



BEYOND TOOL USE: AN ANALYSIS OF PROMPT LITERACY AND EDUCATORS' READINESS FOR ARTIFICIAL INTELLIGENCE IN SCHOOLS

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ABSTRACT

Aim/Purpose	The purpose of this study is to identify teachers' and school administrators' readiness for artificial intelligence (AI) integration by conducting a comprehensive needs analysis, with a particular focus on the role of prompt literacy as an emerging dimension of AI competence.
Background	While AI-based tools are more widely accessible in educational settings, many educators struggle to use them pedagogically and strategically. Existing research has primarily emphasized AI adoption rather than educators' readiness, leaving a gap in understanding the competence-related and institutional factors shaping meaningful AI integration.
Methodology	The study adopted an exploratory mixed-methods design. Quantitative and qualitative data were collected via a researcher-developed online needs analysis survey distributed to teachers and school administrators in public schools in Türkiye (N = 434). Quantitative data were analyzed using descriptive statistics and non-parametric relational analyses, while open-ended responses were examined through thematic analysis.
Contribution	This paper contributes to the literature by systematically positioning prompt literacy as a foundational component of educators' AI readiness and by integrating quantitative and qualitative evidence within a needs-based framework. It extends AI-in-education research beyond tool adoption toward pedagogical and institutional readiness.
Findings	Findings indicate that although most participants reported using AI tools, the majority perceived their competence as beginner-level. Prompt literacy was

Accepting Editor Kay Fielden | Received: January 21, 2026 | Revised: March 3, March 8, March 12, 2026 | Accepted: March 25, 2026.

Cite as: Uğur, S. (2026). Beyond tool use: An analysis of prompt literacy and educators' readiness for artificial intelligence in schools. *Journal of Information Technology Education: Research*, 25, Article 14. <https://doi.org/10.28945/5751>

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	strongly associated with AI competence. Qualitative findings revealed pedagogical uncertainty, ethical and data security concerns, workload pressures, and a lack of institutional guidance as key barriers to effective AI integration.
Recommendations for Practitioners	Professional development initiatives should adopt differentiated and staged designs, prioritizing prompt literacy as a foundational skill and emphasizing pedagogical integration, ethical awareness, and context-specific classroom applications.
Recommendations for Researchers	Future research should conceptualize and operationalize prompt literacy, employ validated measurement instruments, and examine the effects of targeted AI professional development interventions using experimental or design-based research approaches.
Impact on Society	By supporting educators' pedagogically and ethically informed use of AI, the findings contribute to more responsible, equitable, and sustainable AI integration in education, helping to mitigate risks related to misuse, data privacy, and superficial adoption.
Future Research	Subsequent studies may explore longitudinal changes in educators' AI readiness, conduct comparative analyses across institutional or national contexts, and investigate how leadership practices and policy frameworks influence sustainable AI adoption in schools.
Keywords	artificial intelligence, prompt literacy, educators' readiness, professional development, teachers, school leaders, educational technologies, needs analysis, mixed methods

INTRODUCTION

The rapid proliferation of artificial intelligence (AI) technologies has begun to reshape educational practices across all levels of schooling. In particular, the widespread availability of generative AI tools has expanded educators' access to automated content creation, instructional support, and data-driven insights. As a result, AI is no longer perceived solely as a future-oriented innovation, but increasingly as a practical component of everyday teaching and school management. However, the integration of AI into educational practice remains uneven, raising critical questions regarding educators' readiness, competence, and professional development needs.

Recent studies indicate that although many teachers and school leaders have begun experimenting with AI tools, their use is often concentrated on content generation or administrative assistance (Chen et al., 2025; Tripathi et al., 2025). Reports of systematic pedagogical integration, such as AI-supported assessment or data-informed instructional decision-making, remain comparatively limited. This pattern suggests a potential gap between AI availability and pedagogically structured use in schools.

Understanding educators' needs is essential given the complexity of AI-driven systems. Unlike earlier educational technologies, AI tools operate through opaque decision-making processes, rely on large-scale data, and raise ethical concerns related to privacy, bias, and student autonomy (Ramnani, 2024). These characteristics require educators not only to acquire technical skills, but also to exercise informed pedagogical judgment and ethical awareness. Consequently, professional development initiatives that are not grounded in a systematic understanding of educators' existing practices and concerns risk remaining fragmented or ineffective.

Within this context, prompt literacy has emerged as a critical yet underexamined dimension of AI competence. Prompt writing – the ability to communicate instructional intent to generative AI systems – shapes the quality and pedagogical relevance of AI-generated outputs. Recent scholarship emphasizes that without adequate prompt literacy, educators may experience inconsistent results, diminished trust in AI systems, and reluctance to integrate AI into instructional practices (Biagini, 2025; Mehdaoui, 2024). Despite its importance, empirical evidence on educators’ prompt literacy levels and related needs remains limited.

In addition to teachers, school administrators play a pivotal role in shaping institutional conditions for AI integration. Leadership decisions influence not only the availability of technological infrastructure but also the establishment of ethical guidelines, professional development priorities, and organizational vision. Research on educational leadership suggests that without coherent institutional frameworks, AI use tends to remain individualized and unsustainable (Enăchescu, 2025; Sposato, 2025). Yet, studies that jointly examine teachers’ and administrators’ AI-related needs remain scarce.

Against this backdrop, conducting a systematic needs analysis constitutes a critical first step toward evidence-based AI integration in education. Needs analysis enables researchers and policymakers to identify gaps between current practices and desired competencies, as well as contextual barriers related to pedagogy, ethics, workload, and leadership. By integrating quantitative indicators with qualitative insights, needs-based approaches offer a comprehensive understanding of educators’ readiness for AI-enhanced teaching and school management (Cinganotto & Montanucci, 2025).

Accordingly, the present study aims to examine teachers’ and school administrators’ current use of AI, self-reported competence levels, and professional development needs through a mixed-method needs analysis. By focusing on both quantitative trends and qualitative explanations, the study seeks to provide an empirically grounded foundation for designing pedagogically meaningful and ethically informed AI-oriented professional development initiatives. In doing so, it contributes to the growing literature on AI readiness in education by foregrounding prompt literacy, pedagogical uncertainty, and leadership support as interconnected dimensions of effective AI integration.

LITERATURE REVIEW

AI IN EDUCATION: FROM TOOL ADOPTION TO PEDAGOGICAL INTEGRATION

AI has increasingly become a prominent component of educational discourse, driven by advances in generative models, learning analytics, and automated decision-support systems. Early research on AI in education focused on intelligent tutoring systems and automation of instructional tasks (Luckin et al., 2016). More recent studies, however, have shifted attention toward generative AI tools and their potential to support instructional design, assessment, and personalized learning experiences (Holmes et al., 2022).

Despite this growing interest, literature reports a discrepancy between the availability of AI tools and their pedagogically meaningful use in educational settings. Reported AI use is frequently concentrated on content generation or administrative support, with comparatively fewer examples of systematically embedded pedagogical applications (Selwyn, 2019; Williamson & Eynon, 2020). This pattern suggests that AI adoption in education is not merely a technological issue, but a pedagogical and organizational challenge.

TEACHERS’ AND SCHOOL LEADERS’ READINESS FOR AI INTEGRATION

Research on teachers’ readiness for educational technologies has long emphasized the importance of pedagogical beliefs, contextual support, and professional experience (Ertmer et al., 2014). Within the

AI context, recent studies indicate that educators' readiness is shaped not only by technical competence but also by ethical awareness, data literacy, and confidence in pedagogical decision-making (Pedrosa Prats, 2025).

School leaders play a critical role in shaping institutional conditions for AI integration. Leadership-oriented studies highlight that without clear policies, ethical guidelines, and strategic vision, AI use in schools tends to remain fragmented and dependent on individual initiative (Mehdaoui, 2024). Consequently, understanding both teachers' and administrators' perceptions and needs is essential for designing sustainable AI-related professional development initiatives.

PROMPT LITERACY AS AN EMERGING DIMENSION OF AI COMPETENCE

The rapid diffusion of generative AI systems in educational contexts has shifted attention from mere tool access toward the competencies required for meaningful human-AI interaction. Among these competencies, prompt literacy has emerged as a critical yet under-theorized dimension that influences the quality, relevance, and pedagogical value of AI-generated outputs. Unlike passive tool consumption, effective AI use requires the capacity to formulate structured, context-rich, and goal-oriented prompts that guide the system toward desired instructional outcomes.

Recent scholarship conceptualizes prompt literacy as a hybrid competence situated at the intersection of domain knowledge, pedagogical intent, and communicative precision (Hwang et al., 2023). However, it is important to distinguish prompt literacy from adjacent constructs such as AI literacy, digital literacy, and data literacy. AI literacy typically refers to understanding how AI systems function, their capabilities, and limitations, often emphasizing algorithmic awareness and ethical considerations. Digital literacy focuses on the effective and responsible use of digital technologies, while data literacy involves interpreting and critically evaluating data-driven outputs. In contrast, prompt literacy is interactional and generative; it concerns the ability to structure queries strategically in ways that shape AI responses for pedagogical purposes.

This distinction is particularly significant in educational settings. An educator may possess general AI literacy – understanding, for example, how large language models operate – yet still lack the practical skill required to construct prompts that produce curriculum-aligned explanations, differentiated materials, or higher-order thinking tasks. Similarly, digital fluency does not translate into the capacity to scaffold AI interactions pedagogically. Prompt literacy, therefore, functions not merely as a technical sub-skill, but as an enabling competence that mediates between pedagogical knowledge and AI system affordances.

Emerging empirical studies suggest that variations in prompt formulation significantly affect the depth, coherence, and instructional value of AI-generated outputs (Kasneci et al., 2023). Inconsistent or underspecified prompts often lead to generic responses, reinforcing perceptions that AI tools are superficial or unreliable. Conversely, structured prompting incorporating context, role specification, constraints, and iterative refinement has been associated with higher-quality outputs and more sustained engagement with AI systems. These findings imply that educators' perceived AI competence may depend less on system familiarity and more on their ability to operationalize pedagogical intent through effective prompting.

Despite its growing relevance, prompt literacy remains underexplored in empirical research on AI integration in schools. Much of the existing literature emphasizes adoption rates, ethical concerns, or institutional policies, while overlooking the micro-level interactional practices that determine AI effectiveness in classroom contexts. Moreover, few studies examine prompt literacy within a needs-analysis framework that foregrounds educators' lived experiences and professional development needs.

Addressing this gap is essential for advancing AI readiness models beyond generalized digital competence. If prompt literacy constitutes a foundational mechanism shaping AI-mediated teaching and learning, then professional development initiatives must move beyond introductory AI awareness

sessions toward structured, scaffolded training in prompt design, refinement, and pedagogical alignment. Accordingly, this study positions prompt literacy not as a peripheral technical skill, but as a core dimension of educators' AI readiness requiring systematic investigation.

ETHICAL, ORGANIZATIONAL, AND WORKLOAD CONSIDERATIONS IN AI ADOPTION

Beyond pedagogical competence, ethical concerns and organizational constraints significantly influence AI adoption in educational contexts. Studies report educators' concerns regarding data privacy, student dependency, algorithmic bias, and academic integrity (Selwyn, 2019; Williamson & Eynon, 2020). Additionally, time constraints and increasing workload pressures limit educators' capacity to experiment with and critically reflect on emerging technologies (Trust et al., 2023).

These findings suggest that AI-related professional development should not be framed solely as skill acquisition, but rather as a comprehensive process addressing pedagogical design, ethical reasoning, and institutional governance.

INTEGRATIVE SYNTHESIS

Overall, the reviewed literature reveals a critical shift in AI-in-education discourse, from questions of access and adoption toward deeper concerns of pedagogical readiness, ethical governance, and interactional competence. While prior research has established that AI integration depends on teachers' technological and pedagogical knowledge, emerging scholarship suggests that the quality of human–AI interaction itself may function as a decisive factor in determining educational value. In this respect, prompt literacy appears to operate as a mediating competence linking pedagogical intent to AI system outputs. Yet, empirical investigations rarely situate prompt literacy within broader institutional and professional development frameworks. Moreover, needs analysis studies in educational technology have typically examined general digital competence rather than AI-specific interactional skills. Consequently, there remains a limited understanding of how educators' prompt-related competencies intersect with perceived AI competence, professional experience, and organizational context. Addressing this gap requires an exploratory, mixed-method needs analysis capable of capturing both statistical patterns and lived experiences. The present study responds to this need by systematically examining educators' AI use, prompt literacy levels, and professional development requirements within a unified framework.

THEORETICAL FRAMEWORK

PEDAGOGICAL TECHNOLOGY INTEGRATION AND AI READINESS

This study is theoretically grounded in pedagogical technology integration frameworks that emphasize the interaction between technological tools, pedagogical knowledge, and contextual factors. While models such as Technological Pedagogical Content Knowledge (TPACK) have been widely used to conceptualize teachers' technology integration (Koehler & Mishra, 2009), recent scholarship argues that AI introduces additional layers of complexity related to autonomy, data-driven decision-making, and ethical responsibility (Holmes et al., 2022).

In the context of AI, educators' readiness extends beyond traditional technology acceptance or skill-based models. It encompasses pedagogical judgment, ethical awareness, and institutional alignment. Accordingly, this study adopts a needs-based readiness perspective, conceptualizing AI readiness as a multidimensional construct shaped by individual competence, pedagogical confidence, and organizational support.

NEEDS ANALYSIS AS A FOUNDATION FOR AI-ORIENTED PROFESSIONAL DEVELOPMENT

Needs analysis has been widely recognized as a critical first step in designing effective professional development programs, particularly in complex and rapidly evolving technological domains. In educational technology research, needs-based approaches enable the identification of gaps between current practice and desired competencies, thereby informing evidence-based training design (Tondeur et al., 2017).

Within the AI context, needs analysis serves a dual function: (a) mapping educators' existing AI use and perceptions, and (b) uncovering latent barriers related to pedagogy, ethics, and leadership. By integrating quantitative indicators of AI use with qualitative insights into educators' concerns, expectations, and needs, a needs analysis provides a robust empirical foundation for subsequent intervention design.

RESEARCH QUESTIONS

Guided by the literature and theoretical framework outlined above, this study addresses the following research questions while uncovering contextual barriers in pedagogy, ethics, workload, and leadership. By integrating quantitative indicators with qualitative insights, needs-based approaches offer a comprehensive understanding of educators' readiness for AI-enhanced teaching and school management (Tondeur et al., 2017).

- RQ1:** What are teachers' and school administrators' current levels of AI use and self-reported competence in educational contexts?
- RQ2:** What types of AI tools and application areas are most reported by teachers and school administrators?
- RQ3:** What are teachers' and school administrators' perceived professional development needs related to AI use in education?
- RQ4:** How do teachers and school administrators report their levels of prompt literacy, and how is prompt literacy situated within their broader AI-related needs?
- RQ5:** What pedagogical, ethical, organizational, and workload-related factors underlie teachers' and school administrators' reported AI-related needs?

Accordingly, the present study aims to examine teachers' and school administrators' current use of AI, self-reported competence levels, and professional development needs through a mixed-methods needs analysis. By focusing on both quantitative trends and qualitative explanations, the study seeks to provide an empirically grounded foundation for designing pedagogically meaningful and ethically informed AI-oriented professional development initiatives. In doing so, it contributes to the growing literature on AI readiness in education by foregrounding prompt literacy, pedagogical uncertainty, and leadership support as interconnected dimensions of effective AI integration.

METHOD

RESEARCH DESIGN

This study employed an exploratory mixed-methods research design to conduct a comprehensive needs analysis of teachers' and school administrators' use of AI in educational contexts. The design was formative rather than confirmatory, aiming to map educators' AI practices, perceived competence levels, prompt literacy, and professional development needs prior to any structured intervention.

Quantitative and qualitative data were collected concurrently through a researcher-developed survey instrument and integrated during the interpretation phase (Doyle et al., 2016). Given the exploratory

purpose and the absence of validated instruments for measuring prompt literacy in school contexts, the development of a context-sensitive instrument was deemed appropriate.

POPULATION, SAMPLING, AND PARTICIPANTS

The broader population consisted of 12,716 teachers working in Eskişehir province, Türkiye. However, the survey was disseminated only to educators employed in the province's central districts, where 4,922 teachers were working at the time of data collection. The sampling frame, therefore, included teachers and school administrators working in public schools in these central districts. Private schools were excluded due to administrative access constraints and the study's focus on the public education system administered by the Ministry of National Education.

The survey remained open for three weeks during the 2025 academic term. Participation was voluntary and anonymous. A total of 434 valid responses were collected, corresponding to approximately 8.8% of the central-district teacher population. Of the participants, 391 were teachers (90.1%), and 33 were school administrators (7.6%).

Teachers represented various subject areas, while administrators included principals and vice-principals working in primary and secondary public schools. Some participants reported prior professional experience in different regions of Türkiye, contributing to a diversity of institutional perspectives.

RECRUITMENT AND DATA COLLECTION PROCEDURE

Following ethical approval, the survey was officially disseminated by the Eskişehir Provincial Directorate of National Education. The survey link (Google Forms) was distributed through:

- Official institutional email lists
- WhatsApp communication groups used by the central-district public school staff

Participation was entirely voluntary (opt-in), and no incentives were provided. Responses were submitted anonymously, and no personal identifiable information was collected.

Instrument development

The data collection instrument was developed by the researcher specifically for this study. The survey consisted of 10 items organized into three sections:

1. Demographic Information (3 items)

Participants reported their professional role (teacher or administrator), educational level, and years of professional experience.

2. AI Experience and Use (4 items)

This section included closed-ended items assessing:

- Prior experience with AI tools
- Frequency of AI use
- Self-reported AI competence
- Self-reported prompt writing literacy

3. AI-Related Learning Needs (3 items)

This section included closed-ended and multiple-response questions examining areas in which participants wished to receive further professional development (e.g., instructional content development, assessment, data analysis, classroom management, decision-making). Several items included optional open-ended fields allowing participants to elaborate on their responses.

Before presenting the findings, it is important to clarify the analytical rationale guiding the statistical procedures employed in this study. Because key variables were measured using ordinal self-report categories (AI competence: 3 levels; prompt literacy: 4 levels), non-parametric statistical techniques

were deemed appropriate. Accordingly, descriptive statistics were used to map general patterns, while chi-square tests of independence were employed to examine associations between categorical variables. In addition, ordinal association analyses (Spearman's rho and Kendall's tau-b) were used to assess monotonic relationships between ordered competence ratings, without imposing distributional assumptions. These procedures align with the exploratory nature of the study and the formative purpose of the needs analysis, which prioritizes pattern identification over causal inference.

Operationalization of key variables

AI Competence. AI competence was operationalized as participants' self-reported level of proficiency in using AI tools for educational purposes, measured on a three-category ordinal scale:

- Beginner
- Intermediate
- Advanced

This measure reflects perceived competence rather than objective skill assessment.

Prompt Literacy. Prompt literacy was operationalized as participants' self-reported ability to:

- Formulate clear and structured prompts
- Provide contextual information when interacting with AI systems
- Break complex instructional tasks into structured requests
- Iteratively refine prompts based on AI responses

Participants rated their prompt literacy using the same four-point ordinal scale:

- Beginner
- Basic
- Intermediate
- Advanced

A brief definition of prompt writing was provided within the survey to ensure conceptual clarity.

Content Validity. To enhance content validity, the initial version of the survey was reviewed by two experts:

- One expert in educational technology
- One expert in measurement and evaluation

Based on their feedback, revisions were made to improve clarity, alignment with study objectives, and scale consistency. Minor wording adjustments and item sequencing modifications were implemented prior to dissemination.

DATA ANALYSIS

Quantitative analysis

Given the ordinal nature of the variables and reliance on self-reported measures, non-parametric statistical techniques were employed. The following analyses were conducted:

- Descriptive statistics (frequencies and percentages)
- Chi-square tests of independence
- Spearman's rho
- Kendall's tau-b

These procedures were used to examine associations between AI competence, prompt literacy, professional experience, and teaching branch. The exploratory orientation of the study prioritizes pattern identification rather than causal inference.

Qualitative analysis

Open-ended responses were analyzed using descriptive thematic analysis following an inductive coding process. The analysis proceeded through:

1. Familiarization with responses
2. Initial open coding
3. Theme clustering
4. Iterative refinement of categories

The primary researcher conducted the initial coding. A domain expert reviewed emerging themes during the refinement stage to enhance interpretive credibility. Discrepancies were resolved through discussion.

Mixed-methods integration

Quantitative and qualitative findings were integrated during the interpretation phase using a narrative convergence approach. Integration involved:

- Comparing statistical patterns with qualitative explanations
- Identifying convergence and divergence across data strands
- Using thematic insights to contextualize quantitative trends

This strategy enabled explanatory depth while preserving the exploratory character of the needs analysis.

Ethical considerations

Ethical approval for the study was obtained from the Ethics Committee of Anadolu University (Approval No: 897546). Following ethical approval, the survey was officially disseminated to teachers and school administrators through the Provincial Directorate of National Education. Participation was voluntary, informed consent was obtained digitally, and all responses were collected anonymously. No personally identifiable information was requested or recorded. The survey was officially shared with teachers and school administrators by the Provincial Directorate of National Education, ensuring institutional permission and transparency. Participation was voluntary, informed consent was obtained digitally, and no personally identifiable information was collected. All procedures were conducted in accordance with established ethical standards for educational research.

FINDINGS

This section reports the findings of the needs analysis conducted to examine teachers' and school administrators' AI use, perceived competence, and professional development needs. Consistent with the exploratory mixed-methods design and the stated research questions, quantitative findings are presented first, followed by qualitative findings derived from thematic analysis of open-ended responses. An integrative synthesis then explains the quantitative patterns through qualitative insights.

Before presenting the findings, it is important to clarify the analytical rationale guiding the statistical procedures employed in this study. Given that the primary variables (e.g., perceived AI competence and prompt literacy levels) were measured using three and four-point ordinal self-report scales, non-parametric statistical techniques were deemed appropriate. Unlike parametric methods that assume interval-level data and normal distribution, non-parametric analyses allow for the examination of ordinal associations without imposing distributional assumptions. Accordingly, descriptive statistics were used to map general patterns of AI use and competence levels, while chi-square tests of independence, Spearman's rho, and Kendall's tau-b were employed to examine associations between variables. These procedures align with the exploratory nature of the study and the formative purpose of the needs analysis, which prioritizes pattern identification over causal inference.

QUANTITATIVE FINDINGS

Participant characteristics

Regarding professional experience, Figure 1 shows that more than half of the participants (52.2%) had 11–20 years of teaching experience, while 27.6% reported 21 years or more. Early-career teachers constituted a smaller segment of the sample, with 7.4% having 0–5 years of experience and 12.9% having 6–10 years of experience.

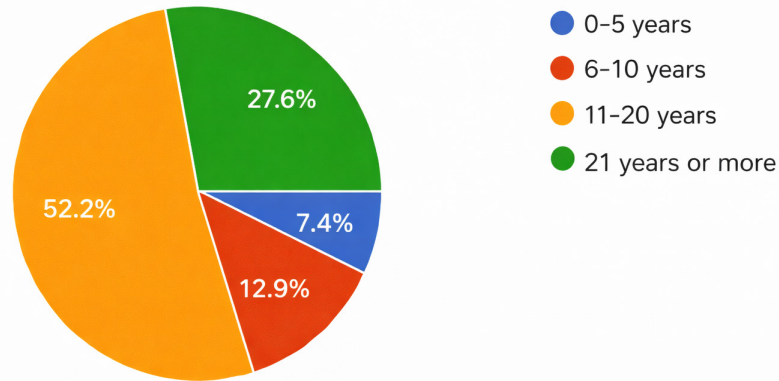


Figure 1. Professional experience of participants

The dominance of mid- and late-career educators suggests that the identified needs and skill gaps are not merely generational but rather indicative of a broader system-level challenge in adapting professional competencies to emerging AI technologies. Analysis of subject areas (Figure 2) revealed that Turkish language teachers constituted the largest group (54.7%), followed by mathematics teachers (12.9%). Science, social studies, information technologies, arts, music, physical education, and special education were represented in smaller proportions.

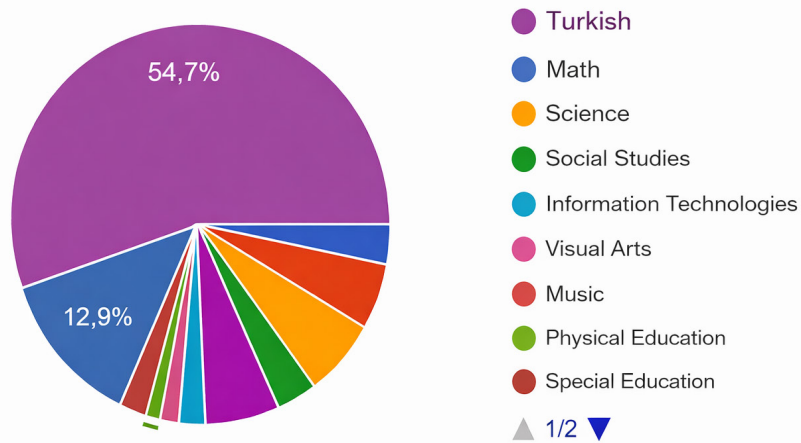


Figure 2. Subject area distribution

This uneven distribution should be considered when interpreting AI use and readiness, as prior research suggests that subject-specific pedagogical cultures influence both technology adoption and perceived relevance (Kaponda, 2024).

As shown in Figure 3, participants represented a broad range of educational levels. The largest group consisted of elementary school teachers (37.9%), followed by middle school teachers (28.3%) and

high school teachers (21.6%). Smaller proportions were drawn from preschool (7.4%) and other educational contexts (4.8%), with university-level education constituting a minimal share of the sample.

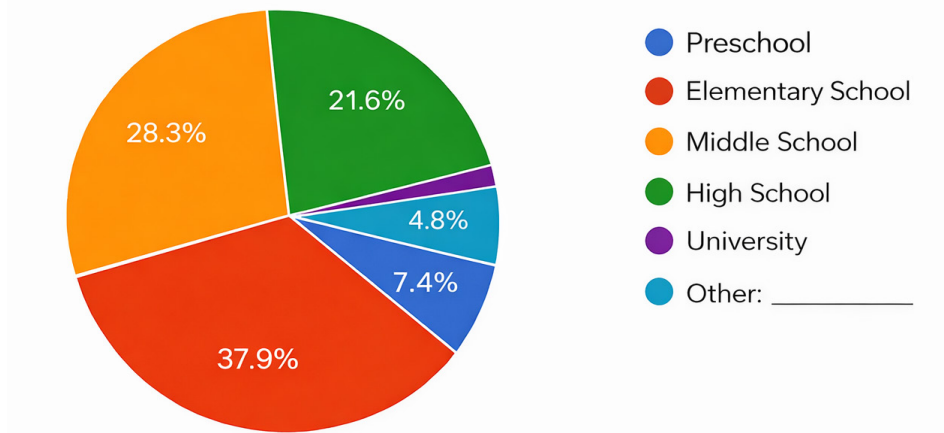


Figure 3. Distribution across educational levels

This distribution indicates that the findings reflect K–12 educational contexts, where AI-related pedagogical transformation is often shaped by curriculum constraints, assessment pressures, and institutional regulations.

Most participants are experienced educators, with nearly 4 out of 5 reporting more than 10 years of professional experience. This profile indicates that the identified AI-related needs are more closely associated with pedagogical integration and institutional alignment than with novice uncertainty, consistent with prior research on technology integration among experienced teachers (Ertmer et al., 2014; Tondeur et al., 2017).

AI USE FREQUENCY AND SELF-REPORTED COMPETENCE

Participants' AI use frequency and perceived competence levels are presented in Table 1.

Table 1. Frequency and self-reported level of AI use

Variable	Category	f	%
AI use	No	77	17.7
	Yes, occasionally	265	60.9
	Yes, frequently	93	21.4
AI competence level	Beginner	303	69.7
	Intermediate	122	28.0
	Advanced	10	2.3

Despite relatively high reported usage rates, Table 1 shows that 69.7% of participants identified themselves as beginners, stating that they are still in the learning phase. Only 28% perceived themselves at an intermediate level, and a very small proportion (2.3%) considered themselves advanced users. Although a substantial majority reported using AI tools, nearly 70% perceived their competence as beginner-level. This pattern reveals a clear access–competence gap, reinforcing the argument that exposure to AI tools does not automatically lead to pedagogically meaningful integration (Alexandrowicz, 2024; Koehler & Mishra, 2009).

This discrepancy between frequency of use and perceived competence highlights a critical issue: AI tools are being used instrumentally rather than pedagogically or strategically. The finding supports

emerging arguments in the literature that AI adoption in schools often remains at a surface level unless supported by structured training and pedagogical framing.

PROMPT LITERACY LEVELS

Participants' prompt writing literacy levels are shown in Table 2. Approximately 90% of participants reported having no or only basic prompt-writing knowledge. Given the pivotal role of prompt quality in shaping generative AI outputs, this finding positions prompt literacy as a structural constraint on effective pedagogical AI use (Haugsbaken & Hagelia, 2024; Kasneci et al., 2023). These findings are particularly significant given the central role of prompt literacy in effective human–AI interaction. The data suggest that AI use without prompt literacy may limit educators' ability to leverage AI tools meaningfully, reinforcing concerns raised in recent conceptual work on AI literacy and human–AI collaboration.

Table 2. Prompt writing literacy levels of participants

Level	f	%
No knowledge	270	62.1
Basic	119	27.4
Intermediate	39	9.0
Advanced	7	1.6

AI TOOLS AND APPLICATION AREAS

The AI tools most frequently reported by participants are presented in Table 3, while areas of AI use and learning needs are summarized in Table 4.

Table 3. AI tools used by participants (multiple responses)

AI tool	f
ChatGPT	337
Canva AI	201
Gemini	168
ClassDojo	80
Microsoft Copilot	79

Table 4. Areas of AI use and learning needs (multiple responses)

Area	f
Instructional content and material development	326
Classroom management and planning	245
Data analysis and reporting	262
Student behavior and learning monitoring	250
Administrative and strategic decision-making	92

The dominance of generative AI tools (e.g., ChatGPT, Canva AI) indicates that participants primarily associate AI with content production and instructional support. However, substantial interest in data

analysis, student monitoring, and decision-making suggests emerging recognition of AI's broader pedagogical and organizational potential (Selwyn, 2019; Williamson & Eynon, 2020).

QUALITATIVE FINDINGS: THEMATIC ANALYSIS

Open-ended responses were analyzed using an inductive thematic analysis approach. Initial codes derived from participants' statements were iteratively grouped into categories, sub-themes, and overarching themes. The integrated analysis yielded five interrelated themes reflecting educators' pedagogical, technical, ethical, and institutional experiences with AI in schools. Table 5 presents the themes, subthemes, and categories that emerged from the qualitative analysis.

Table 5. Themes, sub-themes, categories, and sample quotations derived from open-ended responses

Theme	Sub-theme	Category	Sample quotation
<i>Pedagogical Uncertainty and Integration Anxiety</i>	Instructional alignment	Difficulty embedding AI into lesson design	"I know the tools, but I am not sure how to use them correctly in my lessons." (T18)
	Assessment uncertainty	Fear of inappropriate or superficial use	"I don't know how to evaluate student work created with AI." (T11)
<i>Limited Prompt Literacy as a Barrier</i>	Prompt formulation	Inconsistent AI outputs	"The results change depending on how I ask, but I don't really know how to ask properly." (T7)
	Conceptual gap	Trial-and-error interaction	"I usually try random sentences and hope it works." (T29)
<i>Ethical and Data Security Concerns</i>	Data privacy	Fear of exposing student data	"I am worried about entering students' data into these systems." (T25)
	Academic integrity	Dependency and misuse concerns	"Students may rely too much on AI instead of learning." (T33)
<i>Time Constraints and Workload Pressures</i>	Learning curve	Perceived initial effort	"It can save time, but learning how to use it properly takes too much effort at first." (T36)
	Workload intensity	Lack of time for experimentation	"We already have too many responsibilities to explore AI deeply." (T9)
<i>Need for Institutional Guidance and Leadership Support</i>	Policy ambiguity	Absence of clear regulations	"There is no clear roadmap at the school level." (A4)
	Leadership support	Expectation of guidance from the administration	"We need official guidance to feel confident using AI." (T41)

NARRATIVE INTEGRATION OF THEMES

The qualitative findings provide critical explanatory depth to the quantitative results. The first theme, pedagogical uncertainty and integration anxiety, indicates that educators' challenges stem less from technical incapacity and more from difficulties aligning AI use with instructional goals. This supports earlier research suggesting that pedagogical beliefs and instructional design considerations play a decisive role in technology integration (Ertmer et al., 2014).

The second theme, limited prompt literacy, emerged as a foundational barrier influencing both perceived competence and learning outcomes. Participants' descriptions of trial-and-error interactions with AI tools closely align with the quantitative finding that a substantial majority lacked prompt-

writing skills. This reinforces the conceptualization of prompt literacy as a core component of AI literacy (Walter, 2024).

Ethical and data security concerns formed the third theme, particularly salient among experienced teachers and school administrators. These concerns appear to restrict AI use to low-risk activities such as content generation, consistent with prior literature on cautious adoption of emerging technologies in education (Selwyn, 2019).

The fourth theme highlights time constraints and workload pressures as structural barriers. Although participants recognized AI’s potential to save time, the perceived learning curve discouraged deeper engagement. These findings echo well-documented workload-related obstacles to educational innovation (Williams-Lewis, 2025).

Finally, the need for institutional guidance and leadership support underscores the importance of governance, policy clarity, and pedagogical leadership. Participants’ calls for institutional roadmaps and official guidelines suggest that sustainable AI integration requires organizational as well as individual readiness (Holmes et al., 2022; Mariam et al., 2024).

INTEGRATION OF QUANTITATIVE AND QUALITATIVE FINDINGS

Integrating quantitative and qualitative findings reveals that while AI use among teachers and school administrators is increasingly common, it remains surface-level, tool-oriented, and largely individualized. Quantitative results demonstrate widespread access but low perceived competence and prompt literacy, whereas qualitative insights attribute these patterns to pedagogical uncertainty, ethical concerns, time constraints, and limited institutional guidance. Collectively, the findings indicate that effective AI integration requires professional development initiatives that address prompt literacy, pedagogical design, ethical awareness, and leadership-supported implementation, thereby aligning with the needs-based readiness framework guiding this study.

RELATIONSHIPS BETWEEN KEY VARIABLES

Relationship between professional experience and AI competence level

Teachers’ and school administrators’ years of professional experience and their self-reported AI competence levels were examined using a chi-square test of independence. The results indicated a statistically significant relationship between professional experience and AI competence level, $\chi^2(6) = 19.02$, $p = 0.004$. The relationship between professional experience and AI competence level is shown in Table 6.

Table 6. Relationship between professional experience and AI competence level

Professional experience	Beginner	Intermediate	Advanced
0–5 years	↑	↑	–
6–10 years	↑	↑	–
11–20 years	↑↑	↑	–
21+ years	↑↑	↑	↑

Note. Arrows indicate relative concentration patterns for interpretive purposes.

Educators with longer professional experience were more likely to report higher levels of AI competence. However, even among highly experienced participants, advanced AI competence remained limited. This finding suggests that professional seniority alone does not guarantee advanced AI proficiency, but may facilitate greater openness or confidence in engaging with emerging technologies. Similar patterns have been reported in prior research, emphasizing the role of pedagogical maturity rather than age or tenure alone in technology integration (Ertmer et al., 2014; Tondeur et al., 2017).

Relationship between teaching branch and AI use

The relationship between participants' teaching branch and their AI use status (user vs. non-user) was analyzed using a chi-square test of independence. The results revealed a statistically significant association, $\chi^2(20) = 34.84$, $p = 0.021$. Data on the relationship between participants' field of study and the use of AI are presented in Table 7.

Table 7. Relationship between teaching branch and AI use

Branch (selected examples)	AI use: Yes	AI use: No
Classroom teachers	↑↑	↓
ICT/Computer Science	↑↑	↓
Mathematics & Science	↑	↓
Social Sciences	↑	↑
Other branches	↑	↑

AI use varied across teaching branches, with classroom teachers and ICT-related branches reporting higher levels of AI use. This variation may reflect differences in curricular flexibility, access to digital tools, and perceived relevance of AI to subject-specific pedagogical practices. Prior studies similarly suggest that disciplinary culture and subject epistemology influence educators' technology adoption patterns (Koehler & Mishra, 2009; Lai et al., 2022).

The relationship between participants' teaching branch and their AI use status (user vs. non-user) was examined using a chi-square test of independence. The analysis revealed a statistically significant association between teaching branch and AI use, $\chi^2(20) = 34.84$, $p = 0.021$.

To assess the strength of this association, Cramér's V was calculated, yielding a value of $V = 0.28$, which indicates a small to moderate effect size. This result suggests that while AI use varies significantly across teaching branches, branch affiliation alone does not fully account for differences in AI engagement.

Descriptive inspection of the contingency table indicated that classroom teachers and information and communication technology-related branches reported higher rates of AI use, whereas more content-specific branches demonstrated greater variability. This pattern implies that curricular flexibility and perceived relevance of AI to instructional practice may influence educators' likelihood of adopting AI tools.

Relationship between AI competence level and prompt writing literacy

To examine the relationship between AI competence level and prompt writing literacy, a chi-square test of independence was conducted. The analysis revealed a very strong and statistically significant association, $\chi^2(6) = 234.78$, $p < 0.001$. Table 8 presents data on the relationship between AI proficiency level and speed typing skills.

Prompt writing literacy was strongly associated with perceived AI competence. Participants who reported higher AI competence levels were substantially more likely to demonstrate intermediate or advanced prompt-writing skills. This finding empirically supports recent conceptualizations of prompt literacy as a core mechanism underlying effective AI use, rather than a peripheral technical skill (Kasneci et al., 2023; Walter, 2024). To further examine the association between participants' AI competence levels and their prompt writing literacy, a Spearman rank-order correlation analysis was conducted. The analysis revealed a moderate to strong positive correlation between AI competence and prompt writing literacy ($\rho = 0.53$, $p < 0.001$).

Table 8. Relationship between AI competence level and prompt writing literacy

AI competence level	No prompt knowledge	Basic	Intermediate	Advanced
Beginner	↑↑	↑	↓	–
Intermediate	↓	↑↑	↑	–
Advanced	–	↓	↑	↑

This result indicates that participants who reported higher AI competence were significantly more likely to demonstrate stronger prompt-writing skills. Conversely, participants with low AI competence tended to report limited or no prompt literacy. The strength and significance of this relationship empirically support the argument that prompt literacy is not a peripheral technical skill, but rather a core mechanism underlying effective AI use in educational contexts.

Integrative interpretation of relationship analyses

When all these findings are considered together, these relational analyses deepen the understanding of the needs analysis findings. While professional experience and disciplinary background influence AI engagement, prompt literacy emerges as the most decisive factor distinguishing low and high levels of AI competence. This pattern reinforces the argument that effective AI integration in education depends less on tenure or subject area and more on educators' ability to meaningfully interact with AI systems through well-structured prompts.

These results further suggest that professional development initiatives should prioritize prompt-based pedagogical design, tailored to different disciplinary contexts and experience levels, rather than adopting one-size-fits-all AI training models.

Ordinal association between AI competence and prompt writing literacy

AI competence level and prompt writing literacy were measured on ordinal scales. In addition to Spearman's rho, the association between these two variables was further examined using Kendall's tau-b, which is particularly suitable for ordinal data with tied ranks.

The analysis revealed a statistically significant and positive association between AI competence and prompt writing literacy, $\tau_b \approx 0.41$, $p < 0.001$. This result confirms the robustness of the previously observed relationship between AI competence and prompt literacy. Participants with higher AI competence levels consistently demonstrated stronger prompt-writing skills, whereas those at lower levels tended to report limited or no prompt literacy. The convergence of Spearman and Kendall coefficients strengthens the validity of the finding and indicates that prompt literacy is a stable and meaningful correlate of AI competence in educational contexts.

Profile-based analysis of AI competence levels

To provide a more pedagogically meaningful interpretation of the quantitative findings, participants were grouped into three AI competence profiles based on their self-reported competence levels:

- Low competence profile (Beginner)
- Moderate competence profile (Intermediate)
- High competence profile (Advanced)

These profiles were examined in relation to prompt literacy levels, AI use frequency, and reported learning needs. Table 9 shows the profile characteristics by AI competence level.

Table 9. Profile characteristics by AI competence level

AI competence profile	Prompt literacy (dominant level)	AI use frequency	Dominant learning needs
Beginner	No knowledge/Basic	Occasional	Content generation, basic use
Intermediate	Basic/Intermediate	Occasional–Frequent	Data analysis, classroom support
Advanced	Intermediate/Advanced	Frequent	Pedagogical design, strategic use

The profile-based analysis reveals a clear progression pattern. Participants in the beginner profile primarily engaged with AI at a surface level and expressed needs related to basic operational use. In contrast, intermediate and advanced profiles demonstrated increasing interest in data-informed decision-making, pedagogical design, and strategic applications of AI.

This progression suggests that educators' AI-related needs evolve in tandem with their competence levels, underscoring the importance of differentiated professional development pathways rather than one-size-fits-all training models.

Integrative interpretation of extended analyses

When the additional analyses are considered together, the three key findings are further strengthened. First, the relationship between AI competence and prompt writing literacy is both statistically robust and pedagogically meaningful, as evidenced by multiple ordinal association measures. Second, AI competence profiles reveal distinct patterns of use and need, indicating that educators' expectations from AI shift from operational support toward pedagogical and strategic functions as competence increases. Third, these findings support a needs-based, staged approach to AI-oriented professional development, in which prompt literacy functions as a foundational competence that enables higher-level pedagogical integration.

Descriptive comparison between teachers and school administrators

Descriptive comparisons suggested notable role-based differences between teachers and school administrators. Teachers tended to report AI use primarily for instructional content generation and classroom-related tasks, whereas school administrators more often reported AI use for administrative decision-making, planning, and policy-related applications. In addition, administrators more often highlighted concerns related to ethical use, data security, and the need for institutional guidance. Teachers, by contrast, emphasized pedagogical uncertainty and challenges related to prompt writing and instructional integration. These patterns should be interpreted as descriptive tendencies rather than causal differences, reflecting participants' professional roles and responsibilities within the school system.

In summary, the results reveal three central patterns. First, although AI tools are widely accessed and occasionally used, perceived competence levels remain predominantly at the beginner or basic stages. Second, prompt literacy demonstrates a strong and consistent association with perceived AI competence, suggesting that the quality of human–AI interaction plays a critical role in shaping educators' confidence and engagement. Third, qualitative findings indicate that pedagogical uncertainty, ethical concerns, workload pressures, and limited institutional guidance constrain deeper AI integration. Together, these findings suggest that AI readiness is not merely a matter of access or familiarity, but rather a multidimensional construct shaped by interactional competence and contextual conditions.

DISCUSSION

The purpose of this study was to conduct a comprehensive needs analysis of teachers' and school administrators' AI use, competence levels, and professional development needs. By integrating quantitative findings with an in-depth thematic analysis of open-ended responses, the study provides a nuanced understanding of educators' readiness for AI integration and the structural factors shaping their engagement with AI in educational contexts.

FROM WIDESPREAD ACCESS TO PEDAGOGICAL UNCERTAINTY

In relation to RQ1, which examined educators' levels of AI use and perceived competence, one of the most salient findings of this study is the discrepancy between educators' widespread access to AI-based tools and their limited pedagogical confidence in using them. However, a substantial proportion of participants reported frequent or occasional AI use, and nearly two-thirds identified themselves as beginner-level users. This access-competence gap aligns with prior research indicating that technology availability alone does not ensure meaningful pedagogical integration (Koehler & Mishra, 2009; Selwyn, 2019).

The qualitative findings deepen this interpretation by revealing pedagogical uncertainty and integration anxiety as a dominant theme. Participants' narratives indicate that challenges are not rooted in resistance to AI, but rather in uncertainty about how to align AI tools with instructional design, assessment practices, and learning objectives. This finding reinforces the view that AI integration constitutes a pedagogical transformation rather than a purely technological shift, requiring deliberate instructional frameworks and reflective practice (Holmes et al., 2022).

PROMPT LITERACY AS A FOUNDATIONAL DIMENSION OF AI READINESS

In response to RQ2, a central and original contribution of this study lies in empirically establishing prompt literacy as a foundational component of educators' AI competence. Quantitative analyses demonstrated significant associations between self-reported AI competence and prompt-writing skills, while thematic analysis identified limited prompt literacy as a pervasive barrier to effective AI use.

Participants frequently describe trial-and-error interactions with AI systems and inconsistent outputs resulting from unclear prompts. These findings extend recent conceptual discussions by providing empirical evidence that prompts literacy functions not as an auxiliary technical skill, but as a core mechanism shaping educators' agency in human–AI interaction (Kasneci et al., 2023; Walter, 2024). Moreover, the data suggest a developmental trajectory in AI engagement: educators with limited prompt literacy tend to confine AI use to surface-level content generation, whereas those with stronger prompt skills engage more confidently in pedagogical design and strategic decision-making.

EXPERIENCE, DISCIPLINARY CONTEXT, AND CONTEXTUAL CONSTRAINTS

Relational analyses further indicate that professional experience and teaching branch are associated with AI engagement, albeit with modest effect sizes. While greater professional experience may support pedagogical experimentation, the persistence of low advanced-competence rates across experience levels suggests that experience alone is insufficient to foster advanced AI integration.

Similarly, differences across teaching branches highlight the influence of disciplinary culture and curricular flexibility. Subjects more closely aligned with digital practices exhibited relatively higher AI engagement, echoing prior findings on the role of subject epistemology in technology adoption (Koehler & Mishra, 2009; Mariam et al., 2024). However, the modest effect sizes reinforce the importance of needs-based professional development over discipline-specific assumptions.

Although the associations identified were statistically significant, the modest effect sizes suggest that structural variables such as professional experience and disciplinary affiliation alone do not strongly predict AI readiness. This may indicate that AI competence development depends more on targeted

training and interactional practice than on accumulated teaching experience. Such findings challenge assumptions that pedagogical maturity naturally translates into advanced AI integration.

ETHICAL CONCERNS, WORKLOAD PRESSURES, AND INSTITUTIONAL READINESS

With respect to RQ3, addressing professional development needs and contextual barriers to AI integration. Participants' hesitation to use AI for assessment or data-informed decision-making reflects broader concerns regarding data privacy, student dependency, and academic integrity. These concerns align with the literature, which frames AI adoption in education as an ethical and governance challenge rather than a purely pedagogical one (Williamson & Eynon, 2020).

Workload-related constraints further complicate AI adoption. Although participants recognized AI's potential to save time, they perceived the initial learning curve as demanding. This tension underscores the need for professional development models that balance conceptual depth with practical feasibility, offering scaffolded, context-specific learning experiences (Mills & Harrison, 2020).

Importantly, school administrators emphasized the absence of clear institutional roadmaps and policy frameworks. This finding highlights the role of pedagogical leadership and governance in sustaining AI integration, suggesting that individual initiative alone is insufficient without organizational alignment and ethical clarity (Fullan et al., 2018; Holmes et al., 2022).

The findings should also be interpreted within the structural characteristics of the Turkish public education system. Schools operate within a centralized governance framework under the Ministry of National Education, where policy directives, curriculum standards, and professional development structures are largely determined at the national level. In such contexts, the absence of formal AI-related guidelines or structured professional learning pathways may amplify educators' uncertainty and contribute to fragmented, individually driven experimentation. The relatively modest representation of school administrators in the sample further underscores the need for leadership-level engagement in AI integration processes. Thus, while the patterns identified in this study resonate with international discussions on AI readiness, the centralized administrative structure may shape how institutional support and policy alignment influence AI adoption in schools. This contextual dimension highlights the importance of aligning prompt literacy development with systemic professional development initiatives rather than relying solely on individual initiative.

THEORETICAL IMPLICATIONS

The findings of this study offer several theoretical contributions to the emerging literature on AI readiness in education. First, the results suggest that existing models of technology integration may require refinement to account for interactional competencies specific to generative AI systems. While established frameworks such as TPACK emphasize the intersection of technological, pedagogical, and content knowledge, they do not explicitly address the micro-level dynamics of human–AI interaction that characterize large language model usage. The present findings indicate that prompt literacy serves as a mediating competence, enabling educators to translate pedagogical intent into effective AI outputs. In this sense, prompt literacy may function as a bridge between technological knowledge and pedagogical application within AI-mediated environments.

Second, the study advances conceptualizations of AI readiness by distinguishing between access, general AI awareness, and operational competence. The observed access–competence gap reinforces the notion that AI readiness cannot be equated with tool availability or basic familiarity with tools. Instead, readiness appears to involve layered competencies, including strategic prompting, contextualization of instructional goals, and iterative refinement practices. By empirically demonstrating the strong association between prompt literacy and perceived AI competence, the study suggests that AI readiness models should incorporate interactional skill dimensions alongside ethical and institutional factors.

Third, the integration of quantitative and qualitative findings highlights the multidimensional nature of AI readiness. Pedagogical uncertainty, ethical hesitation, workload pressures, and a lack of institutional guidance were not peripheral concerns but structurally interrelated dimensions that shaped educators' AI engagement. These results support the view that AI readiness is best conceptualized as a sociotechnical construct, where individual competencies (such as prompt literacy) interact with organizational and governance conditions. Thus, the study extends prior readiness discussions by foregrounding prompt literacy as a foundational enabling competence embedded within broader institutional ecosystems.

Finally, by framing prompt literacy as a measurable, developmentally staged construct, the study contributes to clarifying the theoretical foundations of AI competence. Rather than treating prompting as an informal or intuitive skill, the findings indicate that prompt literacy can be conceptualized as progressing from surface-level query formulation toward structured, pedagogically aligned, and strategically refined interaction patterns. This staged understanding opens avenues for future model development and theory building in AI-supported teaching and learning.

These contributions collectively indicate that AI readiness in schools must be reconceptualized beyond adoption metrics and surface-level technological familiarity. The findings suggest that meaningful AI integration depends on interactional depth, pedagogical intentionality, and the capacity to structure human–AI exchanges strategically. Prompt literacy, therefore, emerges not merely as a technical micro-skill, but as a structurally enabling competence that mediates between instructional design and generative system affordances. In this sense, developing prompt literacy represents a shift in the pedagogical architecture of AI-mediated education, positioning educators not as passive tool users but as active designers of AI-supported learning processes.

IMPLICATIONS FOR AI PROFESSIONAL DEVELOPMENT, PRACTICE, AND POLICY

The results indicate that AI professional development should adopt a differentiated and staged structure rather than a uniform training model. Given the strong association between AI competence and prompt literacy, prompt writing should be positioned as a foundational competency in AI training programs. Introductory modules may focus on structured prompt construction, contextualization strategies, and instructional alignment, while advanced modules can address data-informed decision-making, pedagogical design, and strategic AI integration.

Furthermore, professional learning initiatives should prioritize pedagogical application over technical demonstration. The prevalence of pedagogical uncertainty among participants suggests that educators require concrete instructional scenarios, classroom-ready examples, and opportunities for guided practice. Embedding AI training within authentic teaching tasks may reduce uncertainty and promote sustainable integration.

Workload and time constraints reported by participants highlight the importance of flexible, modular, and practice-oriented formats. Short, scenario-based learning units, blended delivery models, and micro-credentialing approaches may enable educators to engage in AI training without intensifying existing workload pressures.

IMPLICATIONS FOR SCHOOL LEADERSHIP AND POLICY

At the institutional level, the findings underscore the critical role of leadership and governance in shaping AI integration. School administrators' expressed need for guidance suggests that AI use should be supported by clear institutional policies addressing ethical standards, data privacy, pedagogical boundaries, and responsible AI practices. Without such frameworks, AI adoption risks remaining fragmented and dependent on individual initiative.

From a policy perspective, needs-based evidence such as that generated by this study can inform system-level professional development strategies. Policymakers should prioritize integrated AI training programs that combine pedagogical, ethical, and leadership dimensions rather than focusing solely on tool proficiency. Establishing shared standards for AI literacy and prompt competence may further support coherence, equity, and sustainable implementation across schools.

By aligning prompt literacy development with institutional support mechanisms, educational systems can move beyond experimental AI use toward a strategically guided, pedagogically grounded integration.

CONCLUSION

This study examined teachers' and school administrators' AI use, competence levels, and professional development needs through a comprehensive mixed-methods needs analysis. The findings reveal that while AI tools are widely accessible, educators' engagement remains largely surface-level and characterized by limited pedagogical depth and low prompt literacy.

By integrating quantitative and qualitative evidence, the study demonstrates that prompt literacy functions as a foundational interactional competence shaping both the quality of AI-generated outputs and educators' confidence in using generative systems. AI readiness, therefore, extends beyond access or technological familiarity and depends on educators' capacity to strategically structure, contextualize, and refine their interactions with AI tools.

These insights support a shift from tool-centered training toward pedagogically embedded, ethically grounded, and institutionally supported professional development models. Recognizing prompt literacy as a central dimension of instructional competence is essential if AI integration is to enhance rather than dilute educational practice.

LIMITATIONS

Several limitations of this study should be acknowledged when interpreting the findings. First, the study was conducted within a single provincial context in Türkiye. Although participants represented diverse teaching branches, professional experience levels, and, in some cases, prior service in different regions of the country, the findings remain context-specific. As such, caution is warranted in generalizing the results to other national or institutional settings with different policy frameworks, technological infrastructures, or professional development cultures.

Second, the data were collected using a researcher-developed survey instrument designed specifically for needs analysis rather than psychometric scale validation. While content validity was supported through expert review, and the instrument was appropriate for descriptive and exploratory purposes, the findings should not be interpreted as definitive measurements of stable psychological constructs. Future studies may benefit from employing validated AI literacy or competence scales alongside needs-based instruments to strengthen inferential claims.

Third, the study relied on self-reported data, which may be subject to social desirability bias or discrepancies between perceived and actual competence. Although the integration of qualitative data helped mitigate this limitation by providing contextual depth, observational or performance-based measures could further enrich future investigations.

Finally, while the study included both teachers and school administrators, the distribution of participants across roles was uneven. For this reason, the analysis emphasized descriptive and thematic comparisons rather than inferential group comparisons. Future research may more systematically explore role-based differences using balanced samples or comparative research designs.

Despite these limitations, the study offers a robust, empirically grounded needs analysis by combining quantitative and qualitative evidence, thereby providing a valuable foundation for subsequent intervention- and design-based research on AI professional development in educational settings.

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