

Bridging The Artificial Intelligence Knowledge Gap: An Empirical Study on AI Literacy in Secondary School Level

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Abstract

Background: Over the past two decades the artificial intelligence (AI) has provoked a significant discourse on the rise of AI in shaping society, especially in education system. Especially, The integration of AI in education has gained momentum, with AI tools like ChatGPT and Gemini increasingly influencing teaching and learning processes. However, the role of secondary school teachers, particularly how gender influences their AI adoption and literacy, remains underexplored. This study investigates gender-based patterns in AI application usage, confidence, and perceived challenges among secondary school teachers, aiming to identify any disparities and inform inclusive professional development.

Results:

Survey data from 100 secondary school teachers revealed no statistically significant gender differences in general AI use, content creation, lesson clarification, and problem-solving. Both male and female teachers demonstrated comparable interaction levels with AI tools, as reflected in weak and non-significant correlations. However, a significant gender gap was found in selecting AI tools for updating professional knowledge, with male teachers reporting greater confidence (69%) than female teachers (48%). This result was statistically significant ($p = 0.024$) and moderately correlated ($r = 0.213$), suggesting differential exposure to AI training or access to digital resources. Overall, while gender was not a major factor in most AI literacy dimensions, this particular gap indicates a need for targeted intervention.

Conclusions:

The study concludes that AI adoption among secondary teachers is not significantly influenced by gender in most dimensions. However, the observed disparity in professional development usage highlights the importance of equitable access to AI training. These findings support the need for inclusive, gender-sensitive policies and professional development programs to bridge confidence and usage gaps. Empowering all educators with the necessary skills to integrate AI effectively will be crucial for maximizing its educational potential.

Key words: Artificial intelligence in education, AI literacy, gender differences, secondary school teachers, teacher perceptions, professional development, educational technology adoption.

1. Introduction

Over the past two decades the artificial intelligence (AI) has provoked a significant discourse on the role of AI in shaping society, especially in education system. As AI becomes increasingly embedded across society, the educational institutions must change or adapt the AI technology to foster students with the requisite knowledge and competencies to

thrive in AI driven context. AI not only restricted with theoretical computation or higher level robotization but also, interact with everyday life starting from adaptive recommendation techniques for intelligent tutoring systems. AI as a discipline, it is traced its conceptual roots to mythology and philosophy but AI attained significantly, its scientific formulation in 1956 (Chen et al.,2020). Later in 1959, the machine learning (ML) emerged as a subset of artificial intelligence (AI), followed by the development of deep learning DL in 1986. But these two AI technologies as a type of AI, got widely significant attention as well as AI application in the educational system during the 2010s. (Chan& Zary, 2019). The quick advancement technological progress emphasizes the cultivating the embedded AI Literacy into formal education system at across all the education level, especially giving much importance to secondary level, where foundational cognitive level and career trajectories are established.

Despite the growing prevalence of AI, a significant knowledge gap endures among secondary school educators in the context of widespread uses. Research studies, consistently revealed that, teachers often lack exposure and training towards knowledge and its application, that is necessary to understand and apply AI tools and concepts effectively in the teaching learning process for better effective classrooms. (Shin et al., 2020 & Williams et al., 2022). In order to address and tackle this significant gap especially at educational institutions AI Literacy needs to be viewed and integrate as a full and comprehensive set of AI competencies or skills that encompass cognitive, ethical and pedagogical dimensions rather than merely technical skills. (Long& Magerko, 2020; Ng et al., 2021). In order to provide better understand and the emergence and shine on the development of AI Literacy, the existing literature synthesized into five thematic areas viz. illuminating the evaluation of the AI literacy, The development of AI Literacy, its significance, its integration into secondary education and theoretical models or frameworks that inform its instructional design.

2. Conceptual framework:

The Evolution of Literacy Concept

Historically, the term “Literacy” was defined as the ability to read and write. However, in the digital age, the concept of literacy has changed as evolving concept that encompassing digital data, media and AI literacy with the proliferation of digital technologies, digital literacy that emerged in the 1970s with the emphasizing access and leverage of digital technology (Leahy & Dolan., 2010; Carolus et al.,2023). Understanding the fostering of AI literacy, needs to be examine its roots of the earlier forms of the literacy, especially in the context of digital and computational literacies.

Digital literacy emerged in 1970, along the raise of the computers, majorly emphasizing ability to use, access and leveraging technological tools (Kandlhofer et al., 2016). As the digital age progressed, data literacy was introduced to address competencies in organizing, evaluating, analyzing and comprehend the vast amount of digital information. The shift in digital literacy reflected by societal transformation that largely cognitive process intervened by digital technologies or systems. (Burgsteiner et al., 2016). There is a wide spread recognition that literacy is dynamic and rather it changes in the response to the technological and societal demands. However, yet, the recurring significant gap identified in the various research papers such as under theocratization of AI literacy as dynamic concept within k-12 education. (Carolus et al., 2023). Many educational institutions emphasizing more on traditional literacies. Often ignoring or vaguely newer technologies such as AI literacy because ambiguously defined within the context of k-12 education.

In the 21st century, the shifting perspective on literacy forms the foundation for the integration of AI literacy into educational discourse and it sets stage for the rethinking of what literate means and reinforce the importance of study in exploring and assessing how secondary school educators conceptualize and apply the AI related competencies.

AI Literacy (Definitions and Its Evolution)

AI literacy has been depicted in various ways through the literature encompassing both operational and conceptual definitions such as ability to use AI tools effectively, and more conceptual like knowledge of AI ethics, decision making process more societal impacts. According to (Ng et al., (2021); Chiu &Sanusi (2024) by understanding with AI technologies, machine learning, algorithms especially in understanding in interaction of AI tools such as Chat GPT, Gemini and Microsoft Copilot etc. Understanding AI Literacy helps to interact AI applications effectively in the context of digital sources and data literacies.

In order to foster AI Literacy, in 1970s, the Seymour papert introduced logo programming by helping children to nurture computational thinking reasoning. (Ng et al.,2021). Since then, the role of AI in education as an educational field inflated significantly, by evolving dramatically, shifting from beyond programming language to educational objectives such as including ethics, transparency and societal impacts in a more expanded form as an educational field (Yim,2024).

According to literature, there is a distinguish between technological and human perspective on AI literacy with the certain frameworks (Long & Magerko, 2020). That emphasize on technical fluency while others given much importance or prioritize on cognitive understanding and ethical aspects as role of AI as social and moral entity. This contrast highlights the research gap and integrating the both the domains into cohesive unified framework for AI Literacy that can be seen by this dichotomy. Another consistent recurring topic is having lack of common definition or framework especially, at the secondary education level for AI Literacy. The no of studies recommended that, the development of interdisciplinary age-appropriate curricula that strike balance between the conceptual knowledge and practical experience or applications (Zhang et al., 2022; Chiu & Sanusi, 2024). This reaffirms the necessity of organized AI literacy programs and support the rationale for to study the current study that explore comprehending how the educators operationalize and implement AI literacy.

Importance of AI in Education

According to Wang, (2019); Chan & Zary, (2019) The transformative potential of AI education has been well established through innovative technologies such as adaptive learning tools, intelligent tutoring system, adaptive assessment, automated grading and predictive analysis of the data are now been implemented in the classrooms across globally. These innovative tools hold the potential to enable personalized instructions, instant feedback and data driven teaching approaches. Nevertheless, as Southworth et al., (2023) pointed out that, the effectiveness of these technologies heavily dependent on educators' ability to comprehend and critical review of AI system.

According to Koehler & Mishra, (2009) Teachers are acknowledged as crucial stakeholders and increasingly progressive in facilitating AI tools adaption within the educational setting especially in school level. Despite this, empirical research indicates that most of the educators and teachers lack necessary skills that are needed to use properly AI tools in the classroom situations (Shin et al., 2020). This shows extreme paradox although, while the AI tools are becoming more widely recognizable, the educational integration and classroom implications are still inconsistent.

Furthermore, the AI Literacy plays vital role in fostering digital citizenship and ethical reasoning in addition to improve student capabilities and teaching instructions (Ng et al., 2021). By gaining insights on how algorithmic process works and understanding broadly its impact and applications in the educational setting equips students to engage more responsibly in the AI driven societies.

While, evidently, the education has lot of advantages with the uses of AI in day-to-day classrooms and real-life context, but research strongly warns against the techno solutionism, notion that AI can resolve all educational problems single handedly. The eminent scholars highlighted that critical literacy techniques such as AI limitations, inherent bias and potential risks of the AI technologies. (Southworth et al., 2023). This emphasizes the importance of present study if teachers are inadequately equipped in the uses of AI and not materialized especially at the under resources areas such as rural and semi urban teachers without getting training in the leverage of AI may goes worst, where professional development is limited and if not trained professionally.

AI Literacy in Secondary Education

As, secondary education is very crucial and highly important to choose their own career path for students, in order to teach how to access AI driven technology and leverage of AI at this stage. However, access of AI and AI literacy instruction is very much limited and not fully adaptable in the educational system. (Kandlhofer et al., 2016; Williams et al., 2022). In order to be effective teaching learning process inculcation of AI tools or technology is highly significant but shin et al., (2020) pointed out that there weren't sufficient teacher training programs and leverage of AI technology access though education system emphasizing integrating the concept of Techno pedagogical content knowledge concept (TPACK). Especially, rural and semi urban school teachers are facing uses and access of technology, hence this becomes a bigger challenge for the education system (Mishra & Koehler 2006).

According to wang (2019), to be successful classroom the effective strategies are very significant, hence, the inculcation of AI tools are necessary in the integration of interdisciplinary disciplines such as mathematics, science, and even social studies to promote holistic understanding. To enhance learning more joyful and student friendly and for the conceptual clarity the researcher emphasized that project-based learning, creating gamified environment and introducing simulations through various AI tools are very much important. (Sun et al., 2023).

Yet, there is a notable gap in understanding the evaluating the efficacy of new interventions on AI Literacy and the more focused on student-based outcome but understanding teacher perception, AI knowledge, reediness and experience in used of AI was not studies. Hence, this study addresses the collecting empirical data by assessing AI Literacy in the context of AI Knowledge, AI Understanding, AI Use, AI Ethics, AI Creation especially for the secondary level teachers of CBSC schools.

Theories on AI Literacy

AI literacy has strong connection with various types of disciplines of literacy such as computational literacy, data analysis, digital data but these domains affect how extent people comprehend and leverage AI driven systems. (Long& Magerko 2020; Ng et al., 2021). Digital literacy that emerged along with the growth of the personal computers that encompasses the ability to access, analyze, and communicate digital information effectively. (Koehler& Mishra, 2009; Leahy & Dolan, 2010). This is the foundation for the computer literacy that support the people to learn how to think and solve problems and create algorithms, which the necessary to create any AI tool and to comprehend strength and weakness of AI and it goes beyond these domains by including about understanding of machine learning works, and being able to think critically about AI powered decision-making processes. (Brennan &Resnick, 2012; Grover & Pea, 2018; Chin & Sanusi 2024; Yim, 2024). Some of the studies like Zhang et al., (2022) & South worth et al., (2023) emphasizes that AI Literacy is not about technical skills it is more than developing how AI systems shape social norms and human behavior.

There have been several numbers of models that proposed to define and measure AI Literacy but long& Magerko's (2020) framework specifies the most relevant AI Literacy competencies in the context of what is AI, how AI thinks, how AI make decisions and thinking and evaluating about AI ethics that arises from AI. Wang (2019) & Sun et al., (2023) highlighted the importance of conceptual knowledge and procedural knowledge of AI, that differentiate between symbolic AI and machine learning base and interacting with AI system effectively. Meanwhile, other research studies emphasized that constructive approach is more focusing towards AI education, that provides experiential learning where students can access AI tools and enhance AI understanding more better way. However, these theories are fit with techno pedagogical content knowledge (TPACK), that emphasize teachers to use AI tools in their specific subject area where they can foster students in the context of uses and access AI literacy. (Antonietti & Cantoia, 2020; Williams et al., 2022; Mishra & Koehler, 2006; Shin et al., 2020). In the light of growing significant importance of AI literacy there is still difficulties persist in creating inclusive and AI education programs. (Kandlhofer et al., 2016 &Burgsteiner et al., 2016). Researcher emphasized that, to ensure AI literacy and its relevance in the various educational context as AI Literacy continuously evolving there is a need to refinement of AI Literacy models. (Ng et al., 2021& Russell Norving 2021). However, despite of these improvements all the models are western centric framework that need to be customized for a different kind of educational circumstance within the Indian context.

Despite of all, the significant recognition of AI literacy in secondary education becomes widely acknowledged. Yet, its implementation has still remained unchanged such as lack of teacher preparedness, lack of training programs, awareness of the teachers and not having adequately standardized frameworks hinder its effective implementation. Plenty of teachers lacking knowledge of AI to teach AI concepts which could lead to misconceptions among students and hindering meaningful engagement with AI technologies. Furthermore, the present curriculum does not address the AI ethics and its awareness and technical skills that all are included in AI Literacy. Therefore, consequently to ensure that all students are prepared for the future readiness driven by artificial intelligence this study is need to conduct to identify gaps in AI literacy awareness and their comprehend understanding about AI literacy in the context of AI Knowledge, AI Understanding, AI Use, AI Ethics, AI Creation. Especially, for the secondary level teachers of CBSC schools and to assist the creation of structured AI education. In order to achieve the research aim, the following research questions and objectives and Hypotheses were framed.

3. Research Questions

1. What is the current AI literacy among secondary school teachers of CBSE, State Board?
2. How does AI literacy vary across male and female teachers of secondary school level?
3. What is the impact of gender, rural and experience on AI literacy?

4. Research Objectives

- 1) To assess the AI literacy with respect to (AI Knowledge, AI Understanding, AI Use, AI Ethics, AI Creation) of secondary school teachers of CBSE and State board.
- 2) To analyze the influence of demographic variables (locality and teaching experience) on AI literacy.
- 3) To compare the AI literacy among male and female secondary school teachers.

5. Hypothesis

- 1.1 There is no difference of AI Literacy between CBSE and State board of secondary school teachers in dimension wise.
- 1.2 There is no difference of AI Literacy between Male and female Secondary school teachers.
- 1.3 There is no difference on AI Influence between locality of the Secondary school teachers.
- 1.4 There is no difference on AI influence based on teaching experience of Secondary school teachers.

6. Methodology

The study employed a descriptive survey method to qualitatively assess a defined a group of secondary school teachers from various states to understand the levels of AI Literacy especially, focusing on five dimensions: AI Identification, AI Understanding, AI Uses, AI Application, and AI Creation.

The population of this study comprised of all CBSE and state board teachers of secondary level. A snow ball sampling technique was used to select sample and ensure representation across different teaching experiences (0–5 years, 6–10 years, and >10 years), with participants drawn from various educational boards, including CBSE and State Board schools.

The researcher developed a structured questionnaire in English that is used to assess AI Literacy with the focus on five dimensions in the context of AI Identification, AI Understanding, AI Uses, AI Application, and AI Creation. The tool consists of three section the section one included informed consent form such as emphasizing the voluntary participation, confidentiality, instructions of the tool. Section two consists of demographic variables such as name, gender, designation, name of the school board, gender, stream, locality, experience, type of family. Section three consists of various questions on dimension wise to assess the comprehend understanding of AI Literacy emphasizing five dimensions. Using a five-point Likert scale. The content/ items of the tool aligned with the based on existing AI Literacy framework and literature review in Indian context. To enhance the study's credibility, reliability and validity tests were conducted, resulting in a reliability with a Cronbach's alpha of **0.89** indicating highly internal consistency for the questionnaire.

The Data collection was conducted through google forms through snow ball sampling and descriptive statistics (mean, percentage, and frequency) and inferential statistics (t-tests and correlation analysis such as p-values and correlation coefficients 'r') used to determine the significance applied to analyze using Excel and SPSS software. Consequently, nonparametric tests were employed the Mann–Whitney U test to assess gender differences and the Kruskal–Wallis H test to examine variations based on teaching experience.

7. Analysis and Results

Objective 01: To analyze the AI literacy competencies and relationship among male and female secondary school teachers.

To achieve the objective, the researcher conducted both descriptive and inferential statistical analyses to examine gender-based differences in AI literacy dimensions among secondary school teachers. Detailed numerical data and full table descriptions are provided in the Supplementary Tables.

Supplementary table 01: Assessment of AI Identification among Secondary Teachers Based on Gender. (See Supplementary Table 01 for detailed descriptive and inferential statistics.)

The findings revealed that, there is no significant gender differences in AI identification, understanding, or perceptions among secondary teachers. Both genders demonstrate similar confidence in recognizing AI in devices (75% males, 76% females) and understanding AI in daily life (69% each). Male teachers report higher AI recognition in applications (91% vs. 69% for females), while females strongly agree more often in understanding AI. However, statistical tests ($p > 0.05$) confirm no meaningful gender impact. These variations suggest that **structural and pedagogical factors, rather than gender alone, shape AI literacy**, emphasizing the need for equitable training and curriculum improvements in AI education.

Supplementary table no 02: Assessment of AI Understanding among Secondary Teachers Based on gender (See Supplementary Table 02 for detailed descriptive and inferential statistics.)

The findings reveal both convergence and divergence in AI literacy among secondary teachers based on gender. While male and female teachers exhibit comparable perceptions regarding AI benefits, risks ($p = 0.177$), and information processing ($p = 0.195$), significant disparities emerge in specific domains of AI knowledge. Male teachers report notably higher confidence in explaining AI concepts (84% vs. 47%), supported by a statistically significant difference ($p = 0.031$) and a moderate positive correlation ($r = 0.233$, $p = 0.027$). Additionally, awareness of AI's visual functions is higher among males (100% vs. 88%; $p = 0.038$, $r = 0.219$). These results suggest gender-related gaps in applied AI literacy, particularly in knowledge articulation and functional understanding. Addressing these disparities through gender-responsive, skill-oriented training initiatives is essential to foster equitable AI integration in educational practice and policy.

Supplementary table no 03: Assessment of AI Uses among Secondary Teachers Based on Gender.

(See Supplementary Table 03 for detailed descriptive and inferential statistics.)

The findings reveal minimal gender differences in AI use among secondary teachers, with both groups showing similar confidence in content creation, lesson support, and summarization, as indicated by non-significant p-values and weak correlations. However, a significant gap was observed in selecting AI tools for knowledge updates, where male teachers (69%) outperformed females (48%) ($p = 0.024$, $r = 0.213$). This suggests greater AI exposure among males and underscores the need for gender-responsive training to ensure equitable AI competence across educators.

Supplementary table no 04: Assessment of AI Application among Secondary teachers based on gender (See Supplementary Table 04 for detailed descriptive and inferential statistics.)

The analysis reveals no statistically significant gender differences in secondary teachers' adoption and perception of AI applications (Items 16–19). Both male and female teachers report comparable levels of experience with AI tools ($p = 0.312$), confidence in AI's benefits for teaching ($p = 0.086$), perceptions of AI development challenges ($p = 0.245$), and AI tool adoption for learning enhancement ($p = 0.064$). All correlation coefficients (ranging from -0.146 to 0.161) are weak and non-significant ($p > 0.05$), suggesting minimal association between gender and AI engagement. These findings suggest that AI application adoption is shaped more by professional exposure and individual readiness than by gender. Hence, equitable, gender-inclusive training initiatives are essential for promoting broader and more effective integration of AI in teaching practices.

Supplementary table no 05: **Assessment of AI Creation among Secondary teachers based on gender.** (See Supplementary Table 05 for detailed descriptive and inferential statistics.)

The analysis indicates significant gender disparities in advanced AI creation among secondary teachers. Male teachers show higher engagement and confidence in developing AI models and applications ($p = 0.009$; $p = 0.006$), with negative correlation coefficients ($r = -0.249$; -0.267) suggesting reduced confidence among females. However, no significant gender differences are observed in simpler AI tasks, such as developing basic AI-powered educational tools ($p = 0.369$) and identifying AI resources for integration ($p = 0.233$). These results suggest that while gender influences complex AI development, both groups demonstrate comparable readiness for practical AI adoption. Weak correlations across all items indicate that training and exposure may play a more pivotal role than gender in shaping AI creation competencies.

Objective 02: To explore the AI literacy and relationship of secondary school teachers with respect to locality and teaching experience.

To achieve this objective, the researcher conducted descriptive and inferential statistical analyses to examine variations in AI literacy dimensions based on teachers' locality and years of teaching experience. Comprehensive numerical data and detailed table descriptions are presented in the Supplementary Tables.

Supplementary table no 06: Assessment of AI Identification among secondary teachers based on locality. (See Supplementary Table 06 for detailed descriptive and inferential statistics.)

The analysis reveals modest but significant locality-based differences in AI identification skills among secondary teachers. Urban teachers show greater confidence in identifying AI-embedded devices ($p = .018$, $r = .249$), while rural teachers struggle with recognizing AI in daily life ($p = .059$, $r = -.200$). No significant differences are observed in recognizing AI applications ($p = .211$) or distinguishing AI from human intelligence ($p = .906$). Misconceptions about AI's societal impact persist across both groups ($p = .609$). These results underscore the need for targeted, context-sensitive AI literacy initiatives, especially in rural settings.

Supplementary table no 07: Assessment of AI Understanding among Secondary teachers based on locality (See Supplementary Table 07 for detailed descriptive and inferential statistics.)

The analysis indicates that urban teachers exhibit slightly higher AI awareness than their rural counterparts; however, the differences are not statistically significant (all $p > 0.05$). Weak correlations suggest minimal influence of locality on AI understanding, with AI benefits negatively correlated ($r = -0.184$) and AI skills ($r = 0.189$) and processing ($r = 0.127$) showing minor positive trends. Higher agreement among urban teachers is noted in areas such as AI's visual functions (75% vs. 68%). These findings suggest that AI awareness is shaped more by exposure and training than by geographic locality.

Supplementary table no 08: Assessment of AI Uses among Secondary teachers based on locality. (See Supplementary Table 08 for detailed descriptive and inferential statistics.)

Urban teachers report slightly higher AI adoption than rural teachers, particularly in content creation (67% vs. 49%) and knowledge updates (51% vs. 50%), though usage for concept clarification is nearly equal. Correlation values ($r = -0.147$ to 0.187) and non-significant t-test results ($p > 0.05$) indicate no strong locality-based effect. These findings suggest that AI usage is not significantly influenced by locality, underscoring the importance of equitable access to AI training across regions.

Supplementary table no 09: Assessment of AI Application among Secondary teachers based on locality. (See Supplementary Table 09 for detailed descriptive and inferential statistics.)

AI experience among urban and rural teachers is comparable ($p = .283$), indicating broad exposure. However, urban teachers show significantly greater confidence in AI's potential to improve efficiency and learning outcomes ($p = .033$), suggesting a digital confidence gap. Perceptions of AI tool development as challenging are shared across localities ($p = .109$), while AI adoption for learning is widely accepted regardless of location ($p = .238$). Weak correlations support the conclusion that locality has limited influence on AI perceptions, emphasizing the greater impact of training and resource accessibility.

Supplementary table no 10: Assessment of AI creation among Secondary teachers based on locality. (See Supplementary Table 10 for detailed descriptive and inferential statistics.)

The below table shows, the secondary teachers across urban and rural settings show limited experience in AI model development, indicating a general skill gap. While confidence in developing AI applications is low across both groups, urban teachers exhibit significantly higher ability to identify AI tools for integration ($p = .008$), revealing a digital competency divide. However, weak correlations suggest that locality alone does not determine AI adoption; instead, professional training and institutional support are more influential. Targeted interventions are essential to bridge this gap and support effective AI integration in education.

Based on teaching experience:

Supplementary table no 11: Assessment of AI Identification among Secondary Teachers Based on Teaching experience. (See Supplementary Table 11 for detailed descriptive and inferential statistics.)

The analysis reveals teacher experience-based variations in AI identification skills. Teachers with over ten years of experience demonstrated significantly greater competence in recognizing AI-embedded systems and distinguishing AI from human intelligence. In contrast, early-career teachers (0–5 years) showed limited awareness, particularly in identifying AI in daily life, as reflected by higher neutral and disagreement responses. Statistical analysis confirmed a significant association between teaching experience and AI awareness ($p < .05$), leading to the rejection of the null hypothesis. While correlation coefficients were weak, they nonetheless indicate an experience-related trend in AI perception. These findings underscore the importance of targeted professional development to enhance AI literacy across all experience levels.

Supplementary table no 12: Assessment of AI Understanding among Secondary Teachers Based on teaching experience. (See Supplementary Table 12 for detailed descriptive and inferential statistics.)

The analysis indicates that AI understanding among teachers varies with experience. Educators with over ten years of service exhibit stronger comprehension of AI benefits, required skills, and information processing capabilities. Interestingly, early-career teachers (0–5 years) also show awareness, particularly in recognizing AI-driven visual functions. In contrast, mid-career teachers (6–10 years) report lower agreement levels, suggesting potential inconsistencies in their exposure to or engagement with AI-related learning. Statistically significant differences ($p < .05$) in perceptions of AI benefits and visual functions led to the rejection of the null hypothesis. Despite these differences, weak correlation coefficients (ranging from -0.074 to 0.104) indicate that experience alone does not robustly predict AI understanding. These findings emphasize the need for consistent and structured AI training opportunities across all stages of teaching careers.

Supplementary table no 13: Assessment of AI Uses among Secondary Teachers Based on teaching experience. (See Supplementary Table 13 for detailed descriptive and inferential statistics.)

The analysis shows that AI adoption patterns vary with task complexity but are not strongly influenced by teaching experience. While the use of AI tools for basic tasks—such as content creation, knowledge updating, and concept clarification—is widely accepted across experience levels, no statistically significant differences were observed ($p > .05$). Notably, teachers with over ten years of experience exhibited hesitancy toward AI-driven decision-making ($p = .053$), indicating barriers to adopting more complex AI applications. In contrast, the use of AI for summarization tasks showed a statistically significant difference ($p = .025$), suggesting a general preference for simpler, task-oriented AI functions. Weak correlation coefficients further confirm that experience alone does not predict AI adoption behavior. These findings underscore the need for targeted professional development to promote confident and pedagogically meaningful integration of AI tools.

Supplementary table no 14: Assessment of AI Application among Secondary Teachers Based on teaching experience. (See Supplementary Table 14 for detailed descriptive and inferential statistics.)

The analysis reveals that early-career teachers (0–5 years) demonstrate higher engagement with AI tools such as ChatGPT and Gemini ($p = .004$, $r = .328$), indicating greater adaptability to emerging technologies. Across all experience levels, there is strong recognition of AI's potential to improve accuracy and efficiency in educational tasks ($p = .006$). However, teachers with over ten years of experience perceive AI tool development as more challenging ($p = .009$), highlighting possible barriers to advanced adoption. Despite this, AI-powered learning tools receive widespread acceptance ($p = .003$), reflecting a generally positive outlook on AI integration. These results underscore the need for differentiated AI training supporting experienced teachers in overcoming adoption barriers while encouraging the innovative use of AI by younger educators.

Supplementary table no 15: Assessment of AI Creation among Secondary Teachers Based on teaching experience. (See Supplementary Table 11 for detailed descriptive and inferential statistics.)

The analysis shows that teaching experience has minimal influence on AI tool selection for content creation ($p = .946$, $r = -0.014$) and knowledge enhancement ($p = .950$, $r = .001$), indicating a generally neutral stance toward AI adoption across experience levels. Similarly, no strong correlation was found between experience and AI use for concept clarification or lesson preparation ($p = .099$, $r = .085$). However, early-career teachers (0–5 years) display significantly higher acceptance of AI for learning and decision-making purposes ($p = .003$, $r = .090$), reflecting greater openness to integrating AI into pedagogical tasks. These findings reinforce the need for targeted and differentiated AI training programs to support experienced teachers in developing AI-driven instructional and decision-making competencies.

Objective 03: To explore the AI literacy and relationship of secondary school teachers of CBSE and State board.

To achieve this objective, the researcher employed descriptive and inferential statistical analyses to investigate differences in AI literacy dimensions between teachers affiliated with CBSE and State education boards. Detailed numerical data and comprehensive table descriptions are provided in the Supplementary Tables.

Supplementary table no 16: Assessment of AI Identification among Secondary Teachers Based on School type (See Supplementary Table 11 for detailed descriptive and inferential statistics.)

The analysis of AI identification among secondary teachers from CBSE and State Board schools reveals notable differences. CBSE teachers generally exhibit a stronger ability to recognize AI systems, though both groups face challenges in identifying AI in daily life. A significant difference ($p = 0.005$) was observed in AI identification difficulties, with State Board teachers struggling more. Similarly, explaining AI vs. human intelligence showed a significant gap ($p = 0.010$), indicating varying levels of AI understanding. Correlation analysis highlights that teacher who struggle with AI identification tend to have a lower overall AI understanding. These findings emphasize the need for targeted AI literacy programs, particularly for State Board teachers, to bridge the knowledge gap and enhance AI awareness in education.

The major findings indicate that CBSE teachers generally have a better understanding of AI identification compared to State Board teachers. A significant difference was observed in recognizing AI in daily life ($p = 0.005$), where State Board teachers faced greater difficulties. Additionally, the ability to explain the distinction between AI and human intelligence also showed a statistically significant difference ($p = 0.010$), suggesting gaps in AI comprehension. While both groups could recognize AI-driven technologies in everyday life, correlation analysis suggests that those who struggle with AI identification also exhibit weaker overall AI literacy. These findings highlight disparities in AI awareness across different school types, emphasizing the need for structured AI literacy initiatives, particularly for State Board teachers, to ensure uniform understanding and effective AI integration in education.

Supplementary table no 17: Assessment of AI Understanding among Secondary Teachers Based on School type (See Supplementary Table 11 for detailed descriptive and inferential statistics.)

The analysis of AI understanding among secondary school teachers reveals key differences between CBSE and State Board educators. Percentage-based analysis indicates that CBSE teachers generally report higher levels of agreement and strong agreement on AI-related knowledge and skills, while State Board teachers display a more neutral stance. For example, 49% of CBSE teachers agree that AI can implement visual functions, whereas 74% of State Board teachers hold the same view. The t-test results show that the differences between CBSE and State Board teachers are not statistically significant ($p > 0.05$ in all cases), leading to the acceptance of the null hypothesis. Correlation analysis reveals weak or negligible relationships across all items, with coefficients ranging from -0.046 to 0.141 , suggesting no strong linear association between teachers' responses and their AI identification abilities. These findings highlight the need for targeted AI training programs to bridge knowledge gaps and ensure uniform AI literacy across school types.

The major findings indicate that CBSE teachers exhibit a higher level of AI understanding than State Board teachers, as reflected in their stronger agreement on AI-related knowledge and skills. However, a significant portion of State Board teachers remain neutral on AI concepts, suggesting a potential gap in AI awareness. Despite these differences, t-test results reveal no statistically significant variation ($p > 0.05$) between the two groups, implying that observed differences may not be substantial enough to generalize. Correlation analysis shows weak or negligible relationships, with coefficients ranging from -0.046 to 0.141 , indicating no strong association between teachers' responses and their AI identification abilities. These findings suggest that while some teachers demonstrate AI awareness, there is a need for structured AI education

programs to enhance teachers' understanding across both school types and create a more uniform AI literacy framework in secondary education.

Supplementary table no 18: Assessment of AI Uses among Secondary Teachers Based on School type. (See Supplementary Table 11 for detailed descriptive and inferential statistics.)

The findings indicate that both CBSE and State Board teachers demonstrate a moderate level of AI use, with CBSE teachers exhibiting a slightly higher engagement in AI-driven tasks. The percentage-based analysis reveals that while a majority of teachers agree on selecting appropriate AI tools and applications, a considerable portion remains neutral, indicating a lack of confidence or training. The t-test results show no statistically significant differences ($p > 0.05$) in AI usage between CBSE and State Board teachers, suggesting that exposure to AI tools is similar across school types. Correlation analysis further reveals weak relationships between AI adoption and school type, emphasizing that AI integration in teaching is still in its early stages. These findings highlight the need for targeted AI training programs to enhance teachers' competency and confidence in leveraging AI tools for classroom use, ensuring equitable adoption across different educational settings.

The analysis highlights that secondary school teachers, regardless of their school type (CBSE or State Board), show a moderate level of AI awareness and utilization in their teaching practices. A significant portion of teachers agree on the usefulness of AI tools in content creation, knowledge updating, and problem-solving, yet a notable percentage remains neutral, suggesting a gap in confidence or familiarity. The t-test results indicate no statistically significant difference ($p > 0.05$) between CBSE and State Board teachers in their AI adoption, implying that AI exposure is similar across educational boards. Additionally, the correlation coefficients demonstrate weak relationships, signifying that AI integration is not strongly dependent on school type but rather on individual awareness and training. These findings underscore the necessity for structured AI literacy programs to enhance teachers' capabilities, ensuring they can effectively leverage AI for educational purposes.

Supplementary table no 19: Assessment of AI Application among Secondary Teachers Based on School type. (See Supplementary Table 11 for detailed descriptive and inferential statistics.)

The analysis reveals a significant disparity in AI engagement between CBSE and State Board teachers. CBSE teachers reported higher levels of interaction with AI tools, with 45% strongly agreeing to prior AI experience compared to 13% among State Board teachers. A statistically significant difference was found in AI interaction experience ($p = .010$), indicating greater exposure among CBSE teachers. However, no significant differences were observed in perceptions of AI's benefits or challenges across school types. Correlation analysis revealed a weak but statistically significant positive relationship between AI interaction experience and AI adoption ($r = .246$, $p = .020$), suggesting that prior exposure may influence integration. Other correlations were weak and non-significant, indicating that confidence and perceived challenges have limited impact on AI adoption.

Supplementary table no 20: Assessment of AI Creation among Secondary Teachers Based on School type. ((See Supplementary Table 11 for detailed descriptive and inferential statistics.)

The analysis indicates that CBSE teachers report slightly higher confidence in AI development and application compared to State Board teachers; however, strong agreement levels remain low across both groups, suggesting limited expertise. T-test results show statistically significant differences ($p < .05$) in AI model development and application, leading to the rejection of the null hypothesis. In contrast, no significant differences were observed in other AI-related competencies. Correlation analysis reveals weak negative relationships ($r = -0.221$, -0.201) in AI development, indicating that despite some awareness, practical experience remains limited. These findings underscore the need for structured AI training programs to bridge the competency gap and promote effective AI integration in teaching practices.

8. Discussions:

The major objective of the study is to explore the AI Literacy among secondary school teachers of CBSC and state board across various dimensions such as gender, teaching experience, locality and school type. By contributing, insights into how institutional and demographic factors that impact educators AI resilience and findings add to the expanding body of literature on AI Integrate education.

Gender based differences:

The findings suggested that, male and female teachers are had the essentially, comparable identical levels of AI Literacy which is supporting the recent research study by (Li & Zhao, 2024 & Ogolo et al., 2024) that found few differences on certain dimensions such as in digital and certain AI skills between males and females. However, especially like identifying and choosing existed AI tools comprehending its visual functionality male teachers shows little more awareness and confidence. As previous researchers pointed out that, these disparities can be caused by the access of digital devices and differential access getting opportunity in participating AI workshops and awareness of uses. Additionally, both men and women teachers show, comparable barriers in the creation of AI models that demonstrating structural disparity, that passes beyond gender boundaries. These findings highlights' the importance and necessity of AI emphasizing on competency-based training programs rather than gender specific in order to foster AI Literacy.

AI Literacy variations Based on Locality:

In general, urban teachers revealed that have comprehend of AI awareness, especially in the context of embedded AI education system and recognizing AI impact on education. This is in line with Haque,2024 & Varghese & Arya (2024) that reported better digital literacy among secondary school teachers or educators because of having more awareness and better infrastructure. More ever, there is no significant differences were found in most of the dimensions such as like the AI understanding and AI Application. Furthermore, the results reveled that, locality itself does not help in fostering AI competencies based on weak correlation coefficient. This highlights, the importance of AI education that providing equitable access to AI training and digital infrastructure in rural areas to ensure uniform adoption irrespective of locality.

Teaching Experience and AI Literacy

In the dimension of teaching experience on AI Literacy, results discovered that, the teacher who are having experience between 0-5 years were more flexible in uses of new AI Technologies such as Chat GPT and Gemini etc. but teachers with more experience greater than 10 years were had more awareness on AI embedded system and their advantages. These studied are more aligned with the previous researcher who found that experienced teachers are had better awareness. (Smith et al., 2021; Nguyen, 2024). but may lack adaptability to newer technologies without structured training. Conversely, younger teachers often digital natives are more enthusiastic adopters, but may lack conceptual depth. Weak correlations across experience levels indicate that experience alone is not a reliable predictor of AI competence, reaffirming the need for role- and level-specific AI professional development programs.

School Type (CBSE vs. State Board)

The comparison between CBSE and State Board teachers revealed significant discrepancies. CBSE educators expressed increased trust in AI detection and development, presumably attributable to the proactive integration of AI modules within the CBSE curriculum (Ziesche & Bhagat, 2022). Conversely, State Board educators faced difficulties in fundamental AI understanding and tool creation, underscoring a lack in curriculum and exposure. Nonetheless, both groups had analogous attitudes regarding the educational potential and problems of AI, indicating a mutual readiness to include AI when sufficiently supported. These findings correspond with Zhao & Collier (2023), who underscored that structural support is important for successful AI adoption, surpassing the significance of institutional affiliation alone.

Unexpected Patterns and Limitations

Interestingly, mid-career teachers (6–10 years) demonstrated lower AI awareness in some dimensions than both early- and late-career educators. This anomaly may reflect inconsistent access to professional development or curriculum transitions during their training period. Additionally, weak correlation values across all variables suggest that factors like institutional support, access to resources, and personal interest may play more decisive roles in shaping AI literacy than demographic characteristics alone.

This study has several limitations. The sample was limited to secondary teachers of limited states which may affect the generalizability of findings to other states or education levels. The reliance on self-reported data may also introduce response biases. Future research should employ larger, cross-regional samples and incorporate mixed-method approaches including interviews or classroom observations for a more nuanced understanding of AI literacy in practice.

Conclusion: This study explored AI literacy among secondary school teachers of various states across country, that examining the influence of gender, locality, teaching experience, and school type. The findings disclosed that, while teachers exhibit a general awareness of AI's potential in education, significant gaps remain in advanced competencies such as AI development and application. CBSE teachers, urban educators, and those with extensive teaching experience tend to demonstrate higher confidence in certain AI dimensions, while early-career teachers show greater adaptability to newer AI tools. Gender differences were minimal but limited in specific skills like tool selection and visual AI functions.

Overall, the study highlights that demographic factor alone do not strongly determine AI literacy. Instead, professional development, curriculum integration, and equitable access to AI resources emerge as critical determinants. These insights underscore the urgent need for structured, inclusive, and differentiated AI training programs for teachers at all levels. By equipping educators with the skills and confidence to use AI meaningfully, schools can better prepare students for an increasingly AI-driven future.

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