

Impact of AI Literacy Professional Development on Teaching: Evaluating Changes in Perceptions and Classroom Practices

Valerie Riggs
Morgan State University, USA

ABSTRACT

This study explores the impact of an AI literacy professional development institute at a Historically Black College/University (HBCU) for 20 public school teachers teaching in underserved communities. The program covered AI concepts, ethics, and classroom applications. Participants had limited AI knowledge and reported increased confidence in using AI tools and intention to implement them into their teaching. Findings also noted barriers to AI adoption in resources, access to training, and student data privacy concerns.

Keywords: AI Literacy, AI Bias in Education, Data Literacy, Equitable Access, Professional Development for K-12 Teachers, Underserved Schools

INTRODUCTION

As artificial intelligence (AI) technologies continue to expand, understanding the way in which this technology is integrated into education is crucial. Exploring AI's impact on teacher practices and student learning is essential for the continued relevance of educational systems. This ensures that teachers are well-prepared to implement these technologies. This study, conducted by researchers at a Northeastern urban HBCU, examines the impact of AI literacy workshops on K-12 teachers' understanding of AI, their perceptions, and their intended use of AI

tools. It also explores teachers' experiences with barriers to implementation and their overall confidence in applying AI practices in the classroom. This research is supported by efforts to advance equity and inclusion, particularly in underserved areas.

LITERATURE REVIEW

AI Literacy and Professional Development for Teachers

AI literacy is defined as having a deeper knowledge of how AI systems operate, not only in terms of simple technical ability. Teachers need to understand how to use artificial intelligent tools in the classroom in order to impact their teaching and student learning. AI Literacy also requires a deeper understanding of ethical ways to implement these tools. Targeted professional development in artificial intelligence has been found to greatly increase teachers' confidence and capacity to include this new technology into their teaching strategies (Ng et al., 2023; Mills et al., 2024). Tools driven by artificial intelligence have great potential for improving learning results. Studies emphasize how important artificial intelligence literacy is in contemporary 21st century learning. It is crucial for teachers to be ready to negotiate a technologically driven classroom environment through advanced abilities like prompting and applying critical thought to output (Silva & Janes, 2023). Implementing AI targeted professional development supplies teachers with the information and tools required to become literate in artificial intelligence and apply it successfully in their classroom.

Theoretical Foundations for AI Literacy in Teacher Professional Development

Developing basic AI literacy among K-12 teachers is not just about increasing technical skills. This involves fostering critical thinking, data literacy, and awareness of bias and ethics, Ng et al. (2023). These researchers argue that AI literacy should ideally begin in pre-service teacher education programs and should ultimately be developed into a core competency to ensure impact on pre-service teachers. In addition to implementing initial training with future teachers, implementing training and AI literacy for current teachers is necessary to keep them technologically relevant in this rapidly changing space.

There is current research on AI Literacy training that finds that there are some basic fundamentals that must be present in order for it to be effective with teachers. Chiu & Chai (2020) found that AI education requires teacher motivation and institutional support. Their qualitative study of K-12 teachers found that AI literacy training was most effective when teachers had numerous opportunities to

experiment with AI tools and also when they received mentorship to support their technology training. Casal-Otero et al. (2023) performed a systematic review of AI literacy curriculum models and found that professional development should be created by using a module format and it should be flexible so that teachers could have the opportunity to learn at their own pace. Celik et al. (2022) also supported the notion that AI training programs must be teacher-centered to be effective.

This study took into account the need for hands-on, engaging and teacher centered curriculum as referenced by the previous researchers.. Therefore the design of the professional development was framed in Mills et al. (2024) structured framework for AI literacy as well as the conceptual framework “Five Big Ideas in AI” developed by Touretzky et al. (2022). Mills et al. (2024) outlined three tenets in his framework. The tenets were: understanding AI concepts, evaluating AI applications, and effectively using AI tools.

Touretzky et al. (2022) outlined how students should learn about AI. They found that AI-based learning should include data literacy, human-AI interaction, and ethical considerations. Their findings suggest that students should learn to engage critically with the technology rather than passively accepting AI-generated output. Consequently, it is essential that K-12 teachers first grasp these key concepts. In addition to Mills et al. (2024) tenets, this study is also framed in the 5 Big Ideas in AI framework. This served as a model for the design of the AI summer institute, the professional development for teachers. Big Idea #1 highlights how computers use sensors to perceive the world, an important concept for educators to understand AI data interpretation and its real-world applications, which enhances critical thinking . Big Idea #2 focuses on AI agents using models for reasoning, which can be used in teaching to help students understand complex AI models and support rigorous instructional planning . Big Idea #3 centers on data literacy, emphasizing AI's ability to learn from large datasets to enhance students' problem-solving and data analysis skills . Big Idea #4 deals with improving human-AI interaction, ensuring AI systems are user-friendly and effectively integrated into education . Finally, Big Idea #5 explores AI's societal impacts, stressing the importance of ethical practices and awareness of bias, crucial for teaching the broader implications and responsible use of AI (AI4K12, 2023; Touretzky et al. (2022)).

Table 1 provides a detailed overview of the design of the HBCU AI Summer Institute professional development opportunity for teachers working in underserved schools. The table outlines the alignment with the frameworks discussed and examples of implementing the concepts.

Table 1*HBCU AI Summer Institute Professional Development Design for Teacher AI Literacy Development*

Framework	Component	Activities and Tools Integrated into the Program
Mills et al. (2024): Three Tenets of AI Literacy	Understanding AI Concepts	<ul style="list-style-type: none"> - Introduced AI fundamentals - Hands-on exploration using AI tools
	Evaluating AI Applications	<ul style="list-style-type: none"> - Group discussions on algorithms, bias, and ethical use of AI - Project activities reviewing outputs and analyzing for bias
	Effectively Using AI Tools	<ul style="list-style-type: none"> - Practical sessions using tools such as Magic School for lesson planning and automated assignment creation - Teachers designed sample lesson plans incorporating AI tools to support differentiated learning
Touretzky et al. (2022): Five Big Ideas in AI	Perception (How computers sense the world)	<ul style="list-style-type: none"> - Demonstrated how AI tools interpret data - Teachers explored AI image generators and speech recognition tools
	Representation and Reasoning (How AI models make decisions)	<ul style="list-style-type: none"> - Teachers experimented with GPT models to learn about prompting and how decisions are made
	Learning (How AI improves through data)	<ul style="list-style-type: none"> - Teachers practiced with AI lesson plans that adapt to performance - Teachers explored ML models that train on feedback
	Human-AI Interaction (Collaboration between humans and AI)	<ul style="list-style-type: none"> - Developed ethical classroom guidelines - Teachers participated in role-play activities to model responsible use with GPT models
	Societal Impact (AI's influence on society)	<ul style="list-style-type: none"> - Case studies on impact of AI bias in education - Group discussions on data privacy and current AI-related events from misuse

Note. AI = Artificial Intelligence; ML = Machine Learning. Activities align with AI literacy goals from Mills et al. (2024) and Touretzky et al. (2022), including conceptual understanding, tool application, and ethical use.

Challenges to Equitable AI Access and Adoption in Underserved Schools

Equitable access to artificial intelligence in education presents opportunities as well as risks. AI has the potential to close achievement gaps by enhancing student learning and promoting the development of critical thinking skills through prompting and increased efficiency. However, it can also exacerbate existing disparities, mainly if access to AI is not equitably distributed (Holstein & Doroudi, 2021; Giannini, 2023). Historically, schools in underserved communities often lack the infrastructure, funding, and institutional support necessary to implement advanced technology resources including the newest AI technology.

Holstein and Doroudi (2021) expand on the issue of equity in AI, arguing that AI is not in itself equitable. Its impact depends on how tools are designed and which ways they are implemented. Their theoretical review identifies four ways in which AI could amplify educational inequities. They found that bias in the algorithm may reinforce systemic issues. Limited access to AI learning tools was an issue in marginalized communities. There was unequal AI literacy training for teachers across these same communities, which impacted teachers ability to integrate AI into their instruction. Lastly, using algorithms for unchecked decision making through AI could penalize students based on biased data taken out of context. Holstein & Doroudi (2021) also found that many teachers, particularly those in under-resourced schools, lack AI training opportunities. Even when AI tools are available, educators still struggle with technical barriers and ethical issues while navigating AI's role in education.

Privacy and data ethics are also growing concerns. Many AI-powered educational platforms rely on student data collection to personalize learning experiences. However, without clear guidelines on data security and AI transparency, educators and parents remain skeptical about AI's role in schools (Giannini, 2023). Many school districts still do not have documented AI policies. Schools must establish transparent policies for responsible AI use that promotes equity and use that is free from bias.

METHOD

This study analyzes the impact of providing AI literacy workshops on 20 public school teachers, teaching in underserved school districts. The participants attended an AI Summer Research Institute at an urban Historically Black College and University (HBCU) in the Northeast. The institute aimed to provide the teachers with AI Literacy Professional development and hands-on opportunities. The workshop used the 5 Big Ideas in AI framework (Touretzky et al., 2022; AI4K12, 2023) and Mills et al. (2024) tenets for best practices in gaining AI literacy. This project explored the following research questions:

1. How do AI literacy workshops impact teachers' knowledge, perceptions, and intended use of AI tools?
2. How do teachers perceive the potential uses of AI tools in their teaching practices after participating in AI literacy professional development?
3. What barriers and challenges do teachers, especially those in underserved schools, face in adopting AI technologies in educational settings?

RESEARCH DESIGN

We collected both quantitative and qualitative data collection. Table 2 presents the participant demographics for the study as follows:

Table 2

Demographic Characteristics of Study Participants

Category	Details	n	%
Gender	Male	8	40
	Female	11	55
	Non-binary/Prefer not to say	1	5
Race/Ethnicity	Black or African American	15	75
	White	3	15
	Hispanic/Latino	1	5
	Two or more races	1	5
Years of Teaching Experience	1–3 years	4	20
	4–6 years	6	30
	7–9 years	5	25
	10+ years	5	25
Grade Levels Taught	Elementary (K–5)	7	35
	Middle (6–8)	6	30
	High School (9–12)	7	35
Educational Background	Bachelor's Degree	9	45
	Master's Degree	11	55
School Type	Underserved Urban Schools	20	100
Institutional Context	Northeastern Urban HBCU	20	100

Note. The total number of participants was 20. Percentages reflect the proportion of the total sample.

PROCEDURE

The quantitative data for this study was collected through a survey designed to assess how the teachers participation in an AI Summer Institute influenced teachers' classroom practices, perceptions, and plans for using AI tools. The

survey included both demographic questions and Likert-scale items measuring participants' familiarity with AI, their evaluation on the professional development's effectiveness, and expectations regarding AI's impact on teaching and student engagement. Descriptive statistics using means, medians, and modes were applied to analyze the responses.

The qualitative data was gathered from open-ended surveys designed to explore teachers' experiences with AI, their expectations, perceived challenges, and plans for integrating AI into their classrooms. A thematic coding process was used where open coding identified key concepts from participants' responses. Next similar codes were grouped into categories, which identified three themes: *Enhanced Teaching Strategies*, *Increased Student Engagement*, and *Challenges in Adoption*.

ANALYSIS

The quantitative survey responses provide insight into participants' AI knowledge, their evaluation of the AI Summer Institute, and their anticipated use of AI tools in teaching. The survey used a 5-point Likert scale that measured prior knowledge, workshop helpfulness, intended AI use, and perceptions of AI's impact on teaching and student engagement. The results highlight the potential impact of this type of AI related professional development in under-resourced schools. Participants rated their familiarity with AI on a 5-point scale ranging from "Very Unfamiliar" to "Very Familiar." The average familiarity score was 2.8, indicating that most teachers started the summer institute with limited prior experience in AI. The median rating was 3, suggesting a generally low to moderate level of AI knowledge. Participants reported an average score of 4.5 on the effectiveness of the program, with the highest number of responses selecting 5 ("Very Helpful"). These results reflect a strong consensus that the professional development opportunity was valuable in expanding their understanding of AI tools and concepts.

Participants also shared how frequently they intended to use AI tools in their teaching after the institute. Responses, measured on a 5-point scale from "Never" to "Always," averaged 3.7, with both the median and mode at 4, indicating that most planned to use AI tools regularly. The survey further asked participants about their perceptions of AI's impact on teaching methods and student engagement. Using a 5-point scale from "Negative" to "Positive," participants gave an average rating of 4.2 for how positive they expected their training to impact their teaching, with both the median and mode at 4. Similarly, participants averaged 4.1, with a median and mode of 4, indicating that most of the teachers believed AI would enhance their student learning experiences. Table 3 presents a summary of

teachers' self-reported experiences as described above..

Table 3

Teachers' AI Knowledge, Tool Usage, and Perceptions Following Professional Development

Category	Scale (1–5)	Total (n = 20)	Mean	Median	Mode
AI Knowledge and Usage Statistics					
Familiarity with AI Before Institute (1 = Very Unfamiliar, 5 = Very Familiar)	1–5	20	2.8	3	3
Helpfulness of Institute Sessions (1 = Very Unhelpful, 5 = Very Helpful)	1–5	20	4.5	4	5
Planned Frequency of AI Tool Usage (1 = Never, 5 = Always)	1–5	20	3.7	4	4
Perceptions of AI Impact on Teaching and Learning					
Impact on Teaching Methods (1 = Negative, 5 = Positive)	1–5	20	4.2	4	4
Impact on Student Engagement and Learning Outcomes (1 = Negative, 5 = Positive)	1–5	20	4.1	4	4

Note. Results are based on participant responses from a 5-point Likert scale (1 = lowest, 5 = highest). Mean, median, and mode reflect the central tendencies of the responses from 20 participants. Responses were collected following the HBCU AI Summer Institute.

An open-ended survey was sent to teachers after their Fall 2024 year began. Teachers were encouraged to reflect upon their work with the AI Summer Institute and how it impacted their instructional practices. Questions were designed to gather insights on teacher experiences with AI tools, their perceptions of how AI influenced teaching and student engagement, and any challenges they faced when integrating AI into their classrooms. The survey asked participants to share their thoughts on the effectiveness of the institute in preparing them to use AI tools and to identify areas where additional support or training might be needed. After the coding process was completed, several key themes emerged.

Theme 1: Enhanced Teaching Strategies

Participants described how AI tools helped them develop more efficient teaching strategies. Teachers found that AI-enabled tools, such as real-time feedback systems and automated grading platforms, reduced their administrative workload and gave them more time to focus on instruction. Several participants shared how

AI-supported lesson planning helped them design differentiated lessons with varying learning activities for students of all levels.

One teacher noted, *“Using AI-based formative assessments allows me to identify struggling students immediately and adjust my lesson plans to meet their needs.”* Another described using an AI-powered reading platform to provide personalized assignments based on student performance: *“The tool assigns reading passages according to their comprehension level, which has made a noticeable difference for my lower-performing students.”* A third participant explained how AI-supported automated feedback tools improved their efficiency: *“I use an AI grading assistant to handle quizzes, which frees up time for me to provide more meaningful feedback during class discussions.”*

One participant mentioned that they used an AI-assisted brainstorming tool to develop project-based learning activities: *“I used an AI tool to generate project ideas aligned with standards—it saved me hours of planning and inspired new approaches to group work.”* These responses highlight how teachers leveraged AI to enhance instruction, streamline tasks, and create more personalized learning experiences for their students.

Theme 2: Increased Student Engagement

Participants generally agreed that AI technologies increased student engagement by making learning experiences more interactive. Several teachers shared how tools such as AI created quizzes and gamification increased student engagement and motivation. One teacher observed, *“Students are excited to use the AI-powered math app because it feels like a game, but they are learning while competing for higher scores.”* A participant highlighted how an AI-based writing assistant increased participation in writing assignments: *“My students who usually hate writing now enjoy getting instant suggestions and feedback from the tool.”* Another teacher described using AI to facilitate group projects: *“We used an AI chatbot to help students brainstorm project ideas. It sparked creativity and kept them engaged throughout the process.”*

Several participants also commented on how AI tools supported students with different learning needs. One teacher shared that their English Language Learners (ELL’s) responded well to AI translation tools that helped them with assignments: *“Students who struggle with English are more confident participating because the AI provides real-time translations and support.”* Another noted that students who typically lost interest in traditional assignments were more engaged when the lessons content was delivered through AI platforms: *“AI tools let me provide assignments that adapt to students’ pace, which keeps them from getting frustrated or bored.”*

Theme 3: Challenges in Adoption

Participants felt enthusiastic about AI's potential overall, however many encountered significant barriers to adoption. One common issue was a lack of school resources, such as outdated technology and limited device access. Teachers reported that without sufficient access to technology, they were unable to fully implement what they had learned during the institute. One participant explained, *"I'm excited to use these tools, but my classroom only has a few working computers, which makes it difficult to fully implement what I learned."* Another teacher raised concerns about professional development, stating: *"The institute was a great introduction, but I still need more hands-on training to feel confident using these tools effectively."*

Participants also cited insufficient administrative support and a lack of clear policies around AI use. Several respondents felt that while they were motivated to use AI, their schools lacked formal plans or guidance for technology integration. One teacher commented, *"Without support from my administration, it's hard to get the resources I need or even know what policies to follow regarding AI tools."*

Concerns about student data privacy and possible ethical issues were also of concern. Teachers were particularly concerned about how AI tools collected and used student data and whether those tools were free from bias. One participant expressed apprehension about privacy: *"I'm not sure how to explain data privacy to parents, and I worry about what happens to the data collected by these AI platforms."* Another respondent questioned the fairness of AI algorithms: *"I've read about bias in AI—how do we ensure the tools are giving all students a fair chance, especially those from marginalized backgrounds?"*

These qualitative findings highlight the potential and challenges of AI adoption in education and emphasize the importance of AI literacy for teachers, particularly in underserved areas. Teachers expressed excitement about how AI can enhance teaching practices and increase student engagement. However, barriers such as limited resources, insufficient training, and data privacy concerns were seen as barriers. As identified in the literature, these challenges are often magnified in underserved communities, where schools frequently face technology issues, lack of funds, and reduced access to advanced technology professional development opportunities.

Implications for the Future

The quantitative and qualitative findings from this study emphasize the importance of AI literacy professional development for teachers. Data from teachers who

participated in the AI Summer Institute professional development were analyzed, and the following discussion presents implications for future work on AI literacy with teachers working in under-resourced areas.

Enhanced Teaching Strategies and Sustained Professional Development

The findings revealed that while many participants recognized AI's potential to improve teaching practices, most felt that they needed more than one workshop and expressed a need for ongoing training and hands-on practice. Participants called for peer collaboration, mentorship, and classroom modeling opportunities. Future professional development on AI should extend beyond introductory workshops. There is an opportunity to develop coaching, learning communities, and other learning networks, especially for educators in underserved areas, where access to professional development is limited. Providing access to consistent AI professional development will help teachers become confident in using AI tools to enhance instruction and overall efficiency.

Barriers to AI Adoption and Equitable Resource Allocation

Many teachers identified restricted access to technology and or unreliable internet/computers as a major challenge to successful AI implementation. Equitable access to AI technology should be important for school districts and policy makers. They should prioritize funding for technology upgrades and internet access in underserved schools. Moving forward, districts should consider collaborating with private partners such as EdTech companies for software and technical support. Without targeted resource investments, the digital divide will widen. Students in under-resourced communities will be left behind without access to the personalized learning opportunities AI tools can provide.

Privacy Concerns and Ethical AI Policies

Several teachers expressed concerns about student data privacy and algorithmic bias. Teachers were unsure how to protect student information or explain privacy policies to parents. In many schools AI privacy policies were still being developed. Bias in AI algorithms was also a concern for teachers. They were aware that biased output or biased AI related decision making can potentially worsen existing inequalities especially for schools with marginalized populations. To promote responsible AI use, school districts and policymakers should work to develop clear guidelines on student data privacy. Training on ethical AI use and privacy practices should be provided to all school employees.

Increased Student Engagement and Inclusive AI Tools

The findings showed that most teachers believed AI tools could improve student engagement. Teachers discussed how effective it was to use AI with English Language Learners and students with disabilities. Future discussion on the integration of AI tools should prioritize inclusivity. School districts can work to select tools that work best with their particular student populations. They should work to incorporate platforms that increase accessibility features such as text-to-speech, text to image, closed captions, and customizable LLM's for students with disabilities. Additionally, it would be helpful for teachers with the support of their administration and school districts to become familiar with inclusive AI tools to help address achievement gaps and promote equitable learning outcomes.

Equity Gaps and the Need for Ongoing Research

There remains a lack of understanding about AI's long-term impact on student learning outcomes, teacher experiences, and equity. While the quantitative data in this study showed excitement towards AI's potential, qualitative responses suggested that teachers were unsure about how they would keep connected with accessing AI and being trained on the new technology, particularly in resource-limited schools. Teachers expressed uncertainty about how AI would affect student achievement and teacher workload over time. Future research on how AI integration affects teacher workload, satisfaction, and instructional practices is also necessary. Further, it is suggested that research focuses on equity related projects, examining whether AI tools help close or widen learning gaps, especially in underserved communities. These findings are critical as we work to close the digital divide.

CONCLUSION

The study assessed participants' familiarity with AI, their views on its potential to enhance teaching and learning, and their plans for integrating AI into classroom practice through both quantitative and qualitative methods. Additionally, the study gathered insights into obstacles to AI adoption by teachers, such as limited resources, lack of advanced technology training, and student data privacy concerns, as well as participants' evaluations of the workshop's effectiveness in supporting their use of AI tools.

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Bio

VALERIE RIGGS, Ed.D, is an Assistant Professor in the School of Education and Urban Studies, Morgan State University USA. Her major research interests include AI literacy, teacher professional development, educational equity, and technology integration in underserved communities.

Email: valerie.riggs@morgan.edu