should consider expanding this scale to enhance psychometric robustness.

This study provides a comprehensive overview of Estonian teachers' experiences with and perceptions of AI in education. It reveals that while a significant proportion (53.2%) have already incorporated AI tools into their teaching, many barriers still prevent widespread adoption. Chief among these are gaps in readiness, limited perceived usefulness among non-users, and a lack of systemic institutional support. These findings highlight that the successful integration of AI in teaching is less about teachers' demographic background and more about their personal competencies, experiences, and the environments in which they work.

A key conclusion is that teachers' readiness and perceived usefulness are the strongest predictors of AI adoption. These findings are consistent with the Technology Acceptance Model and other contemporary frameworks on digital transformation in education (Ayanwale et al., 2022; Scherer and Teo, 2019). They indicate the importance of both psychological preparedness, such as confidence and motivation, and contextual enablers like access to tools, content, and leadership support.

Importantly, the study emphasizes the essential role of school leadership in fostering a culture of innovation. When school environments actively support experimentation, peer learning, and shared responsibility in technology adoption, even hesitant teachers are more likely to explore and adopt AI (Molefi et al., 2024). Therefore, leadership development and strategic alignment with innovation goals must be part of any AI integration strategy.

Despite the optimism around AI, there are serious limitations and ethical concerns. Over-reliance on AI may also diminish the human dimensions of education, such as empathy, critical dialog, and moral development, which are essential for nurturing holistic learners (Renz and Vladova, 2021). This calls for careful implementation guided by human-centered and ethical principles.

Future research should explore specific training and support mechanisms that most effectively enhance teachers' readiness and perceived usefulness of AI, as well as how these factors impact teaching quality and student outcomes in the long term. Longitudinal and mixed-methods studies are particularly needed to understand the evolving dynamics of AI integration in education. Further, research should investigate the role of AI in supporting students' transversal competencies, such as collaboration, digital literacy, and self-regulation. It is also essential to study how AI can be tailored to support the inclusion of diverse learners and how teachers can be trained to critically evaluate algorithmic systems' pedagogical and ethical implications in classrooms.

To conclude, this study underscores that while AI holds a promise to transform education, its integration requires much more than access to tools—it requires systemic readiness, ethical safeguards, teacher empowerment, and leadership engagement. Policymakers and educational leaders must invest in sustainable strategies that not only train but also inspire teachers to harness the full pedagogical potential of AI in a way that is equitable, effective, and ethically sound, without creating an educational divide.

Data availability statement

The datasets presented in this study can be found in online repositories. Requests to access these datasets should be directed to the corresponding author.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and

institutional requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kind.

Author contributions

MG: Methodology, Writing – review & editing, Writing – original draft. PO: Writing – review & editing, Writing – original draft.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The authors declare that no Generative AI was used in the creation of this manuscript.

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