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**คุณลักษณะของบัณฑิตครูที่พึงประสงค์ในยุคปัญญาประดิษฐ์
(AI): การปรับตัวของวิชาชีพครูเพื่อการศึกษาขั้นพื้นฐาน
ในบริบทการเปลี่ยนแปลง**

**Desirable Attributes of Prospective Teachers in the
Age of Artificial Intelligence (AI): Adapting the
Teaching Profession for Basic Education in a
Changing World**

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บทคัดย่อ

ความก้าวหน้าอย่างรวดเร็วของปัญญาประดิษฐ์ (AI) ได้ก่อให้เกิดความท้าทายสำคัญต่อการศึกษาระดับพื้นฐานและการผลิตครูในศตวรรษที่ 21 การศึกษานี้มีวัตถุประสงค์เพื่อระบุและสังเคราะห์คุณลักษณะที่พึงประสงค์ของบัณฑิตครูในยุค AI โดยอาศัยวรรณกรรมที่เกี่ยวข้องกับสมรรถนะในศตวรรษที่ 21 การจัดการเรียนการสอนที่สนับสนุนด้วย AI และการผลิตครู การวิจัยนี้ใช้ระเบียบวิธีวิจัยเอกสารโดยประยุกต์ใช้การทบทวนวรรณกรรมเชิงวิเคราะห์ตามแนวทางของ Snyder (2019) งานวิจัยนี้ทบทวนบทความที่ตีพิมพ์ระหว่าง ค.ศ. 2020 ถึง 2025 จำนวน 37 บทความ และคัดเลือกบทความจำนวน 28 บทความสำหรับการวิเคราะห์

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เชิงลึก โดยพิจารณาจากความเกี่ยวข้องและความเหมาะสมกับประเด็นการศึกษา ผลการสังเคราะห์พบว่า คุณลักษณะที่พึงประสงค์ของบัณฑิตครูประกอบด้วย 5 โดเมนสำคัญ ได้แก่ (1) ทักษะด้านเทคโนโลยีดิจิทัลและการเรียนรู้ตลอดชีวิต (2) ความยืดหยุ่นและความพากเพียร (3) การออกแบบการเรียนรู้เพื่อความเท่าเทียมและนวัตกรรม (4) คุณธรรม จริยธรรม และความเข้าใจบริบทของผู้เรียน และ (5) ภาวะผู้นำการเรียนรู้เชิงสร้างสรรค์ โดเมนเหล่านี้ชี้ให้เห็นว่า บัณฑิตครู จำเป็นต้องมีคุณลักษณะทางวิชาชีพแบบบูรณาการ ซึ่งช่วยให้สามารถใช้ AI อย่างมี วิจารณญาณ ปรับตัวต่อสภาพการศึกษาที่เปลี่ยนแปลง ออกแบบประสบการณ์ การเรียนรู้ที่ครอบคลุมผู้เรียนทุกกลุ่ม ปฏิบัติอย่างมีจริยธรรม เข้าใจบริบทของผู้เรียน และนำการเรียนรู้ด้วยความคิดสร้างสรรค์และความรับผิดชอบทางวิชาชีพ ผลการศึกษานี้สามารถนำมาใช้เป็นข้อมูลประกอบการพัฒนาหลักสูตรผลิตครู การพัฒนาวิชาชีพครู และการอภิปรายเชิงนโยบายเกี่ยวกับการผลิตครูสำหรับการ ศึกษาขั้นพื้นฐานในยุค AI

คำสำคัญ: บัณฑิตครู ปัญญาประดิษฐ์ สมรรถนะศตวรรษที่ 21

คุณลักษณะที่พึงประสงค์ การศึกษาขั้นพื้นฐาน

Abstract

The rapid advancement of artificial intelligence (AI) has created significant challenges for basic education and teacher preparation in the 21st century. This study aimed to identify and synthesise the desirable characteristics of prospective teachers in the age of AI by drawing on literature related to 21st-century competencies, AI-supported teaching, and teacher preparation. The study employed documentary research and adopted an analytical literature review approach based on Snyder (2019). A total of 37



articles published between 2020 and 2025 were reviewed, from which 28 articles were selected for in-depth analysis based on their relevance and appropriateness to the focus of the study. The synthesis revealed five key domains of desirable characteristics for prospective teachers: 1) digital literacy and lifelong learning skills, 2) flexibility and perseverance, 3) learning design for equity and innovation, 4) ethics, morality, and understanding of learner contexts, and 5) creative learning leadership. These domains indicate that prospective teachers need integrated professional characteristics that enable them to engage with AI critically, adapt to shifting educational conditions, design inclusive learning experiences, act ethically, understand learners' backgrounds, and lead learning with creativity and professional responsibility. The findings can be used as evidence to inform teacher education curriculum development, continuous professional development, and policy discussions concerning teacher preparation for basic education in the age of AI.

Keywords: Prospective teachers, Artificial intelligence, 21st-Century competencies, Desirable characteristics, Basic education

1. Introduction

Artificial intelligence (AI) has increasingly influenced basic education by changing how teachers design instruction, manage learning activities, assess student progress, and support individual learning needs. In this context, the role of teachers is no longer limited to delivering content; rather, it also involves making pedagogical,



ethical, and professional judgements about how digital technologies should be used to support learners. In basic education, where teachers work closely with children and adolescents during critical stages of development, the integration of AI requires careful attention to both instructional effectiveness and humanistic values. Prospective teachers therefore need characteristics that enable them to use technology critically, respond to changing classroom conditions, protect learners' well-being, and maintain the ethical foundations of the teaching profession.

In Thailand, the preparation of prospective teachers must also be considered in relation to professional expectations, professional standards, and the responsibilities of teachers in basic education. Prospective teachers are expected to possess professional knowledge, instructional competence, ethical conduct, learner-centred dispositions, and the capacity to promote learning in diverse classroom contexts. These expectations are consistent with the broader direction of 21st-century teacher education, which emphasises digital literacy, lifelong learning, adaptability, equity-oriented instruction, ethical responsibility, and professional leadership (Yang et al., 2024; Järvelä et al., 2025; Jain, 2025; Gabriel, 2024). Related studies in the Thai context have addressed selected competencies relevant to prospective teachers, including life and career skills, AI literacy, digital citizenship, responsible technology use, and instructional design competence (Paiwithayasiritham & Yanprechaset, 2023; Jarupongputtana et al., 2022; Pimdee & Leekitchwatana, 2022; Samngamjan et al., 2024; Khaewphueng & Nuangchalerm, 2025).



However, these studies have generally examined specific competencies separately rather than synthesising them into an integrated account of the desirable characteristics required for teacher preparation in the AI era.

Although international research and studies conducted in Thailand have increasingly examined teacher competencies in relation to AI and educational transformation, research that synthesises these competencies in ways that are directly relevant to Thai teacher preparation, professional expectations, and basic education remains limited. This gap raises an important question regarding the desirable characteristics that prospective teachers should develop in order to respond appropriately to AI-supported teaching and learning while remaining aligned with the professional values expected of teachers in Thailand.

This study addresses this gap by identifying and synthesising the desirable characteristics of prospective teachers in the age of AI through an analytical review of theoretical and empirical literature related to 21st-century competencies, AI-supported teaching, and teacher preparation. Rather than treating AI merely as a technological issue, the study positions teacher preparation as a professional process that must integrate digital competence, ethical responsibility, learner understanding, and adaptive instructional practice. The study aims to provide a clearer knowledge base for teacher education institutions, curriculum developers, and policymakers in considering how prospective teachers can be prepared for basic education in a changing world. Its expected contribution is to offer a literature-based



synthesis that can inform curriculum development, teacher professional preparation, and future research on teacher characteristics required in the AI era.

2. Literature Review

2.1 21st-Century Competencies and Teacher Preparation

Twenty-first-century teacher preparation increasingly requires prospective teachers to develop competencies that extend beyond subject knowledge and routine instructional skills (Kayima, 2022). In the context of rapid technological change, teachers are expected to develop digital and AI literacy, lifelong learning habits, and the capacity to adapt their professional practices to changing educational conditions (Yang et al., 2024; Çilek et al., 2023; Järvelä et al., 2025). They also need ethical awareness, learner-centred dispositions, and the ability to design meaningful and inclusive learning experiences for diverse learners (Gabriel, 2024; Walsh et al., 2023; Jain, 2025). These competencies are particularly important in basic education because teachers at this level must support learners' academic development while responding to their diverse needs, ensuring their safety, and taking account of their developmental contexts (Bai, 2025; Park, 2025). Accordingly, teacher preparation should integrate technological and pedagogical competence with humanistic values, including ethical responsibility, respect for learner diversity, the protection of learners' dignity and safety, and sensitivity to their social and developmental contexts (Walsh et al., 2023; Gabriel, 2024; Park, 2025). Contemporary studies likewise emphasise that prospective teachers need to combine



technological competence with pedagogical judgment, reflective practice, and professional responsibility in order to respond effectively to complex classroom conditions (Järvelä et al., 2025; Kayima, 2022; Zhang et al., 2024). In this sense, 21st-century competencies provide an important foundation for identifying the desirable characteristics of prospective teachers in the age of artificial.

2.2 Artificial Intelligence and Basic Education Teaching

Artificial intelligence has become increasingly relevant to teaching in basic education because it can support instructional design, learning analytics, assessment, adaptive learning, accessibility, and personalised learning (Bai, 2025; Xue & Talin, 2024). However, its educational value depends on teachers' capacity to select and use AI tools in pedagogically appropriate and ethically responsible ways (Hava & Babayiğit, 2024; Walsh et al., 2023). For prospective teachers, AI-related competence should, therefore, include not only the ability to use digital tools but also the capacity to evaluate AI-generated outputs, protect learner data, recognise bias, and maintain human judgment in teaching and assessment (Bai, 2025; Järvelä et al., 2025; Walsh et al., 2023; Zhang et al., 2024). Previous studies further indicate that AI literacy, computational thinking, artificial intelligence–technological pedagogical content knowledge (AI-TPACK), and responsible AI use are important for preparing teachers to work effectively in AI-supported learning environments (Hava & Babayiğit, 2024; Xue & Talin, 2024; Yang et al., 2024; Zhang et al., 2024). In basic education, these competencies should be applied with particular



sensitivity to learner diversity, accessibility, safety, and contextual needs (Bai, 2025; Gabriel, 2024; Park, 2025).

2.3 Theoretical Perspectives Supporting the Analytical

Synthesis

The analytical synthesis in this study is informed by three theoretical perspectives that help explain why prospective teachers need to develop an integrated set of characteristics in the AI era. First, dynamic capabilities theory, developed principally by Teece, Pisano, and Shuen (1997) and subsequently elaborated by Teece (2007, 2025), emphasises the capacity to sense changes, seize opportunities, and transform practices in response to evolving environments. When applied to teacher preparation, this perspective highlights the need to develop teachers who can recognise technological and pedagogical changes, select appropriate tools and strategies, and continuously adapt their teaching practices. Second, the concept of hybrid intelligence emphasises the complementary integration of human and artificial intelligence, whereby their respective strengths are combined to achieve outcomes that neither could attain as effectively alone (Dellermann et al., 2019; Rafner et al., 2022). This perspective reinforces the view that AI should support, rather than replace, teachers' professional judgement, creativity, ethical reasoning, and contextual understanding of learners (Järvelä et al., 2025; Mnguni et al., 2024). Third, transformative learning theory, originally developed by Mezirow (1978), emphasises critical reflection, awareness of underlying assumptions, and the transformation of professional perspectives. It supports the development of teachers who can



reconsider their professional roles, engage in reflective practice, and facilitate learning in ways that are responsive to technological and social change (Mangkhong et al., 2022). Taken together, these theoretical perspectives provide a conceptual basis for analysing the desirable characteristics of prospective teachers as interconnected competencies rather than as isolated skills.

3. Conceptual Basis of the Study

This study is grounded in the literature on 21st-century competencies, artificial intelligence (AI)-supported teaching, teacher preparation, and the professional characteristics required for basic education. This section outlines the conceptual basis used to guide the analytical synthesis of the literature and clarifies the role of the five synthesis domains in this study. The five synthesis domains reported in the findings serve as analytical categories for organising, comparing, and interpreting the reviewed literature rather than as an empirically validated conceptual framework. They are literature-derived categories that provide a structured basis for explaining the desirable characteristics of prospective teachers in the age of AI.

The analytical categories were informed by recurring themes in previous studies concerning teacher competencies in technologically changing educational contexts. These themes include digital competence, lifelong learning, adaptability, equity-oriented learning design, ethical and responsible technology use, learner-context understanding, and teacher leadership in instructional innovation. In the context of basic education, these characteristics are



particularly important because teachers must respond to learners' diverse and contextual needs while promoting responsible digital participation and ethical technology use (Jarupongputtana et al., 2022; Park, 2025; Pimdee & Leekitchwatana, 2022; Samngamjan et al., 2024). Therefore, the conceptual basis of this study positions prospective teachers as professionals who must combine technological competence with pedagogical judgement, ethical responsibility, and a human-centric understanding of learners.

Based on this conceptual basis, the reviewed literature has been organised into five synthesis domains: digital literacy and lifelong learning skills, flexibility and perseverance, learning design for equity and innovation, ethics, morality, and learner-context understanding, and creative learning leadership. These domains function as analytical categories for presenting the findings of the literature review. Together, they provide a structured basis for explaining the desirable characteristics of prospective teachers required for basic education in the age of AI.

4. Research Methodology

4.1 *Research Approach.*

This study employed documentary research and adopted an analytical literature review approach based on Snyder (2019). This approach was selected because the purpose of the study was not to conduct a meta-analysis or test causal relationships, but rather to collect, analyse, and synthesise relevant scholarly literature in order to identify the desirable characteristics of prospective teachers in the



age of AI. Following the logic of an analytical literature review, the study focused on transparent literature selection, conceptual categorisation, cross-study comparison, and the synthesis of recurring themes relevant to teacher preparation for basic education.

4.2 Literature Search and Selection.

The literature search was conducted using academic search sources and publication databases relevant to education, teacher preparation, educational technology, and AI-supported learning. These sources included Scopus, ScienceDirect, ERIC, Google Scholar, Taylor & Francis, and other indexed academic sources relevant to the topic. The search covered publications from 2020 to 2025 in order to capture recent developments in AI, teacher education, and twenty-first-century competencies. The search terms included combinations of keywords such as “artificial intelligence and teacher education,” “AI literacy,” “AI competency for teachers,” “prospective teachers,” “pre-service teachers,” “teacher preparation,” “basic education,” “digital literacy,” “lifelong learning,” “learning design for equity,” “AI ethics in education,” “digital citizenship,” “teacher leadership,” and “creative learning leadership.”

4.3 Inclusion and Exclusion Criteria.

The inclusion criteria were established to ensure that the selected literature was directly relevant to the purpose of the study. Articles were included if they met the following criteria: 1) they were published between 2020 and 2025, 2) they addressed teacher education, prospective teachers, pre-service teachers, basic education, or teaching and learning in AI-supported contexts, 3) they discussed



competencies, characteristics, attributes, or professional capacities relevant to teachers in the AI era, 4) they provided empirical findings, conceptual arguments, or theoretical insights relevant to one or more synthesis domains, and 5) they were accessible in full text and published in academic journals, conference proceedings, or indexed scholarly sources.

The exclusion criteria were also applied to maintain the focus and quality of the review. Publications were excluded if they were not directly related to teacher preparation, teaching practice, basic education, or AI-supported learning; if they focused solely on technical AI development without educational relevance; if they were opinion pieces without sufficient conceptual or empirical grounding; if they duplicated content already represented in another selected study; or if they did not provide sufficient information for extracting data related to the study's analytical categories. Publications that addressed general digital transformation but did not connect clearly with teacher characteristics, competencies, or educational practice were also excluded.

4.4 Screening and Quality Consideration.

The screening process began with 37 initially identified publications. These publications were first screened by title, abstract, and keywords to determine their relevance to teacher education, AI-supported teaching, and 21st-century competencies. The full texts of potentially relevant publications were then reviewed to assess their alignment with the inclusion criteria and the five synthesis domains. After this screening and quality consideration process, 28 publications



were retained for in-depth analysis. Nine publications were excluded because they did not sufficiently align with the focus of the study, were too general in relation to AI and education, focused mainly on technical or non-educational aspects of AI, or lacked sufficient relevance to prospective teachers, basic education, or teachers' professional characteristics.

Quality consideration was conducted by examining the relevance, scholarly credibility, clarity of purpose, methodological or conceptual soundness, and usefulness of each publication for the analytical synthesis. Empirical studies were considered in terms of their research focus, context, participants, methods, and findings. Conceptual and theoretical papers were considered in terms of the clarity of their arguments, their relevance to teacher preparation, and their contribution to understanding the competencies or characteristics required in the AI era. This process helped ensure that the selected publications provided an appropriate basis for synthesis.

4.5 Data Extraction and Analytical Synthesis.

Data extraction focused on information relevant to the study's purpose and analytical categories. For each selected publication, the following information was extracted: author(s), year of publication, research context, educational level, study focus, key concepts, methodology or article type, major findings or arguments, and relevance to the synthesis domains. Particular attention was given to sections reporting findings, conceptual propositions, theoretical arguments, and implications for teacher education or teaching in basic education.



The analytical synthesis procedure involved several steps. First, the extracted information was reviewed to identify recurring concepts related to teacher characteristics in the age of AI. Second, these concepts were grouped under the five synthesis domains established from the conceptual basis of the study. Third, the evidence within each domain was compared across international and Thai scholars to identify common patterns, contextual differences, and practical examples. Fourth, the findings were synthesised into key indicators, descriptions, practical examples, and supporting references, which are presented later in Tables 1 to 5. This process enabled the study to organise the literature systematically while maintaining the interpretive nature of an analytical literature review.

5. Findings

The analytical synthesis of the 28 selected publications revealed five synthesis domains representing the desirable characteristics of prospective teachers in the age of artificial intelligence (AI). These domains were organised according to recurring concepts identified across the reviewed literature, including digital competence, lifelong learning, adaptability, equity-oriented learning design, ethical and responsible technology use, learner-context understanding, and creative learning leadership. The findings are presented below according to the five synthesis domains. Each domain includes key indicators, descriptions, practical examples, and supporting references.



5.1 Digital Literacy and Lifelong Learning Skills

The analysis and synthesis of the literature indicate that digital literacy and lifelong learning skills are essential characteristics for prospective teachers in the age of AI. These characteristics involve the ability to understand AI, use digital tools critically, apply data and media for instructional purposes, monitor learner progress through AI-supported systems, and continuously develop professional knowledge and skills. The key indicators are presented in Table 1.

Table 1 Digital Literacy and Lifelong Learning Skills

No	Key Indicator	Description	Practical Example	References
1	AI Literacy and Computational Thinking (CT)	Conceptual understanding of AI and computational thinking for learning design and interaction with intelligent systems	A teacher designs a “problematising with prompts” activity in Grade 6 in which students use AI assistants to create scientific experiment plans and reflect on model limitations.	Yang et al. (2024); Zhang et al. (2024)
2	Technological Pedagogical Content Knowledge (TPACK) and AI-TPACK Integration	Integration of technology, pedagogy, and content with AI to support instruction	Grade 8 students use AI summarisation tools to prepare multi-level materials, followed by teacher-designed higher-order questions for diverse learners.	Hava & Babayiğit (2024); Xue & Talin (2024)
3	Data, Media, and Information Literacy	Critical use of data and digital media to inform	A teacher analyses student behaviour data from a learning management system	Bai (2025); Samngamjan et al. (2024)



No	Key Indicator	Description	Practical Example	References
		instructional decisions	to schedule individualised tutoring sessions.	
4	Learning Analytics and Assessment with AI	Use of artificial intelligence and analytics to monitor student progress under human supervision	Teachers adjust weekly lesson plans using dashboards that highlight misconceptions.	Xue & Talin (2024); Zhang et al. (2024)
5	Lifelong Learning Habits and Reflective Practice	Continuous inquiry, reflective thinking, and professional upskilling	Teachers engage in professional learning communities to complete AI-related micro-credentials each semester and conduct collaborative lesson studies.	Çilek et al. (2023); Kayima (2022)

Table 1 shows that digital literacy and lifelong learning skills are not limited to technical proficiency. Rather, they involve the integrated use of AI literacy, computational thinking, TPACK or AI-TPACK, data literacy, learning analytics, and reflective professional learning. These indicators suggest that prospective teachers need to use AI critically, connect technology with pedagogy and content, and continue improving their professional practice in response to technological change.

5.2 Flexibility and Perseverance

The literature indicates that flexibility and perseverance are necessary for prospective teachers because AI-supported education requires teachers to respond to uncertainty, changing classroom



conditions, and emerging forms of human-AI collaboration. These characteristics include adaptive expertise, resilience, emotional regulation, collaborative problem-solving, and iterative improvement, as presented in Table 2.

Table 2 Flexibility and Perseverance

No	Key Indicator	Description	Practical Example	References
1	Adaptive Expertise	Applying knowledge creatively in new contexts	A teacher shifts from a lecture format to a studio-based activity when internet connectivity fails, supplemented by offline materials.	Järvelä et al. (2025)
2	Growth Mindset and Resilience	Holding a development-tal perspective and persisting through challenges	A class-level “challenge log” is used to document obstacles and solutions, with weekly celebrations of micro-wins.	Ha & Rodrigo (2024)
3	Self-Regulation and Emotional Regulation	Managing oneself and one’s emotions in uncertain situations	Teachers use emotional check-ins at the beginning of class and short breathing strategies to restore focus.	Ha & Rodrigo (2024)
4	Collaborative Problem-Solving in Human-AI Teams	Collaborating with artificial intelligence while maintaining human leadership	Students assume roles such as questioner, fact-checker, and ethics summariser when analysing AI outputs.	Järvelä et al. (2025); Mnguni et al. (2024)
5	Iterative Improvement	Refining instructional	Teachers trial three AI-supported	Çilek et al. (2023)



No	Key Indicator	Description	Practical Example	References
	under Uncertainty	practices iteratively using real- time evidence	instructional tools, collect evidence, and select the most suitable option for rural school contexts.	

Table 2 shows that flexibility and perseverance refer to more than general adaptability. They include the ability to apply knowledge in new situations, sustain motivation during challenges, regulate emotions, collaborate with AI while maintaining human judgement, and improve instruction based on evidence from practice.

5.3 Learning Design for Equity and Innovation

The reviewed literature shows that learning design for equity and innovation is an important characteristic for prospective teachers in the AI era. This domain emphasises the ability to design accessible, inclusive, and contextually meaningful learning experiences for diverse learners. The key indicators are presented in Table 3.

Table 3 Learning Design for Equity and Innovation

No	Key Indicator	Description	Practical Example	References
1	Universal Design for Learning with AI Supports	Universal Design for Learning enhanced by artificial intelligence to expand accessibility	Teachers prepare three levels of learning materials and AI-generated visual or audio summaries for diverse learners.	Gabriel (2024); Bai (2025)



No	Key Indicator	Description	Practical Example	References
2	Data-Informed Differentiation	Using data to diagnose and address individual learning needs	Teachers use digital portfolios and automated rubrics to supplement classroom observations.	Jain (2025); Xue & Talin (2024)
3	Accessibility and Assistive Technologies	Employing assistive tools to enhance access while preserving learner dignity	A visually impaired student uses AI-powered text-to-speech (TTS) technology in combination with hands-on practice.	Bai (2025); Zhang et al. (2024)
4	Culturally Responsive and Community-Based Design	Integrating local culture and community perspectives into instructional design	Students participate in digital citizenship projects that analyse local online media in collaboration with community partners.	Jarupongputtana et al. (2022)
5	Instructional Design Competence	Ethically grounded and creatively driven capacity for instructional planning and implementation	Teachers collaboratively develop a learning-unit blueprint titled “STEAM for the Community.”	Khaewphuang & Nuangchalem (2025); Reyna & Baguio (2025)

Table 3 indicates that learning design for equity and innovation involves the use of AI and digital tools to expand access, respond to learner diversity, and connect instruction with local and community contexts. These indicators emphasise that prospective teachers should be able to design learning that is both innovative and inclusive.



5.4 Ethics, Morality, and Learner-Context Understanding

The literature demonstrates that ethics, morality, and learner-context understanding are indispensable human-centric characteristics for prospective teachers in the AI era. This domain includes responsible AI use, privacy protection, awareness of bias, digital citizenship, and sensitivity to learners’ contexts and voices, as presented in Table 4.

Table 4 Ethics, Morality, and Learner-Context Understanding

No	Key Indicator	Description	Practical Example	References
1	Artificial Intelligence Ethics and Responsible Use	Ethical principles for the use of artificial intelligence in teaching and assessment	A classroom policy requires students to cite the AI tools they use and to verify the accuracy of AI-generated outputs.	Walsh et al. (2023); Zhang et al. (2024)
2	Privacy, Safety, and Data Protection	Ensuring digital security and safeguarding learner data	Teachers use parental and student consent forms and properly configure digital privacy settings.	Bai (2025); Xue & Talin (2024)
3	Bias and Fairness Awareness	Recognising and addressing bias in data and algorithms	Students engage in a simulated “bias hunt” by experimenting with varied prompts.	Walsh et al. (2023)
4	Digital Citizenship and Responsible Internet Use	Promoting ethical online behavior and responsible digital participation	Teachers use the appropriate internet use behaviour (AIUB) rubric to assess students’ digital communication and citation practices.	Pimdee & Leekitchwana (2022)



No	Key Indicator	Description	Practical Example	References
5	Contextual Pedagogy and Student Voice	Understanding learners' contexts and amplifying their perspectives	Teachers conduct weekly reflective circles and individualised coaching sessions for at-risk students.	Park (2025); Samngamjan et al. (2024)

Table 4 shows that ethical and learner-centred characteristics are essential for maintaining professional responsibility in AI-supported education. These indicators highlight the importance of protecting learners, addressing bias, encouraging responsible digital participation, and designing instruction that respects learners' contexts.

5.5 Creative Learning Leadership

The reviewed literature indicates that creative learning leadership is a desirable characteristic that enables prospective teachers to guide instructional innovation, inspire learners, and support educational change in AI-supported learning environments. This domain includes ethical vision, innovation frameworks, transformative learning facilitation, professional collaboration, and evidence-informed decision-making, as presented in Table 5.

Table 5 Creative Learning Leadership

No	Key Indicator	Description	Practical Example	References
1	Vision and Ethical Stance on AI	Articulating a clear vision and ethical position regarding the use of artificial intelligence	A subject-group teaching reform plan emphasises that "AI is an assistant, not a	Li & Fu (2024); Zhang et al. (2024)



replacement for teachers.”				
2	Instructional Innovation Frameworks	Applying frameworks that integrate artificial intelligence into innovative instruction	Teachers implement the 5P Funnel with an entire cohort of prospective teachers.	Li et al. (2025)
3	Transformative and Adaptive Learning Facilitation	Facilitating learning that is reflective, adaptive, and transformative	Teachers use the AI-TEACH model to design collaborative and reflective classroom activities.	Siddiqui et al. (2025)
4	Professional Learning Communities, Mentoring, and Capacity Building	Enhancing teacher capacity through collaboration and sustained professional development	Teachers conduct monthly “AI micro-labs” supported by multidisciplinary coaching teams.	Patphol (2022); Kayima (2022)
5	Evidence-Informed Decision-Making and Student Agency	Making pedagogical decisions based on evidence while empowering student participation	Teachers use engagement data to adjust lessons and enable students to co-design assessment rubrics.	Mnguni et al. (2024); Reyna & Baguio (2025)

Table 5 shows that creative learning leadership involves the ability to guide AI-supported instructional change with ethical awareness, creativity, collaboration, and evidence-based judgment. These indicators suggest that prospective teachers should not only use



AI tools but also lead learning processes that encourage reflection, participation, and learner agency.

6. Discussion

The findings indicate that the desirable characteristics of prospective teachers in the age of artificial intelligence (AI) should not be understood as separate or isolated qualities. Rather, they represent interconnected professional characteristics that collectively support teacher preparation for basic education in a rapidly changing technological environment. The five synthesis domains, which comprise digital literacy and lifelong learning skills, flexibility and perseverance, learning design for equity and innovation, ethics, morality, and learner-context understanding, and creative learning leadership, together reflect the need for prospective teachers to integrate technological competence with pedagogical judgement, ethical responsibility, contextual sensitivity, and professional agency.

First, digital literacy and lifelong learning skills serve as the foundational domain that enables prospective teachers to understand, select, and use AI-supported tools for instructional purposes. These skills include AI literacy, computational thinking, technological pedagogical content knowledge (TPACK), AI-TPACK integration, data literacy, learning analytics, and reflective professional learning. From the perspective of dynamic capabilities theory, this domain reflects teachers' capacity to sense technological changes, seize relevant opportunities for instructional improvement, and transform teaching practices in response to new educational conditions (Teece et al.,



1997; Teece, 2007, 2025). The literature from both international and Thai contexts indicates that teachers who possess AI literacy and computational thinking are better prepared to design learning activities, interpret digital information, and adapt their instructional decisions to learners' needs (Yang et al., 2024; Zhang et al., 2024; Samngamjan et al., 2024).

Second, flexibility and perseverance strengthen teachers' ability to sustain professional practice under conditions of uncertainty. In AI-supported educational environments, teachers may face changing technologies, unequal access to digital resources, unexpected classroom constraints, and diverse learner responses to technology. The reviewed studies suggest that adaptive expertise, resilience, self-regulation, and iterative improvement allow teachers to maintain instructional quality despite such challenges (Järvelä et al., 2025; Ha & Rodrigo, 2024; Çilek et al., 2023). This domain is closely related to hybrid intelligence because it emphasises that effective teaching in the AI era depends on the complementary collaboration between human judgement and machine support (Dellermann et al., 2019; Rafner et al., 2022; Järvelä et al., 2025). AI can assist teachers in generating information, analysing data, and supporting learning processes, but teachers remain responsible for interpreting results, making contextual decisions, and maintaining the human direction of learning.

Third, learning design for equity and innovation connects technological use with inclusive pedagogical purposes. The literature shows that AI can support accessibility, differentiated learning, assistive technologies, and data-informed instructional decisions when teachers



use it with an equity-oriented intention (Gabriel, 2024; Bai, 2025; Jain, 2025; Xue & Talin, 2024). This domain is therefore not merely about designing innovative lessons but also about ensuring that innovation expands learning opportunities for diverse learners. In basic education, this point is especially important because students differ in age, ability, background, language, resources, and learning needs. Learning design for equity and innovation also aligns with dynamic capabilities theory because teachers must continually adjust instructional designs in response to evidence from learners and local contexts (Teece et al., 1997; Teece, 2007, 2025).

Fourth, ethics, morality, and learner-context understanding function as the normative and human-centric foundation of all other domains. The use of AI in education raises concerns about privacy, data protection, algorithmic bias, fairness, digital citizenship, and the risk of reducing learners to data profiles. The reviewed studies emphasise that teachers must be able to guide responsible AI use, protect learner data, recognise bias, and support ethical online participation (Walsh et al., 2023; Zhang et al., 2024; Pimdee & Leekitchwatana, 2022). This domain also reflects the limits of AI. Although AI may assist with data processing and instructional support, it cannot replace teachers' moral judgement, empathy, understanding of learners' lived experiences, or professional responsibility. For this reason, ethical awareness and learner-context understanding must guide the use of digital and AI-supported tools in teacher preparation.

Fifth, creative learning leadership integrates the preceding synthesis domains into professional action. Prospective teachers are



not expected merely to use AI tools, but to lead learning processes that are reflective, collaborative, ethical, and responsive to change. The reviewed literature indicates that creative learning leadership involves having a clear ethical stance toward AI, applying instructional innovation models, facilitating transformative and adaptive learning, participating in professional learning communities, and making evidence-informed pedagogical decisions (Li & Fu, 2024; Li et al., 2025; Siddiqui et al., 2025; Patphol, 2022; Mnguni et al., 2024). This domain is closely linked to transformative learning theory because it emphasises critical reflection, perspective transformation, and professional growth (Mezirow, 1978; Mangkhang et al., 2022). Teachers who develop creative learning leadership are better positioned to help learners become active participants in their own learning rather than passive users of technology.

The interrelationships among the five domains may be understood from both developmental and functional perspectives. Digital literacy and lifelong learning skills provide the technical and cognitive foundations for AI-supported teaching by enabling prospective teachers to understand, evaluate, and apply emerging technologies in pedagogically meaningful ways (Hava & Babayiğit, 2024; Yang et al., 2024; Zhang et al., 2024). Flexibility and perseverance support the adaptive application of these competencies under uncertain and changing educational conditions, including emerging forms of human–AI collaboration (Järvelä et al., 2025; Mnguni et al., 2024). Learning design for equity and innovation provides pedagogical and inclusive direction for the use of technology by connecting AI-



supported practices with learner diversity, accessibility, and contextual needs (Bai, 2025; Gabriel, 2024; Xue & Talin, 2024). Ethics, morality, and learner-context understanding provide the professional and human-centric values needed to regulate the use of AI, protect learners, and promote responsible digital participation (Pimdee & Leekitchwatana, 2022; Walsh et al., 2023). Creative learning leadership then translates these capacities into professional action through instructional innovation, reflective practice, collaboration, and evidence-informed decision-making (Patphol, 2022; Siddiqui et al., 2025). Viewed through the lenses of dynamic capabilities theory, hybrid intelligence, and transformative learning theory, these domains can be interpreted as complementary and mutually reinforcing professional characteristics rather than as a fixed developmental sequence or a checklist of discrete skills (Dellermann et al., 2019; Mezirow, 1978; Teece, 2007, 2025; Teece et al., 1997).

Overall, the synthesis suggests that preparing prospective teachers for the AI era requires a balanced approach that combines technological capability with humanistic and professional responsibility. This finding is consistent with Dynamic Capabilities Theory, which highlights adaptation and transformation; Hybrid Intelligence, which emphasises human-AI complementarity; and Transformative Learning Theory, which stresses reflection and professional change. The evidence from the research conducted by the international and Thai scholars collectively supports the view that teacher preparation for basic education should move beyond technical AI training alone. Instead, it should cultivate integrated characteristics



that enable prospective teachers to use AI critically, design equitable learning, respond to uncertainty, act ethically, understand learners' contexts, and lead creative learning in ways that remain grounded in human values.

7. Recommendations

7.1 Future Research Directions

Future research should empirically examine the five desirable characteristics synthesised in this study in authentic teacher education and basic education contexts. Further studies may develop and validate measurement instruments for assessing AI literacy, flexibility and perseverance, learning design for equity and innovation, ethics and learner-context understanding, and creative learning leadership among prospective teachers. Comparative studies across institutional, regional, and international contexts are also recommended to examine whether these characteristics are applicable across different teacher preparation systems. In addition, longitudinal research should be conducted to investigate how prospective teachers develop these characteristics through coursework, practicum experiences, and early professional practice.

7.2 Practical Implications for Teacher Education and Policy

Teacher education institutions should revise teacher preparation curricula by embedding AI literacy, digital citizenship, ethical technology use, and learning design for equity into both general education and professional teacher education courses. These



characteristics should not be treated as isolated training topics but should be integrated into instructional design, classroom assessment, practicum preparation, and reflective professional learning. In particular, teacher education programmes should provide prospective teachers with opportunities to design AI-supported lessons, evaluate AI-generated outputs, apply data-informed instructional decision-making, protect learner privacy, and create inclusive learning activities for diverse learners in basic education settings.

At the curriculum and school-practice levels, faculties of education should strengthen collaboration with basic education schools by using practicum experiences, mentoring systems, and professional learning communities as mechanisms for developing the five desirable characteristics identified in this study. Mentor teachers and university supervisors should be prepared to support prospective teachers in applying AI-TPACK, learning analytics, Universal Design for Learning, ethical AI use, and learner-context understanding in real classroom situations. Schools can also support this development by creating small-scale AI-supported learning projects, classroom innovation laboratories, and reflective teaching activities that allow prospective teachers to connect technological tools with learners' needs, local contexts, and professional ethics.

At the policy level, educational policymakers and professional bodies should consider using the synthesised characteristics as a reference for reviewing teacher competency standards, teacher education accreditation criteria, and professional development policies for basic education teachers. Policy support



should include guidelines for responsible AI use in schools, minimum competencies for AI literacy and digital citizenship, data protection practices for learners, and professional development pathways for both prospective and in-service teachers. These policy directions may help ensure that teacher preparation in the AI era remains responsive to technological change while preserving the humanistic, ethical, and learner-centered foundations of the teaching profession.

8. Conclusion

This study identified and synthesised the desirable characteristics of prospective teachers in the age of artificial intelligence (AI) through an analytical literature review. Drawing on 28 selected publications published between 2020 and 2025, the study organised the reviewed literature into five synthesis domains: digital literacy and lifelong learning skills, flexibility and perseverance, learning design for equity and innovation, ethics, morality, and learner-context understanding, and creative learning leadership. These domains indicate that prospective teachers in basic education need more than technical competence in using AI. They require an integrated set of professional characteristics that enables them to use AI critically, adapt to shifting educational conditions, design inclusive learning experiences, act ethically, understand learners' contexts, and lead learning with creativity and professional responsibility.

The synthesis contributes to academic discussion on teacher preparation in the AI era by positioning desirable teacher characteristics as interconnected professional capacities rather than isolated skills.



Digital literacy provides the foundation for AI-supported teaching, flexibility enables teachers to respond to uncertainty, learning design for equity ensures that innovation serves diverse learners, ethics and learner-context understanding protect humanistic values, and creative learning leadership integrates these characteristics into reflective and transformative educational practice. This interpretation is consistent with the theoretical perspectives discussed in the study, including Dynamic Capabilities Theory, Hybrid Intelligence, and Transformative Learning Theory.

In practical terms, the findings of the present study can inform teacher education curriculum development, practicum design, professional development, and policy discussions related to teacher preparation for basic education. However, the identified characteristics should be further examined through empirical studies in authentic teacher education and school contexts, as this study was based on documentary research and analytical synthesis. Future research should develop measurement instruments, validate the five synthesis domains with prospective teachers and teacher educators, and investigate how these characteristics develop through coursework, practicum experiences, and early professional practice in the AI era.

9. AI Usage Declaration

This manuscript employed AI tools solely for enhancing language clarity and grammatical accuracy. Specifically, ChatGPT (OpenAI) was used to refine sentence structure and improve overall readability, whereas Grammarly was employed to verify grammar, punctuation, and lexical



choice. No AI tools were employed for data analysis, the generation of figures or tables, or the interpretation of results. All intellectual contributions, critical syntheses, and the development of the conceptual framework were conducted exclusively by the author.

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