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Competence, Career, and Compliance: An Integrated Framework Aligning Teacher AI Literacy with National Performance, UNESCO Standards, and Data-Protection Law in Thailand

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Abstract

Teacher artificial intelligence (AI) literacy has become a policy priority, yet the frameworks defining it circulate apart from the national systems that govern how teachers are trained, appraised, and promoted, and apart from the data-protection regimes governing classroom AI use. This disconnection helps explain why professional development (PD) in AI remains fragmented, tool-centric, and weakly adopted. This article develops an integrated framework aligning teacher AI-literacy competencies with three policy layers in Thailand: the Office of the Teacher Civil Service and Educational Personnel Commission's Performance Agreement (PA) and academic-standing system, the UNESCO AI Competency Framework for Teachers (2024), and the Personal Data Protection Act B.E. 2562 (PDPA). Using a structured policy document analysis and a directed crosswalk synthesis, the study maps a six-dimension model of teacher AI literacy onto national performance indicators and career progression, aligns that progression with UNESCO's acquire–deepen–create trajectory, and embeds PDPA obligations as a cross-cutting governance layer. The framework's principal output is an alignment matrix that translates competencies into evidence recognizable within the national performance system, complemented by a developmental progression map, a data-governance overlay, and a phased implementation roadmap. An expert panel (n = 5) rated the framework favorably (overall mean = 4.68) with moderate inter-rater concordance (Kendall's W = 0.42), and item-objective congruence supported the content validity of all mappings. The article argues that anchoring AI-literacy PD in existing accountability and legal structures may offer a more durable route to adoption than standalone training, and discusses the possible transferability of its design logic, rather than its specific mappings, to comparable jurisdictions.

Keywords: AI literacy, teacher professional development, education policy, UNESCO AI Competency Framework, Thailand

1. Introduction

1.1 Background: AI Literacy and the Limits of Standalone Professional Development

The rapid diffusion of generative artificial intelligence (AI) into everyday classroom work has moved teacher AI literacy from a specialist concern to a mainstream policy objective. Ministries and international agencies now issue guidance on what teachers should know and be able to do with AI, and large-scale surveys report climbing adoption alongside persistent unevenness in confidence and skill (OECD, 2023; UNESCO, 2024). Even where enthusiasm runs high, needs assessments continue to find teachers underprepared to use information and communication technologies and AI in inclusive classrooms (Safdar et al., 2026), and preservice teachers report uneven readiness to integrate AI into their practice (Unal & Hobe, 2025). Across systems, however, the instruments that would actually build teacher capacity—professional development programs, competency standards, and appraisal systems—have not kept pace with the ambition expressed at the level of national strategy. The difficulty is structural rather than motivational. AI-literacy PD is usually delivered as separate, tool-focused workshops that sit apart from the frameworks through which teachers are evaluated and promoted, and apart from the rules governing how learner data may be used. Where training sits outside these structures, it is likely to be experienced as an additional demand rather than a route to recognized professional accomplishment. This is a proposition rather than a finding. The evidence supports two related points: teachers report unmet training needs in ICT and AI, and they are adopting data-

intensive tools where governance is still developing (Williamson & Eynon, 2020; Zeide, 2017). The narrower claim that misalignment with appraisal depresses uptake has not been tested directly, so far as we are aware; we treat it as a premise to be tested and return to it in Section 5.5. Professional development changes practice most reliably when it is sustained, job-embedded, and connected to the incentives that shape teachers' work (Darling-Hammond et al., 2017; Timperley, 2011), and standalone AI training rarely meets these conditions.

1.2 The Thai Policy Context: Performance, Data Protection, and Competency

Thailand shows both sides of this pattern. The National AI Strategy and Action Plan (2022–2027) sets human-capital targets (Ministry of Higher Education, Science, Research and Innovation, 2022), and the Ministry of Education has called for AI to be brought into learning management (Ministry of Education Thailand, 2024). At the same time, the relevant instruments exist but operate in isolation. OTEPC governs teacher performance through the Performance Agreement (PA), in which teachers commit annually to development targets assessed against defined indicators and linked to academic-standing (wittayathana) advancement (OTEPC, 2021). The Personal Data Protection Act B.E. 2562, enforced from 2022, imposes duties of lawful processing, purpose limitation, and security on any handling of personal data, including the learner data AI-enabled teaching generates (Personal Data Protection Act, 2019). And scholarship now specifies the competencies that make up teacher AI literacy, including a six-dimension model validated with Thai teachers (Authors, under review). Each is well developed on its own, but no framework connects them.

1.3 The Research Gap, Purpose, and Contribution

Existing crosswalks typically align one competency framework with another, without anchoring either in a national accountability instrument or in data-protection law (Ng et al., 2021; UNESCO, 2024). The result is conceptual coherence without institutional traction: frameworks that describe what teachers should be able to do, but give administrators no way to recognize that capability within existing appraisal, and teachers no assurance that the practices encouraged are lawful. This article aligns teacher AI-literacy competencies with three policy layers in the Thai context, guided by four questions. How do the dimensions of teacher AI literacy map onto Thailand's PA indicators and academic-standing progression? How can UNESCO's (2024) framework be crosswalked with that structure to give a coherent developmental path? How can PDPA duties be embedded as a cross-cutting governance layer rather than appended as compliance? And what implementation pathway follows for PD providers and policymakers? The contribution is fourfold. The study proposes a tri-layer framework bringing together a competency model, a national teacher-performance system, and a data-protection statute. We did not find a prior framework combining all three, though we did not conduct a systematic review and so make no claim of priority. It sets that integration out in an alignment matrix that turns competencies into evidence the performance system can recognize; it treats data protection as part of AI-literacy practice through a PDPA overlay rather than an afterthought; and it derives a phased roadmap with design principles that may transfer elsewhere. The framework is conceptual; the empirical work behind its competency layer is reported in companion work.

2. Literature Review

2.1 Conceptualizing Teacher AI Literacy

Scholarly interest in AI literacy grew around Long and Magerko's (2020) account of it as a set of competencies for evaluating, communicating, and collaborating with AI, later drawn by Ng and colleagues (2021) into four facets covering knowledge, use, creation, and ethics. As attention turned to educators, researchers argued that teacher AI literacy is a distinct professional construct rather than general AI literacy plus teaching, joining technical understanding with pedagogical judgment and ethical responsibility (Celik, 2023; Chan, 2023; Redecker, 2017); Celik's intelligent-TPACK extends the TPACK tradition (Mishra & Koehler, 2006) to the ethical and data dimensions AI introduces. What such models share is a descriptive orientation: they set out what competent practice looks like but seldom say how it might be recognized or rewarded within the systems that govern teachers' careers. The six-dimension model used here sits within this turn, and because it supplies the competency layer its development and validity evidence are summarized so that this article can be read on its own terms. The dimensions were drawn from the AI-literacy and TPACK literatures with consultation with Thai teacher educators, screened for content validity using item-objective congruence, piloted, and administered to a national sample of Thai in-service teachers (N = 406). Second-order confirmatory factor analysis supported six first-order factors loading on one higher-order construct: $\chi^2(393) = 438.56$, $p = .056$, $\chi^2/df = 1.12$, CFI = .995, TLI = .995, RMSEA = .017, 90% CI [.000, .025], SRMR = .019. First-order loadings ranged from .77 to .82 and second-order loadings from .97 to .99, all $p < .001$. Composite reliability (McDonald's ω) ranged from .89 to .90 and average variance extracted from .61 to .63; ω is reported rather than α because the model is congeneric rather than tau-equivalent. Six correlated residuals across dimensions were freed on the basis of modification indices and item content. The high second-order loadings mean the six dimensions are best read as closely related facets of a largely unidimensional construct rather than as separable factors; Section 5.5 gives the consequence for the alignment matrix. Full procedures and coefficients appear in the companion validation study.

2.2 The UNESCO AI Competency Framework for Teachers

The UNESCO AI Competency Framework for Teachers (2024) is the most widely cited recent attempt to standardize expectations internationally. It organizes fifteen competencies across five dimensions—a human-centred mindset, the ethics of AI, AI foundations and applications, AI pedagogy, and AI for professional development—and, importantly for the present argument, articulates a three-level progression from acquire to deepen to create. This progression is the framework's most useful feature for a system that already thinks in terms of career stages, because it implies that AI literacy is developmental rather than binary. Its limitation is the obverse of its strength: as a supranational reference it is deliberately generic, silent on how its levels correspond to any particular national standard, and light on the specific legal obligations that constrain AI use in a given jurisdiction. UNESCO itself frames the document as a reference to be localized, but localization has largely been left to individual systems.

2.3 Competency-based teacher policy and professional development

A separate literature examines how teacher standards, appraisal, and career structures shape practice. Competency-based approaches define expected performance and tie it to progression, on the premise that what is assessed and rewarded receives sustained attention (Darling-Hammond et al., 2017). Reviews of PD effectiveness converge on a consistent set of features, namely content focus, active learning, coherence with policy, sustained duration, and collective participation, and find that one-off training rarely alters classroom practice (Darling-Hammond et al., 2017; Timperley, 2011). Recent work extends these conditions to AI, setting out how responsible AI integration can be built into job-embedded professional development (Bahgat et al., 2024). Thailand's PA system reflects several of these principles: it is annual, evidence-based, and tied to advancement through academic standing (OTEPC, 2021). Its indicators, however, predate generative AI and make no reference to AI capability, so teachers who invest in AI-integrated practice generate value the appraisal system cannot see.

2.4 Datafication, Data Protection, and AI Ethics in Education

The third relevant literature concerns the datafication of education and the governance of AI in schools. Scholars have documented how digital platforms convert learning into data and warned of the privacy and equity risks that follow, particularly for children (Williamson & Eynon, 2020; Zeide, 2017). A now-large body of work on AI ethics has distilled recurring principles—transparency, justice, non-maleficence, responsibility, and privacy—from a proliferation of guidelines (Floridi & Cowls, 2019; Jobin et al., 2019), while privacy-by-design thinking argues that safeguards should be engineered into systems from the outset rather than bolted on (Cavoukian, 2010). In education specifically, several frameworks now articulate ethical principles for AI use and stress the need for trustworthy deployment (Nguyen et al., 2023; Vincent-Lancrin & Van der Vlies, 2020). What this literature has generally not done is operationalize its principles at the level of teacher competency and PD. Data protection tends to appear either as high-level principle or as institutional compliance, rarely as a concrete capability that individual teachers are trained in, assessed on, and supported to enact. In jurisdictions with binding data-protection statutes such as Thailand's PDPA, this omission is consequential: teachers are legally exposed precisely where their AI training is silent. These three literatures rarely inform one another, and the intersection is especially thin in developing-country contexts, where national teacher-standard systems and recent data-protection laws coexist with acute resource constraints.

3. Research Methods

3.1 Research Design

This study develops an integrative policy framework rather than testing empirical hypotheses. It draws on document analysis (Bowen, 2009) and framework synthesis, in which existing conceptual structures serve as a starting scaffold that is then filled in, revised, and extended through systematic reading of source texts. The design suits the research questions, which ask how independently written policy structures can be brought into correspondence, a task calling for structured comparison of documents rather than new behavioral data.

3.2 Policy Corpus and Sources

Three primary texts make up the corpus. The first is the UNESCO AI Competency Framework for Teachers (2024), used for its competency dimensions and its acquire–deepen–create progression. The second is Thailand's PA and academic-standing regulation, comprising the OTEPC criteria and the associated indicators and standing levels (OTEPC, 2021). The third is the Personal Data Protection Act B.E. 2562 and its main obligations (Personal Data Protection Act, 2019). These were read alongside the AI-literacy and teacher-PD literature reviewed above and the six-dimension model that supplies the competency layer (Authors, under review). Texts were included if they carried formal authority over, or provided validated constructs for, one of the three layers; general commentary informed interpretation but was not treated as a mappable source.

3.3 Analytic Procedure

Analysis proceeded in six steps. Mappable units were extracted from each source: the six competency dimensions, the PA indicators and standing levels, the UNESCO dimensions and progression levels, and the main PDPA obligations. Mapping rules were then set: a correspondence was recorded where two units named the same object of practice, or served the same purpose in a teacher's work. A crosswalk assigned each dimension to the PA indicators it most directly evidences, with one-to-many mappings kept and annotated rather than forced into one-to-one form. The competency layer was aligned with UNESCO's progression to give a developmental path expressed in the language of academic standing. PDPA obligations were then overlaid on the activities implied by each competency, and the result drawn together into a roadmap.

Two points need fuller explanation. The first is how the two criteria were decided between when both applied. Three rules were used in order. Rule 1, specificity: the correspondence stated at the finer grain was preferred, since a narrow indicator guides evidence better than a broad one. Rule 2, evidentiary directness: a correspondence that could be documented as evidence under the PA's own conventions was preferred over one based on similar wording alone. Rule 3, coverage: an indicator with no mapping yet was preferred, so that mappings did not cluster on a few indicators. The first rule that separated the options decided the case; where none did, both were kept as a one-to-many mapping. For example, AI-Enhanced Teaching Methods fitted PA indicator 1.4 by object and 1.2 by purpose. Rule 2 favoured 1.2, since lesson designs using AI are routinely submitted as PA evidence, and 1.4 was kept as a secondary mapping.

The second is how the mapping was produced and checked. The crosswalk was built by the team working together rather than by separate parallel coding: each correspondence was stated with the rule it relied on, then confirmed, reassigned, or split. Disagreements were settled by argument against the rules rather than by vote. Independent judgment came from outside the team. The eighteen correspondences were rated separately by each of the five experts described in Section 3.6, without sight of one another's ratings, and their agreement is reported in Section 4.6. We report raw agreement rather than a chance-corrected coefficient because Fleiss's kappa here is −.08 despite 84.4% mean pairwise agreement: 92.2% of ratings fell in one category, so expected agreement exceeds observed agreement (Feinstein & Cicchetti, 1990). Because the crosswalk was built by consensus, the mapping has not been independently replicated, and Section 5.5 records this.

3.4 Trustworthiness

Because framework synthesis is interpretive, the mapping was supported by measures reported here against the four criteria set out by Lincoln and Guba (1985) and applied to framework-based analysis by Nowell et al. (2017). Credibility rests on three checks: correspondences were tested across the three policy texts and against established frameworks, so that no mapping rested on a single reading; every assignment was defended before the full team against the rule it relied on (Section 3.3); and the expert appraisal (Section 3.6) added an external check with the policy and practitioner communities the framework addresses. Dependability rests on setting the mapping and decision rules before coding and applying them consistently, with a dated record of provisional and revised mappings. Confirmability rests on the audit trail, in which each correspondence can be traced to the rule and source passage behind it, and on recording the team's own involvement in developing the competency model, so that readers can judge how far that may have shaped the mapping. Transferability is not claimed but supported: the policy conditions the framework depends on are described in enough detail for readers elsewhere to judge whether those conditions hold, an assessment developed in Section 5.4.

3.5 Scope and Boundaries

Two boundaries should be stated. The framework is anchored in the Thai policy environment, and although its logic is designed to travel, its specific mappings reflect Thai instruments. It is also a design artifact rather than an evaluation; questions of uptake, effect, and equity are empirical and are addressed in companion studies.

3.6 Expert Appraisal of the Framework

Because the framework is an analytical construction, it also needs judgment from outside the team. It was submitted to five purposively selected experts, a panel size suited to item-objective congruence analysis, whose expertise covers teacher professional development, educational technology and AI in education, teacher-career policy and appraisal in Thailand, and data-protection practice. Each held an advanced degree with at least five years of academic or policy experience, or a leadership role in the national system. The instrument is described in Appendix A. Two forms were used. On the first, each expert rated the framework as a whole and each of its six dimensions on suitability, feasibility, utility, and accuracy, using a five-point scale (1 = lowest, 5 = highest). Means were read against equal-interval bands, with 3.50 set in advance as the threshold for acceptance and the standard deviation reported alongside. The second form assessed the content validity of the crosswalk: for every proposed mapping, experts recorded +1 (congruent), 0 (uncertain), or −1 (incongruent) (Rovinelli & Hambleton, 1977). The IOC index is the mean of the five scores, and mappings at 0.50 or above were retained. Concordance was summarized with Kendall's W (Schmidt, 1997). Open-ended prompts invited re-wordings, missing mappings, and additional safeguards, which were used to revise the framework before finalization.

Table 1. Profile of the expert panel

Expert	Field of expertise	Highest degree	Years of experience	Sector
E1	Educational technology	Ph.D.	15	Ministry of Education
E2	Educational administration	Ph.D.	20	Educational Service Area Office
E3	Learning sciences and educational innovation	Ph.D.	22	Higher education (university)
E4	Not reported	Ph.D.	Not reported	Primary Educational Service Area Office
E5	Innovation, technology, and learning sciences	Ph.D.	7	Basic-education school

Note. The panel profile is reported here, with the sampling and instrument description, rather than in the Results, because it characterizes the participants of the appraisal rather than a finding of the study.

3.7 Ethical Considerations

This article reports a conceptual framework and its appraisal by an expert panel. It involves no intervention with learners and no processing of student data. The work forms part of a larger project approved by the Center for Ethics in Human Research, Khon Kaen University (approval no. HE683554). Participation was voluntary and informed, only professional background was recorded, and experts are identified as E1 to E5.

4. Results: The Integrated Framework

4.1 Overview of the Tri-Layer Architecture

The framework has three layers (Figure 1). At its center is the competency layer, the six dimensions of teacher AI literacy that specify what teachers should know and be able to do. Above it sits UNESCO's (2024) framework, which supplies a shared vocabulary and a developmental progression. Below it sit the PA indicators and academic-standing levels through which capability becomes recognized accomplishment. Around all three is the data-governance layer, the PDPA duties that condition every use of learner data. The sections that follow take each articulation in turn.

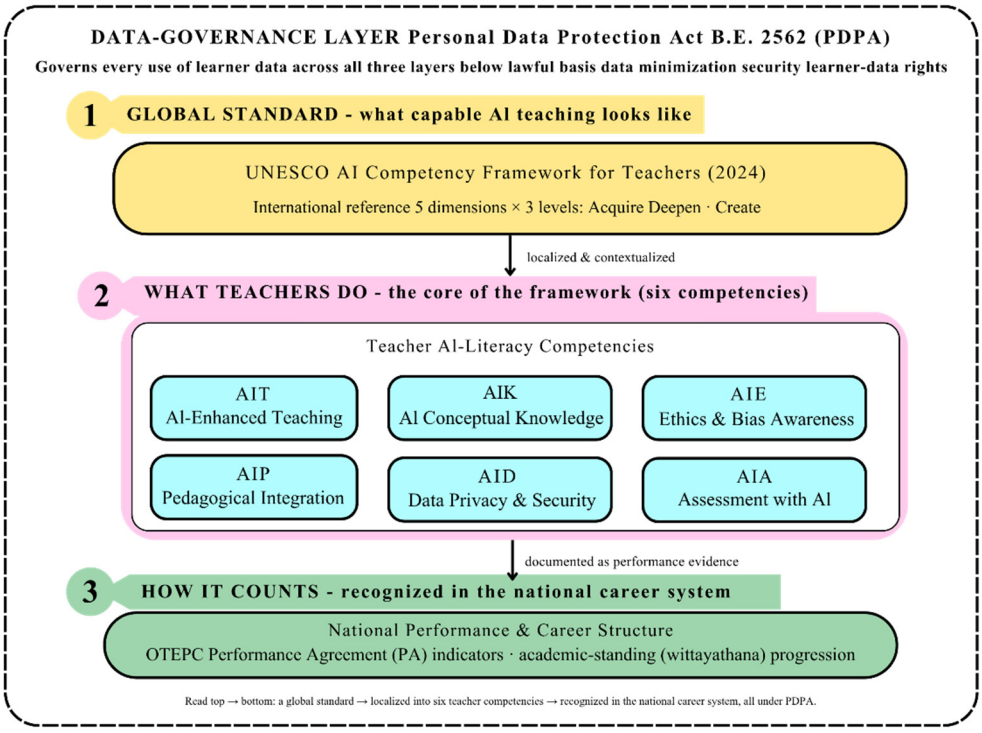


Figure 1. The tri-layer framework: UNESCO reference, teacher AI-literacy competencies, and national career structure, under PDPA governance

4.2 The Alignment Matrix (RQ1)

Table 2 sets out the core of the framework: each AI-literacy dimension mapped to the PA indicators it most directly evidences, the UNESCO dimension it corresponds to, and its main PDPA touchpoint. Three features are worth noting. The two teaching-oriented dimensions, AIT and AIP, map onto the learning-management indicators at the heart of the PA, so that AI-integrated instructional work can be documented as evidence against indicators the appraisal system already values. Data privacy and security maps most strongly onto the learner-information and student-care indicators and carries

the main PDPA duty, which makes explicit that competent AI use and lawful data handling are the same practice seen from two angles. The mapping is many-to-one in places: ethics and bias awareness, for example, informs the supportive-climate and learner-attribute indicators as much as any technical task.

Table 2. Alignment matrix mapping the six AI-literacy dimensions to PA indicators, UNESCO dimensions, and PDPA touchpoints

AI-literacy dimension	Mapped PA performance indicator(s)	UNESCO CFT (2024) dimension	Principal PDPA touchpoint
AI-Enhanced Teaching Methods (AIT)	1.2 Designing learning; 1.3 Conducting learning activities; 1.4 Creating media, innovation, and technology	AI Pedagogy	Purpose limitation and consent, including guardian consent for minors, when learner data feed personalization
AI Conceptual Knowledge (AIK)	1.6 Analyze and synthesize to improve learning; 3.1 Self-development (digital)	AI Foundations and Applications	Awareness of data provenance and inference limits before acting on outputs
AI Ethics and Bias Awareness (AIE)	1.7 Supportive climate; 1.8 Nurture learner attributes; 3.3 Apply knowledge to improve quality	Ethics of AI; Human-Centred Mindset	Fairness and transparency toward data subjects in automated decisions
Pedagogical Integration of AI (AIP)	1.1 Develop curriculum; 1.2 Designing learning	AI Pedagogy; Human-Centred Mindset	Proportionality: using only data necessary for the pedagogical purpose
Data Privacy and Security (AID)	2.1 Learner information; 2.2 Student care-support system; 3.1 Self-development	Ethics of AI; AI Foundations and Applications	Core locus: lawful basis, minimization, security, retention, breach notification, and data-subject rights
Assessment and Evaluation with AI (AIA)	1.5 Measurement and evaluation; 1.6 Analyze to improve learning	AI Pedagogy; AI for Professional Development	Lawful basis (e.g., public task) and consent where required, transparency, and human oversight for analytics on learners

4.3 Developmental Progression (RQ2)

Aligning the competency layer with UNESCO's acquire–deepen–create progression lets AI literacy be expressed in the developmental vocabulary the PA already uses for academic standing. Table 3 proposes this correspondence: entry-level performance corresponds to acquire, the experienced and special-experienced standings to deepen, and the expert and senior-expert standings to create. The value of this articulation is that it gives administrators a basis for judging AI-related capability at each career stage, and gives teachers a visible path in which investment in AI literacy is legible as advancement.

Table 3. Developmental progression crosswalk aligning academic standing with UNESCO's acquire–deepen–create levels

Academic standing / expected level	UNESCO level	Expected AI-literacy performance descriptor	Illustrative PA evidence
Teacher (Execute and Learn)	Acquire	Uses available AI tools with guidance; applies AI-supported materials; follows data-protection rules	Implements AI-assisted lessons; documents consent and tool choices
Experienced (Apply and Adapt)	Acquire and Deepen	Adapts AI tools to context; evaluates outputs critically; handles learner data appropriately	Adapts AI activities to class needs; reflective log of outcomes
Special Experienced (Solve the Problem)	Deepen	Integrates AI to solve learning problems; appraises bias; designs analytics with oversight	Problem-based AI intervention with evaluation evidence
Expert (Originate and Improve)	Deepen and Create	Originates AI-integrated innovations; mentors peers; embeds privacy-by-design	Develops innovation; leads professional learning community
Senior Expert (Invent, Transform, and Create Impact)	Create	Creates transferable AI-pedagogy models; shapes school and system policy; institutional data governance	System-level impact; contribution to policy and standards

4.4 The PDPA Governance Overlay (RQ3)

Table 4 makes the PDPA layer operational by mapping the data-processing activities that AI-enabled teaching involves onto the Act's main duties and onto concrete safeguards. The activities run from generative tools producing materials from student work, which engages lawful basis and purpose limitation, to cloud processing, which engages cross-border transfer rules. Each activity is anchored to the competencies, principally data privacy and security and ethics and bias awareness, that a teacher needs in order to enact the safeguard, closing the loop between legal duty and professional capability.

Table 4. PDPA governance overlay mapping data-processing activities to obligations, safeguards, and anchoring competencies

Data-processing activity in AI-enabled teaching / PD	Relevant PDPA principle	Operational safeguard	Anchoring competency
Generative AI producing materials from student work	Lawful basis; purpose limitation	Obtain consent or legitimate basis; avoid entering identifiable data into third-party models	AID, AIT
Learning analytics on student performance	Data minimization; transparency	Collect only necessary indicators; inform learners and guardians; provide access rights	AIA, AID
Personalized pathways from behavioral data	Proportionality; storage limitation	Define retention periods; pseudonymize where feasible	AIP, AID
Automated or AI-assisted assessment and grading	Fairness; human oversight	Human-in-the-loop review; contestability; bias checks	AIE, AIA
Storing teacher and learner profiles on platforms	Security safeguards; accountability	Access controls, encryption, breach procedures, school-level data steward	AID
Cross-border processing via cloud AI services	Cross-border transfer rules	Verify adequacy or safeguards; use contractual clauses	AID, AIE

4.5 Implementation Roadmap (RQ4)

The framework's practical corollary is a phased pathway (Table 5). Policy integration comes first, giving the later phases an anchor. PD is then redesigned so that it is job-embedded and generates the evidence the PA requires. Infrastructure and data stewardship follow, then recognition and incentives, so that AI-integrated practice counts toward advancement. The final phase institutes monitoring, attentive to equity across school size and region, since gaps in ICT access remain associated with achievement gaps (Ghimire & Regmi, 2025), and periodic revision.

Table 5. Phased implementation roadmap for aligning AI-literacy PD with national policy

Phase	Focus	Key actions	Lead actors
1	Policy and standards integration	Insert AI-literacy descriptors into PA indicators and standing criteria; align terminology	Ministry; OTEPC
2	Professional development redesign	Redesign PD around the alignment matrix; build portfolio evidence tied to the PA	Universities; PD providers
3	Infrastructure and data governance	Deploy PDPA-compliant tools; appoint data stewards; apply privacy-by-design	Schools; ed-tech providers
4	Recognition and incentives	Recognize AI-integrated practice as evidence for academic-standing advancement	OTEPC; schools
5	Monitoring and iteration	Track uptake, outcomes, and equity (school size, region); revise periodically	Ministry; researchers

4.6 Expert Appraisal of the Framework

This subsection reports the appraisal described in Section 3.6; the panel is profiled in Table 1. Table 6 gives the ratings. Every competency dimension and the framework overall passed the 3.50 threshold, with an overall mean of 4.68 (S.D. = 0.47). Suitability was rated highest (4.93), followed by utility (4.83) and accuracy (4.60). Feasibility was lowest (4.37), matching the written concern that school-level data-security infrastructure and central support would condition real-world adoption. These means should be read alongside the concordance statistic. Agreement among raters was moderate rather than strong, though significant (Kendall's $W = 0.42$, $\chi^2(23) = 48.3$, $p = .002$), so the appraisal indicates broad endorsement together with real differences in how experts ranked the components and should not be described as uniform. Table 7 reports content validity. All eighteen mappings met the retention criterion, with IOC indices from 0.80 to 1.00 (mean 0.92) and eleven rated +1 by every member; none was removed. The five members judged 11 of the 18 correspondences identically (61.1%), with mean pairwise agreement of 84.4%. No correspondence was rated incongruent, and each non-unanimous case was a single rater recording uncertainty.

Three comments led to specific changes. The PDPA touchpoint for Assessment and Evaluation with AI (AIA) had been drafted with consent as the lawful basis for learning analytics. The member working in educational administration rated it 0, noting that assessment in compulsory schooling is generally carried out as a public task or under contract, so a consent basis would misstate the school's position and make appraisal impossible if a learner refused. It was rewritten as "lawful basis (e.g., public task) and consent where required, transparency, and human oversight for analytics on learners," with Table 4 amended to match. The member from the learning sciences noted that the Data Privacy and Security (AID) mapping covered minimization and security but not what a teacher must do when a safeguard fails; breach-notification awareness and breach procedures were added. The school-based member noted that AI-Enhanced Teaching Methods (AIT) referred to consent without saying whose, given that the data are children's; guardian consent was stated explicitly. Not every suggestion was adopted. Two members questioned mapping AID to UNESCO's Ethics of AI and AI

Foundations and Applications. It was kept, since UNESCO's framework has no separate data-protection dimension, and the overlap was noted in the matrix instead. Proposals to extend the competency layer, by adding prompt engineering and copyright, academic integrity, and hallucinated output, were recorded for the instrument's next revision, since the competency model was fixed as an input here. Two members also recommended a practical handbook and observable sub-indicators, which the roadmap in Section 4.5 anticipates.

Table 6. Expert evaluation of the framework on a five-point scale: mean ($\bar{x}$) and standard deviation (S.D.)

Framework component	Suitability		Feasibility		Utility		Accuracy		Overall	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
AIT	5.00	0.00	4.20	0.45	5.00	0.00	4.60	0.55	4.70	0.47
AIK	5.00	0.00	4.00	0.00	4.80	0.45	4.40	0.55	4.55	0.51
AIE	5.00	0.00	4.40	0.55	5.00	0.00	4.60	0.55	4.75	0.44
AIP	5.00	0.00	4.80	0.45	5.00	0.00	4.80	0.45	4.90	0.31
AID	5.00	0.00	4.40	0.55	4.40	0.55	4.60	0.55	4.60	0.50
AIA	4.60	0.55	4.40	0.55	4.80	0.45	4.60	0.55	4.60	0.50
Overall	4.93	0.25	4.37	0.49	4.83	0.38	4.60	0.50	4.68	0.47

Table 7. Content validity of the crosswalk assessed by item-objective congruence (IOC)

AI-literacy dimension	IOC: PA mapping	IOC: UNESCO mapping	IOC: PDPA mapping	Decision (retain if ≥ 0.50)
AIT	1.00	0.80	0.80	Retain (all)
AIK	1.00	1.00	1.00	Retain (all)
AIE	0.80	1.00	1.00	Retain (all)
AIP	1.00	0.80	1.00	Retain (all)
AID	0.80	0.80	1.00	Retain (all)
AIA	1.00	1.00	0.80	Retain (all)

Note. Each IOC index is the mean of expert congruence scores (+1, 0, −1) for the mapping; values of 0.50 or above are retained. All 18 mappings were retained (mean IOC = 0.92); 11 of 18 received unanimous endorsement.

5. Discussion

5.1 Alignment as the Mechanism

The central claim is that the weakness of teacher AI-literacy PD is not mainly a deficit of content but a failure of alignment, and that the remedy is to connect competency to the structures through which teachers are recognized and governed. Anchoring AI literacy in the PA can turn it from an optional skill into documentable professional accomplishment; expressing it developmentally through academic standing supplies a career-length path; and embedding PDPA duties as a governance layer makes lawful data handling part of competent practice rather than a separate compliance burden.

The implications differ by audience. Ministries need not create parallel AI standards; they can insert AI-literacy descriptors into existing indicators and standing criteria, using instruments teachers already engage with annually. PD providers and teacher educators can design programs backward from the alignment matrix, so that participation yields portfolio evidence usable in appraisal. School leaders and data stewards gain a clearer view of the governance practices, among them consent, minimization, and oversight, that make classroom AI use defensible. And teachers are offered a clearer bargain: the effort of building AI literacy could be repaid in recognized advancement rather than spent on short-lived training.

5.2 What the Expert Appraisal Does and Does Not Support

A notable pattern in the expert appraisal sharpens this implication. Although the panel endorsed the framework on every criterion, its one relative reservation concentrated on feasibility, and an experienced administrator located that reservation precisely in the three dimensions most bound to compliance—ethics and bias awareness, data privacy and security, and AI-based assessment. The reasoning was instructive: these are the competencies a teacher cannot enact alone, because they presuppose secure systems, a designated data steward, and a defensible legal basis for processing learner data rather than individual skill or willingness. The teaching-, knowledge-, and integration-oriented dimensions, which depend chiefly on the teacher's own practice, drew no comparable concern. This asymmetry is not simply a weakness in the framework; it also bears on its central argument, since the competencies that individual training can least deliver are also those an institutional anchor is designed to support. Adoption is therefore likely to hinge less on persuading individual teachers than on provisioning the enabling conditions—data-security infrastructure, stewardship roles, and clear legal guidance—at the school, area, and ministry levels. The phased roadmap in Section 4.5 places this provisioning (Phase 3) ahead of recognition and incentives, and the expert judgment is consistent with that sequencing: embedding AI-literacy PD in district- and central-support structures, rather than in standalone workshops, is what would make the compliance-bound competencies feasible in practice. The moderate concordance reported in Section 4.6 bears directly on how far this reading can be pressed. That the panel converged well above the acceptance threshold while ordering the components

differently suggests agreement on the framework's overall adequacy but not on the relative priority of its parts. A panel of five, however expert, establishes content validity rather than consensus, and the appraisal should be read as evidence that the mappings are defensible rather than as evidence that practitioners would prioritize them alike.

5.3 Theoretical Contribution and Relation to Existing Competency Models

These implications extend the PD-effectiveness literature's emphasis on coherence and incentive alignment (Darling-Hammond et al., 2017; Timperley, 2011) to a capability that literature predates, offer one way to localize a supranational reference such as UNESCO's (2024), and move the ethics conversation from principle toward practice by setting out data protection at the level of teacher competency (Floridi & Cowls, 2019; Nguyen et al., 2023). The framework also makes a claim about how competency models should be built. The leading models share an architecture: Long and Magerko (2020), Ng et al. (2021), Celik (2023), UNESCO (2024), and DigCompEdu (Redecker, 2017) all treat competence as an attribute of the individual teacher, and the institutional setting as a context of use rather than part of the construct. This framework differs in two ways. First, it treats recognizability as part of a competency statement rather than of its implementation: a competency that cannot be documented within the appraisal system a teacher faces is incompletely specified, however carefully its content is described. Second, it treats data governance as part of competent practice rather than an ethical addition. Where intelligent-TPACK adds ethics as a knowledge domain and UNESCO frames a human-centred mindset as a disposition, the PDPA overlay attaches obligations to particular processing activities, and so to particular teaching acts. The difference from earlier crosswalks is structural: they align competency vocabularies with one another, whereas this one binds a competency vocabulary to an appraisal instrument and a law, which cannot be matched on wording alone. That is why the decision rules in Section 3.3 were needed.

5.4 Transferability Beyond Thailand

The framework's architecture may be portable in principle, even though its content is anchored in Thailand. What could transfer is the design logic and the mapping procedure, not the alignment matrix itself: every correspondence in Table 2 is a claim about Thai instruments and carries no validity outside them. The architecture rests on three conditions that vary across systems. The first is an appraisal instrument that is indicator-based and matters for career progression; where appraisal is narrative or inspection-based, or is only loosely tied to advancement, there is no comparable anchor and the recognition mechanism would not work. The second is a data-protection law that sets out lawful bases and processing duties in enough detail to attach to classroom activities; regimes built on sectoral rules or institutional consent would produce a different overlay. The third is a competency model written for the national context rather than imported unchanged. Where these conditions hold, as they may in middle-income systems that pair standards-based teacher appraisal with recent privacy legislation, the three-layer structure could be rebuilt with local substitutions. Where they do not, the framework is diagnostic rather than prescriptive: it shows which anchor is missing and what would have to be built first. Testing transferability would require repeating the procedure in at least one contrasting system, which we have not done.

5.5 Limitations and Implementation Challenges

Six limitations qualify the claims made here. First, the framework is conceptual, and its mappings, though rule-governed, remain interpretive; other analysts might align some competencies differently, and the crosswalk has not been replicated outside the team. Second, the research team developed the competency model that forms the central layer, so the mapping was done by analysts already committed to it; the external appraisal reduces but does not remove this. Third, the appraisal establishes content validity with a panel of five and moderate concordance; it is not a consensus procedure and does not support inference to the wider expert community. Fourth, the framework has been checked as a design, not as an intervention, and nothing is claimed here about its effect on teacher practice, PD uptake, or learner outcomes. Fifth, it is anchored to one national system and rests on policy texts that change, so it will need revision as the PA indicators, PDPA secondary regulation, and UNESCO guidance develop. Sixth, the competency layer is less differentiated than its six-part structure implies: the six dimensions load on the higher-order construct at .97 to .99, so although they are conceptually distinct and useful for organizing practice, they are not clearly separable in measurement. The alignment matrix should therefore be read as spreading a largely unitary capability across distinct policy indicators.

Implementation would meet obstacles the framework cannot resolve. Appraisal systems invite strategic compliance, so adding AI-literacy descriptors to the PA risks producing paperwork rather than practice. Schools differ sharply in data-security infrastructure, so an overlay that works in a well-resourced urban school may be unrealistic in a small rural one. Assessors would need training to recognize AI-integrated evidence, a cost the framework assumes rather than provides for. And the legal reading behind the overlay may change as PDPA enforcement in education develops.

6. Conclusion

This article has argued that teacher AI-literacy professional development is most likely to take hold when it is aligned with the systems that already structure teachers' work, and has developed a framework to make that alignment in the Thai context. By mapping a six-dimension model of teacher AI literacy onto the PA's indicators and academic-standing

progression, tying that progression to UNESCO's (2024) acquire–deepen–create trajectory, and embedding PDPA duties as a cross-cutting governance layer, the framework brings three independently written policy structures into a single design. Its main outputs, an alignment matrix, a developmental progression, a governance overlay, and a phased roadmap, are intended for practical use by policymakers and PD providers.

The claims that can be made for it are limited. Experts judged it suitable, useful, and accurate, and its mappings were defensible against stated rules and met content-validity criteria. It has not been shown to improve professional development, to raise the uptake of AI-literacy training, or to affect teacher practice or learner outcomes, and no such effect should be inferred here. Future work should extend the appraisal to teachers and classrooms, test whether alignment improves the uptake and equity of AI-literacy PD, and examine how the architecture transfers to other systems that pair national teacher standards with data-protection law. The broader argument is a proposition to be tested rather than a finding to be applied: that building teachers' capacity for AI may be as much a problem of policy design as of training, and that competency, career, and data governance are more usefully treated as one design problem than as three.

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Author contributions

P. Sarakan was responsible for the conceptualization of the study, the policy document analysis, the construction of the alignment matrix, and drafting of the manuscript. P. Kwangmuang supervised the study, contributed to the analytic framework, and revised the manuscript critically. A. Somabut contributed to the research design and the interpretation of the expert appraisal. L. T. Nguyen contributed to the data-governance analysis and to the review and editing of the manuscript. All authors read and approved the final manuscript.

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No additional data are available.

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Appendix A. Expert Evaluation Instrument

The instrument below was used for the appraisal described in Section 3.6 and reported in Section 4.6. It was sent to each panel member together with the framework text, the alignment matrix (Table 2), the developmental progression (Table 3), and the data-governance overlay (Table 4). It was administered in English; members wrote their open responses in Thai, and the research team translated them. The mappings in Part A.3 are shown as the panel saw them, before the changes described in Section 4.6. Response fields are blank because this is the instrument rather than the data; results appear in Tables 6 and 7.

A.1 Expert profile.

Completed by each member; responses supply Table 1, where members appear only as E1 to E5. Fields: field of expertise; highest degree; years of professional experience; institution and sector; date of completion.

A.2 Framework evaluation.

Members rated the framework as a whole and each of the six dimensions against four criteria on a five-point scale (5 = highest, 1 = lowest). Suitability asks whether the component fits the Thai policy context; feasibility, whether it can be enacted under present school conditions; utility, whether it is of practical use to teachers and administrators; accuracy, whether it represents the policy instruments correctly. Means are read against equal-interval bands (1.00–1.49 lowest; 1.50–2.49 low; 2.50–3.49 moderate; 3.50–4.49 high; 4.50–5.00 highest), with 3.50 set in advance as the threshold for acceptance. An open field invited comment on any rating and on any condition necessary for the framework to work in practice.

Framework component	Suitability	Feasibility	Utility	Accuracy
AI-Enhanced Teaching Methods (AIT)				
AI Conceptual Knowledge (AIK)				
AI Ethics and Bias Awareness (AIE)				
Pedagogical Integration of AI (AIP)				
Data Privacy and Security (AID)				
Assessment and Evaluation with AI (AIA)				
Framework overall				

A.3 Content validity.

For each of the eighteen mappings, the six dimensions crossed with their PA indicators, UNESCO CFT dimension, and PDPA touchpoint as worded in Table 2, members recorded +1 (congruent), 0 (uncertain), or −1 (incongruent) (Rovinelli & Hambleton, 1977). The IOC index is the mean of the five scores, and mappings at 0.50 or above were retained; indices appear in Table 7. A second open field invited proposed re-wordings, mappings judged missing, and safeguards judged inadequate. Three rows were revised after the appraisal and so differ from Table 2. The AIA–PDPA touchpoint was rewritten from consent as the lawful basis to lawful basis (e.g., public task) and consent where required, transparency, and human oversight for analytics on learners. Breach-notification awareness was added to AID–PDPA, and guardian consent stated explicitly in AIT–PDPA.

A.4 Overall judgment.

An open field for overall comments, a single choice among accept as is, accept with minor revisions, and major revisions needed, and a signature and date line.

A.5 Analysis conventions.

Part A.2 is summarized as means with standard deviations against the 3.50 threshold (Table 6), with concordance given by Kendall's W (Schmidt, 1997). Part A.3 is summarized as an IOC index per mapping (Rovinelli & Hambleton, 1977), with raw agreement among the five raters reported in Section 4.6. The completed forms are held by the research team and are available from the corresponding author, subject to the anonymity undertaking described in Section 3.7.