International Journal of Didactical Studies
Volume 7, Issue 3, 2026
https://doi.org/10.33902/ijods.202643911

Research Article

The current landscape of teachers' artificial intelligence acceptance: Relationships with TPACK and technostress

Dilara Çakır[1] and Pınar Güner[2]

[1]*Mathematics Education, Istanbul University-Cerrahpasa, Istanbul, Türkiye (ORCID: 0009-0009-9989-5978)*
[2]*Mathematics Education, Istanbul University-Cerrahpasa, Istanbul, Türkiye (ORCID: 0000-0003-1165-0925)*

The purpose of this study was to examine teachers' technological pedagogical content knowledge [TPACK], technostress, and artificial intelligence [AI] acceptance. Specifically, the study aimed to determine overall levels, examine differences based on gender, educational level, professional experience, and subject area, and analyze the relationships among these variables, including the predictive roles of TPACK and technostress in explaining AI acceptance. The sample comprised 204 middle and high school teachers. Teachers reported high levels of TPACK perceptions and AI acceptance, and moderate levels of technostress. AI acceptance differed significantly by gender and professional experience, with female and early-career teachers showing higher acceptance, whereas TPACK and technostress did not differ significantly across these groups. Subject area differences emerged for TPACK and technostress, but not for AI acceptance; arts and physical education teachers reported higher TPACK, whereas humanities teachers experienced higher technostress. No significant differences were found across educational levels for TPACK, technostress, or AI acceptance. TPACK was negatively associated with technostress and positively associated with AI acceptance, whereas technostress showed no significant relationship with AI acceptance. TPACK significantly predicted AI acceptance, explaining 11.4% of the variance, while technostress did not emerge as a significant predictor. The findings underscore the central role of technopedagogical competence in shaping teachers' adoption of AI, while highlighting the influence of factors such as gender and experience.

Keywords: Artificial intelligence acceptance; Teachers; Technostress; TPACK

Article History: Submitted 6 February 2026; Revised 10 April 2026; Published online 16 April 2026

1. Introduction

Rapidly advancing digital technologies are profoundly transforming individual and social life in post-industrial societies (Trusz & Demeshkant, 2025). At the center of this transformation, artificial intelligence [AI] has emerged as one of the most influential driving forces accelerating restructuring processes across numerous domains, including economic systems, professional practices, and educational environments (Aravantinos et al., 2026; Peres et al., 2023). In the context of education, AI-based tools offer multidimensional opportunities, including personalized learning, timely and personalized feedback, AI-assisted assessment, stronger student engagement, and, in some task-specific contexts, support for creative processes and skill development (Ajani et al., 2025; Aravantinos et al., 2026; Baudin, 2025; Fitriati & Williyan, 2025; Kaplan et al., 2026; Kaşkaya & Ateş, 2025; Kavitha & Joshith, 2024; Okanya & Asogwa, 2026; Simiyu et al., 2026). Intelligent tutoring systems and generative AI applications are increasingly supporting the planning, implementation, and evaluation of teaching processes. Accordingly, AI is no longer viewed merely

Address of Corresponding Author

Pınar Güner, PhD, Mathematics Education, Istanbul University-Cerrahpasa, Hasan Ali Yucel Faculty of Education, Istanbul, Türkiye.

pinar.guner@iuc.edu.tr

How to cite: Çakır, D., Güner, P. (2026). The current landscape of teachers' artificial intelligence acceptance: Relationships with TPACK and technostress. *International Journal of Didactical Studies*, *7*(3), e43911. https://doi.org/10.33902/ijods.202643911

as a supportive technological tool but rather as a strategic component capable of transforming teaching and learning processes.

Nevertheless, the integration of AI into education extends beyond a purely technical adaptation process. It entails a multilayered transformation involving pedagogical restructuring, professional identity, beliefs about technology, ethical responsibilities, and psychological adaptation. Although AI tools have the potential to enhance instructional efficiency and reduce teachers' workload, they may simultaneously generate uncertainty, perceptions of loss of control, and concerns regarding professional displacement (Green, 2020; Wang et al., 2024). In this context, teachers constitute the key actors determining the role of AI within classroom practices. Their perceptions of competence and experiences of stress play a critical role in shaping whether AI is perceived as a pedagogical resource that enhances teaching or as a potential threat to professional autonomy.

Understanding the factors that shape teachers' acceptance of AI is therefore crucial for achieving sustainable and effective technology integration in education. In this regard, two key constructs have been particularly prominent in explaining teachers' acceptance of AI: Technological Pedagogical Content Knowledge [TPACK] and technostress. TPACK reflects teachers' competencies in integrating technology, pedagogy, and content knowledge within instructional design (Koehler & Mishra, 2005), whereas technostress refers to the psychological strain arising from technological demands that exceed an individual's coping capacity (Brod, 1984). In the context of complex and rapidly evolving technologies such as AI, these two constructs represent both the cognitive and affective resources that shape teachers' adaptation to technological change.

2. Literature Review

2.1. Technological Pedagogical Content Knowledge

The TPACK framework, developed by Koehler and Mishra (2005), conceptualizes teachers' knowledge as the dynamic interaction among content knowledge, pedagogical knowledge, and technological knowledge. Rather than treating technology as an independent skill domain, this approach emphasizes its integrated use in alignment with pedagogical purposes and disciplinary content. Research indicates that deficiencies in TPACK competencies may limit teachers' intentions to integrate technology and constrain their adoption and implementation of innovative instructional approaches (Blackwell et al., 2016; Joo et al., 2016; Koh et al., 2017). Moreover, the literature consistently reports a negative relationship between TPACK and technostress (Dong et al., 2019; Özgür, 2020). In this regard, TPACK competence is considered an important factor in reducing teachers' stress levels by mitigating perceptions of technological complexity and uncertainty (Algerafi et al., 2023).

With the rapid advancement of artificial intelligence technologies, the TPACK framework has been expanded to encompass AI-related competencies, leading to the emergence of the AI-TPACK perspective (Ning et al., 2024; Trusz & Demeshkant, 2025). This perspective emphasizes not only teachers' ability to use AI tools in alignment with pedagogical strategies and disciplinary knowledge (Ning et al., 2024) but also their capacity to critically evaluate AI-generated outputs and ensure ethical use (Trusz & Demeshkant, 2025). Teachers with higher levels of TPACK have been reported to use AI technologies more effectively in lesson planning, assessment, and differentiated instruction (Aravantinos et al., 2026; Sun et al., 2023). In addition, TPACK strengthens teachers' self-efficacy, reduces the cognitive load associated with technology use, and functions as a psychological resource. Similarly, previous studies demonstrate that TPACK directly and indirectly influences behavioral intentions and plays a mitigating role in reducing technostress (Dong et al., 2019; Özgür, 2020; Teo et al., 2019; Wang et al., 2024).

2.2. Technostress

Technostress refers to the psychological and physiological strain experienced by individuals during the process of adapting to new technologies (Brod, 1984). In educational contexts, it is defined as the stress teachers experience while integrating digital tools and AI platforms into instructional processes (Agogo & Hess, 2015; Khlaif et al., 2023). Tarafdar et al. (2020) conceptualize technostress through five dimensions: techno-overload, techno-complexity, techno-insecurity, techno-invasion, and techno-uncertainty. Research indicates that teachers' TPACK levels are effective in reducing both overall technostress and its subdimensions. For instance, insufficient technological knowledge may increase perceptions of technological complexity, whereas a lack of pedagogical knowledge may intensify feelings of technological insecurity (Kohnke et al., 2024). These stressors are known to negatively affect instructional effectiveness and teachers' willingness to use technology (Ayyagari et al., 2011; Özgür, 2020).

The algorithmic and complex nature of AI systems may further increase teachers' perceptions of uncertainty and loss of control (Castelvecchi, 2016). Continuous system updates and technical issues may also reinforce teachers' feelings of inadequacy. Studies suggest that high levels of technostress can negatively affect teachers' professional development (Ghanizadeh et al., 2025) and may lead to resistance toward AI technologies (Zhang, 2025). However, strong levels of TPACK have been shown to mitigate the adverse effects of technostress (Dong et al., 2019; Özgür, 2020). Accordingly, increasing TPACK competencies and reducing technostress can strengthen positive perceptions regarding the perceived usefulness and ease of use of AI technologies, thereby enhancing AI acceptance (Joo et al., 2016; Teo et al., 2019).

2.3. Artificial Intelligence Acceptance

AI acceptance in education refers to teachers' intentions and behaviors regarding the integration of AI tools into instructional processes (Wu et al., 2026). The Technology Acceptance Model [TAM] and the Unified Theory of Acceptance and Use of Technology [UTAUT] suggest that perceived usefulness, perceived ease of use, social influence, and facilitating conditions are key determinants shaping technology acceptance (Wang et al., 2024). In the context of AI, teachers tend to demonstrate higher acceptance when they perceive that these technologies reduce workload in tasks such as student assessment and instructional material preparation (Ouyang et al., 2023; Ramesh & Sanampudi, 2022). Conversely, concerns related to data privacy, ethical issues, and algorithmic bias may hinder AI acceptance (Green, 2020; Wang et al., 2024). In this respect, teachers' TPACK competencies and levels of technostress emerge as key determinants shaping AI acceptance.

The literature indicates a positive relationship between TPACK and AI acceptance (Teo et al., 2019; Wang et al., 2024). As TPACK levels increase, perceptions of usefulness and ease of use become stronger, which in turn enhances teachers' behavioral intentions to use AI (Durak, 2021; Hsu, 2016; Wu & Wang, 2015). When teachers are able to integrate their pedagogical and technological knowledge with AI tools, they become more willing to adopt these technologies in their teaching practices (An et al., 2023). On the other hand, although the relationship between technostress and AI acceptance is generally assumed to be negative, evidence in this area remains limited. Research on general technology acceptance indicates that technostress negatively influences technology adoption (Joo et al., 2016; Tacy et al., 2016). However, some studies suggest that under conditions of high TPACK competencies and school support, the influence of technostress may be relatively limited (Wang et al., 2024).

2.4. Purpose and Significance of the Study

Despite the widespread diffusion and transformative impact of AI across many sectors (Jordan & Mitchell, 2015), research examining the psychological and pedagogical factors influencing AI use in educational contexts remains limited. Existing studies have largely focused on the development of technical systems (Divekar et al., 2021), highlighting the need for research that investigates teachers' psychological readiness, techno-pedagogical competencies, and stress experiences in relation to AI acceptance in K-12 contexts (Chiu et al., 2021; Zawacki-Richter et al., 2019). Teachers do not always possess the professional competencies required to integrate AI tools effectively into instructional processes (Holstein et al., 2017), and they may exhibit resistance to pedagogical changes (Schiff, 2021), which constitutes a significant barrier to the effective adoption of these technologies in education. This situation points to an important gap in the literature regarding AI integration.

Considering that teachers are the primary agents who structure learning processes, understanding their perceptions and competencies holds strategic importance for the development of future AI-supported pedagogical and instructional models (Chai et al., 2021). In this respect, the present study is significant as it represents one of the limited number of studies that examine AI acceptance within the K-12 context through an integrated perspective that encompasses competence and stress dimensions. Furthermore, the findings are expected to contribute to identifying teachers' professional development needs, structuring AI-oriented in-service training programs, and informing educational policy development. Empowering teachers in this regard is considered a key prerequisite for the effective and sustainable adoption of AI in education.

Ensuring the sustainable and effective integration of AI in education requires a deeper understanding of how teachers' technological, pedagogical, and psychological readiness is shaped by various contextual and individual characteristics. Examining constructs such as TPACK, technostress, and AI acceptance across demographic variables can therefore contribute to both theoretical insights and practical implications. Previous research presents inconsistent findings regarding the influence of gender on TPACK (Li, 2023; Zhakiyanova et al., 2023), technostress (Huffman et al., 2013; Marchiori et al., 2019; Shu et al., 2011; Tarafdar et al., 2011), and AI acceptance (Ayanwale et al., 2024; Zhang et al., 2023), suggesting the need for further investigation across diverse cultural and educational contexts. Similarly, professional experience and age have been identified as influential factors in technology adaptation and stress experiences, with more experienced teachers often reporting higher levels of uncertainty and technological insecurity (Wang & Zhao, 2023) and stronger perceptions of technology-related workload and intrusion (Depante & Astillero, 2025). Moreover, previous studies indicate that negative perceptions toward technology use may increase with age (Burton-Jones & Hubona, 2005; Venkatesh et al., 2012). Educational level is also considered an important cognitive and professional resource that strengthens teachers' capacity to cope with technological demands (Depante & Astillero, 2025; Wu et al., 2026), playing a critical role in both reducing technostress and facilitating technology acceptance. Additionally, teachers' subject areas and fields of expertise emerge as important variables, given that technology and AI integration may vary across disciplines. For instance, teachers in STEM fields have been reported to demonstrate higher levels of competence and adaptation in technology integration (Lindner & Berges, 2020). These findings suggest that teachers' individual and professional characteristics may shape AI integration processes in different ways.

Accordingly, the present study aims to determine the levels of TPACK, technostress, and AI acceptance of teachers; to examine whether these variables differ significantly according to demographic characteristics such as gender, professional experience, educational level, and subject area; to explore the relationships among these constructs; and to evaluate the predictive power of TPACK and technostress on AI acceptance. By integrating pedagogical and psychological dimensions of teachers' AI acceptance, the study seeks to contribute to a more comprehensive understanding of this emerging phenomenon. Within this scope, the study seeks to answer the following research questions:

RQ 1) What are teachers' levels of TPACK, technostress, and AI acceptance?

RQ 2) Do teachers' levels of TPACK, technostress, and AI acceptance differ significantly according to gender, professional experience, educational level, and subject area?

RQ 3) Are there significant relationships among teachers' TPACK, technostress, and AI acceptance?

RQ 4) Do teachers' TPACK and technostress significantly predict their AI acceptance?

3. Method

3.1. Research Design

This study employed a survey research design to examine the relationships among teachers' TPACK, technostress, and AI acceptance and to determine whether these constructs vary according to demographic variables. Survey research designs are widely used in educational research because they enable the examination of patterns among multidimensional variables within natural contexts and facilitate the analysis of differences between groups (Fraenkel et al., 2015). In the present study, this design was considered appropriate because the aim was to identify the role of TPACK and technostress in explaining teachers' AI acceptance, analyze the relationships among these constructs, and reveal variation patterns across different teacher groups. Rather than implementing an experimental or causal intervention, the study sought to examine the current situation from a multidimensional perspective. Accordingly, the study can be characterized as a descriptive and correlational investigation aimed at depicting the current state of AI integration in education and identifying key factors influencing teachers' acceptance of AI technologies.

3.2. Population and Sample

The population of the study consisted of teachers working at middle school and secondary school levels in Istanbul, Türkiye. The sample included 204 teachers who voluntarily participated from 12 middle schools and 12 secondary schools selected from this population. A convenience sampling method was employed due to the researcher's accessibility to participants and the practical feasibility of the data collection process. As a non-probability sampling approach based on voluntary participation, convenience sampling is frequently used in educational research because it facilitates efficient data collection aligned with research purposes (Gravetter & Forzano, 2012). The demographic characteristics of the participants are presented in Table 1. As shown in Table 1, 47% of the participants were middle school teachers (n = 95) and 53% were secondary school teachers (n = 109). In terms of gender distribution, 64% were female (n = 130) and 36% were male (n = 74). The majority of the participants had 1–5 years of professional experience (n = 82; 40%). Regarding educational level, more than half of the sample consisted of teachers holding a bachelor's degree (n = 136; 66%). Additionally, the distribution across subject areas indicates that most of the participants worked in quantitative/scientific subjects (n = 70; 34%).

Table 1
Demographic Characteristics of the Sample

Demographic Characteristics	N	%
School level		
Middle school	95	47
Secondary school	109	53
Gender		
Female	130	64
Male	74	36
Professional experience		
1-5 years	82	40
6-10 years	52	25
11-15 years	36	18
16 years and above	34	17
Educational level		
Bachelor's degree	136	66
Master's degree	41	20
Doctoral degree	27	14
Subject area		
Quantitative/Scientific Subjects	70	34
Humanities Subjects	58	28
Language Subjects	30	15
Arts & Physical Education Subjects	46	23

3.3. Data Collection Instruments

Three measurement instruments were used in this study to assess teachers' TPACK, technostress, and AI acceptance. Data were collected through face-to-face administration of the scales, and the data collection process took approximately 15–20 minutes per participant. Reliability coefficients were reported based on the original/adaptation studies and on the internal consistency values obtained in the present study.

3.3.1. TPACK Scale for 21st-Century Skills

Teachers' TPACK levels were measured using the TPACK scale for 21st-century skills, originally developed by Valtonen et al. (2017) and adapted into Turkish by Alpaslan et al. (2021). Grounded in the theoretical framework proposed by Mishra and Koehler (2006), the scale consists of seven subdimensions (TK, PK, CK, TPK, TCK, PCK, and TPACK) and 38 items. Items are rated on a six-point Likert scale ranging from 1 ("I have too many knowledge gaps") to 6 ("My knowledge level is very good"). In the adaptation study, Rasch person reliability was reported as .90 and item reliability as .91 (Alpaslan et al., 2021). In the present study, the overall Cronbach's alpha coefficient was found to be .96, indicating a high level of internal consistency for the scale.

3.3.2. Teachers' Techno-stress Levels Defining Scale

Teachers' stress levels associated with technology use were measured using the technostress scale, developed by Çoklar et al. (2017). The scale consists of 28 items and includes five subdimensions: learning–teaching process-oriented, profession-oriented, technical issue-oriented, personal-oriented, and social-oriented technostress. Items are rated on a five-point Likert scale ranging from 1 ("Strongly disagree") to 5 ("Strongly agree"). In the original study, the overall Cronbach's alpha coefficient was reported as .917. In the present study, the overall internal consistency coefficient was calculated as .95, indicating a high level of internal consistency for the scale.

3.3.3. Teachers' Acceptance of Artificial Intelligence in Education Instrument

Teachers' AI acceptance levels were determined using the teachers' acceptance of artificial intelligence in education instrument, developed by Guo et al. (2025) and adapted into Turkish by Balıkçı and Yıldız Durak (2025). The five-point Likert scale consists of six subdimensions: AI usage experience, perceived usefulness, perceived ease of use, behavioral intention, self-efficacy, and anxiety, with a total of 38 items. In the adaptation study, the overall reliability of the scale was reported as .958 (Balıkçı & Yıldız Durak, 2025). In the present study, the overall Cronbach's alpha coefficient was calculated as .94, indicating a high level of internal consistency for the scale.

3.4. Data Analysis

The data were analyzed using IBM SPSS Statistics 27. Before statistical analyses, the dataset was examined for missing data, outliers, and normality assumptions. For variables, skewness and kurtosis coefficients were calculated, and all values were found to fall within the acceptable range of ±1 (Tabachnick & Fidell, 2013). Descriptive statistics (means and standard deviations) were calculated to determine teachers' levels of TPACK, technostress, and AI acceptance. Relationships among variables were examined using the Pearson correlation coefficient. To compare groups based on demographic variables, independent samples t-tests and one-way analysis of variance (ANOVA) were conducted. When significant differences were identified, appropriate post hoc tests were applied. Furthermore, the predictive power of TPACK and technostress on AI acceptance was tested using multiple linear regression analysis.

4. Results

In the analysis process, normality tests were first conducted to determine the suitability of the dataset for statistical analyses. Table 2 presents the descriptive statistics and normality test results for TPACK, technostress ve AI acceptance scales.

Table 2
Descriptive Statistics and Normality Results for TPACK, Technostress, and AI Acceptance

Variables	*N*	*M*	*SD*	*Skewness*	*Kurtosis*
TPACK	204	4.32	.89	−.26	.49
Technostress	204	2.73	.97	.41	−.38
AI Acceptance	204	3.78	.64	−.71	.53

Table 2 presents the descriptive statistics for teachers' TPACK, technostress, and AI acceptance levels. Skewness and kurtosis values for all variables fell within ±1, indicating an approximately normal distribution. TPACK scores, measured on a six-point Likert scale, were interpreted using the formula [(Maximum – Minimum)/Number of options], with scores classified as very low (1.00–2.00), low (2.01–3.00), moderate (3.01–4.00), high (4.01–5.00), and very high (5.01–6.00). According to Table 2, teachers' TPACK perceptions were high (M = 4.32, SD = .89). Technostress and AI acceptance scores were measured on five-point Likert scales and interpreted according to established criteria (Çoklar et al., 2017): low (1.00–2.33), moderate (2.34–3.67), and high (3.68–5.00). Teachers' technostress levels were moderate (M = 2.73, SD = .97), while AI acceptance was high (M = 3.78, SD = .64).

Table 3 summarizes the results of independent samples t-tests examining gender differences in TPACK, technostress, and AI acceptance. Preliminary assessments confirmed that assumptions of normality and homogeneity of variance were satisfied, allowing for parametric testing.

Table 3
Gender Differences in TPACK, Technostress, and AI Acceptance

Variables and Groups	*N*	*M*	*SD*	*t(202)*	*p*
TPACK					
Female	130	4.40	.88	1.79	.074
Male	74	4.17	.89		
Technostress					
Female	130	2.67	.99	−1.230	.220
Male	74	2.85	.96		
AI Acceptance					
Female	130	3.86	.60	2.22	.028
Male	74	3.65	.69		

Table 3 indicates that teachers' TPACK ($t(202) = 1.79$, $p = .074$) and technostress ($t(202) = -1.23$, $p = .220$) levels did not differ significantly by gender. In contrast, a significant gender difference was found for AI acceptance ($t(202) = 2.22$, $p = .028$). Female teachers' mean AI acceptance score (M = 3.86, SD = 0.60) was significantly higher than that of male teachers (M = 3.65, SD = 0.69), suggesting that gender may play a statistically significant role in the acceptance of AI technologies in educational contexts.

Differences in TPACK, technostress, and AI acceptance were also examined based on teachers' educational levels. Assessments of normality and homogeneity of variance confirmed that the assumptions for parametric testing were met; accordingly, a one-way analysis of variance [ANOVA] was conducted to investigate differences across educational levels. Table 4 presents the results of the one-way ANOVA for teachers' TPACK, technostress, and AI acceptance levels by educational level.

Table 4

Educational Level Differences in TPACK, Technostress, and AI Acceptance

Variables and Groups	*N*	*M*	*SD*	*F(2, 201)*	*p*
TPACK					
Bachelor's degree	136	4.26	.88	1.942	.146
Master's degree	41	4.62	.86		
Doctoral degree	27	4.60	.87		
Technostress					
Bachelor's degree	136	2.71	.98	1.461	.234
Master's degree	41	2.76	.90		
Doctoral degree	27	3.35	1.21		
AI Acceptance					
Bachelor's degree	136	3.77	.64	.004	.996
Master's degree	41	3.78	.63		
Doctoral degree	27	3.79	.83		

Table 4 shows that TPACK levels did not differ significantly among teachers holding a bachelor's, master's, or doctoral degree, $F(2, 201) = 1.942$, $p = .146$. Similarly, no significant differences were observed in technostress levels across educational levels, $F(2, 201) = 1.461$, $p = .234$. Likewise, AI acceptance levels did not vary significantly according to teachers' educational qualifications, $F(2, 201) = .004$, $p = .996$. Overall, these findings indicate that teachers' educational levels do not have a statistically significant differentiating effect on TPACK, technostress, or AI acceptance levels.

Differences in TPACK, technostress, and AI acceptance were also examined according to teachers' years of professional experience using a one-way analysis of variance. In cases where significant differences were detected, Post-hoc analyses were performed to identify the source of the differences. The results of these analyses are presented in Table 5.

Table 5

Professional Experience Differences in TPACK, Technostress, and AI Acceptance

Variables and Groups	*N*	*M*	*SD*	*F(3, 200)*	*p*	*Significant Differences*
TPACK						
(1) 1-5 years	82	4.38	.95	1.103	.349	
(2) 6-10 years	52	4.36	.80			
(3) 11-15 years	36	4.14	.75			
(4) 16 years and above	34	4.09	.88			
Technostress						
(1) 1-5 years	82	2.73	.96	.473	.701	
(2) 6-10 years	52	2.76	.98			
(3) 11-15 years	36	2.58	.95			
(4) 16 years and above	34	2.91	1.10			
AI Acceptance						
(1) 1-5 years	82	3.95	.51	13.16	<.001	1>3
(2) 6-10 years	52	3.82	.64			1>4
(3) 11-15 years	36	3.59	.68			2>4
(4) 16 years and above	34	3.15	.76			

The results in Table 5 indicate that teachers' TPACK levels did not significantly differ by professional experience, $F(3, 200) = 1.103$, $p = .349$. Similarly, technostress levels did not vary significantly across experience groups, $F(3, 200) = .473$, $p = .701$. In contrast, a statistically significant difference was found in AI acceptance across professional experience groups, $F(3, 200) = 13.16$, $p < .001$. Post-hoc, Tukey HSD, comparisons revealed that teachers with 1–5 years of experience reported significantly higher AI acceptance levels than those with 11–15 years and 16 years and above (1 > 3, 4). Additionally, teachers with 6–10 years of experience demonstrated significantly higher AI acceptance than those with 16 years and above (2 > 4). Notably, AI acceptance levels decreased with increasing professional experience, with the lowest levels observed among teachers with 16 years and above (M = 3.15, SD = .76). Overall, these findings suggest that while TPACK and technostress remain relatively stable across career stages, AI acceptance appears to be more sensitive to professional seniority, with less experienced teachers demonstrating higher levels of acceptance.

Differences in teachers' TPACK, technostress, and AI acceptance levels were also examined across subject areas, and the results of the one-way ANOVA are presented in Table 6.

Table 6
Subject Area Differences in TPACK, Technostress, and AI Acceptance

Variables and Groups	*N*	*M*	*SD*	*F(3, 200)*	*p*	*Significant Differences*
TPACK						
(1) Quantitative/Scientific Subjects	70	4.12	.86	7.847	<.001	1>4
(2) Humanities Subjects	58	4.47	.92			
(3) Language Subjects	30	4.39	.98			
(4) Arts & Physical Education Subjects	46	4.88	.89			
Technostress						
(1) Quantitative/Scientific Subjects	70	2.53	.94	6.383	<.001	1>2
(2) Humanities Subjects	58	3.21	1.05			
(3) Language Subjects	30	2.89	.90			
(4) Arts & Physical Education Subjects	46	3.09	.89			
AI Acceptance						
(1) Quantitative/Scientific Subjects	70	3.79	.67	2.24	.084	
(2) Humanities Subjects	58	3.57	.62			
(3) Language Subjects	30	3.61	1.02			
(4) Arts & Physical Education Subjects	46	3.96	.50			

As shown in Table 6, significant differences were observed in both TPACK and technostress, whereas AI acceptance did not differ significantly among subject areas. For TPACK, a one-way ANOVA indicated a significant effect of subject area, $F(3, 200) = 7.85$, $p < .001$. Post-hoc, Tukey HSD, comparisons showed that teachers of arts & physical education subjects (M = 4.88, SD = .89) scored significantly higher than those teaching quantitative/scientific subjects (M = 4.12, SD = .86), suggesting that arts and physical education teachers reported higher technological pedagogical content knowledge. No other pairwise differences reached significance. Regarding technostress, the ANOVA also revealed a significant effect of subject area, $F(3, 200) = 6.38$, $p < .001$. Tukey HSD results indicated that teachers of quantitative/scientific subjects (M = 2.53, SD = .94) experienced significantly lower technostress compared to those teaching humanities subjects (M = 3.21, SD = 1.05), implying that humanities teachers reported higher stress related to technology use. Other comparisons were not statistically significant. In contrast, AI acceptance did not vary significantly across subject areas, $F(3, 200) = 2.24$, $p = .084$, indicating that teachers' acceptance of AI was relatively consistent regardless of their subject area. Overall, these results suggest that subject area influences teachers' TPACK and technostress levels, with arts and physical education teachers showing higher TPACK and humanities teachers experiencing greater technostress, while AI acceptance appears similar across all disciplines.

Pearson correlation analyses were conducted to examine the relationships among TPACK, technostress, and AI acceptance, and the results of the analyses are presented in Table 7.

Table 7
Correlations Among TPACK, Technostress, and AI Acceptance

Variables	1	2	3
1. TPACK	–		
2. Technostress	–.292**	–	
3. AI Acceptance	.321**	.007	–

Note. **p < .001

As seen in Table 7, the results revealed a significant negative correlation between TPACK and technostress (r = −.292, p < .001), indicating that higher levels of TPACK perception were associated with lower levels of technostress. Additionally, TPACK was positively and significantly correlated with AI acceptance (r = .321, p < .001), suggesting that teachers with higher TPACK perception tended to report greater acceptance of AI. In contrast, technostress was not significantly correlated with AI acceptance (r = .007, p > .001), indicating no meaningful relationship between technology-related stress and teachers' acceptance of AI. Overall, the findings suggest that TPACK plays a central role in relation to both technostress and AI acceptance, whereas technostress does not appear to be associated with AI acceptance.

A multiple regression analysis was conducted to examine the extent to which TPACK and technostress predict AI acceptance among teachers. The results obtained from this analysis are presented in Table 8.

Table 8
Regression Analysis Predicting AI Acceptance from TPACK and Technostress

	Unstd. coefficients		*Std. coefficients*					
Variables	*B*	*SE*	*β*	*t*	*p*	*R*	R^2	*Adjusted* R^2
(Constant)	2.483	0.282		8.791	<.001			
TPACK	0.255	0.050	.353	5.091	<.001	.338	.114	.105
Technostress	0.073	0.046	.111	1.593	.113			

According to Table 8, the overall model was significant, explaining approximately 11.4% of the variance in AI acceptance (R = .338, R^2 = .114, p < .001). TPACK significantly predicted AI acceptance (β = .353, p < .001), whereas technostress was not a significant predictor (β = .111, p = .113). These findings suggest that teachers' perception of technological pedagogical content knowledge is a key factor in AI acceptance, while technostress does not appear to exert a significant effect.

5. Discussion and Conclusion

The purpose of this study was to examine teachers' technological pedagogical content knowledge, technostress, and artificial intelligence (AI) acceptance by (a) determining their overall levels, (b) investigating whether these constructs differed according to gender, educational level, professional experience, and subject area, (c) analyzing the relationships among them, and (d) testing the predictive roles of TPACK and technostress in explaining AI acceptance. The results indicate that teachers' TPACK perceptions and AI acceptance levels were high, whereas their technostress levels were moderate. The high TPACK perceptions align with large-scale studies on teachers' technopedagogical competencies (e.g., Erdoğan & Akbaba, 2022; Giannakos et al., 2015; Li et al., 2022), suggesting that teachers are able to maintain a dynamic balance among technology, pedagogy, and content knowledge, structuring technology as a functional tool to enhance instruction. Similarly, the high AI acceptance levels suggest that teachers view AI as an assistant capable of enhancing professional performance and have internalized its perceived benefits (An et al., 2023). On the other hand, the moderate technostress experienced by teachers points to the psychological pressure associated with technological innovations, including workload, complexity, and continuous updates (Dönmez & Seferoğlu, 2025; Sanni, 2025). Although the literature emphasizes that technostress—through factors such as technology overload, complexity, and insecurity—can negatively affect teacher performance (Wu et al., 2026), the moderate stress levels in this study suggest that high TPACK competence may serve as a buffering mechanism. Supporting this, previous studies have shown that teachers with strong technopedagogical knowledge can manage technology-induced anxiety and stress more effectively, viewing technology as an opportunity rather than a threat, and tend to utilize it more frequently (Dong et al., 2019; Özgür, 2020).

The results revealed no significant gender differences in TPACK perceptions. This finding indicates that teachers' self-perceptions of integrating technology, pedagogy, and content knowledge develop similarly regardless of gender. This aligns with Li (2023), who found no significant gender differences in TPACK competence, suggesting that expectations regarding technological integration in Türkiye create similar competence levels for both genders. Similarly, no gender-based differences were observed in teachers' technostress. The literature reports conflicting results regarding gender and technostress; some studies suggest that female teachers experience higher technostress (e.g., Çoklar & Şahin, 2011; Ong & Lai, 2006), whereas others indicate higher technostress among male teachers when facing technological complexity and insecurity (Jena & Mahanti, 2014; Shu et al., 2011; Tarafdar et al., 2011). The present findings, however, align with Özgür (2020), Valiao (2025), and Qi (2019), suggesting that technostress may relate more to the nature of work than to gender. This implies that both groups experience similar psychological thresholds in coping with digital transformation.

A notable gender-related finding was the significantly higher AI acceptance among female teachers. This parallels Ayanwale et al. (2024), who reported that female teachers exhibited lower anxiety regarding AI-based educational technologies, suggesting that differences in anxiety levels may influence AI acceptance. However, this contrasts with previous studies suggesting that male teachers may have advantages in general technology use (e.g., Papastergiou & Solomonidou, 2005; Sanchez-Franco, 2006). The result implies that female teachers are more likely to perceive AI tools as facilitators that enrich instructional processes, contributing to their higher acceptance. Overall, while TPACK competence and technostress were similar across genders, female teachers demonstrated higher motivation to adopt AI, a finding particularly relevant given the predominance of female teachers among future educators (Zhang et al., 2023). These insights suggest that professional development programs should address potential AI-related reservations among male teachers (e.g., technological insecurity) and support collaborative platforms that enable female teachers to translate their high acceptance into best practices.

The study further revealed that teachers' TPACK perceptions, technostress, and AI acceptance did not differ significantly by educational level. This supports the view that TPACK is not merely acquired through formal academic education but is shaped through practice and experience, exhibiting context-sensitive (Angeli & Valanides, 2009) and dynamic properties (An et al., 2023). While some studies argue that higher education provides a deeper pedagogical perspective, enhancing technological management skills (Depante & Astillero, 2025; Li et al., 2022; Wu et al., 2026), the present study shows that TPACK competencies are similar across educational levels. This may suggest that Turkish middle and secondary school teachers' preparedness for technology is shaped more by professional development opportunities and classroom practice than by educational level. The absence of differences in technostress across education levels, despite prior expectations that higher qualifications might enhance coping strategies (Depante & Astillero, 2025; Wu et al., 2026), may be explained by similar exposure to institutional infrastructure, curriculum pressures, and technological expectations. Similarly, AI acceptance did not differ significantly by educational level, indicating that individual perceptions—such as perceived usefulness, ease of use, and technological self-efficacy—may play a more decisive role than formal education (Granić & Marangunić, 2019). Consequently, policymakers should prioritize TPACK competence development and mitigate technostress through institutional support rather than focusing solely on teachers' academic degrees.

Teachers' TPACK perceptions and technostress did not differ significantly by professional experience. This suggests that teachers exhibit similar technopedagogical readiness and technology-related stress regardless of career stage, consistent with previous findings (e.g., Mansour et al., 2024; Ozudogru & Ozudogru, 2019). Accordingly, Mansour et al. (2024) propose that TPACK development is more closely linked to targeted technology integration training than to general teaching experience. As another explanation, differences in subcomponents of TPACK, such as stronger technological knowledge [TK] among early-career teachers and more developed pedagogical and content knowledge (PK, CK, PCK) among experienced teachers, may balance out, resulting in similar overall TPACK perceptions (Lee & Tsai, 2010). Similarly, technostress was consistent across experience groups, aligning with Valiao (2025) and research suggesting that age is not a significant factor in technostress (e.g., Krishnan, 2017; Maier et al., 2015; Wang et al., 2008). In contrast, AI acceptance significantly differed by professional experience. AI acceptance decreased with increasing professional experience, likely because younger teachers, having grown up in technology-rich environments, perceive AI as a natural enhancement to instruction, whereas senior teachers, despite high TPACK, may perceive AI as a potential threat to autonomy and expertise (Chan & Lee, 2023; Tondeur et al., 2017). This generational difference underscores the importance of professional development addressing senior teachers' concerns and fostering collaborative environments (Lin et al., 2025) that combine experienced pedagogical knowledge with younger teachers' AI competencies, such as peer/reverse mentoring.

Significant differences were observed in TPACK perceptions across subject areas, with arts & physical education teachers scoring higher than quantitative/scientific subjects teachers. This supports the context-sensitive and dynamic nature of technopedagogical knowledge (An et al., 2023; Angeli & Valanides, 2009). Contrary to assumptions that STEM teachers are more advanced in technology use (Lindner & Berges, 2020), the findings suggest that teachers in creative and practice-oriented subjects integrate digital tools more deeply into pedagogical processes. On the other hand, technostress varied by subject area; humanities teachers reported higher stress than quantitative/scientific subjects teachers, consistent with the person–

environment misfit perspective (Califf & Brooks, 2020; Wang et al., 2020), where misalignment between skills and technological demands increases stress. Such misalignment arises when teachers find technological tools incompatible with their pedagogical practices, feel unprepared to use them, or experience increased workload, potentially leading to lower motivation and burnout (Chen et al., 2026). Quantitative/scientific subjects teachers' familiarity with analytical systems, such as algorithmic thinking and systematic problem-solving, may mitigate perceived complexity, whereas humanities teachers may perceive AI and related technologies as more complex and overwhelming. Notably, AI acceptance did not differ significantly across subject areas, indicating that teachers universally recognize AI as a tool enhancing professional efficiency (Henderson & Corry, 2021; Ouyang et al., 2023; Ramesh & Sanampudi, 2022). This suggests that while subject area shapes TPACK and technostress, AI acceptance reflects a broader, cross-disciplinary recognition of AI's potential in education. From a curriculum and teacher education perspective, these findings suggest that integrating AI-supported activities into subject-specific curricula should consider the epistemological nature of each discipline. For instance, while structured and problem-oriented tasks may naturally align with AI use in mathematics and science, more explicit scaffolding and adaptation strategies may be needed in other subject areas. In particular, micro-teaching practices and teacher training programs can be designed to help pre-service and in-service teachers experiment with AI-supported instructional scenarios, adapt digital tools to their subject-specific needs, and develop confidence in technology integration. Such targeted interventions may help reduce perceived complexity and support more balanced technopedagogical development across subject areas. In light of these findings, it is recommended that education policymakers design subject-specific professional development programs that address the unique pedagogical needs of each discipline (e.g., the use of AI in arts education). Increasing school support, particularly in subjects experiencing high levels of technostress, is also considered crucial for ensuring the sustainable adoption of AI (Özgür, 2020).

The study also revealed a significant negative relationship between TPACK perceptions and technostress, suggesting that higher self-perceived ability to integrate technology, pedagogy, and content knowledge reduces the psychological pressure and stress associated with technology use. TPACK is recognized as a key preventive mechanism against technostress, with a strong technopedagogical foundation mitigating the complexity and uncertainty of technology, thereby enhancing teachers' sense of control (Dong et al., 2019; Joo et al., 2016; Özgür, 2020; Teo et al., 2019; Wang et al., 2024). A significant positive relationship was also found between TPACK and AI acceptance, indicating that teachers with higher cognitive and pedagogical readiness strengthen their intentions to integrate AI into instructional practices. This aligns with prior research suggesting that higher TPACK enhances perceived usefulness and positively correlates with AI adoption (An et al., 2023; Teo et al., 2019; Wang et al., 2024). Understanding how to align AI tools with subject-specific pedagogical strategies appears to facilitate adoption, enabling AI to enhance professional performance. Notably, no significant relationship was observed between technostress and AI acceptance. While general technology adoption models suggest that stress and complexity can impede technology use (e.g., Joo et al., 2016), recent AI-focused studies report a similar absence of this relationship (e.g., Wang et al., 2024). This indicates that teachers' confidence in AI's pedagogical potential can offset stress-related barriers, particularly when supported by school support and high TPACK competence (Dong et al., 2019; Özgür, 2020).

Finally, the results showed that TPACK accounted for approximately 11.4% of the variance in AI acceptance, confirming its role as a strong and significant predictor (Wang et al., 2024). The findings reinforce that TPACK, encompassing technological, pedagogical, and content knowledge, is critical for effectively integrating emerging technologies such as generative AI into educational settings (Antonenko & Abramowitz, 2023; Hava & Babayiğit, 2025; Mao et al., 2024; Mishra et al., 2023; Yang et al., 2025). On the other hand, the absence of a significant predictive effect of technostress on AI acceptance reinforces the notion that, in the context of AI, knowledge outweighs stress in shaping adoption decisions. Overall, the results highlight that strengthening teachers' pedagogical design skills alongside AI tools can support professional development and facilitate sustainable integration of AI in education. On the other hand, the relatively modest explained variance (11.4%) indicates that AI acceptance is a multifaceted construct influenced by additional factors beyond TPACK, such as perceived usefulness, technological self-efficacy, and institutional support. In this regard, teacher education programs should incorporate practice-oriented activities, such as analyzing, adapting, and redesigning instructional or textbook activities with AI tools. Such experiences may strengthen the link between pedagogical competence and AI adoption, supporting more effective and sustainable technology integration.

6. Limitations and Recommendations

Despite the contributions of this study, several limitations should be acknowledged. First, the study employed a survey research design; therefore, causal relationships among TPACK, technostress, and AI acceptance cannot be established. Future studies using longitudinal or experimental designs could provide deeper insights into how teachers' technopedagogical competencies and AI acceptance evolve. Second, the data were collected through self-report scales, which reflect teachers' perceived competencies and attitudes rather than their actual classroom practices. Although such instruments are common in educational research, future studies could benefit from incorporating multiple data sources, such as classroom observations, teaching artifacts, or qualitative interviews, to obtain a more comprehensive picture of AI integration in instructional contexts. Third, the sample consisted of middle and secondary school teachers within a specific educational context, which may limit the generalizability of the findings. In addition, differences in access to digital resources, institutional support, and technological readiness may have influenced teachers' technostress levels and AI acceptance. Therefore, future studies should consider school-level variables and infrastructural conditions to better understand how contextual factors shape teachers' experiences with emerging technologies. Educational systems differ in terms of technological infrastructure, policy priorities, and institutional support for AI integration; therefore, cross-cultural or multi-country studies would help validate and extend the present findings. Fourth, although the regression analysis revealed that TPACK significantly predicts AI acceptance, the explained variance of the model remained modest. This suggests that additional factors—such as perceived usefulness of AI, technological self-efficacy, school support, or ethical concerns—may also play an important role in shaping teachers' adoption of AI technologies. Future research could incorporate these variables to develop more comprehensive explanatory models.

From a policy perspective, the findings highlight the strategic importance of strengthening teachers' TPACK competencies for the successful integration of artificial intelligence in education. Rather than focusing solely on technical training, professional development initiatives should emphasize how AI tools can be pedagogically integrated into subject-specific teaching practices. In addition, policy makers should support sustainable professional learning ecosystems—such as collaborative teacher communities, peer/reverse mentoring models—that enable teachers to share experiences and experiment with AI-supported instructional strategies. Such initiatives may not only enhance teachers' technopedagogical readiness but also reduce technostress and foster a more sustainable adoption of AI in educational environments.

Author contributions: Dilara Çakır: Conceptualization, Data curation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. Pınar Güner: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Data availability: The dataset analyzed during the current study is available from the corresponding author on reasonable request.

Declaration of generative AI in scientific writing: In this study, the artificial intelligence program ChatGPT-4 was utilized exclusively to refine the language and enhance the readability of the manuscript. Notably, no assistance was sought from ChatGPT-4 in terms of conceptual contributions.

Declaration of interest: The authors declared that there were no potential conflicts of interest.

Ethics declaration: Istanbul University-Cerrahpasa Social and Human Sciences Ethics Committee approved this research with approval number 2026/211. The purpose of this research was clarified to participants, and they gave written informed consent to participate in the study.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

Agogo, D., & Hess, T. J. (2015). *Technostress and technology induced state anxiety: Scale development and implications* [Paper presentation]. 36th International Conference on Information Systems (pp. 1-11), Fort Worth, Texas, EUA.

Ajani, O. A., Gamede, B., & Matiyenga, T. C. (2025). Leveraging artificial intelligence to enhance teaching and learning in higher education: Promoting quality education and critical engagement. *Journal of Pedagogical Sociology and Psychology, 7*(1), 54–69. https://doi.org/10.33902/jpsp.202528400

Algerafi, M. A., Zhou, Y., Alfadda, H., & Wijaya, T. T. (2023). Understanding the factors influencing higher education students' intention to adopt artificial intelligence-based robots. *IEEE Access, 11*, 99752-99764. https://doi.org/10.1109/ACCESS.2023.3314499

Alpaslan, M. M., Ulubey, Ö., & Ata, R. (2021). Adaptation of technological pedagogical content knowledge scale into Turkish culture within the scope of 21st century skills. *Psycho-Educational Research Reviews, 10*(1), 77-91.

An, X., Chai, C. S., Li, Y., Zhou, Y., Shen, X., Zheng, C., & Chen, M. (2023). Modeling English teachers' behavioral intention to use artificial intelligence in middle schools. *Education and information technologies*, *28*(5), 5187-5208. https://doi.org/10.1007/s10639-022-11286-z

Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT–TPCK: Advances in technological pedagogical content knowledge (TPCK). *Computers & education*, *52*(1), 154-168. https://doi.org/10.1016/j.compedu.2008.07.006

Antonenko, P., & Abramowitz, B. (2023). In-service teachers'(mis) conceptions of artificial intelligence in K-12 science education. *Journal of Research on Technology in Education*, *55*(1), 64-78. https://doi.org/10.1080/15391523.2022.2119450

Aravantinos, S., Lavidas, K., Komis, V., Karalis, T., & Papadakis, S. (2026). Artificial ıntelligence in k-12 education: a systematic review of teachers' professional development needs for aı ıntegration. *Computers*, *15*(49), 1-30. https://doi.org/10.3390/computers15010049

Ayanwale, M. A., Adelana, O. P., & Odufuwa, T. T. (2024). Exploring STEAM teachers' trust in AI-based educational technologies: A structural equation modelling approach. *Discover Education*, *3*(44), 1-22. https://doi.org/10.1007/s44217-024-00092-z

Ayyagari, R., Grover, V., & Purvis, R. (2011). Technostress: Technological antecedents and implications. *MIS Quarterly, 35*(4), 831-858. https://doi.org/10.2307/41409963

Balıkçı, H. C., & Yıldız Durak, H. (2025). *Öğretmenlerin yapay zekâ teknolojilerini eğitimde kabul etme düzeylerinin incelenmesi: Bir ölçek uyarlama çalışması* [Examining teachers' acceptance levels of artificial intelligence technologies in education: A scale adaptation study] [Paper presentation]. 5th International Conference on Engineering, Natural and Social Sciences (ICENSOS 2025), Konya, Türkiye.

Baudin, J. S. P. (2025). Assessing the psychometric properties of AI-generated multiple-choice exams in a psychology subject. *Journal of Pedagogical Sociology and Psychology, 7*(3), 18–34. https://doi.org/10.33902/jpsp.202536891

Blackwell, C. K., Lauricella, A. R., & Wartella, E. (2016). The influence of TPACK contextual factors on early childhood educators' tablet computer use. *Computers & Education, 98*, 57-69. https://doi.org/10.1016/j.compedu.2016.02.010

Brod, C. (1984). *Technostress: The human cost of the computer revolution*. Addison Wesley Publishing Company.

Burton-Jones, A., & Hubona, G. S. (2005). Individual differences and usage behavior: Revisiting a technology acceptance model assumption. *ACM SIGMIS Database: the DATABASE for Advances in Information Systems, 36*(2), 58-77. https://doi.org/10.1145/1066149.1066155

Califf, C. B., & Brooks, S. (2020). An empirical study of techno-stressors, literacy facilitation, burnout, and turnover intention as experienced by K-12 teachers. *Computers & Education, 157*, 103971. https://doi.org/10.1016/j.compedu.2020.103971

Castelvecchi, D. (2016). Can we open the black box of AI? *Nature News, 538*(7623), 20-23. https://doi.org/10.1038/538020a

Chai, C. S., Lin, P., Jong, M. S., Dai, Y., Chiu, T. K. F., & Qin, J. (2021). Perceptions of and behavioral intention towards learning artificial intelligence in primary school students. *Educational Technology & Society, 24*(3), 89-101. https://www.jstor.org/stable/27032858

Chan, C. K. Y., & Lee, K. K. (2023). The AI generation gap: Are Gen Z students more interested in adopting generative AI such as ChatGPT in teaching and learning than their Gen X and millennial generation teachers?. *Smart Learning Environments, 10*, 60. https://doi.org/10.1186/s40561-023-00269-3

Chen, S., Li, Y., & Chen, Y. (2026). How School Digital Culture Relates to K-12 Teachers' ICT-Enabled Productivity: Roles of Techno-Stressors and Emotional Exhaustion. *European Journal of Education, 61*(1), e70485. https://doi.org/10.1111/ejed.70485

Chiu, T. K., Meng, H., Chai, C. S., King, I., Wong, S., & Yam, Y. (2021). Creation and evaluation of a pretertiary artificial intelligence (AI) curriculum. *IEEE Transactions on Education 65*(1), 30-39. https://doi.org/10.1109/TE.2021.3085878

Çoklar, A. N., Efilti, E., & Sahin, L. (2017). Defining teachers' technostress levels: A scale development. *Journal of Education and Practice, 8*(21), 28-41.

Çoklar, A. N., & Sahin, Y. L. (2011). Technostress levels of social network users based on ICTs in Turkey. *European Journal of Social Sciences, 23*(2), 171-182.

Depante, P., & Astillero, A. (2025). Technostress and teaching performance of public school teachers in Santa Rosa City of Laguna. *Educational Research*, *7*(3), 160-194.

Divekar, R. R., Drozdal, J., Chabot, S., Zhou, Y., Su, H., Chen, Y., Zhu, H., Hendler, J. A., & Braasch, J. (2021). Foreign language acquisition via artificial intelligence and extended reality: design and evaluation. *Computer-Assisted Language Learning*, *35*(9), 2332-2360. https://doi.org/10.1080/09588221.2021.1879162

Dong, Y., Xu, C., Chai, C. S., Zhai, X. (2019). Exploring the structural relationship among teachers' technostress, technological pedagogical content knowledge (TPACK), computer self-efficacy, and school support. *The Asia-Pacific Education Researcher, 29*, 1-11. https://doi.org/10.1007/s40299-019-00461-5

Donmez, O., & Seferoğlu, S. S. (2025). The Role of ICT Self-Efficacy, Technostress, Individual Innovativeness and Mindset on Artificial Intelligence Literacy: Artificial Intelligence Literacy. *International Journal of Curriculum and Instruction, 17*(3), 950-977.

Durak, H. Y. (2021). Modeling of relations between K-12 teachers' TPACK levels and their technology integration self-efficacy, technology literacy levels, attitudes toward technology and usage objectives of social networks. *Interactive Learning Environments, 29*(7), 1136-1162. https://doi.org/10.1080/10494820.2019.1619591

Erdoğan, E., & Akbaba, B. (2022). The role of gender, TPACK, school support and job satisfaction in predicting the technostress levels of social studies teachers. *Education and Science, 47*(210), 193-215. https://org.doi/10.15390/EB.2022.11183

Fitriati, S. W., & Williyan, A. (2025). AI-enhanced self-regulated learning: EFL learners' prioritization and utilization in presentation skills development. *Journal of Pedagogical Research, 9*(2), 22–37. https://doi.org/10.33902/JPR.202530647

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2015). *How to Design and Evaluate Research in Education (9th ed.).* McGraw-Hill Education.

Ghanizadeh, A., Hedeshi, E., & Jalili, M. (2025). Teacher professional development in the light of technostress, job commitment, and work engagement. *Teacher Development*. Advance online publication. https://doi.org/10.1080/13664530.2025.2542215

Giannakos, M. N., Doukakis, S., Pappas, I. O., Adamopoulos, N., & Giannopoulou, P. (2015). Investigating teachers' confidence on technological pedagogical and content knowledge: an initial validation of TPACK scales in K-12 computing education context. *Journal of Computers in Education, 2*(1), 43-59. https://doi.org/10.1007/s40692-014-0024-8

Granić, A., & Marangunić, N. (2019). Technology acceptance model in educational context: A systematic literature review. *British Journal of Educational Technology, 50*(5), 2572-2593. https://doi.org/10.1111/bjet.12864

Gravetter, J. F., & Forzano, L. B. (2012). *Research methods for the behavioral sciences (4th Ed.).* Linda Schreiber-Ganster.

Green, B. P. (2020). *Artificial intelligence and ethics: Sixteen challenges and opportunities.* Markkula Center for Applied Ethics at Santa Clara University. https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteen-challenges-and-opportunities

Guo, S., Shi, L., & Zhai, X. (2025). Developing and validating an instrument for teachers' acceptance of artificial intelligence in education. *Education and Information Technologies, 30*(10), 13439-13461. https://doi.org/10.1007/s10639-025-13338-6

Hava, K., & Babayiğit, Ö. (2025). Exploring the relationship between teachers' competencies in AI-TPACK and digital proficiency. *Education and Information Technologies, 30*(3), 3491-3508. https://doi.org/10.1007/s10639-024-12939-x

Henderson, J., & Corry, M. (2021). Teacher anxiety and technology change: A review of the literature. *Technology, Pedagogy and Education, 30*(4), 573-587. https://doi.org/10.1080/1475939X.2021.1931426

Holstein, K., McLaren, B. M., & Aleven, V. (2017). Intelligent tutors as teachers' aides: Exploring teacher needs for real-time analytics in blended classrooms. In I. Molenaar, X. Ochoa, & S. Dawson (Eds.), *Proceedings of the seventh international learning analytics & knowledge conference, ACM* (pp. 257-266). ACM. https://doi.org/10.1145/3027385.3027451

Hsu, L. (2016). Examining EFL teachers' technological pedagogical content knowledge and the adoption of mobile-assisted language learning: A partial least square approach. *Computer Assisted Language Learning, 29*(8), 1287-1297. https://doi.org/10.1080/09588221.2016.1278024

Huffman, A. H., Whetten, J., & Huffman, W. H. (2013). Using technology in higher education: The influence of gender roles on technology self-efficacy. *Computers in Human Behavior, 29*(4), 1779-1786. https://doi.org/10.1016/j.chb.2013.02.012

Jena, R. K., & Mahanti, P. K. (2014). An empirical study of technostress among Indian academicians. *International Journal of Education and Learning, 3*(2), 1-10. http://dx.doi.org/10.14257/ijel.2014.3.2.01

Joo, Y. J., Lim, K. Y., & Kim, N. H. (2016). The effects of secondary teachers' technostress on the intention to use technology in South Korea. *Computers & Education, 95*, 114-122. https://doi.org/10.1016/j.compedu.2015.12.004

Jordan, M. I., & Mitchell, T. M. (2015). Machine learning: Trends, perspectives, and prospects. *Science, 349*, 255-260. https://doi.org/10.1126/science.aaa8415

Kaplan, K., Ertan Özen, N., & Özcan, H. Z. (2026). The impact of ChatGPT-integrated reading activities on the reading attitudes and habits of middle school students. *Journal of Pedagogical Sociology and Psychology, 8*(1), e41122. https://doi.org/10.33902/JPSP.202641122

Kaşkaya, A., & Ateş, Ş. N. (2025). The effect of artificial intelligence-supported visualization applications on students' writing disposition in the creative writing process. *Journal of Pedagogical Research, 9*(2), 5–21. https://doi.org/10.33902/JPR.202531916

Kavitha, K., & Joshith, V. P. (2024). Pedagogical incorporation of artificial intelligence in K-12 science education: A decadal bibliometric mapping and systematic literature review (2013–2023). *Journal of Pedagogical Research, 8*(4), 437–465. https://doi.org/10.33902/JPR.202429218

Khlaif, Z. N., Sanmugam, M., Hattab, M. K., Bensalem, E., Ayyoub, A., Sharma, R. C., Joma, A., Itmazi, J., Najmi, A. H., Mitwally, M. A. A., Jawad, A. A., Ramadan, M. & Bsharat, T. R. (2023). Mobile technology features and technostress in mandatory online teaching during the COVID-19 crisis. *Heliyon, 9*(8), e19069. https://doi.org/10.1016/j.heliyon.2023.e19069

Koehler, M. J., & Mishra, P. (2005). What happens when teachers design educational technology? The development of technological pedagogical content knowledge. *Journal of Educational Computing Research, 32(*2), 131-152. https://doi.org/10.2190/0EW7-01WB-BKHL-QDYV

Koh, J. H. L., Chai, C. S., & Lim, W. Y. (2017). Teacher Professional development for TPACK-21CL: Effects on teacher ICT integration and student outcomes. *Journal of Educational Computing Research, 55*(2), 172-196. https://doi.org/10.1177/0735633116656848

Kohnke, L., Zou, D., & Moorhouse, B. L. (2024). Technostress and English language teaching in the age of generative AI. *Educational Technology & Society, 27*(2), 306-320. https://doi.org/10.30191/ETS.202404_27(2).TP02

Krishnan, S. (2017). Personality and espoused cultural differences in technostress creators. *Computers in Human Behavior, 66*, 154-167. https://doi.org/10.1016/j.chb.2016.09.039

Lee, M. H., & Tsai, C. C. (2010). Exploring teachers' perceived self efficacy and technological pedagogical content knowledge with respect to educational use of the World Wide Web. *Instructional Science, 38*, 1-21. https://doi.org/10.1007/s11251-008-9075-4

Li, M. (2023). Chinese mathematics teachers' TPACK and attitudes toward ICT integration in the post-pandemic era. *Eurasia Journal of Mathematics Science and Technology Education, 19*(7), em2301. https://doi.org/10.29333/ejmste/13346

Li, S., Liu, Y., & Su, Y. S. (2022). Differential analysis of teachers' technological pedagogical content knowledge (TPACK) abilities according to teaching stages and educational levels. *Sustainability, 14*(12), 7176. https://doi.org/10.3390/su14127176

Lin, T., Zhang, J., & Xiong, B. (2025). Effects of technology perceptions, teacher beliefs, and AI literacy on AI technology adoption in sustainable mathematics education. *Sustainability, 17*(8), 3698. https://doi.org/10.3390/su17083698

Lindner, A., & Berges, M. (2020). Can you explain AI to me? Teachers' pre-concepts about artificial intelligence. In E. Board (Eds.), *2020 IEEE Frontiers in Education Conference* (FIE) (pp. 1-9). IEEE. https://doi.org/10.1109/FIE44824.2020.9274136

Maier, C., Laumer, S., & Eckhardt, A. (2015). Information technology as daily stressor: Pinning down the causes of burnout. *Journal of Business Economics, 85*(4), 349-387. https://doi.org/10.1007/s11573-014-0759-8

Mansour, N., Said, Z., Çevik, M., & Abu-Tineh, A. (2024). Science and mathematics teachers' integration of TPACK in STEM subjects in Qatar: A structural equation modeling study. *Education Sciences, 14*, 1138. https://doi.org/10.3390/educsci14101138

Mao, J., Chen, B., & Liu, J. C. (2024). Generative artificial intelligence in education and its implications for assessment. *TechTrends, 68*(1), 58-66. https://doi.org/10.1007/s11528-023-00911-4

Marchiori, D. M., Mainardes, E. W., & Rodrigues, R. G. (2019). Do individual characteristics influence the types of technostress reported by workers? *International Journal of Human-Computer Interaction, 35(3), 218-230. https://doi.org/10.1080/10447318.2018.1449713*

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: a framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Mishra, P., Warr, M., & Islam, R. (2023). TPACK in the age of ChatGPT and Generative AI. *Journal of Digital Learning in Teacher Education, 39*(4), 235-251. https://doi.org/10.1080/21532974.2023.2247480

Ning, Y., Zhang, C., Xu, B., Zhou, Y., & Wijaya, T. T. (2024). Teachers' AI-TPACK: Exploring the relationship between knowledge elements. *Sustainability, 16*(3), 978. https://doi.org/10.3390/su16030978

Okanya, V. A., & Asogwa, J. O. (2026). Evaluating human–AI collaborative pedagogical model for sustainable skill development in technical education workshops. *Sustainable Education and Digital Transformation, 1*(1), e43677. https://doi.org/10.33902/SEDT.202643677

Ong, C. S., & Lai, J. Y. (2006). Gender differences in perceptions and relationships among dominants of e-learning acceptance. *Computers in Human Behavior, 22*(5), 816-829. https://doi.org/10.1016/j.chb.2004.03.006

Ouyang, F., Wu, M., Zheng, L., Zhang, L., & Jiao, P. (2023). Integration of artificial intelligence performance prediction and learning analytics to improve student learning in online engineering course. *International Journal of Educational Technology in Higher Education, 20*(1), 4. https://doi.org/10.1186/s41239-022-00372-4

Ozudogru, M., & Ozudogru, F. (2019). Technological pedagogical content knowledge of mathematics teachers and the effect of demographic variables. *Contemporary Educational Technology, 10*(1), 1-24. https://doi.org/10.30935/cet.512515

Özgür, H. (2020). Relationships between teachers' technostress, technological pedagogical content knowledge (TPACK), school support and demographic variables: A structural equation modeling. *Computers in Human Behavior, 112*, 106468. https://doi.org/10.1016/j.chb.2020.106468

Papastergiou, M., & Solomonidou, C. (2005). Gender issues in Internet access and favourite Internet activities among Greek high school pupils inside and outside school. *Computers & Education, 44*(4), 377-393. https://doi.org/10.1016/j.compedu.2004.04.002

Peres, R., Schreier, M., Schweidel, D., & Sorescu, A. (2023). On ChatGPT and beyond: How generative artificial intelligence may affect research, teaching, and practice. *International Journal of Research in Marketing, 40*(2), 269-275. https://doi.org/10.1016/j.ijresmar.2023.03.001

Qi, C. (2019). A double-edged sword? Exploring the impact of students' academic usage of mobile devices on technostress and academic performance. *Behaviour & Information Technology, 38*(12), 1337-1354. https://doi.org/10.1080/0144929X.2019.1585476

Ramesh, D., & Sanampudi, S. K. (2022). An automated essay scoring systems: A systematic literature review. *Artificial Intelligence Review, 55*(3), 2495-2527. https://doi.org/10.1007/s10462-021-10068-2

Sanchez-Franco, M. J. (2006). Exploring the influence of gender on the web usage via partial least squares. *Behaviour & Information Technology, 25*(1), 19-36. https://doi.org/10.1080/01449290500124536

Sanni, L. O. (2025). *Impact of technostress on pre-service teachers'perceptions of technology integration in classroom teaching* [Unpublished doctoral dissertation]. Montana State University, Bozeman.

Schiff, D. (2021). Out of the laboratory and into the classroom: The future of artificial intelligence in education. *AI & Society, 36*(1), 331-348. https://doi.org/10.1007/s00146-020-01033-8

Shu, Q., Tu, Q., & Wang, K. (2011). The impact of computer selfefficacy and technology dependence on computer-related technostress: A social cognitive theory perspective. *International Journal of Human-Computer Interaction, 27*(10), 923-939. https://doi.org/10.1080/10447318.2011.555313

Simiyu, C. N., Malanga, K. N., & Wabwoba, F. (2026). Bridging the AI chasm: A strategic framework for generative AI in higher education. *Sustainable and Pedagogical Technologies, 2*(1), e42185. https://doi.org/10.33902/SPT.202642185

Sun, J., Ma, H., Zeng, Y., Han, D., & Jin, Y. (2023). Promoting the AI teaching competency of K-12 computer science teachers: A TPACK-based professional development approach. *Education and information technologies, 28*(2), 1509-1533. https://doi.org/10.1007/s10639-022-11256-5

Tabachnick B. G.,& Fidell L. S. (2013*). Using multivariate statistics, (6th Ed.).* Pearson.

Tacy, J., Northam, S., & Wieck, L. (2016). Understanding the effects of technology acceptance in nursing faculty: A hierarchical regression. *Nursing Education Research Conference (NERC), 71,* 1-8. https://www.sigmarepository.org/nerc/2018/presentations_2018/71

Tarafdar, M., Tu, Q., Ragu-Nathan, T. S., & Ragu-Nathan, B. S. (2011). Crossing to the dark side: examining antecedents and consequences of technostress. *Communications of the ACM, 54*(9), *113-120.* https://doi.org/10.1145/1995376.1995403

Tarafdar, M., Maier, C., Laumer, S., & Weitzel, T. (2020). Explaining the link between technostress and technology addiction for social networking sites: A study of distraction as a coping behavior. *Information Systems Journal, 30*(1), 96-124. https://doi.org/10.1111/isj.12253

Teo, T., Sang, G., Mei, B., & Hoi, C. K. W. (2019). Investigating pre-service teachers' acceptance of web 2.0 technologies in their future teaching: A Chinese perspective. *Interactive Learning Environments, 27*(4), 530-546. https://doi.org/10.1080/10494820.2018.1489290

Tondeur, J., Scherer, R., Siddiq, F., & Baran, E. (2017). A comprehensive investigation of TPACK within preser-vice teachers' ICT profiles: Mind the gap! *Australasian Journal of Educational Technology, 33*(3), 46-60. https://doi.org/10.14742/ajet.3504

Trusz, S., & Demeshkant, N. (2025). Teachers' technological, pedagogical, and content knowledge related to artificial intelligence as a protective factor against technostress and techno-anxiety. *Studia z Teorii Wychowania*, *53*(4), 303-327. https://doi.org/10.5604/01.3001.0055.5084

Valiao, A. (2025). Technostress and its impact on the job performance of teachers. *Journal of Interdisciplinary Perspectives, 3*(2), 352-361. https://doi.org/10.69569/jip.2024.0692

Valtonen, T., Sointu, E., Kukkonen, J., Kontkanen, S., Lambert, M. C., & Mäkitalo-Siegl, K. (2017). TPACK updated to measure pre-service teachers' twenty-first century skills. *Australasian Journal of Educational Technology, 33*(3), 15-31. https://doi.org/10.14742/ajet.3518

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly, 36*(1), 157-178. https://doi.org/10.1111/j.1540-4560.1981.tb02627.x

Wang, K., Chai, C. S., Liang, J. C., & Sang, G. (2024). Exploring teachers' behavioural intentions to design artificial intelligence-assisted learning in Chinese K–12 education. *Technology, Pedagogy and Education, 33*(5), 629-645. https://doi.org/10.1080/1475939X.2024.2369241

Wang, K., Shu, Q., & Tu, Q. (2008). Technostress under different organizational environments: An empirical investigation. *Computers in Human Behavior, 24*(6), 3002-3013. https://doi.org/10.1016/j.chb.2008.05.007

Wang, Q., & Zhao, G. (2023). Exploring the influence of technostress creators on in-service teachers' attitudes toward ICT and ICT adoption intentions. *British Journal of Educational Technology*, *54*(6), 1771-1789. https://doi.org/10.1111/bjet.13315

Wang, X., Tan, S. C., & Li, L. (2020). Technostress in university students' technology-enhanced learning: An investigation from multidimensional person-environment misfit. *Computers in Human Behavior, 105*, 106208. https://doi.org/10.1016/j.chb.2019.106208

Wu, Y., & Wang, A. (2015). Technological, pedagogical, and content knowledge in teaching English as a foreign language: Representation of primary teachers of English in Taiwan. *The Asia-Pacific Education Researcher, 24*(3), 525-533. https://doi.org/10.1007/s40299-015-0240-7

Wu, C., Zhang, W., Hu, L., & Li, M. (2026). Research on middle school teachers' technostress empowered by artificial intelligence. *Frontiers in Artificial Intelligence, 8,* 1732088. https://doi.org/10.3389/frai.2025.1732088

Yang, Y., Xia, Q., Liu, C., & Chiu, T. K. (2025). The impact of TPACK on teachers' willingness to integrate generative artificial intelligence (GenAI): The moderating role of negative emotions and the buffering effects of need satisfaction. *Teaching and Teacher Education, 154,* 104877. https://doi.org/10.1016/j.tate.2024.104877

Zhang, C., Schießl, J., Plößl, L., Hofmann, F., & Gläser-Zikuda, M. (2023). Acceptance of artificial intelligence among pre-service teachers: a multigroup analysis. *International Journal of Educational Technology in Higher Education*, *20*(49), 1-22. https://doi.org/10.1186/s41239-023-00420-7

Zhang, Y. (2025). Research on formation mechanism of teachers' intention to use generative artificial intelligence. *E-education Research, 46*(2), 121-128. https://doi.org/10.13811/j.cnki.eer.2025.02.016

Zhakiyanova, Z., Zhaitapova, A., Orakova, A., Baizhekina, S., Shnaider, V., & Nametkulova, F. (2023). Investigation of primary school teachers' professional competencies and technological pedagogical content knowledge (TPACK) competencies. *International Journal of Education in Mathematics Science and Technology*, *11*(5), 1154-1172. https://doi.org/10.46328/ijemst.3604

Zawacki-Richter, O., Marin, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education–where are the educators? *International Journal of Educational Technology in Higher Education, 16*(1), 1-27. https://doi.org/10.1186/s41239-019-0171-0