

Understanding K-12 Teachers' Needs for AI Education: A Survey-Based Study

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Abstract

With the rapid rise of AI technologies such as ChatGPT, understanding and integrating AI into K-12 education has become increasingly important. However, teachers often lack the AI literacy necessary to navigate these tools, which can lead to the perpetuation of misconceptions and biases in the classroom. This study seeks to identify K-12 teachers' self-identified needs regarding AI education and compare them with existing research on professional development (PD) for AI integration. We surveyed 34 K-12 teachers to assess their knowledge of AI, identify areas where they require further support, and evaluate the relevance of current PD offerings. Our findings reveal a significant disconnect between the top-down assumptions of expert-driven PD initiatives and the practical needs articulated by teachers. Key themes emerged, including a diverse range of AI understanding among educators, a strong preference for hands-on, practical training, and a demand for ongoing institutional support. Additionally, teachers expressed a desire for collaborative learning environments to share strategies and experiences related to AI. This study underscores the importance of tailoring PD programs to address the unique contexts and challenges faced by educators, advocating for a more personalized approach that fosters confidence and competence in AI integration. By aligning PD offerings with teachers' needs, we aim to enhance their ability to effectively utilize AI tools in the classroom, ultimately enriching the educational experience for students.

Problem Statement and Purpose

With the unveiling of OpenAI's ChatGPT in the fall of 2022, public awareness and interest in AI surged, including within educational contexts (Heaven 2023). In the public imagination, AI is often equated with Machine Learning, despite the complexity and diversity of AI technologies. While experts are aware of the limitations, biases, and misinformation inherent in Machine Learning-based systems (MLs) and Generative AI (GenAI), the general public often lacks this understanding, largely due to insufficient training on how these systems function. Like the general population, teachers also frequently lack AI literacy and hold misconceptions about the workings of MLs and GenAI, shaped by their prior knowledge and beliefs. As a result, they may struggle to correct their students' misunderstandings about AI applications

(Nazaretsky et al. 2022). Without a critical approach to tools like ChatGPT, teachers risk reinforcing biases, spreading misconceptions, and perpetuating flawed mainstream viewpoints in their classrooms.

Despite the critical role of teachers' beliefs and experiences in effectively integrating AI tools in K-12 classrooms, and the potential impact of teachers' misconceptions on students' understanding of AI, there has been limited research focused on understanding teachers' needs in this area (Amplio and Butler 2023; Celik 2023). An extensive literature review by Ng et al. (2023) revealed that most AI-related interventions have targeted primary and secondary school students, with only 2 out of 38 reviewed studies focusing specifically on teachers. This highlights the urgent need for more dedicated research and resources to support teachers in understanding and using AI effectively.

Professional development (PD) for teachers often begins with expert assumptions about what educators need, but this top-down approach can overlook the actual needs and preferences of teachers. This disconnect may result in PD experiences that do not fully resonate with educators, reducing their effectiveness and impact. As AI becomes more integrated into education, it is crucial that PD programs designed to enhance teachers' AI literacy and classroom integration are grounded in a clear understanding of what teachers believe they need to know. Without directly assessing these needs, PD initiatives risk being seen as irrelevant or impractical. Research in teacher education consistently shows that the most effective PD programs are those that teachers perceive as directly relevant and immediately applicable to their classroom practice (Garet et al. 2001; Desimone 2009). When teachers are actively involved in identifying their learning needs, they are more likely to value the PD and to implement what they have learned into their teaching (Darling-Hammond, Hyler, and Gardner 2017). However, many PD programs, particularly those focused on emerging topics like AI, are still based on expert-driven assumptions rather than empirical needs assessments involving teachers themselves.

This study aims to address this gap by directly surveying teachers to understand their self-identified needs regarding AI education. By comparing these needs with existing research literature, the study provides valuable insights into how aligned or misaligned current PD offerings are with

teachers' real concerns and desires. Furthermore, this approach acknowledges teachers as co-creators in the development of PD, rather than passive recipients. PD programs tailored to the specific needs articulated by teachers are likely to be more effective, leading to greater adoption of AI tools and strategies in the classroom and ultimately enhancing student outcomes.

The findings from this study inform the design of more relevant and impactful PD programs that align with teachers' needs and preferences, thereby increasing the likelihood that teachers will effectively integrate AI into their everyday teaching practices. This approach not only respects the professional judgment of teachers but also leverages their insights to create PD experiences that are both meaningful and practical.

Research Question

What are the self-identified needs of K-12 teachers regarding AI education, and how do these needs compare to the needs identified by existing research literature?

Theoretical Framework

Teacher agency theory provided the theoretical foundation for this study. This theory offers a lens for understanding how teachers navigate professional development, integrate new knowledge, and respond to emerging educational challenges such as AI technologies. Rooted in social-ecological frameworks, it emphasizes the ability of teachers to make intentional choices, act on them, and adapt to their professional environments (Priestley, Biesta, and Robinson 2015). Teachers are seen as active agents who exercise professional judgment, mediate policy interventions, and enact change based on their beliefs, experiences, and contextual realities (Eteläpelto et al. 2013). This theory is especially relevant in understanding how teachers address the complexities of AI education, where top-down PD initiatives often fail to meet their real-world needs (Cong-Lem 2021).

Central to this theory is the "temporal-relational" dimensions of agency, considering how teachers' past experiences, present conditions, and future goals influence decision-making (Priestley, Biesta, and Robinson 2015). Teachers' prior professional development experiences, their current familiarity with AI, and their goals for integrating AI technologies inform their engagement with PD and perceptions of relevance. Applying this theory situates teachers as active participants in PD programs, recognizing that effective AI-focused PD must be relevant to teachers' practices, support their classroom integration aspirations, and respect their autonomy.

In this study, teacher agency theory provided a framework for analyzing the gap between assumed needs embedded in expert-driven PD programs and the self-identified needs of K-12 teachers. The findings contributed to understanding how PD programs can support teacher agency, making learning experiences meaningful and practical. This aligns with research emphasizing teacher agency's role in fostering sustainable educational change (Soini et al. 2015). Framing this study within teacher agency theory underscores the im-

portance of empowering teachers to take ownership of their learning and adapt AI tools to fit their classroom contexts.

Given the challenges and opportunities AI education presents, teacher agency is crucial in determining how to integrate AI technologies like ChatGPT into classrooms. This process is shaped not only by resources and PD availability but also by teachers' perceptions of AI's relevance and their ability to address potential biases or misconceptions (Varpanen et al. 2022). The study explored how teachers' self-identified needs for AI education reflect their agency in shaping their professional development. It highlighted how PD programs may empower or inhibit teachers' ability to incorporate AI effectively, depending on their alignment with perceived needs. This framework also supports the idea that PD should involve teachers as co-creators, giving them the agency to shape their learning (Priestley, Biesta, and Robinson 2015). This theoretical framing aligns with findings from studies such as Cong-Lem (2021), who identified teacher agency as central to implementing educational innovations, and Varpanen et al. (2022), who emphasized the role of teachers' long-term visions for educational change in the context of new technologies like AI.

Methods

We developed a survey to gather K-12 teachers' perceptions and needs related to Artificial Intelligence (AI) education. The survey instrument was based on a framework for understanding teachers' professional development needs in emerging educational technologies and AI literacy. The survey questions were divided into six parts: (1) Demographics and Background Information, (2) Current Knowledge and Use of AI, (3) Interest in AI, (4) Perceived Challenges and Concerns, (5) Professional Development Preferences, and (6) Feedback and Suggestions. The instrument included both closed-ended (e.g., Likert-scale, multiple-choice) and open-ended questions (e.g., What would you like to learn about AI that you currently don't know? What barriers do you face in learning or teaching AI?), to allow for a comprehensive understanding of teachers' perspectives.

Participants and Recruitment

The survey was distributed via social media (e.g., K-12 teacher communities on Facebook) and national teacher associations' email listservs (e.g., National Science Teacher Association, National Association of Teachers of Mathematics, etc.). No specific sampling method was employed, and participation in the study was voluntary. The email invitation provided an overview of the study's objectives, the participants' rights, and a link to the online survey, which was created and administered using Google Forms.

While we are continuing the process of gathering data, at the time of the writing of this manuscript, 34 teachers responded to the survey, providing enough data to capture teachers' overall perceptions and preferences.

Respondents included teachers from a range of grade levels (elementary, middle/junior high, and high school) and a variety of subjects, including science, mathematics, social studies, computer science, and others. The diversity in

grade levels and subject areas provided a broad perspective on teachers' needs and perceptions regarding AI education.

Data Analysis

Descriptive statistics were used to analyze the closed-ended survey questions. Frequencies and percentages were calculated to summarize the distribution of responses across demographic variables (e.g., grade level taught, years of experience, subjects taught) and key perception-related variables (e.g., familiarity with AI, interest in AI, and perceived challenges). Inferential statistical tests were conducted to explore relationships and differences between variables. A one-way ANOVA was performed to assess the difference in AI interest across grade levels. A Chi-Square test was used to examine the association between AI familiarity and the grade level taught. A paired T-test was conducted to compare teachers' preferences for practical versus theoretical professional development (PD) in AI. Qualitative responses to open-ended questions were analyzed using thematic analysis. Responses were coded based on recurring themes related to teachers' expressed needs, challenges, and desired professional development opportunities. The coding process involved identifying and categorizing emergent themes, such as concerns about AI's ethical implications, the need for hands-on training, and the desire for AI-related classroom resources. Data from both quantitative and qualitative analyses were compared to identify potential patterns or relationships between teachers' demographic backgrounds and their perceptions of AI in education. These findings were then used to inform the study's conclusions about gaps in existing professional development programs and areas where further support is needed for teachers to effectively integrate AI into their teaching practices.

Preliminary Findings

The analysis of the survey data collected from K-12 teachers regarding their perceptions and needs related to AI in education yielded several key findings. The results are organized into three main sections: descriptive statistics, inferential statistics, and qualitative findings.

Descriptive Statistics

Demographic Overview. The survey included a diverse group of K-12 teachers, with varying levels of experience and familiarity with AI. 53-percent of the respondents were high school teachers, 32.4-percent were middle/junior high school teachers, and 17.6 were elementary school teachers. While science and mathematics teachers comprised the majority of the respondents, Figure 1 reveals that our pool included a diversity of subject areas taught by teachers, enriching the understanding of AI's applications and needs, and leading to more comprehensive and inclusive professional development and curriculum integration.

The analysis of teachers' years of experience revealed a diverse distribution among respondents, with a notable concentration of educators having 11 to 20 years of teaching experience (Figure 2). This suggests a wealth of practical

knowledge within the group, which may influence their perspectives on integrating AI into educational practices. The varied experience levels highlight the importance of tailored PD programs that cater to both novice and veteran teachers, ensuring that all educators receive the support they need to effectively engage with AI in the classroom.

AI Familiarity and Interest. The analysis of teachers' familiarity with AI paints a compelling picture of the current landscape in K-12 education (Figure 3). While many reported a moderate understanding of AI concepts, a significant number indicated limited familiarity, signaling an urgent opportunity for growth and development in this area. In contrast, the distribution of interest in AI among teachers is strikingly positive, with a robust enthusiasm for learning more about its applications in the classroom (Figure 4). This eagerness reflects a vibrant readiness to embrace AI and integrate it into educational practices. Together, these findings illuminate a promising pathway for PD programs. By addressing the gap between familiarity and interest, we can empower educators with the knowledge and skills they need to harness the transformative potential of AI, ultimately enriching the learning experience for students and preparing them for a technology-driven future.

Professional Development Preferences. The most favored PD option was workshops, with 15 respondents indicating a strong preference for hands-on, interactive sessions (Figure 5). Peer collaborations follow closely, with 14 teachers valuing opportunities to learn from and share experiences with colleagues. Online courses and self-paced modules each garnered 11 responses, highlighting the desire for flexible learning options. Webinars were the least preferred, with only 6 teachers selecting this format. Overall this finding underscores the importance of providing engaging, collaborative, and flexible PD opportunities to effectively support teachers in integrating AI into their classrooms.

Inferential Statistics

AI Familiarity and Grade Level. A Chi-Square test of independence was employed to examine the relationship between teachers' familiarity with AI and the grade level they teach. The results indicated no significant association between AI familiarity and grade level ($\text{Chi}^2(8) = 8.16, p = 0.4183$). This finding suggests that teachers' familiarity with AI does not significantly differ across grade levels, indicating a widespread need for foundational AI education regardless of the grade taught. This lack of association highlights the necessity for comprehensive PD programs that cater to all educators, ensuring that every teacher, regardless of their teaching level, has access to the resources and training needed to effectively incorporate AI into their teaching practices.

AI Interest across Grade Levels. A one-way Analysis of Variance (ANOVA) was performed to assess whether there were significant differences in AI interest scores among teachers from different grade levels (Elementary, Middle/Junior High, and High School). The results indicated a statistically significant difference in AI interest scores across the

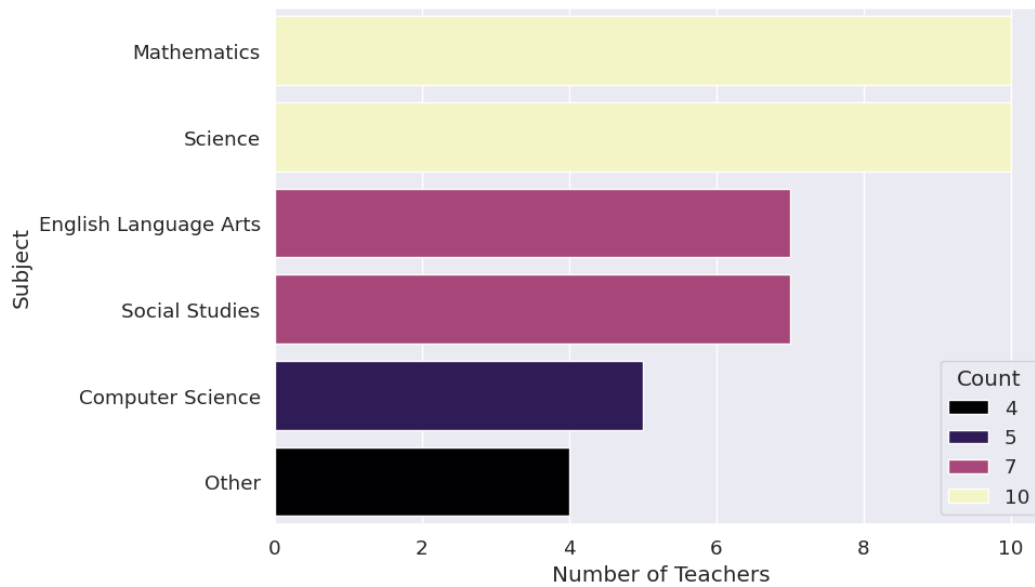


Figure 1: Distribution of Subject Areas Taught by Teachers.

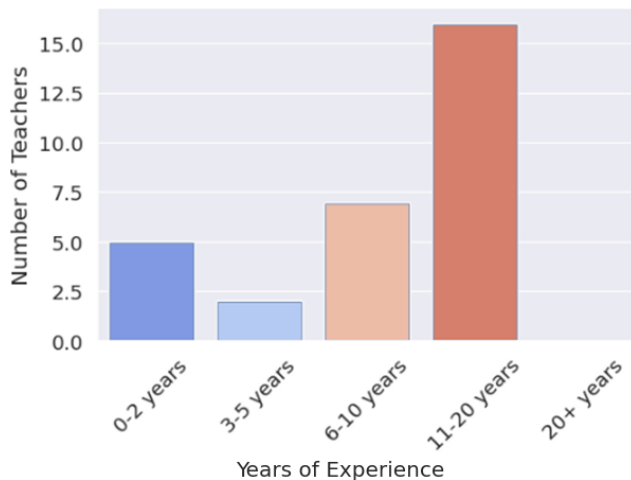


Figure 2: Distribution of Teaching Experience of Teachers.

groups ($F(2, 97) = 7.40, p = 0.0024$). This finding suggests that teachers' interest in AI varies significantly depending on the grade level they teach, with some grade levels demonstrating a higher propensity for engagement with AI concepts. Post-hoc analyses, such as Tukey's HSD, could be conducted to identify specific group differences, providing further insights into which grade levels exhibit the highest and lowest interest in AI. This information is crucial for tailoring professional development initiatives that resonate with the unique needs of educators at different stages of their teaching careers.

AI Familiarity and Interest. A correlation analysis was conducted to explore the relationship between AI familiarity and AI interest (Figure 6). The results revealed a moderate positive correlation ($r = 0.40$), indicating that teachers who

are more familiar with AI tend to exhibit greater interest in learning about it and integrating it into their teaching. This finding aligns with the expectation that increased familiarity often leads to heightened curiosity and engagement with a subject. However, the correlation between AI familiarity and AI confidence was weaker ($r = 0.22$), suggesting that while familiarity may enhance interest, it does not necessarily translate to increased confidence in teaching AI concepts. This discrepancy points to the need for professional development programs that not only enhance knowledge but also provide practical experiences that build teachers' confidence in their ability to teach AI effectively. Additionally, the strong positive correlation between AI interest and AI confidence ($r = 0.81$) indicates that teachers who are more interested in AI are also more likely to feel confident in their ability to use AI tools in their teaching. This suggests that fostering interest in AI could be a key strategy for enhancing teachers' confidence. Thus, professional development initiatives should focus on engaging teachers' interest while simultaneously providing hands-on experiences that reinforce their confidence in applying AI in educational contexts.

Preference for Practical vs. Theoretical PD. To evaluate teachers' preferences for the types of PD related to AI, a paired T-test was conducted comparing the interest in practical, hands-on training versus theoretical approaches. The results revealed a significant preference for practical PD ($T(99) = 3.38, p = 0.0019$). This finding underscores the importance of providing educators with experiential learning opportunities that allow them to engage directly with AI tools and applications, rather than solely relying on theoretical knowledge. The strong preference for hands-on training suggests that PD programs should prioritize interactive workshops and collaborative learning experiences, enabling teachers to build confidence and competence in integrating AI into their classrooms.

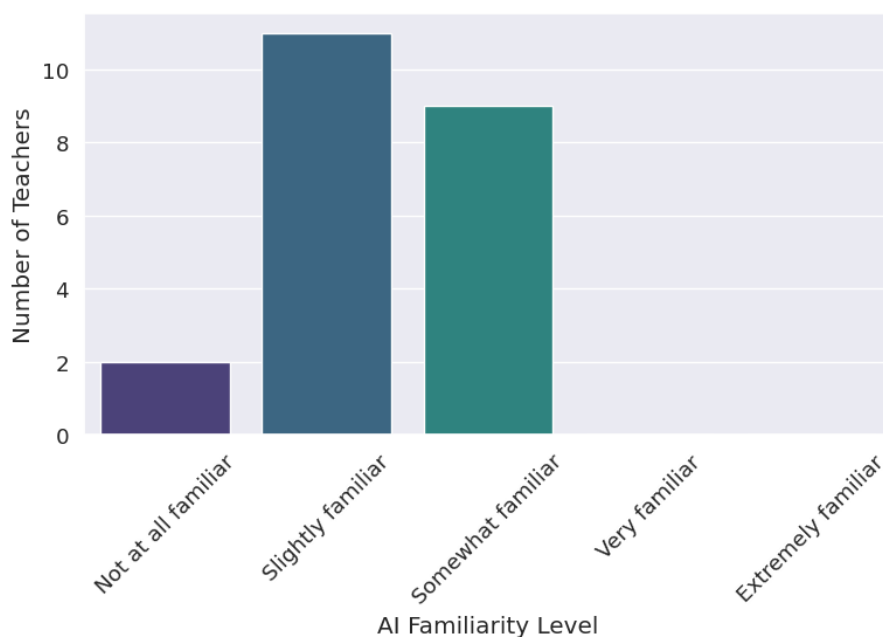


Figure 3: Distribution of Teachers' Familiarity with AI.

Qualitative Analysis

The qualitative analysis of open-ended survey responses provided rich insights into K-12 teachers' perceptions, needs, and aspirations regarding Artificial Intelligence (AI) in education. By categorizing and thematically analyzing these responses, several key findings emerged that highlight the complexities of teachers' experiences and their expectations for professional development in AI.

Diverse Understanding of AI Concepts. Teachers exhibited a wide range of understanding regarding AI concepts, from basic awareness to more advanced knowledge. Many respondents expressed confusion about what constitutes AI, often conflating it with general technology use in the classroom. This indicates a need for foundational training that clearly defines AI, its applications, and its implications in educational settings. Teachers emphasized the importance of demystifying AI to foster a more informed and confident approach to its integration into their teaching practices.

Desire for Practical Applications. A recurring theme in the responses was the desire for practical, hands-on experiences with AI tools. Teachers sought PD that not only introduces AI concepts but also provides concrete examples of how AI can be utilized in lesson planning, student assessment, and personalized learning. This finding underscores the necessity for PD programs to include interactive components, such as workshops where teachers can experiment with AI tools and see their impact on student engagement and learning outcomes.

Concerns about Implementation and Support. Many teachers voiced concerns about the challenges of implementing AI in their classrooms, particularly regarding the lack of institutional support and resources. Respondents highlighted

issues such as inadequate access to technology, insufficient time for training, and a lack of administrative backing. These barriers can hinder the effective integration of AI into the curriculum. Teachers expressed a need for ongoing support from school leadership, including access to resources, time for collaboration, and encouragement to experiment with AI in their teaching.

Interest in Collaborative Learning Opportunities. The analysis revealed a strong interest in collaborative learning opportunities among teachers. Many respondents indicated that they would benefit from peer collaboration, where they could share experiences, strategies, and challenges related to AI. Teachers expressed a desire for professional learning communities, where they can learn from one another and collectively explore innovative ways to incorporate AI into their teaching. This finding suggests that PD providers should facilitate networking and collaboration among educators to foster a sense of community and shared learning.

Ethical Considerations and Student Impact. Several teachers raised concerns about the ethical implications of AI in education, particularly regarding data privacy and the potential for bias in AI algorithms. They expressed a need for training that addresses these ethical considerations, ensuring that educators are equipped to navigate the complexities of AI responsibly. Additionally, teachers were interested in understanding how AI could impact student learning and equity, emphasizing the importance of ensuring that AI tools are used to enhance, rather than hinder, educational opportunities for all students.

Call for Tailored Professional Development. Finally, the qualitative analysis highlighted a strong call for tailored professional development that considers the unique contexts

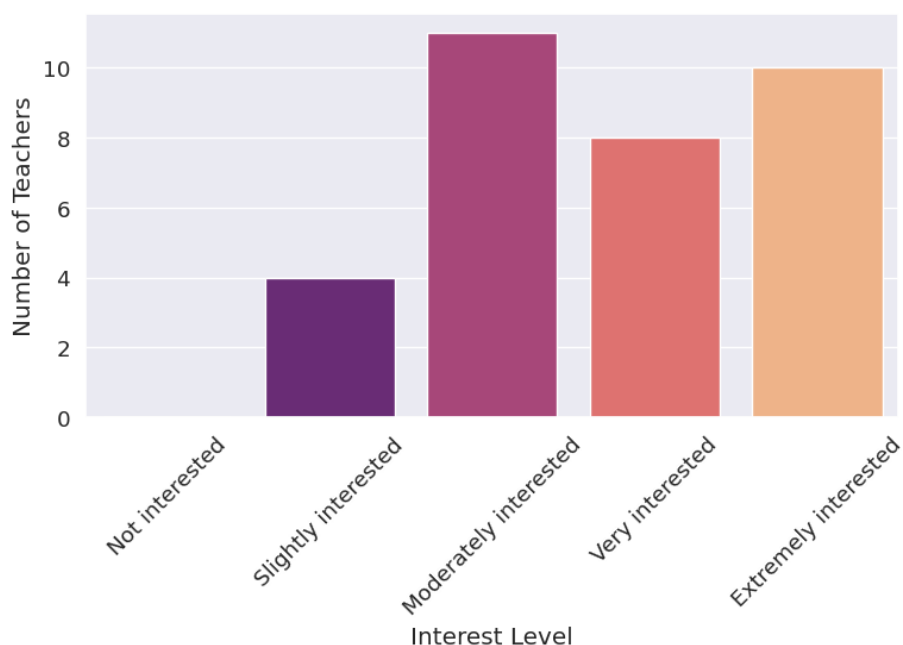


Figure 4: Levels of Teachers' Interests in AI.

and needs of different educators. Teachers emphasized that a one-size-fits-all approach to training would not be effective, as their experiences and familiarity with AI vary widely. They advocated for personalized learning pathways that allow educators to progress at their own pace and focus on areas most relevant to their teaching practice. This finding suggests that professional development providers should adopt a more individualized approach, offering a range of training options that cater to diverse skill levels and interests.

Implications for Professional Development

The findings of this study carry significant implications for AI experts and teacher educators involved in the development and implementation of educational technologies and PD. As the integration of AI into K-12 education continues to evolve, AI experts should recognize the diverse needs of K-12 educators and advocate for the design of PD programs that are tailored to specific grade levels and teaching contexts. The significant differences in AI interest across grade levels suggest that a one-size-fits-all approach may not be effective. Instead, AI experts can collaborate with teacher educators to create customized training modules that address the unique challenges and opportunities faced by teachers at different stages of their careers. This targeted approach can enhance engagement and ensure that educators feel supported in their journey to integrate AI into their classrooms.

The strong preference for hands-on, practical PD highlights the need for AI experts to focus on creating experiential learning opportunities. Workshops, simulations, and collaborative projects that allow teachers to engage directly with AI tools and applications can significantly enhance their confidence and competence. AI experts should work to develop resources and training materials that emphasize

real-world applications of AI in education, enabling teachers to see the relevance and potential impact of AI on their teaching practices.

The weaker correlation between AI familiarity and confidence suggests that AI experts have a critical role in not only providing knowledge but also fostering a supportive environment that encourages educators to experiment with AI technologies. Mentorship programs, peer collaboration, and ongoing support networks can help teachers navigate the complexities of AI integration. AI experts should consider developing frameworks that facilitate these supportive structures, ensuring that educators have access to guidance and resources as they implement AI in their classrooms.

AI experts are in a unique position to influence the development of educational AI tools that are user-friendly and aligned with teachers' needs. Insights from this study can inform the design of AI applications that are intuitive and accessible, allowing educators to seamlessly incorporate AI into their teaching practices. By prioritizing user experience and educator feedback in the development process, AI experts can create tools that not only enhance learning outcomes but also empower teachers to feel confident in their use of technology.

Finally, AI experts should advocate for the importance of AI literacy among teachers and students alike. As AI continues to permeate various aspects of society, equipping teachers with the knowledge and skills to understand and teach AI concepts is essential. AI experts can contribute to the development of curricula and resources that promote AI literacy, ensuring that both educators and students are prepared to engage with AI technologies critically and effectively.

By addressing the diverse needs of teachers and fostering a culture of confidence and experimentation, AI experts can

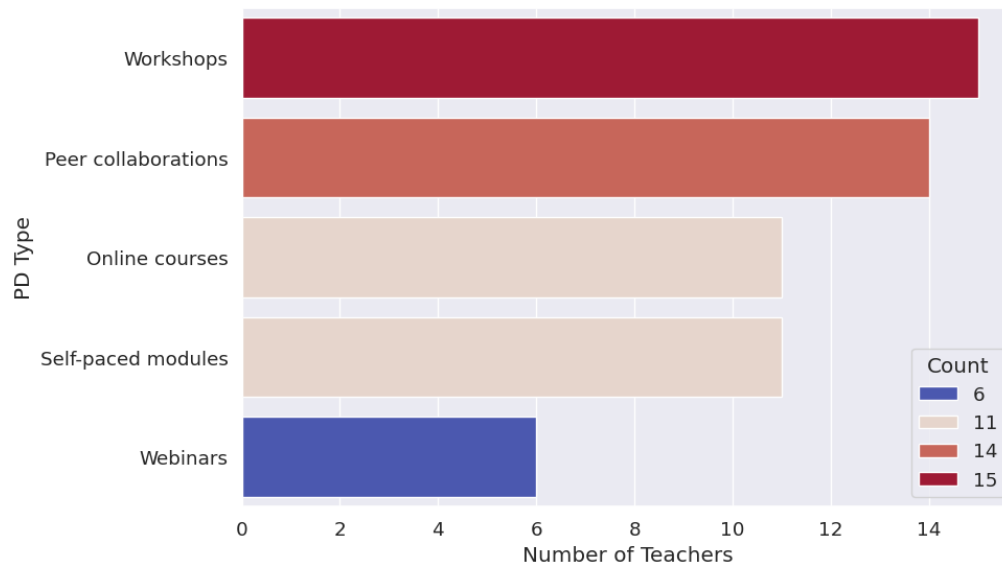


Figure 5: Types of Professional Developments Teachers Preferred.



Figure 6: Correlation Matrix of AI Familiarity, Interest, and Confidence among Teachers.

play a pivotal role in shaping the future of education in an increasingly technology-driven world. Through targeted PD, user-friendly tools, and advocacy for AI literacy, AI experts can help empower educators to harness the transformative potential of AI, ultimately enriching the educational experience for all students.

Conclusion

This study has illuminated critical insights into K-12 teachers' familiarity with and interest in AI, revealing both opportunities and challenges in the current educational landscape. The significant differences in AI interest across various grade levels highlight the necessity for tailored PD pro-

grams that cater to the unique needs of educators at different stages of their teaching careers. By recognizing that teachers in certain grade levels exhibit a higher propensity for engagement with AI, we can strategically design initiatives that resonate with their specific contexts and experiences.

Moreover, the strong preference for practical, hands-on PD underscores the importance of experiential learning in fostering educators' confidence and competence in integrating AI into their classrooms. This finding suggests that traditional theoretical approaches may not suffice; instead, educators thrive when provided with interactive and collaborative learning opportunities that allow them to explore AI tools and applications in real-world scenarios.

The correlation between AI familiarity and interest further emphasizes the interconnectedness of knowledge and engagement. While familiarity with AI concepts can enhance interest, the weaker correlation with confidence indicates that simply increasing knowledge is not enough. Professional development programs must also focus on building teachers' confidence through practical experiences, mentorship, and ongoing support.

In conclusion, the findings of this study advocate for a comprehensive approach to PD that not only enhances teachers' familiarity with AI but also actively engages them in meaningful learning experiences. By addressing the diverse needs of educators and fostering a culture of continuous learning, we can empower teachers to effectively integrate AI into their teaching practices. This, in turn, will enrich the educational experience for students, equipping them with the skills and knowledge necessary to thrive in an increasingly technology-driven world. As we move forward, it is imperative that educational stakeholders collaborate to create and implement innovative professional development initiatives that bridge the gap between familiarity, interest, and confidence in AI education.

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