

Exploring Digital Competencies among B.Ed Teacher Trainees

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Abstract: Artificial Intelligence (AI) in education refers to the use of intelligent technologies to enhance teaching and learning processes. AI can personalize learning by adapting content to individual students' needs, provide real-time feedback, automate administrative tasks, and support educators in designing effective instructional strategies. The study explores the level of Artificial Intelligence (AI) literacy and digital competencies among the B.Ed teacher trainees from five districts of Karnataka such as Mysuru, Shivamogga, Hassan, Mandya, and Bengaluru. The present study uses a descriptive survey design by using self constructed Artificial Intelligence Assessment Scale (AIAS) which measure the three dimensions such as AIKU (AI knowledge & understanding), AIUA (AI use & apply), AISE (AI self-efficacy) and IE (AI ethics), data collected from 436 trainee and collected data analyses by using t-test and regression analysis. The result of the study revealed that the gender and the geographical location or background does not significantly impact on the learning and enhancing AI-related competencies but both I year & II Year exhibited similar mean scores, indicating consistent AI awareness and readiness regardless of their academic year. The study also revealed that the strong and positive predictive relationship between B.Ed teacher trainees' understanding of AI concepts and their ability to apply AI in educational contexts, teacher trainees who possess stronger knowledge and understanding of AI tend to show higher confidence (self-efficacy) and stronger ethical awareness in using AI applications. The study recommends that integration of AI focused curriculum, ethical training of AI, pedagogical innovation and professional development for prepare future educators for AI- driven classrooms.

Keywords: Artificial Intelligence (AI) Literacy, B.Ed teacher trainees, TPACK, Digital competence.

I. INTRODUCTION

Artificial Intelligence (AI) is one of the most preferable agenda selected by many education leaders today in educating the next generation across the globe. Artificial intelligence (AI) promotes studies in everyday life not only in the students when with the public also. Now days AI become extremely attached to Humanity is unavoidable therefore, it is very much essential to understand what it is and what it can do. AI literacy is a set of skills that include the use, application, and interaction with AI (Eduardo Lérias et.al.,2024) Artificial intelligence (AI) was first defined as "the science and engineering of making intelligent machines" in 1956 (McCarthy, 22007, Wang2019) AI will perform cognitive tasks, especially learning and problem-solving with the exciting technological innovations like machine learning and neural networks (Zawacki-Richter et al., 2019). Now a days the use of AI has spread across various domains (e.g., business, science, art, education) to enhance user experience and improve efficiency. AI, encompassing technologies that emulate human cognitive functions like learning and problem-solving, has demonstrated its potential to revolutionize language education through intelligent tutoring systems and personalized learning experiences (Malik et al., 2023). AI exists in many parts of our everyday life such as smart home appliances, smartphones, Google, Siri. (Burg Steiner et al., 2016, Davy et.al.,2021) AI has become more prevalent in the education system. It is essential to equip both educators and students with necessary skills to engage AI tools effectively and responsibly and not only equip the technical skills but also an understanding of the ethical dimensions of AI (Roza, et.al.,2024)). I the 21st century, the largest adoption of AI technologies have fundamentally modified our lifestyles, occupations, and interactions with our environment. From the seamless integration of virtual assistants in our daily lives to the ground-breaking advancements in autonomous vehicles, AI has become synonymous with innovation and progress (Shahzada Akhter, et.al.,2024)

AI as a Key Technological Skill of the 21st Century

AI has become more popular during 2019-2022 because of pandemic issues. The classes room shifted from traditional to online, Virtual, blended teaching and learning. The education tried to incorporate new technologies in their classrooms (Nget al., 2020; Sarika et al., 2021; Whalley et al., 2021). a variety of definitions of AI literacy was noticed. The most common approach to define AI literacy is based on different types of 'literacies' which have recently been applied to define skill sets in varied disciplines. In our review, most researchers advocated that instead of merely knowing how to use AI applications, learners should be inculcated with the use, application and underlying AI concepts

for their future career, as well as the ethical concerns of AI applications to become a responsible citizen. Establishing AI competency standards within STEM subjects and humanities helps for interdisciplinary learning and make students an AI-driven workforce (Barrera Castro et al., 2024). AI helps educators for comprehensive professional development for educators, by equipping necessary knowledge and tools to teach AI concepts effectively. Artificial Intelligence in Education (AIED) technology has become more popularity during this period. It facilitates for teaching, learning and also for assessment. The usage of AI technologies, such as intelligent tutoring systems, chat bots, robots, and automated assessment tools, across various digital platforms to enhance educational performance across subjects.

The AI literacy concept refers to the ability to understand, use, monitor, and critically reflect on Artificial Intelligence practical applications and their broader implications. It's about furnishing individuals, from the general person to professionals in various fields, with the navigation of knowledge and skills necessary to an increasingly AI-driven world safely, ethically, and effectively. AI literacy is still in the development stage. but at its core, it creates a broader idea of digital literacy and media literacy, extending them into the day-to-day situation. AI not only emphasizes the technical understanding but also the social, ethical, and practical dimensions of engaging with AI in daily life, education, and work.

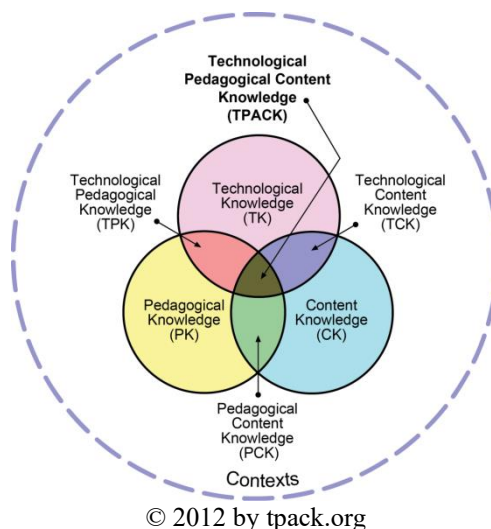
- **Dimensions of AI Literacy:** Cognitive Dimension (Knowledge & Understanding): Know about how AI functions (such as basic concepts of algorithms, machine learning, data, automation). Understanding AI practical applications and its limitations. Practical Dimension (Skills & Application): Use and apply of AI tools in education, workplace, and day-to-day problem-solving, interpretation of outcomes in order to revoke effect decision within the specific time period. Critical Dimension (Awareness & Evaluation): transparency, biases, and ethical implications related questions concerning to AI system. Measuring the reliability, credibility, and fairness of information provided by AI. Ethical & Social Dimension (Values & Responsibility): Understanding AI's impact on privacy, employment, democracy, and society. Promoting responsible, fair, and inclusive use of AI. Creative Dimension (Innovation & Co-creation): Use AI as a co-creator in knowledge production rather than as a user of information.

➤ **TPACK and AI Literacy among Pre-Service Teachers**

The TPACK framework highlights how technical, pedagogical, and content knowledge are interrelated. It is based on Shulman's idea of Pedagogical Content Knowledge (PCK). It identifies seven categories, each of which represents a crucial area of teacher proficiency in integrating technology: TK, CK, PK, PCK, TCK, TPK, and TPACK. (Schmidt et al., 2009)

- **Content Knowledge (CK):** Teachers need to have clarity about specific subject, including concepts, theories, evidence, frameworks, and best practices for effectively conveying the material to students.
- **Pedagogical Knowledge (PK):** Teachers must have knowledge of teaching methods, learning processes, classroom management, lesson planning, student learning styles, and assessments.
- **Technological Knowledge (TK):** Teachers know about the adoption of emerging technologies which support or hinder learning, and adapting to new tools effectively.
- **Pedagogical Content Knowledge (PCK):** Teachers must connect content with teaching methods, including curriculum design, assessment, and strategies that promote effective learning.
- **Technological Content Knowledge (TCK):** Teachers make use the appropriate tools to enhance the content along with the specific tools.
- **Technological Pedagogical Knowledge (TPK):** Teachers understanding the technology that can shape teaching and learning and how to integrate tools effectively with pedagogy.

Technological Pedagogical Content Knowledge (TPACK) Framework provides a comprehensive model to understand the complex concepts such as Content Knowledge and Pedagogical Knowledge and Technological Knowledge. Bed teacher trainees represent the future of education, and their ability to integrate technology into pedagogical practice is critical. TPACK provides a valuable lens to assess how Bed teacher trainees develop technological proficiency along with pedagogical and content knowledge. Many studies show that TPACK serves as a foundation for evaluating tenders' preparedness in use and application of digital and emerging technologies effectively in the classroom and also provide guidance to identify the ways and means to improve and provide support to teacher trainees in achieving AI Literacy. In the recent era Artificial Intelligence (AI) has emerged as one of the most transformative technologies, influencing each and every aspect of education and employment. Modern AI tools like intelligent tutoring systems, automated grading, and adaptive learning platforms become essential to acquire new competencies to remain relevant in digital classrooms.



AI literacy enables teacher trainees to know about fundamental AI principles, educational tools, and the pedagogical implication of their tools effectively and allows them to design engaging and adaptive learning environments. Despite AI's growing very fast among multiple disciplines, there are shortfalls and limited exposure of these tools in the teacher training programs, and insufficient emphasis on digital ethics and critical thinking, to address these issues. There is an essence to introducing AI-focused curriculum in teacher education programs, providing hands-on experience through simulation based on AI and digital Pedagogy, engaging collaboration with interdisciplinary, inculcating ethics awareness and opportunities for continuous professional training and workshops on emerging AI applications in education.

AI Literacy means the knowledge, understanding, and skill of AI in order to use, interact and evaluate with AI in a responsible way. It provides a broad set of competencies that enable individuals to steer the opportunities and challenges of AI in personal, professional, and societal contexts. In essence, the concept of AI literacy means equipping individuals with the capacity to understand, use, critique, and shape AI technologies in ways that are informed, ethical, and empowering. TPACK can grow significantly throughout teacher preparation, particularly when pedagogical training, conceptualization, and reflection are used to technology integration. But maintaining this development into professional practice calls for constant assistance and a fit between the needs of teaching in the real world and courses.

II. REVIEW OF RELATED LITERATURE

2.1 AI Across Curriculum

AI's ability to personalize instruction, boost student engagement, and support teacher decision-making. The integration of AI is seen as a global educational trend, impacting both theory and practice. The study calls for inclusive planning and development to ensure that all learners benefit from AI (Neelam C. Dey, 2025). Teachers appreciated AI tools like Chat-GPT for their ability to streamline lesson planning and enhance personalization. The study found that while teachers were optimistic, many needed more targeted training and support. Successful integration requires aligning AI tools with existing curricula and cultural norms (Filiz, Kaya, & Adiguze, 2025). AI is transforming educational practices by enhancing efficiency and personalization. Technologies such as natural language processing, intelligent tutoring, and automated grading are emphasized. AI enables teachers to deliver more tailored instruction and make data-driven decisions. (Dipanwita Bit et al., 2024). The study highlights that well-designed professional development programs can build teacher capacity for AI-driven education. It also shows that enhancing digital literacy is key to preparing educators for a tech-centered future (Lademann et al., 2024). The study identifies AI's key strengths: personalized instruction, improved motivation, and increased teacher efficiency. A major issue is the lack of sufficient training for educators to effectively use AI tools. It highlights the complexity of AI adoption (Azzam & Charles, 2024). Study indicate AI can tailor content, pace, and feedback to individual learner needs, boosting engagement and outcomes. Benefits include adaptive learning pathways, automated feedback, and streamlined administrative tasks (Merino-Campos, 2025). AI applications simulate human reasoning to help both teachers and students. The study reveals AI provides tailored learning paths and highlights perceived benefits, like efficiency and learner engagement. AI tools automatically assess and help address diverse learner needs and challenges (Lazar Krstić, et.al., 2022). AI technical understanding and practical application positively influence output quality and self-efficacy. Surprisingly, AI literacy had minimal effect on academic performance. The findings suggest that students may use AI tools effectively, critical awareness reduces overconfidence (Senad Bećirović, Edda Polzand Isabella Tinke, 2025). This mixed-methods study examines educators' attitudes and preparedness regarding AI integration in classrooms.

The findings reveal AI adequately prepared or supported and can shape future AI development (Gayed, 2025) this article introduces modern applications of AI in education, framing it within the broader context of Industry 4.0. It discusses how AI is transforming traditional classrooms through tools like smart tutoring systems, adaptive learning, and automated evaluations. AI reduces teacher workload while offering personalized learning paths for students. While these technologies show promise, the authors warn of ethical and social challenges (Ojha et al. (2024) This study highlights AI's benefits like personalized learning, better assessment techniques, and reduced teacher workload. Teachers and institutions should be equipped to manage AI tools responsibly. Furthermore, preparing students for AI-dominated environments is crucial (Ayala-Pazmiño.2023) Aligning AI applications with pedagogical theories like constructivism and self-directed learning. Infrastructure support and faculty readiness are crucial for realizing AI's full potential. Ultimately, AI is portrayed as a double-edged sword requiring strategic integration (Ajani, Akintolu, & Afolabi 2024). The AI platform also increased engagement, with students reporting enhanced motivation and attentiveness. Interviews showed that 77% of students found the tool useful for engagement and regulations. The study suggests integrating such tools into curricula to support personalized and autonomous learning. (Shafiee Rad (2025) It finds that AI facilitates personalized instruction, abundant resource access, and real-time performance feedback. These features improve learning outcomes and support individualized teaching approaches (Heyuan Guan, 2023). This study investigates what influences teachers' intention to adopt generative AI in classrooms using an extended Technology Acceptance Model (TAM). Institutional support directly and indirectly affects adoption, with internal factors serving as mediators. Teachers who feel more confident and motivated are more likely to integrate AI. The model offers a comprehensive view of the psychological and systemic factors driving AI use. (Hazzan-Bishara, et al., 2024) It identifies that AI enables personalized instruction, enhances student engagement, and supports flexible learning environments. The integration of AI has positively influenced performance, satisfaction, and learning outcomes. (Maphalala & Ajani, 2025) The researchers developed a Human-AI Synergy Degree Model (HAI-SDM) to analyze and enhance this collaboration. The "synergy degree" varied between low and moderate, revealing inconsistencies in how the human and AI system worked together across different subsystems such as subject, process, or environment (Kong, Fang, Chen, Xiao & Zhang (2025) The study explores the use of "Shiksha Copilot," an AI-powered lesson planning tool in government schools in Karnataka. The findings reveal that Shiksha Copilot significantly reduced lesson planning time and administrative stress. (Dennison et al., 2025) the study examine the AI technologies influence affective learning factors like motivation, attitude, and anxiety in English as a Foreign Language (EFL) classrooms. The findings suggest that AI tools can enhance learner engagement and reduce anxiety, though evidence remains limited (AlTwjiri & Alghizzi, 2025). The authors adapt existing competency frameworks such as DigCompEdu and P21—to include AI-specific skills. The study identifies the need for structured teacher training focused on using AI for teaching, learning, and assessment. It concludes that equipping educators with the right tools and knowledge is essential for sustainable AI adoption (Ng et al., 2023). The study adapts the DigCompEdu and P21 frameworks to address AI's role. Findings suggest that 21st-century teaching demands updated digital literacy. Teachers must be equipped to both use and teach AI. (Davy Tsz Kit et al, 2023) the study emphasizes the importance of regulation and ethical standards in managing AI's role in education. Suggested solutions such as strengthening legislation, raising awareness, and reinforcing human oversight. It also predicts a future where creative, non-digital assessments may replace traditional evaluation methods (Chokri Kooli, 2024). AI Tools such as adaptive learning systems and speech recognition software help address individual learning needs. It stresses that AI should empower teachers and learners rather than replace human interaction. Overall, the study affirms that with the right policies and practices, AI can enhance inclusivity in education (Julien, 2024). Adoption is hindered by poor connectivity, lack of AI training, and parental skepticism. The volunteers stressed that AI should complement, not replace, traditional teaching methods (Goyal et al., 2025) It advocates for comprehensive strategies to mitigate ethical, pedagogical, and technological risks. The authors urge policymakers to maintain a balance between technological innovation and human-centered education (Al-Zahrani 2024)

2.2 Artificial Intelligence Literacy revolution in India

AI's potential to revolutionize for teaching, learning, and educational administration. Specially personalized learning, improved access, and data-driven decision-making (Viji & Agarwal, 2024) AI in education is not about replacing the human teacher into robotic teacher but it is about using computer intelligence to make the teaching and learning more better and effective than traditional classroom learning (Mita Banerjee, Pandey, 2024) Peer-supported collaborative learning (PSCL) acts as a mediator, boosting students' AI tool engagement and academic perceptions. It suggests integrating AI tools and PSCL into curricula to optimize learning environments (Genimon Vadakkemulanjanal Joseph, Athira P, 2024) AI is improving teaching efficiency, enhancing student engagement, and supporting personalized learning experiences. Administrative tasks and assessment methods are also being redefined by AI. (Krishna Kumari Chetry 2024) AI enhances access, personalization, and educational quality through tools like adaptive learning platforms and virtual tutors. It includes teacher training, better policy, and ethical standards. Collaboration among stakeholders (Anand Y. Kenchakkanavar, 2024) AI could help to know about the dropouts, assess student needs, and reduce administrative burdens. India faces uneven teacher distribution, low tech adoption, and lack of awareness. It argues AI may eventually dominate teaching, leaving teachers to manage discipline (S. K. Khatik and Praful Patel, 2021) this bibliometric study analyses scientific research on AI in higher education from 2007 to 2017. It concludes

that despite AI's growing relevance, literature on its educational impact needs further development (Francisco-Javier, Hinojo-Lucena, 2019) The research encourages new measurement tools and inclusion of AI literacy in broader education policy(Hasan M. H. Mansoor, Ala Bawazir,2024)

2.3 B.Ed Teacher Trainee's AI Literacy

The study explores AI literacy in teacher education through a professional partnership model. Using the Digital Education Council's AI Literacy Framework, they restructured their teaching approach to include AI-driven methods. (Michelle Kelley and Taylor Wenzel, 2025) AI literacy is conceptualized in teacher education literature. The results reveal a global rise in interest but limited focus on professional teaching knowledge in AI contexts (Katarina Sperling et al., 2024) the study investigates pre-service teachers' use of the Magic School AI tool for assessment. It found AI increased time efficiency and supported question generation and rubrics(Gamze Erdem Coşgun, 2025) The study revealed that most students agree AI tools should not be misused for academic dishonesty and AI can enhance learning but must be applied with care and ethical oversight(Souvik Paul, Dr. Biswajit Chatterjee, 2025) Generative artificial intelligence (GenAI) has the potential to be a powerful tool for educators.This study recommended to provide practical approaches to improve key attributes to adaptation of artificial intelligence in teacher education (Priya Panday-Shukla, 9 June 2025). The Digital Education Council's AI Literacy Framework guided the approach.AI is shown to streamline administration and personalize learning.(Michelle Kelley and Taylor Wenzel,2025)The findings emphasize the urgent need to improve digital competence for future educators and the importance of training programs in enhancing digital teaching tools and AI readiness.(Ummul Bashir, Ishrat Naaz,2024) Study calls for structured teacher preparation programs with practical and theoretical AI components. AI is seen as a tool to complement not replace teachers.(Lucas Kohnke et al., 2025) The study measures the targeted AI literacy training for pre-service physics teachers and advocate embedding such modules in all teacher education curricula(Aigerim Abdulayeva et al.,2025) The study recommends incorporating ethics-based AI training into teacher education. Students viewed AI positively but urged responsible use (Souvik Paul et al.,2025)Design-Based Research, tools were developed and tested in real educational settings. The study used the European DigCompEdu model to assess self-reported competence. The initiative aims to align teacher education with real-world digital demands(Tamara Rachbauer, Johannes Graup, Eva Rutter(2025) Foundational AI training, collaborative learning, and continuous professional development emphasizes mindset shifts toward AI-assisted teaching and learner empowerment(Akilu Ismail et al., 2024) Chat-GPT found benefits in personalized learning, access, and efficiency. Chat-GPT empowered teaching innovation (Fatih Karataş et al., 2024).AI stresses the importance of fairness, openness, and explanation ability in AI-based education.AI just plays a supportive role; it won't replace the teacher (Swagatika Devi, et al., 2023) Practical strategies including AI curriculum integration and awareness initiatives. Strengthening foundational literacy is essential to prepare future educators. Ruisi Shi, (2024) Findings reveal emerging areas like adaptive learning technologies and AI-based feedback systems. It stresses the importance of aligning teacher growth with AI integration. Key thoughts focus on individualized professional learning in digital contexts (Ruixue Yang, et al., 2023) Ethical awareness and confidence in using AI tools correlated with hands-on experience. Practical training and collaborative learning are recommended. (Bo Pei a, et al., 2024) AI literacy positively influenced understanding, ethics, and problem-solving, but did not predict emotion regulation.It recommends developing AI literacy curricula focused on comprehension, creation, and ethical use(Musa Adekunle Ayanwale a, et al., 2024)AI is often viewed merely as automation, neglecting ethical and pedagogical contexts. The study calls for AI literacy strategies that involve critical thinking and ethics.(Melis Dilek Evrim Baran Ezequiel Aleman,2025)The study demand strong policy support, collaboration of public-private partnerships to adopt AI in classroom situations(Kumar, A., & Singh, P. (2020).

III. OBJECTIVES OF THE STUDY

- To find weather there is a significant difference in AIKU (AI knowledge & understanding), AIUA (AI use & apply), AISE (AI self-efficacy) and AIE (AI ethics) among male and female B.Ed teacher trainees.
- To find weather there is a significant difference in AIKU (AI knowledge & understanding), AIUA (AI use & apply), AISE (AI self-efficacy) and AIE (AI ethics) among B.Ed teacher trainees belong to urban and rural.
- To find weather there is a significant difference in AIKU (AI knowledge & understanding), AIUA (AI use & apply), AISE (AI self-efficacy) and AIE (AI ethics) among I year and II year B.Ed teacher trainees.
- To find whether Knowing and understanding AI significantly predicts use and applying of AI.
- To find whether Knowing and understanding AI significantly predicts AI Self-efficacy & AI ethics.

IV. HYPOTHESIS OF THE STUDY

- There is no significant difference in AIKU (AI knowledge & understanding), AIUA (AI use & apply), AISE (AI self-efficacy) and AIE (AI ethics) among male and female B.Ed teacher trainees.
- There is no significant difference in AIKU (AI knowledge & understanding), AIUA (AI use & apply), AISE (AI self-efficacy) and AIE (AI ethics) among B.Ed teacher trainees belong to urban and rural.

- There is no significant difference in AIKU (AI knowledge & understanding), AIUA (AI use & apply), AISE (AI self-efficacy) and AIE (AI ethics) among I year and II year B.Ed teacher trainees.
- Knowing and understanding AI significantly predicts use and applying of AI.
- Knowing and understanding AI significantly predicts AI Self-efficacy & AI ethics.

V. METHODOLOGY

5.1 Sample and Respondents Profile: The samples for the study consisted of B.Ed. teacher trainees currently enrolled in teacher education institutions from five districts of Karnataka such as Mysuru, Shivamogga, Hassan, Mandya, and Bengaluru. A total of 436 B.Ed. teacher trainees participated in the study. The inclusion of multiple districts was intended to capture potential regional variations across teacher training institutions. The study employed a stratified random sampling technique to ensure representativeness. The population was divided into strata based on locality, academic year, gender, and academic stream, and participants were then randomly selected from each subgroup. Table 1 presents the demographic profile of the respondents.

Table No 1. Demographic distribution of B.Ed. teacher trainees (N = 436)

Sample	Demography	Sub-sample	Frequency (%)
Gender	Male	99	23
	Female	337	77
Locality	Urban	236	70
	Rural	100	30
Academic Year	First Year	257	76
	Second Year	179	24

Table No 1 depicts the demographic analysis revealed variations across gender, locality, and programme streams, reflecting the diversity within the B.Ed. teacher trainee population.

5.2 Instrument, Data Collection and Data Analysis: The study employed a Descriptive Survey research method to gather detailed information about the AI literacy of B.Ed. teacher trainees.

5.3 Instrument: A self-constructed Artificial Intelligence Literacy Assessment Scale (AILAS) was developed by the researcher, drawing from existing literature on AI literacy and digital pedagogy. The questionnaire used for data collection consisted of three sections. The first section assessed the demographic profile of the participants, which includes gender, age, and programme of study. The second section of the questionnaire contained survey items related to responsive use of AI in assignment writing, while the last section contained items related to the independent variable, namely

AI literacy. The scale included 22 items across three dimensions.

- AIKU (AI knowledge & understanding)
- AIUA (AI use & apply)
- AISE (AI self-efficacy) and AIE (AI ethics)

Each item was measured on a 5-point Likert scale, ranging from Strongly Disagree (1) to Strongly Agree (5). The instrument was designed to assess participants' understanding, practical application, learning, ethical awareness, and problem-solving skills related to AI.

5.4 Data Collection: The data were collected directly from B.Ed. teacher trainees through a structured online questionnaire. Participation was voluntary, and informed consent was obtained prior to data collection. Anonymity and confidentiality of the respondents were maintained throughout the process.

5.5 Data Analysis: The collected data were analyzed using SPSS. Both descriptive and inferential statistics were employed:

- **Descriptive statistics:** Mean and Standard Deviation were used to summarize responses.
- **Inferential statistic: Independent t-test** was used to examine the differences in AI literacy between background variables (e.g., gender, urban/rural, year of study).

Linear regression was used to predict the influence of components within AI literacy. This analytical approach provided a comprehensive understanding of the AI literacy levels among B.Ed. teacher trainees across different demographic categories.

Results and Interpretation

Objective 1: To find weather there is a significant difference in AIKU (AI knowledge & understanding), AIUA (AI use & apply), AISE (AI self-efficacy) and AIE (AI ethics) among male and female B.Ed teacher trainees.

Hypothesis 1: There is no significant difference in AIKU (AI knowledge & understanding), AIUA (AI use & apply), AISE (AI self-efficacy) and AIE (AI ethics) among male and female B.Ed teacher trainees.

Table No 2: Showing the gender wise difference in AIKU (AI knowledge & understanding), AIUA (AI use & apply), AISE (AI self-efficacy) and AIE (AI ethics)among male and female B.Ed teacher trainees.

Variable	Gender	Standard Deviation	Mean (SD)	t - value	p - value	Result
AIKU (AI knowledge & understanding)	Male	3.63	27.78	0.07	0.944	NS*
	Female	3.71	27.81			
AIUA (AI use & apply)	Male	3.62	23.79	1.10	0.243	NS*
	Female	3.73	23.30			
AISE (AI self-efficacy) and AIE (AI ethics)	Male	5.71	34.58	0.08	0.931	NS*
	Female	5.10	34.43			

*NS - Not Significant, $p > 0.05$

Table No 2 represents the mean scores, standard deviations, t-values, and p-values for AI knowledge & understanding, AI use & application, AI self-efficacy, and AI ethics among male and female B.Ed teacher trainees. Across all variables, male trainees had an identical mean scores to female trainees, with minor differences in standard deviations indicating slightly more variability among females. The above table evidenced the mean for AI knowledge & understanding is 27.78 for males and 27.81 for females, with a t-value of 0.07 and p-value of 0.944, which indicated no significance. The results for AI use & application, self-efficacy, and ethics fall on same line. The non-significant t-values in all represented components indicate that there is no meaningful difference between male and female trainees' conceptual understanding, readiness, or self-efficacy in integrating AI concepts. Therefore, the null hypothesis stating "There is no significant difference in the levels of conceptual understanding and readiness among male and female B.Ed teacher trainees" is accepted.

The study's findings are consistent with earlier research showing that exposure to AI education and technology-based learning environments eliminates gender differences in technological proficiency. The result might have been achieved by uniform teacher training opportunities and equal access to digital learning resources. Therefore, educational experiences seem to have a greater influence on AI readiness and awareness than gender.

Objective 2: To find weather there is a significant difference in AIKU (AI knowledge & understanding), AIUA (AI use & apply), AISE (AI self-efficacy) and AIE (AI ethics) among B.Ed teacher trainees belong to urban and rural.

Hypothesis 2: There is no significant difference in AIKU (AI knowledge & understanding), AIUA (AI use & apply), AISE (AI self-efficacy) and AIE (AI ethics) among B.Ed teacher trainees belong to urban and rural.

Table No 3: Showing the difference in AIKU (AI knowledge & understanding), AIUA (AI use & apply), ISE (AI self-efficacy) and AIE (AI ethics) among B.Ed teacher trainees belong to urban and rural.

Variable	Locality	Standard Deviation	Mean (SD)	t - value	p - value	Result
AIKU (AI knowledge & understanding)	Rural	3.08	27.84	0.18	0.851	NS*
	Urban	3.92	27.81			
AIUA (AI use & apply)	Rural	3.35	23.67	0.04	0.966	NS*
	Urban	3.80	23.69			
AISE (AI self-efficacy) and AIE (AI ethics)	Rural	4.66	34.75	0.49	0.622	NS*
	Urban	6.01	34.47			

*NS - Not Significant, $p > 0.05$

Table No 3 shows the mean scores, standard deviations, t-values, and p-values for AI knowledge, application, self-efficacy, and ethics by rural and urban locality. Rural and urban teacher trainees have nearly identical mean scores for all indicators - AI knowledge & understanding is 27.84 (rural) and 27.81 (urban), with a t-value of 0.18 and a p-value of 0.851. Similarly, the other variables like application and self-efficacy shows very close mean scores and non-significant t-values. The findings of the study indicates that the locality urban versus rural has no measurable effect on trainees' readiness or awareness of educational technology and AI practices. Hence, in this regard the null hypothesis stating "There is no significant difference in the levels of conceptual understanding and readiness among rural and urban B.Ed teacher trainees" is accepted.

The results suggests that the geographical location or background does not significantly impact on the learning and enhancing AI-related competencies. The findings also reflect that the growing digital equity between urban and rural educational settings due to accessible online resources, teacher training programs, and widespread use of smartphones and the internet. The data implies that AI literacy and readiness are becoming more uniform across different localities, emphasizing the success of inclusive technology initiatives in teacher education.

Objective 3: To find weather there is a significant difference in AIKU (AI knowledge & understanding), AIUA (AI use & apply), AISE (AI self-efficacy) and AIE (AI ethics) among I year and II year B.Ed teacher trainees.

Hypothesis 3: There is no significant difference in AIKU (AI knowledge & understanding), AIUA (AI use & apply), AISE (AI self-efficacy) and AIE (AI ethics) among I year and II year B.Ed teacher trainees.

Table No 4: Showing the difference in AIKU (AI knowledge & understanding), AIUA (AI use & apply), AISE (AI self-efficacy) and AIE (AI ethics) among among I year and II year B.Ed teacher trainees.

Variable	Year	Standard Deviation	Mean (SD)	t - value	p - value	Result
AIKU (AI knowledge & understanding)	I Year	3.65	27.70	0.62	0.530	NS*
	II Year	3.65	27.92			
AIUA (AI use & apply)	I Year	3.60	23.72	0.25	0.802	NS*
	II Year	3.72	23.63			
AISE (AI self-efficacy) and AIE (AI ethics)	I Year	5.11	34.79	0.98	0.324	NS*
	II Year	6.19	34.25			

*NS - Not Significant, $p > 0.05$

Table 4 delineates the scores of mean, standard deviations, t-values, and p-values for AI knowledge & understanding, application, self-efficacy, and ethics between I year and II year B.Ed teacher trainees. Both years' teacher trainees

attained very similar mean scores for each variable - AI knowledge & understanding, the means are 27.70 (I year) and 27.92 (II year), with a t-value of 0.62 and a p-value of 0.530, which was not significant. All other variables reflect similarly small differences and non-significant t-values. These results indicated the no significant difference in conceptual understanding and readiness between I year and II year teacher trainees, therefore, the null hypothesis “There is no significant difference in the levels of conceptual understanding and readiness among I year and II year B.Ed teacher trainees” is accepted.

Both I year & II Year exhibited similar mean scores, indicating consistent AI awareness and readiness regardless of their academic year. The consistency in the data suggests that AI-related exposure and understanding are integrated early and evenly across the B.Ed. curriculum. It may also delineates that both cohorts have received similar training and digital experiences, minimizing learning gaps between both the years. Hence, the teacher education program appears effective in maintaining a steady level of AI competence throughout the training duration.

Objective 4: To find whether AIKU (Knowing and Understanding AI) significantly predicts AIUA (Use and Applying of AI).

Hypothesis 4: AIKU (Knowing and Understanding AI) significantly predicts AIUA (Use and Applying of AI).

Table No 5: Showing the Model Summary of Regression Analysis

Model	B1	R ²	Standard Error	df	t-value	p-value
Constant	3.23	0.51	0.91	1	3.55	0.00

*NS - Not Significant, $p > 0.05$

Table No 5 indicates the regression model summary between AIKU (Knowing and Understanding AI) and AIUA (Use and Applying of AI). The obtained regression coefficient (B_1) value is 3.23, with $R^2 = 0.51$, and a t-value of 3.55 which shows significant at $p < 0.01$. The table value delineates that AIKU (Knowing and Understanding AI) significantly predicts AIUA (Use and Applying of AI). The R^2 value of 0.51 implies that 51% of the variance in the dependent variable AIUA (Use and Applying of AI) is explained by the independent variable AIKU (Knowing and Understanding AI). Hence, the hypothesis that “AIKU (Knowing and Understanding AI) significantly predicts AIUA (Use and Applying of AI)” is accepted.

The regression results suggest a strong and positive predictive relationship between B.Ed teacher trainees’ understanding of AI concepts and their ability to apply AI in educational contexts. This means that trainees with greater conceptual understanding of AI tend to demonstrate higher competence and readiness in applying AI-based tools and strategies. The finding aligns with prior research emphasizing that conceptual literacy in technology enhances educators’ capacity to integrate AI meaningfully in teaching and learning. The result highlights the importance of embedding AI literacy modules in B.Ed programs to strengthen both theoretical and practical aspects of AI integration. Strengthening AI knowledge among B.Ed teacher trainees can therefore lead to more effective application of AI in classrooms, bridging the gap between awareness and practice.

Objective 5: To find whether AIKU (Knowing and Understanding AI) significantly predicts AISE (AI self-efficacy) and AIE (AI ethics).

Hypothesis 5: AIKU (Knowing and Understanding AI) significantly predicts AISE (AI self-efficacy) and AIE (AI ethics).

Table No 6: Showing the Model Summary of Regression analysis

Model	B1	R ²	Standard Error	df	t-value	p-value
Constant	7.57	0.40	1.58	1	4.76	0.00

*NS - Not Significant, $p > 0.05$

Table No 6 represents the regression model summary between AIKU (Knowing and Understanding AI) and AISE (AI self-efficacy) and AIE (AI ethics). The obtained regression coefficient (B_1) value is 7.57, with $R^2 = 0.40$, and a t-value of 4.76, which shows statistically significant at $p < 0.01$. This clearly indicates that AIKU (Knowing and

Understanding AI) is a significant positive predictor of AISE (AI self-efficacy) and AIE (AI ethics). The R^2 value of 0.40 shows that 40% of the variation in AI Self-efficacy and AI Ethics can be explained by trainees' level of AIKU (Knowing and Understanding AI). Hence, the hypothesis stating "AIKU (Knowing and Understanding AI) significantly predicts AISE (AI self-efficacy) and AIE (AI ethics)" is accepted.

The regression outcome reveals that teacher trainees who possess stronger knowledge and understanding of AI tend to show higher confidence (self-efficacy) and stronger ethical awareness in using AI applications. The finding underscores the inter-connectedness of conceptual understanding, responsible usage, and confidence in technology integration. As trainees gain deeper insights into AI principles, they become more capable of making informed, ethical decisions in AI-related educational contexts. The consistent result with educational technology research emphasizing that knowledge empowers ethical and confident use. When B.Ed teacher trainees understand how AI functions and its implications, they develop the self-assurance to apply it responsibly, ensuring technology serves pedagogical and ethical goals. Hence, enhancing AI conceptual training in teacher education programs can foster not only proficiency but also ethical mindfulness and professional confidence among future educators.

Recommendation

- Further research should focus on developing longitudinal studies, cross-cultural comparisons, and adaptive AI literacy models in teaching and learning that respond to the rapid evolution of AI technologies.
- By adopting AI literacy at all levels of education societies will ensure that individuals are equipped with the knowledge and critical thinking skills necessary to engage AI responsibly and ethically.
- With the increasing need of AI in the education field, there is a need to bridge the gap between the needs and the skills and competencies delivered by the university programs.
- AI will help in shaping competent digital citizens and global collaboration in society. This initiative will lead to an innovative educational model by offering a flexible framework adaptable to diverse campus-wide initiatives beyond the scope of AI.
- Responsible Organizations need to establish balanced governance frameworks which encourage AI adoption while performance accountability and maintaining ethical standards. It leads in creating innovation policies that provide clear boundaries for acceptable. AI helps users navigate the tensions between efficiency maximization and ethical compliance through support mechanisms.especially in underserved rural and low-income communities.
- Government and education ministries should embed AI literacy into the national curriculum, ensuring that students at all levels receive structured AI education by the Integration of AI Literacy in the National Education Policies,
- Government and institutions should construct a clear AI ethics policies addressing algorithmic bias, data security, and accountability in AI-driven decision-making which emphasizes ethical considerations, and use of AI in socially responsible manner.
- Comprehensive professional developmental opportunity should be given for teachers as a part of AI literacy programs so it equip the skills and information needed to properly teach AI ideas through workshop and AI-related teacher certification programs (Masrek et al., 2024).

VI. CONCLUSION

AI literacy is an essential 21st-century teacher trainees to lead the competition and bridging the gap between technological proficiency and pedagogical innovation. AI-literacy among the teachers indicates not to only knowing about technology but also cultivating ethical, reflective practices, professional caliber for leveraging AI responsibly. The present study attempted to find the significant difference in AIKU (AI knowledge & understanding), AIUA (AI use & apply), AISE (AI self-efficacy) and AIE (AI ethics) among gender, locality and academic year of B.Ed teacher trainees. The study also analyzed the dimension of AI Literacy to gain a comprehensive understanding of the underlying patterns and relationships and core dimensions that influence the practical, ethical and self-efficacy and essence of AI integration in their curricula. AI competence reflects the positive impact of digital inclusivity and equal access to online educational resources. Overall, the dimension-wise analysis provided valuable insights into the (awareness, perception, attitude, readiness, etc.) of the respondents. The results underscore the importance of each dimension independently to enhance the overall effectiveness of future programs, policies, or educational practices. Future teacher training program should focus on professional development, ethical governance, and collaboration among interdisciplinary to ensure to lead the next generation and transformation toward AI-empowered education

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Abbreviation:

AI	- Artificial Intelligence
AIAS	- Artificial Intelligence Assessment Scale
AIE	- AI ethics
AIED	- Artificial Intelligence in Education
AIKU	- AI knowledge & understanding
AISE	- AI self-efficacy
AIUA	- AI use & apply
B.Ed.	- Bachelor of Education
NS	- Not Significant
TPACK	- Technological Pedagogical Content Knowledge.