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Impact of artificial intelligence and technology leadership on professional teacher development

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ABSTRACT

A mixed-methods approach was employed to investigate how balancing technological leadership with AI advancements is essential, considering its perceived usefulness (PU) and perceived ease of use (PEOU) by the application of the Technology Acceptance Model (TAM) and transformational leadership (TL) theory. The study utilized the TAM and Multifactor Leadership Questionnaire to measure the impact of PU and PEOU on Turkish universities. Using SPSS, correlation analysis revealed a strong and positive correlation between PU ($r=0.769^{**}$), PEoU ($r=0.865^{**}$), TL theory ($r=0.941^{**}$), and Professional Teacher Development (PTD). The impact of the factors facilitating technology leadership and AI integration PEoU ($p=0.000$) and transformational leadership ($p=0.000$) is significant on PTD. In contrast, the impact of PU ($p=0.102$) is insignificant on PTD. The AI-driven learning path for teachers' improvement is improved with the ability to integrate AI competence and improve the PTD outcomes.

Abbreviations: AI: artificial intelligence; TL: transformational leadership; PEOU: perceived ease of use; PU: perceived usefulness; PTD: professional teacher development; LMS: learning management system; MLQ: Multifactor Leadership Questionnaire; VTLD: virtual transformational leadership development; ML: machine learning; AR: augmented reality; VR: virtual reality

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Introduction

Technology leadership is redesigned to accelerate technology integration to develop and produce skills among teachers integrating information and communication technologies (ICT). Technology leaders are expected to impact learning and transform their professional development using technology in this digital world. The important aspects of technology leaders are encompassed by visionary leadership, excellence in professional practice, digital age learning culture, and systematic improvement (Raman & Thannimalai, 2019). They facilitate planning and executing digital-age learning spaces, creating a culture of innovation. Through managing technology resources, they improve instruction and student performance through successful tech integration (Omar & Ismail, 2021; Thannimalai & Raman, 2018).

In professional teacher development (PTD), technology leaders oversee technology materials to improve teaching practice. They enhance professional practice to facilitate the implementation of mobile technologies for learning, thereby enhancing teaching processes by which student learning is achieved (Zhong et al., 2024). This leadership approach also fosters the professional development of teachers and helps them acquire skills relevant to the technologically advanced learning environment. The advancement of leadership in technology not only provides professional growth for teachers but also creates changes that support educational improvements (Schoenbart, 2019).

Considerably, using Artificial Intelligence (AI) in teaching is the game-changing variant for various fields advancing unprecedented transformations. Expert systems assist teachers in practicing technology leadership through smart tutoring systems, smart content, virtual learning environments, and facilitators (Sharma et al., 2021). The use of AI has progressed in education in the area of cognitive learning with tools like tutoring systems, chatbots, and educational robotics. Some application areas include knowledge-based systems, intelligent tutoring systems (ITS), autonomous agents, and natural language processing (NLP) systems. Some teachers applying AI to improve classrooms and online classes include Century Tech, Blippar, Knewton, Thinkster Math, and Quizlet. AI has also enhanced efficiency and resource exploitation and utilization to produce differentiated or personalized learning and lighter instructor workload, which changes the delivery and acquisition of instructions (Shen et al., 2021). AI training enables teachers to use technology in lessons and prepares them to operate in new educational environments, thus positively impacting PTD. Also, AI-based systems inform teachers about their students' learning patterns, which in turn helps improve their teaching methods (Hou et al., 2024).

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Additionally, cobots—robots work with teachers, helping children practice spelling and pronunciation while adjusting to the learners' abilities. AI-based teaching has gone from being able to download content to using intelligent systems that can learn the behavior of instructors and learners to improve the learning experience and the general experience (Chen et al., 2020). In this respect, PTD enriches educators with the competencies to leverage AI applications for instructional management. Thus, PTD can guarantee that educators are ready to transform AI capabilities into the means of developing the institution's outcomes and addressing the challenges characteristic of the educational process (Ding et al., 2024). Kitcharoen et al. (2024) mentioned that the use of AI in PTD helps to improve educators' perception of student individuality, learning process, and results as the system provides them with material containing information on learners' performance and learning styles so that instructors can modify their behavior and contribute to the creation of a positive learning environment (Kitcharoen et al., 2024).

AI in teaching practices is perceived as a potential technological development that provides tools for curriculum development, personalization, supporting professional development, and automating administrative tasks. Nonetheless, the utilization of AI in PTD will determine the effects of AI on teacher leadership. Interactive technologies help students actively participate in the learning process and assist teachers in various administrative, communication, and record-keeping processes, thus contributing to their development (Ghamrawi et al., 2024). These are implemented by the meticulous building of technology leadership, preparing teachers to grow using AI in education (Pham & Sampson, 2022). It also positively contributes to improving teaching-learning efficiency and recognition accuracy and effectively promotes and supports teachers in developing their profession (Zhao et al., 2021). Nonetheless, the attitudes and trust of teachers are based on effective professional development through AI-powered educational technology, as they are more willing to complement their teaching practices with AI. The most potential use of AI in the professional development of teachers is the automated assessment tools merging AI grading recommendations into pedagogy (Nazaretsky et al., 2022).

Past studies showed the effectiveness of AI in instructional practices for teachers, making students' learning experiences unique and offering meaningful insights about student performance. It can perform several functions, such as executing tasks, providing feedback on the instruction given, and analyzing data for instructional decisions. Consequently, the teacher's professional competence, ideas, and flexibility remain the key to creating valuable learning experiences, and its integration with technology and innovations is again important. As it is evident that the application of AI in education has the potential to revolutionize education, this study explicitly seeks to examine how a balance between technological leadership and AI advancements can enhance the implementation of Professional Teacher Development (PTD). This research shows how technology leadership and AI adoption impact the PTD through the lens of the Technology Acceptance Model (TAM) and Transformational Leadership Theory. Thus, this research is performed to answer the following research question:

Research questions

- What is the impact of AI and technology leadership on PTD using the TAM and TL theory?

Theoretical foundations and hypothesis development

Understanding the PTD through the TAM influencing by AI and technological leadership

The TAM presented by Davis is used as a tool widely adopted to explain user adoption of new technologies. The model is based on two factors, PU and PEOU, where PU explains an individual's belief that using a new technology will enhance their performance (Davis, 1989). PEOU is the user perception that relates to the degree to which an individual perceives a specific technology as requiring minimal effort or ease of use to gain its benefits (Na et al., 2022). TAM is applicable for understanding the significant aspects of technology leadership in the current era of 4.0, gathering and exploring future skills, and sharing opinions on key roles. The person's belief is explored in line with the integration of technology dependent on enhancing job performance accounting for professional development grouped with job demands of creating a positive learning environment. A digital leader must transition from a fixed performance to a focused and flexible system based on managing change, competencies, and needs and creating a transparent environment encouraging innovation (Molino et al., 2021).

Understanding the teacher's willingness to adopt AI and technology-based teaching analysis systems is also extended by explaining the TAM model, with goal orientation, trust, and teaching efficacy being the most significant factors. AI has the potential to facilitate processes of teaching since the evaluative properties affect the intelligent nature of the TAM model, where goal orientation and teaching efficacy are considered antecedent variables (Wang et al., 2024). The intention of creating AI is similar to enhancing learning and analyzing multiple situations, developing functions relevant to problem-solving and learning. A system capable of correctly interpreting specific tasks and goals is integrated by AI, where machine-based systems can provide goals and make recommendations based on predictions and decisions that affect the learning environment directly or indirectly (Gaber et al., 2023).

Technology leadership impacts PU and PEOU by increasing trust in the tools and supporting the use of technology. Teachers with higher levels of technological training and pedagogical content knowledge show higher levels of intention to use technology in teaching, and they view technology as tools that support instruction and achievement of course objectives (Sulaiman et al., 2023). Consequently, this leadership supports their function in enhancing learning spaces, teaching method variations, and feedback crucial to PTD. In their research, Gupta and Bhaskar (2020) mentioned that AI's ability to

deliver personalized learning and analyze student data can only be optimized when teachers agree to integrate these systems. Technology leadership is responsible for turning the teachers' psychological readiness to adopt AI into practical application and development (Gupta & Bhaskar, 2020). Based on TAM's role in the PTD impacted by technological leadership, the research aims to analyze the following hypotheses:

H1: PE of TAM, contributing to AI and technology leadership, significantly impacts PTD.

Ho1: PE of TAM, contributing to AI and technology leadership, does not significantly impact PTD.

H2: PEOU of TAM, contributing to AI and technology leadership, significantly impacts PTD.

Ho2: PEOU of TAM, contributing to AI and technology leadership, does not significantly impact PTD.

Transformational leadership (TL) theory influencing by teacher technology leadership and AI integration

TL plays a crucial role in shaping responses to bring change in an organization with innovation. TL theory is the prominent approach to motivate and inspire leaders to use their higher values, articulate a compelling vision, encourage innovation, and instill passion, promoting a collective sense of commitment and purpose. TL motivates school leaders to embrace AI and be technology leaders who embrace open-mindedness and an inclination toward creativity (Shal et al., 2024). This style of leadership is pivotal in the development of technology leadership for teachers by enabling the consideration of using AI-based solutions in teaching (Luo & Wang, 2024). This promoted PTD for developing the practical ability for information-based teaching, creating curriculum resources, and reshaping the role of teaching with AI integration as the latest technological advancement (Meng & Sumettikoon, 2022).

TL enhances teacher technology leadership by creating a flexible, creative, and strategic mindset that can help implement AI in classrooms. Through TL, the teachers do not perceive AI tools as technological solutions implemented in their practice but as tools that can help further develop their PTD to support their student-centered approach (Yang et al., 2024). According to Hou et al. (2024), TL helps leadership adapt to the new atmosphere in education since it provides flexibility, creativity, and strategic thinking. AI supports intelligence and individualization of the educational process in PTD. Nonetheless, some difficulties, like privacy, security, and technical issues, may come into question with the integration of AI (Hou et al., 2024). Such challenges can be mitigated by elements of TL, such as inspirational motivation to ensure that the solutions provided align with organizational goals and objectives. The integration of these components guarantees that the use of AI in K-12 education helps facilitate efficient and fair teaching and learning processes.TL, therefore, facilitates the implementation of change at both the organizational and classroom levels to foster the adoption of AI in enhanced instructional practices (Tarisayi, 2024).

Higher learning institutions must equip the learners and prepare them for the complex society through innovative learning education using technologies. Environments that enable learning transformation, such as The Virtual Transformational Leadership Development (VTLD) experience, incorporate AI, Machine Learning (ML), Augmented Reality (AR) and Virtual Reality (VR) and games within classroom settings to enhance learning engagement, critical thinking and enabling outcomes (Hogan et al., 2021; Nimma, 2024). In addition, the effectiveness of ChatGPT in producing timely, relevant, comprehensible, concise, and impartial information is helpful for scientific research based on digital school leadership and the use of ICT by teachers. Both versions of ChatGPT-3. 5 and both ChatGPT-4 and ChatGPT-5 delivered adequate information; however, ChatGPT-4 offered a more detailed and categorized response. The results imply that carefully designed and deployed AI-based tools can be handy in PTD (Karakose et al., 2023). Therefore, besides directing strategies for integrating AI, transformational leadership influences teachers' readiness and technology leadership, strengthening the hypothesized relationship regarding the impact of TL and PTD. Based on the above, the relationship of TL with the PTD, this research thus analyzed the following hypothesis:

H3: Transformational Leadership is influenced by AI, and technological leadership significantly influences PTD.

Ho3: Transformational Leadership influenced by AI and technological leadership does not significantly influence PTD.

Professional teacher development (PTD) for the technological leadership and AI

PTD is crucial in improving learners' achievements, especially in implementing AI technologies in the learning environment. PTD becomes one way to offer an opportunity to equip teachers with the confidence to incorporate tools into their teaching practices (Brandão et al., 2024). Due to that, the introduction of AI has dramatically impacted the teaching-learning process and teaching practices. Teachers should be knowledgeable in pedagogy, especially technology, to apply intelligence to education to increase interaction and individual learning (Chen et al., 2020). Teachers' knowledge seems essential for successful AI adoption and PTD since the increased AI awareness would lead to better tool choices and more feedback (Krstić et al., 2022).

Using AI in teachers' PTD is based on two leadership frameworks: transformational and technological leadership. Transformational leadership helps encourage teachers to incorporate technology and adopt different changes in their teaching practice (Schmitz, 2023). On the other hand, technology leadership contributes to the enhancement of educators' competencies to implement AI in practice (Du et al., 2023). With such leadership styles, educational institutions can enable teachers' continuous learning and innovation on the effective integration of AI in learning institutions.

Based on the theoretical framework explained above for hypothesis development, the research's independent variables

were derived as PU, PEOU, and TL, whereas the dependent variable is PTD. Their association is shown in Figure 1, computed in the research applying a mixed-methods approach.

Methods

Research design

Integrating AI in education has streamlined instructional practices and administrative tasks, empowering teachers to enrich their professional practices. This research used a mixed-methods approach to investigate the impact of AI and technology leadership on PTD following TAM and TL theory. The study was conducted by employing qualitative and quantitative approaches to examine the correlational impact of AI and technology leadership in the professional development of teachers with nuanced aspects explored from teachers' experiences and perceptions. Phenomenology is the research method offering an in-depth understanding of lived experiences and subjective perspectives (Ghamrawi et al., 2024). The current research followed the phenomenology approach exploring teachers' perceptions on investigating the role technology leadership plays in facilitating the adoption of AI in teacher development.

Data collection

This research collected primary data through close-ended surveys and open-ended interviews. For survey questionnaires, two standardized questionnaires were used to design a questionnaire for the current research and investigate the impact of AI and technology leadership on the professional development of teachers. Two standardized surveys were used and modified according to the study for validity confirmation of the questionnaires. Davis (1989) developed the TAM questionnaire to measure the PU and PEOU. The Multifactor Leadership Questionnaire (MLQ) developed by Bass and Avolio (1995) was used to identify the role TL theory plays in measuring the addressed aim (Avolio et al., 1995; Bass & Avolio, 1995; Davis, 1989).

MLQ was adequate for exhibiting teachers' transformational behavior in adopting technology and AI integration for PTD. The measures considered for the PMLQ include idealized influence, inspirational motivation, and intellectual stimulation. These measures support the TL and thus help determine how it contributes to PTD (Den Hartog et al., 1997). Furthermore, TAM constructs (PU and POEU) determined their willingness to integrate AI tools for technology adoption in their teaching practices for professional development.

Additionally, semi-structured interviews were conducted to gather qualitative insights on TL aspects enhancing AI and technology leadership among teachers for their professional development. The purpose of the interviews was to support the empirical analysis by exploring personal perceptions, experiences, and challenges teachers face in integrating AI and technology leadership for professional development.

Participants

The study sampled 180 teachers through a random sampling technique from multiple universities in the Republic of Türkiye to gather broader perspectives and approach teachers with different years of experience in teaching and degrees. These professionals were recruited through social

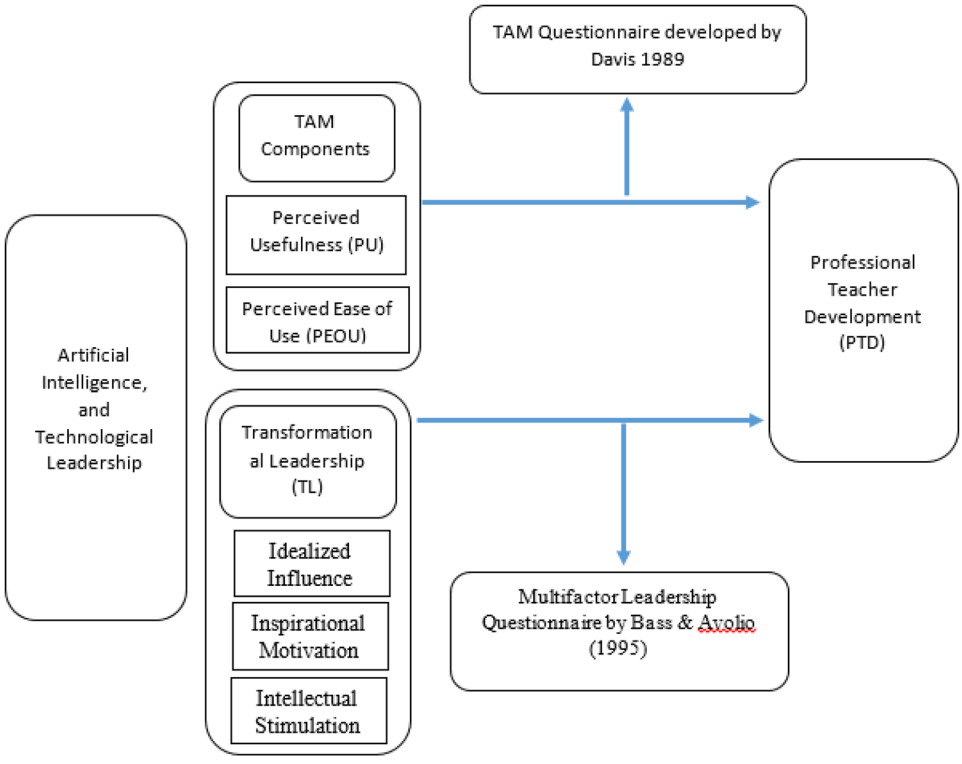

Figure 1. Conceptual framework (Source: Author).

media platforms and professional platforms like LinkedIn. The population was around 380 teachers, who were approached and applied the random sampling technique with a 95% confidence level and 5% margin error; 180 respondents were sampled, and the gathered data was analyzed to test the developed hypothesis. On the other hand, 10 teachers agreed on interviews; some agreed on written interviews, and others agreed on audio interviews, which were later transcribed for analysis.

Data analysis

The quantitative survey data was computed using the latest version of SPSS software. Frequency statistics summarized basic demographic statistics, including age, gender, teaching experience, and education. Reliability was used to assess internal consistency, and further correlation and regression analysis were used to examine the relationship between identified study variables. In contrast, qualitative interview data was analyzed using thematic analysis, which involved identifying themes and patterns and determining the impact of technology leadership and AI on PTD.

Demographics

Table 1 below depicts the demographics of the sampled respondents who completed the surveys. As shown, the majority of the respondents were aged between 31 and 40, i.e., 58.9% (106), whereas 15.0% (27) were aged between 20 and 30, 12.8% (23) were aged between 41 and 50, 8.9% (16) were aged between 51 and 60, and only 4.4% (8) teachers were aged 61 and above.

Additionally, in this research, 60.6% (109) of respondents who participated were male, whereas 35.1% (65) were female, and 3.3% (6) responded not to disclose their gender.

Respondents also reported their years of teaching experience to ensure the credibility of their answers. Most responded that 56.7% (102) have 6-10 years of experience, 29.4% (53) reportedly had 1-5 years of teaching experience, 11.1% (20) were working as teachers for 11-15 years, and only 2.8% (5) teachers have above 15 years of experiences. Notably, upon asking about their education, the majority, 40.0% (70), completed their Bachelor's degree, and 30.0% (54) each completed their education to Master's and Doctoral degrees.

Table 1. Demographics.

Demographics	Categories	Frequency	Percentage %
Age	20–30	27	15.0
	31–40	106	58.9
	41–50	23	12.8
	51–60	16	8.9
	61 and above	8	4.4
Gender	Male	109	60.6
	Female	65	36.1
	Prefer not to say	6	3.3
Years of teaching experience	1–5 years	53	29.4
	6–10 years	102	56.7
	11–15 years	20	11.1
	15 years and above	5	2.8
Education	Bachelor's degree	72	40.0
	Master's degree	54	30.0
	Doctoral degree	54	30.0
Total		180	100%

Reliability analysis

A questionnaire's reliability is tested to confirm the internal consistency of all the items for each questionnaire variable (George & Mallery, 2018). The items' reliability was tested by computing the value of Cronbach's Alpha; these items were set on the Likert Scale (Strongly Agree to Disagree Strongly). The computed value of Cronbach's Alpha for variables is more significant than 0.7, confirming that all variables are reliable and reasonable to be tested for the respective research (Table 2).

Results

Survey results (quantitative analysis)

Correlation analysis

Correlation analysis examines the relationship between multiple research variables and addresses whether the association is linear. The computed value of the Pearson Correlation Coefficient ranges between 0 and 1, showing the correlation between two variables depicted as "*r*." The value of "*r*" between 0 and 0.3 presents a weak correlation; a moderate association is observed when the value is between 0.3 and 0.7. However, a value above 0.7 shows a strong correlation (Gogtay & Thatte, 2017).

Table 3 below presents the correlation between the identified factors of PU, PEOU, and TL as factors associated with AI, technology leadership, and PTD. As noted, the "*r*" value computed between PU and PTD is 0.769**, which shows a strong and positive correlation. Furthermore, the "*r*" value computed between PEOU and PTD is 0.865**, which confirmed a positive and strong correlation. Similarly, the "*r*" value computed between TL theory and PTD is 0.941**, which depicts a strong and positive correlation.

Regression analysis

The research's conceptual model is tested using regression analysis to adequately investigate the significance between the independent and dependent variables of the study (Guillén-Gámez & Mayorga-Fernández, 2020). In the current research, regression analysis was used to determine the impact of AI and technology leadership on PTD.

Table 4 depicts the model summary showing the effect sizes of the model developed for regression, including *R*-value = 0.960 and *R*-square value = 0.921. This predicted that the model of regression is adequately explained by the selected independent variables of the research by 92.1%.

Table 2. Cronbach's reliability test.

Dimension name	Number of statements	Cronbach's alpha (*q*) (standardized) *N* = 180
PU	5	0.839
PEOU	6	0.840
TL	21	0.979

Table 3. Correlation analysis.

Correlations					
		PU	PEOU	TL theory	PTD
PU	Pearson correlation	1	.705**	.764**	.769**
	Sig. (2-tailed)		.000	.000	.000
	N	180	180	180	180
PEOU	Pearson correlation	.705**	1	.803**	.865**
	Sig. (2-tailed)	.000		.000	.000
	N	180	180	180	180
TL theory	Pearson correlation	.764**	.803**	1	.941**
	Sig. (2-tailed)	.000	.000		.000
	N	180	180	180	180
PTD	Pearson correlation	.769**	.865**	.941**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	180	180	180	180

**Correlation is significant at the 0.01 level (2-tailed).

Table 4. Model summary.

Model summary				
Model	*R*	*R* square	Adjusted *R* square	Std. error of the estimate
1	.960[a]	.921	.919	.2516

[a]Predictors: (Constant), TL theory, PU, PEOU.

Table 5 presents an analysis of One-way ANOVA. It shows that the developed regression model significantly examines the successful performance of the recent research ($r = 0.960$, F [43.187] = 682.070, $p = 0.01$).

As presented in Table 6 below, the table of coefficients, the impact of the factors facilitating technology leadership and AI integration PEOU ($p = 0.000$), and TL ($p = 0.000$) is significant on PTD since the sig value computed is below the threshold value of 0.05. However, the impact of PU ($p = 0.102$) is insignificant on PTD. This shows that hypotheses H2 and H3 are accepted, whereas hypothesis H1 is rejected.

Thus, based on the quantitative analysis, the following hypotheses have been accepted:

Ho1: PE of TAM, contributing to AI and technological leadership, does not significantly impact PTD.

H2: PEOU of TAM, contributing to AI and technological leadership, significantly impacts PTD.

H3: Transformational Leadership is influenced by AI, and technological leadership significantly influences PTD.

Thematic results (qualitative analysis)

An open coding method was employed to enhance the quantitative results and examine the phenomenon from a qualitative perspective. This was followed by axial coding to establish a relationship between the codes derived from the study. Specifically, the coding process adopted the conceptual framework developed based on the TAM and TL theory. The interview was taken from 10 respondents cited as T1 to T10. The interviews were audio-recorded with the participants' informed consent and transcribed in full detail by the researcher using a manually-assisted word code. Individual codes emerged from patterns identified within the responses, and the final codes were grouped into themes To answer the overall research question. Table 7 below depicts the interview's thematic coding, highlighting the key themes identified under the interview questions and keywords identified from the repetitive patterns of the interview responses. It shows the overall themes, along with the interview questions that help to analyze the impact of AI and technology leadership on PTD:

Role play by AI in their teaching practices

T4 stated that:

> *"AI has greatly impacted my practice in lesson planning and classroom instruction as a teacher. I now google lessons together with the performance of my students, which allows me to give more pertinent information. Another impact is that, through auto-grading and assessment feedback, I have benefited from efficient time management to be more prompt in addressing students' concerns during my teaching-learning sessions and creating innovative tasks."*

T8 stated that:

> *"Incorporating AI into the system has enhanced my teaching efficiency and confidence. The use of the Gradescope app of artificial intelligence for grading, Knewton Alta for adaptive learning, and Google Classroom AI has eased the monitoring of students and the adoption of new strategies in teaching. It has made me more data-oriented in my approach and instruction to enhance my career as an early adopter and implementer of AI as a mentor within my school."*

Role of TL theory in AI and technological leadership to enhance PTD

T1 stated that:

> *"The last type has greatly influenced my perception of implementing leadership transformation in the teaching space using AI. With the help of TL principles, I started managing the change process. I introduced a proper, effective use of the elements of AI in class, including the effective adaptive learning platform and Edmodo Insights for targeting students' progress. In leadership training, I further broadened my technological leadership competencies by conducting orientations for co-workers on similar AI tools. It improved my professional growth, strengthened my position as a technology advocate within the institution, and increased my readiness to implement new technologies."*

T4 stated that:

> *"With the help of the principles of TL, I have drastically revised the approach to using AI in my practice. The fact that transformative leadership allowed me to pay attention to vision and*

Table 5. One-way ANOVA output for the overall regression analysis.

ANOVA[a]						
Model		Sum of squares	*df*	Mean square	*F*	Sig.
1	Regression	129.562	3	43.187	682.070	.000[b]
	Residual	11.144	176	.063		
	Total	140.706	179			

[a]Dependent variable: PTD.
[b]Predictors: (Constant), TL theory, PU, PEOU.

Table 6. Table of coefficients.

Coefficients[a]						
		Unstandardized coefficients		Standardized coefficients		
Model		*B*	Std. error	Beta	*t*	Sig.
1	(Constant)	−0.287	.035		−8.175	.000
	PU	.051	.031	.056	1.643	.102
	PEOU	.320	.040	.293	7.983	.000
	TL theory	.661	.040	.664	16.465	.000

[a]Dependent variable: PTD.

Table 7. Thematic coding.

Theme	Interview questions	Keywords identified
1. Role play by AI in their teaching practices	What role does AI play in your teaching practice, and how does it influence your teaching career?	• Lesson co-design • Automated grading • Feedback generation • Student engagement • AI-driven personalization • Instructional support • Data-driven teaching decisions • Enhanced productivity • Efficiency in lesson delivery • Classroom innovation
2. Role of TL theory in AI and technology leadership to enhance PTD	How has TL in your institution changed how you implement AI solutions in your teaching practices? Have you used specific examples where leadership initiatives directly relate to your use of AI tools for professional development?	• Change management • Adaptive learning platforms • Personalized learning experiences • Vision and innovation • TL
3. Role of TAM model (PU and POEU) in AI and technology leadership to enhance PTD	What is your attitude toward the usefulness and ease of use of AI tools, and how has this attitude impacted your intentions to use it in your teaching under the leadership of the technology coordinator?	• Perceived usefulness (PU) • Perceived ease of use (PEOU) • Task efficiency • Accessibility • Motivation to use AI
4. Challenges in adopting AI under TL and TAM constructs	1. What have been some of the challenges that you have experienced in implementing AI in your career advancement?	• Limited financial resources • Lack of training • Technology leadership
5. Impact of TL, TAM constructs on PTD to support AI and technological leadership	1. "In what way have you benefited from transformational leadership in your institution for professional growth as a teacher when it comes to embracing and implementing AI tools in effective instruction?" 2. To what extent do the PU and PEOU influence your professional practice as a teacher amid the technological leadership strategy of your organization?"	• Professional growth • Professional development workshops • Technology integration • Sharing feedback • LMS • AI tools

innovation and encouraged me to take a more proactive role in assessing AI applications, such as the systems that predict students' performance. A particular leadership initiative that introduced some changes was the development of the 'Tech Innovators' group of the faculty. Also, to the continuous encouragement of the leadership in using innovative technologies for collaboration, other use for AI such as Turnitin, AI in Kahoot chat, and Moodle AI Learning Analytics effectively entrenching my position of a technology leader in the institution even further."

Role of TAM model (PU and POEU) in AI and technology leadership to enhance PTD

Participant 4 stated that:

"I discovered that AI tools can be easily applied to enhance my teaching activities, such as grading and feedback. That is why such applications and interfaces were convenient and did not require more time to be spent on them, so I used them more often. This helped me develop confidence and growth in my professionalism."

Challenges in adopting AI under TL and TAM constructs

T3 stated that:

"One of the challenges has been the integration of AI as to the leadership skills that I have been developing. Although TL has encouraged me to embrace AI, the rate at which technology is growing makes it challenging to cope with it sometimes. However, the training challenge was an eye-opener and has challenged me to develop my technology leadership skills more than I would have wanted because I had to model the behavior of green use and embrace new AI tools. It compelled me to spearhead AI and become a stronger technology advocate, which I did not expect to be doing on the job."

T5 stated that:

"Even though I can observe the potential of AI in enhancing my performance as a teacher, the application of AI is not as easy as it looks. The lack of training has contributed to the PEOU aspect since these tools cannot be used easily if one has had no training on the usage of these tools, and the lack of financial resources to purchase these tools has been another significant factor. While leadership has been supportive, these barriers have posed a significant challenge in achieving AI's PU. However, despite the limitations, the process has forced me to take ownership of change and improve my technology leadership by identifying various methods to implement AI in delivered services."

Impact of AI facilitated Technology Leadership on PTD

T4 stated that:

"Using TL to integrate AI tools and technological leadership has enhanced my professional development. For instance, AI in grading and communication and tools like Google Classroom have helped me cater for large classes by providing constant feedback and additional materials. With this improvement to my teaching practices, I have become an innovator in integrating AI into our institution's learning management system. For this reason, I have been invited to conduct professional development sessions for other teachers, which is opening up another level in my profession. Moreover, the leadership intervention offered relevant experience in AI implementation that helped increase my confidence in using these tools in teaching and facilitating others in integrating technology into classrooms."

T7 stated that:

"I have also realized that the perceived usefulness of the various tools impacts my teaching practice. After realizing how AI can deliver learning solutions comprehensively and help students get more interested in lessons, I began using it even more actively. Using platforms such as our Learning Management System (LMS) also went well because of the clear leadership strategies promoting change to the technology systems."

T9 stated that:

"In my professional growth, I have applied TL and the TAM to support technological leadership.TL has enhanced my creativity and extended my knowledge about new tools. The user-friendliness of AI systems, such as feedback-providing tools, enhances the likelihood of adoption and more effectively enhances my lesson delivery and assessment of students. The POEU and PU of these AI tools eventually influenced my decision to use them in teaching. Such theories support the technological leadership in AI management to ensure that AI such as EdTech is adopted and integrated within teacher training, enhancing educational achievement.

Discussion

The findings of this mixed-methods research underscored the importance of TL and AI for PTD based on the principles of TL and TAM. The regression analysis depicted research hypotheses showing that PEOU and TL positively impact PTD; PU was not found to have a significant relationship with PTD, indicating that ease of use and TL may be more excellent motivators for use than perceived usefulness. The thematic analysis corroborated these findings, revealing that AI, coupled with robust technology leadership, has transformed PTD through the accessible application of AI tools. This AI-driven learning pathway, enabling teachers to integrate AI competence, ultimately elevates PTD outcomes.

These findings are consistent with existing studies showing that TL helps teachers be motivated and enthused to use AI and technology (Shal et al., 2024). Transformational leaders also build a culture of innovation and risk-taking and provide vision and goals for using technologies, which can enhance teachers' commitment and bring positive outcomes in using AI (Raman & Thannimalai, 2019). However, the relationship between PTD and PU was found to be non-significant, contradicting earlier studies on PUs that confirmed their positive relationship in supporting the implementation of trends and educational technologies and innovations more effectively (Davis, 1989). This paradox suggests that when deciding to use technology, the convenience, usability, and access to training of teachers from Turkey might have a negative impact.

In addition, the qualitative results revealed the role of AI in teaching practices. The above responses show that AI provides many benefits to teachers, including automated grading, feedback generation, student engagement, AI-driven personalization, instructional support, etc. Past research has also coated such benefits. For instance, according to Vashishth et al. (2025), intelligent tutoring systems and adaptive learning platforms help teachers deliver lessons with differentiated instruction and, at the same time, help to reduce the clerical work of adaptive learning (Vashishth et al., 2025). Similarly, in the article by Chen et al. (2020), the authors establish that, in the classroom context, AI helps to save time by providing feedback and analyzing data (Chen et al., 2020). This practice is in line with the respondent's response. These researches support the positive role of AI in the teaching practice. The above qualitative research also highlighted the barriers, including students' reluctance and insufficient teachers' training. These barriers impact teacher technology leadership, even if they value using AI. This makes it necessary for institutions to fund such professional development programs and make arrangements to assist teachers in dealing with all these challenges. These challenges, like financial constraints and challenges facing AI implementation, have also been noted in past papers (George & Wooden, 2023; Mambile & Mwogosi, 2025; Tapalova & Zhiyenbayeva, 2022).

This research highlighted the adoption of AI and PTD in Turkey's higher education context. Based on the findings, it is clear that enhancing PEOU while advocating for transformational leadership contributes to the effective infusion of AI in teacher education and overall professional development.

Conclusion

AI and technology leadership's role is potentially to curtail collaboration, diminish autonomy, and redirect teachers for professional development. Teachers adopting the approach of TL theory can streamline their workload and bring change by integrating technology leadership facilitated by AI. It assists teachers in advancing their professional development by transforming their operations by creating personalized

teaching and learning experiences and implementing predetermined algorithms for instructional decision-making for their administrative and classroom tasks. This boosts innovation and effective time management in teaching practices, leveraging AI as a significant tool for facilitating technology leadership.

Limitations and future research

The research was limited to a sample of 180 teachers from higher educational institutions of the Türkiye, which may hinder the generalizability of the research. However, future research can be extended to other West Asian countries to generalize the study outcomes and address additional insights from people of similar cultures and languages. A comparison of AI with other new technologies can be conducted in the future to evolve research with the continuous developments in education. Future research can also delve into the in-depth perspectives of higher management on the provided resources and training for technology integration for PTD.

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Data availability statement

Data will be available upon request.

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