

DESIGNING DIFFERENTIATED DIGITAL LITERACY TRAINING FOR LOCAL APPLIED UNIVERSITIES: A THEORY-DRIVEN FRAMEWORK AND DESIGN PRINCIPLES

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Abstract: Local applied universities educate a large share of undergraduates, yet their teachers' digital literacy is uneven and professional development is usually designed for an imagined average. Existing frameworks specify what teachers should know but not how training should be differentiated; research on professional development identifies general features of effectiveness but not how those features should be calibrated to different teachers. This conceptual paper addresses that gap. Drawing on multidimensional accounts of digital literacy, cognitive load theory, the zone of proximal development, situated learning, and self-determination theory, it develops a configuration-based typology of university teachers along two dimensions—technological fluency and pedagogical integration—yielding four archetypes: Cautious Novices, Tool-Oriented Practitioners, Pedagogy-Led Integrators, and AI-Empowered Designers. It then proposes a three-alignment framework—diagnostic, curricular, and relational—that specifies how content, task demand, and social support should be matched to each configuration, and articulates seven design principles and six testable propositions. The paper contributes a theory-driven alternative to one-size-fits-all training and offers practical guidance for institutions seeking to implement national digital literacy standards without reducing them to attendance requirements.

Keywords: Digital literacy; Differentiated training; Teacher typology; Professional development; Applied universities; Design principles

1 INTRODUCTION

Digital competence has moved from the periphery of university teaching to its center. Governments and international bodies have produced frameworks that specify what teachers should know and be able to do with technology [1], and China's 2022 Professional Standard for Teachers' Digital Literacy has made digital competence an explicit element of teaching quality. Universities are now expected to translate these expectations into everyday practice. The translation is particularly consequential in local applied universities, institutions that educate a large proportion of undergraduates and are charged with preparing students for regional industry and public service.

Yet the dominant model of professional development in these institutions remains uniform. A single workshop series, a common set of tool demonstrations, and a required number of attendance hours are offered to all faculty, regardless of discipline, career stage, or prior experience. This model rests on an implicit assumption of homogeneity: that teachers arrive at training with comparable needs and that the same content, delivered at the same pace, will produce comparable change. The assumption is difficult to sustain. A mechanical engineering teacher may be fluent in simulation software but unfamiliar with learning analytics; a senior humanities scholar may design extraordinary discussion-based courses but avoid digital platforms; an early-career lecturer may use generative AI daily without understanding its implications for assessment integrity. These teachers do not need the same training.

Two bodies of literature appear to address this problem, but neither does so directly. The first specifies what teachers should know. TPACK describes the integration of technological, pedagogical, and content knowledge [2]; DigCompEdu organizes educator competence into six areas with progression levels [1]; the teacher digital competency framework integrates technical, cognitive, and social-emotional dimensions [3]; and the Chinese standard defines five dimensions of digital literacy [4]. These frameworks are valuable as descriptions of the destination. They are less useful as specifications for the journey, because they describe competence rather than the training decisions that produce it.

The second body of literature identifies features of effective professional development: content focus, active learning, coherence, sustained duration, collective participation, modelling, coaching, and feedback [5-6]. This literature explains why some programmes work better than others, but it treats effectiveness largely as a property of programme design in general. It says little about how those features should be calibrated when participants differ systematically, or which features matter most for which teachers.

What is missing is a design theory: a set of concepts that links a diagnosis of teacher differences to decisions about content, sequence, task demand, and social support. This paper develops such a theory for local applied universities. It asks three conceptual questions. First, on what dimensions should university teachers' digital literacy be differentiated? Second, through what mechanisms can training design be aligned with those dimensions? Third, which design principles follow from the framework, and what propositions can guide empirical testing?

The paper makes three contributions. Theoretically, it reframes digital literacy as a configuration rather than a level, and specifies three alignment mechanisms that connect diagnosis to design. Practically, it offers seven design principles that

institutions can use to audit and redesign existing programmes. Programmatically, it advances six propositions that convert the framework into a research agenda, so that the argument can be tested rather than merely asserted. The remainder of the paper reviews the relevant literature, develops the typology and the framework, articulates the design principles, states the propositions, and discusses implications and limitations.

2 CONCEPTUAL BACKGROUND

2.1 Digital Literacy as a Multidimensional and Situated Construct

Digital literacy is not a single skill. Early definitions emphasized the operational capacity to access, evaluate, and use digital information [7]. Later work expanded the construct to include critical interpretation, communication, collaboration, creation, and ethical judgment [8]. In teacher education, the construct is usually treated as composite: it includes technical knowledge, pedagogical knowledge, disciplinary knowledge, and the integration of the three [2]. Falloon adds a social-emotional dimension, arguing that confidence, persistence, and willingness to experiment are not peripheral but constitutive of digital competence [3].

Two implications follow. First, digital literacy is multidimensional: teachers can be strong on one dimension and weak on another, and a single total score conceals this variation. Second, it is situated: what counts as competent practice depends on disciplinary norms, course objectives, and institutional conditions. A history seminar and a materials laboratory place different demands on technology, and the same tool may be pedagogically appropriate in one setting and inappropriate in another. These two features—multidimensionality and situatedness—are the foundation of the argument developed in this paper.

Teachers' beliefs about technology and their confidence in using it shape adoption as much as technical skill [9-10]. This is why training that addresses only operational skill tends to produce uneven results: it changes what teachers can do in a laboratory session without changing what they believe is possible, appropriate, or worth doing in their own classrooms.

2.2 What Existing Frameworks Provide, and What They Leave Unspecified

Four frameworks dominate current discussion. TPACK conceptualizes teacher knowledge as the intersection of technology, pedagogy, and content [2], and has generated a large body of research on teacher knowledge [11-13]. DigCompEdu organizes educator competence into six areas—professional engagement, digital resources, teaching and learning, assessment, empowering learners, and facilitating learners' digital competence—and describes progression from newcomer to pioneer [1]. The teacher digital competency framework integrates technical, cognitive, and social-emotional dimensions [3]. The Chinese standard specifies digital awareness, knowledge and skills, application, social responsibility, and professional development [4].

Teacher education programmes have long struggled to integrate technology in ways that go beyond isolated courses [14-15]. The same problem appears in continuing professional development: workshops may introduce tools, but they rarely alter the design routines through which teachers plan and assess learning.

Table 1 compares the four frameworks. All four are strong on description and weak on design. They tell an institution what a digitally literate teacher looks like, but not how to decide which teacher needs what, in which sequence, at what level of difficulty, and with what kind of support. DigCompEdu comes closest to a developmental account through its progression levels, but the levels describe a single ladder. A teacher who is technically proficient yet pedagogically conservative and a teacher who is pedagogically sophisticated yet technically anxious may occupy the same rung while needing opposite kinds of training.

Table 1 What Existing Frameworks Offer and What They Leave Unspecified for Training Design

Framework	Core contribution	Unit of analysis	Design guidance	Limitation for differentiation
TPACK [2]	Integration of technological, pedagogical and content knowledge	Individual teacher knowledge	Indirect: implies authentic design tasks	Describes knowledge, not a training sequence; measurement contested
DigCompEdu [1]	Six competence areas with progression levels	Educator competence profile	Moderate: progression levels suggest staging	Single ladder; conflates different configurations
TDC framework [3]	Technical, cognitive and social-emotional competence	Whole teacher	Indirect: highlights confidence and persistence	No specification of matching or dosage
China standard [4]	Five dimensions of digital literacy	Policy-defined teacher role	Low: policy expectations, not design rules	Compliance-oriented; no diagnostic mechanism

2.3 Differentiation in Professional Development

Differentiated instruction begins from the premise that learners differ in readiness, interest, and learning profile, and that teaching should be adapted accordingly [16]. Applied to professional development, the premise implies that content, entry points, task difficulty, and support should vary with teachers' prior competence and working context. Adult learning

theory reinforces this view: adult learners need to perceive relevance, draw on experience, and solve problems that matter in their own practice [17].

Research on teacher professional development has identified features that make programmes effective: content focus, active learning, coherence, sustained duration, and collective participation [5]; modelling, coaching, and feedback [6]; and attention to the mechanisms through which change occurs [18-19]. These features are necessary but not sufficient. A programme can include all of them and still fail if the content is pitched at the wrong level for a substantial part of the audience. Differentiation is the missing variable that determines whether effective features actually reach particular teachers.

Professional learning is also a complex system rather than a simple transmission process [20-21], and its evaluation requires attention to outcomes beyond satisfaction [22]. These observations reinforce the argument that differentiation cannot be reduced to offering more options; it must be embedded in the routines through which teachers plan, teach, and review their work.

Differentiation also carries risks. It can become a labelling exercise that fixes teachers in categories, or an administrative burden that consumes the resources it was meant to allocate. The framework developed here treats differentiation as a design decision rather than an identity claim: profiles are working hypotheses for allocating tasks and support, not permanent classifications of teachers.

2.4 The Institutional Context of Local Applied Universities

Local applied universities have a distinctive configuration of conditions. They educate a large share of undergraduates, emphasize applied and professional programmes, and maintain close links with regional industry. Their faculty are heterogeneous: some are recruited from industry and bring strong practical knowledge but limited experience of academic professional development; others are recruited from doctoral programmes oriented toward research and may find applied teaching unfamiliar. Teaching loads are often high, research time is limited, and professional development is typically centralized, credit-based, and evaluated by attendance.

These conditions amplify the cost of mismatch. When time is scarce, a workshop that is irrelevant to a teacher's discipline does not merely waste an afternoon; it consumes the limited discretionary effort that might otherwise have supported a meaningful change in practice. Uniform training is therefore not neutral in this context: it systematically disadvantages teachers whose needs deviate from the imagined average, which is precisely the majority in a heterogeneous institution.

The policy environment adds a further layer. National standards and institutional evaluation regimes often reward visible compliance—workshops held, hours completed, certificates issued—rather than changes in practice. This creates a tension between the logic of accountability and the logic of development. Local applied universities are also subject to periodic evaluation exercises that encourage uniform documentation across programmes. These pressures make differentiation administratively inconvenient, which is one reason it is widely endorsed in principle and rarely implemented in practice.

2.5 Theoretical Foundations

Four theoretical traditions inform the framework. Cognitive load theory distinguishes intrinsic load, which depends on the complexity of the material relative to the learner's prior knowledge, from extraneous load, which is imposed by poor instructional design [23-24]. The theory predicts an expertise reversal effect: instructional support that helps novices can hinder experts, because it imposes unnecessary processing on those who already possess the relevant schemas. Differentiation is, in this sense, a load-management problem.

The zone of proximal development provides a second foundation [25]. Learning is most productive when tasks are slightly beyond current independent capability but achievable with support. A training programme that pitches every task at the average level will place some teachers far outside their zone—producing anxiety or disengagement—and others far inside it, producing boredom. Calibration, not merely content coverage, is the design problem.

Situated learning and legitimate peripheral participation supply a third foundation [26]. Professional knowledge is acquired through participation in communities of practice, initially at the periphery and increasingly at the center [27]. For university teachers, the relevant communities are disciplinary and pedagogical at once: a teacher learns to use technology well by using it in the service of disciplinary teaching, alongside colleagues who model competent practice. This supports the argument that training tasks should be anchored in disciplinary practice and that social arrangements matter as much as content.

Self-determination theory and research on self-efficacy complete the foundation [28-29]. Teachers are more likely to invest in professional learning when it supports their sense of competence, autonomy, and relatedness, and when they experience mastery and vicarious success. Uniform training often undermines all three: it can make competent teachers feel incompetent, reduce their autonomy over what to learn, and isolate them from colleagues who share their concerns. Differentiation, by contrast, can be designed to restore competence signals, preserve choice, and build collegial support. Teacher agency—the capacity to act purposefully within institutional conditions—shapes whether learning translates into practice [30]. A programme that ignores agency may produce compliance without change, particularly when teachers perceive differentiation as something done to them rather than with them.

2.6 Synthesis: Three Design Problems

Taken together, the literature points to three design problems that any differentiated model must solve. The first is diagnosis: how to characterize teachers' digital literacy in a way that is both multidimensional and actionable. The second is calibration: how to match content, task demand, and sequence to the diagnosed configuration. The third is transfer: how to support the movement from training activity to sustained practice. These problems correspond to the three alignment mechanisms developed in Section 4: diagnostic alignment, curricular alignment, and relational alignment. Before specifying the mechanisms, however, the paper develops the typology on which they depend.

3 A CONFIGURATION-BASED TYPOLOGY OF UNIVERSITY TEACHERS

3.1 Why Configurations Rather than Levels

Most needs analyses rank teachers on a single scale from low to high. The ranking is administratively convenient but conceptually impoverished. It implies that the only difference between teachers is how much of a uniform substance they possess, and that training should therefore differ only in dosage. The multidimensionality of digital literacy makes this implication untenable. Two teachers with the same total score may have opposite profiles: one may be technically fluent but pedagogically conservative, the other pedagogically ambitious but technically anxious. Treating them as equivalent obscures the very differences that training must address.

The alternative is to treat digital literacy as a configuration: a patterned combination of capabilities that hangs together in a recognizable way. The configurational view is consistent with person-centred research in vocational and educational psychology, which identifies subgroups of individuals who share a profile rather than a rank [31]. It is also consistent with the situated character of teaching: configurations emerge from the interaction between a teacher's knowledge, disciplinary culture, and institutional affordances, not from an abstract quantity of competence.

A configurational approach has three advantages for design. It directs attention to qualitative differences rather than only to amount; it suggests different entry points and task types for different groups; and it makes visible teachers who would otherwise be invisible in an average—particularly those who are strong in pedagogy but weak in technology, a group that uniform training tends to bore rather than develop.

3.2 Two Dimensions: Technological Fluency and Pedagogical Integration

The typology crosses two dimensions that are conceptually distinct and jointly consequential for practice. The first is technological fluency: the capacity to select, operate, troubleshoot, and adapt digital tools, including generative AI systems, with sufficient confidence to use them under normal classroom conditions. This dimension corresponds to the technical pole of TPACK and to the operational elements of digital competence frameworks [1-2]. It includes not only procedural skill but also the disposition to experiment and recover from failure, which Falloon identifies as social-emotional competence [3].

The second dimension is pedagogical integration: the capacity to design learning activities, assessments, and feedback processes in which technology serves clearly articulated disciplinary objectives. This dimension corresponds to the pedagogical and pedagogical-content elements of TPACK and to the teaching-and-learning area of DigCompEdu. It requires constructive alignment between objectives, activities, and assessment, and it requires judgment about when technology adds value and when it does not.

The two dimensions are conceptually independent. A teacher can be high on one and low on the other: tool fluency does not guarantee pedagogical judgment, and pedagogical sophistication does not guarantee technical confidence. They are also jointly necessary for mature practice: technology without pedagogy becomes an add-on, while pedagogy without technology remains aspirational in a digital environment. Crossing the dimensions produces four configurations, which we treat as archetypes rather than empirical types: they are analytical constructs intended to guide design, not claims about the distribution of teachers in any particular institution.

3.3 Four Archetypes

Figure 1 presents the two-by-two matrix, and Table 2 summarizes the archetypes.

The Cautious Novice combines low technological fluency with low pedagogical integration. This teacher may use technology for administrative tasks but avoids it in teaching, often because of anxiety about failure in front of students. The primary need is not more information about tools but structured, low-risk mastery experiences that build confidence and reveal the pedagogical purpose of the tools.

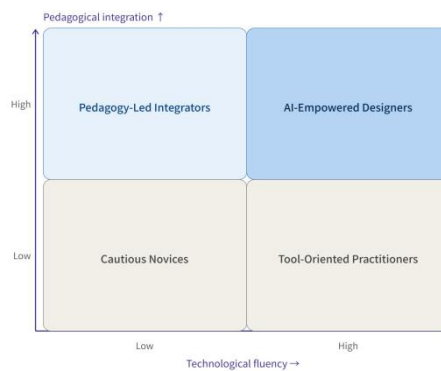


Figure 1 A Two-Dimensional Typology of University Teachers' Digital Literacy Configurations

Table 2 Archetypes, Defining Configurations, Needs, and Risks

Archetype	Defining configuration	Typical strengths	Primary training need	Characteristic risk
Cautious Novices	Low fluency, low integration	Disciplinary expertise; caution; attention to student experience	Low-risk mastery experiences; confidence building; purpose-led tool use	Avoidance; anxiety; disengagement
Tool-Oriented Practitioners	High fluency, low integration	Experimentality; operational speed; peer influence	Constructive alignment; assessment design; criteria for tool value	Technological solutionism; add-on use
Pedagogy-Led Integrators	High integration, lower fluency	Strong design judgment; disciplinary depth	Targeted technical capability tied to a design intention	Narrow repertoire; avoidance of unfamiliar tools
AI-Empowered Designers	High fluency, high integration	Design fluency; adaptability; leadership potential	Critical reflection; ethics; peer review; opportunities to lead	Overreach; novelty-driven design; equity blind spots

The Tool-Oriented Practitioner combines high technological fluency with low pedagogical integration. This teacher adopts tools quickly and enjoys experimenting, but tends to use them as delivery mechanisms rather than as means of redesigning learning. The risk is “technological solutionism”: more tools, more platforms, more dashboards, without a corresponding change in what students do or how learning is assessed. The primary need is pedagogical framing—constructive alignment, assessment design, and criteria for judging when a tool is worth using.

The Pedagogy-Led Integrator combines high pedagogical integration with lower technological fluency. This teacher designs powerful learning experiences and understands disciplinary thinking, but may avoid unfamiliar tools or rely on a narrow repertoire. The primary need is not basic pedagogy but targeted technical capability tied to a specific design intention: for example, learning to build a shared annotation space for a seminar, or a data dashboard for a methods course. Training that begins with tool tours will lose this teacher; training that begins with a design problem will engage them.

The AI-Empowered Designer combines high fluency with high integration. This teacher designs technology-rich learning environments and adapts to new tools, including generative AI. The risk is not incompetence but overreach: adopting tools before their ethical, epistemic, and equity implications are understood, or designing for novelty rather than learning. The rapid diffusion of generative AI has intensified these questions [32-33]. The primary need is critical reflection, peer review, and opportunities to lead, rather than basic training.

3.4 Developmental Trajectories

Archetypes describe configurations at a point in time, not fixed categories. Teachers move between configurations as their knowledge, confidence, and institutional conditions change. The most common trajectory runs from Cautious Novice to Tool-Oriented Practitioner to AI-Empowered Designer, but it is not the only one. A Pedagogy-Led Integrator may move directly to AI-Empowered Designer when a design need creates a reason to master a new tool; a Tool-Oriented Practitioner may stagnate for years without pedagogical challenge; a Cautious Novice may leap forward after a successful classroom experiment.

The framework therefore treats trajectories as design targets rather than developmental laws. The relevant question for a training programme is not “where should every teacher end up?” but “what is the next plausible move for this configuration, and what support makes that move achievable?” This is consistent with the zone of proximal development: the target is the next step, not the final destination.

3.5 Critical Reflexivity as a Cross-Cutting Dimension

A two-dimensional typology risks reducing digital literacy to capability. Capability without judgment can be harmful: a fluent teacher may adopt an AI tool that produces plausible but inaccurate content, or a dashboard that amplifies existing inequities. For this reason, the framework treats critical reflexivity as a cross-cutting dimension rather than a third axis.

It includes ethical awareness, attention to equity and accessibility, understanding of the epistemic limits of digital systems, and the disposition to question whether a technology should be used at all.

Critical reflexivity is not a separate training module to be delivered once. It is a stance that should be cultivated in every module, through cases, peer critique, and design justifications. In this respect the framework aligns with the social responsibility dimension of the Chinese standard and with the ethical areas of DigCompEdu, but it gives them a specific design role: they are the criteria against which technological choices are justified.

4 A THREE-ALIGNMENT FRAMEWORK FOR DIFFERENTIATED TRAINING

4.1 Overview

The framework translates the typology into design decisions through three alignment mechanisms. Diagnostic alignment establishes what kind of configuration a teacher currently enacts. Curricular alignment determines what content, tasks, and sequence are offered. Relational alignment determines who supports the teacher and through what social arrangements. The three mechanisms operate within an institutional layer that supplies time, recognition, and governance. Figure 2 presents the framework.

The mechanisms are not a linear sequence. Diagnosis informs curriculum, but curriculum also generates new diagnostic information as teachers reveal capabilities in tasks. Relational arrangements shape how diagnostic information is interpreted—a mentor may notice a capability that a questionnaire missed—and they sustain engagement with the curriculum. The framework is therefore better understood as a system of mutually reinforcing alignments than as a pipeline.

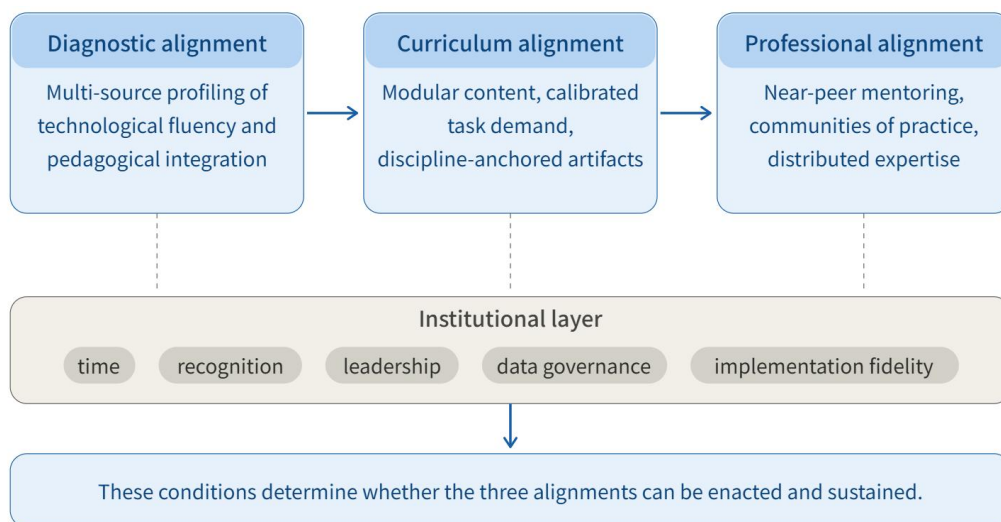


Figure 2 The Three-Alignment Framework for Differentiated Digital Literacy Training.

4.2 Diagnostic Alignment

Diagnostic alignment begins from a simple rule: assess configurations, not deficits. A diagnostic instrument that produces a single score tells an institution how much training to provide but not what kind. A configuration-oriented diagnosis identifies the relative strength of technological fluency and pedagogical integration, and it does so in relation to the teacher's disciplinary context. The purpose is formative: to place a teacher at an appropriate entry point, not to rank or evaluate them.

No single method is sufficient. Self-report captures confidence and perceived capability but is vulnerable to over- and under-estimation. Artifact review—examining a lesson plan, a course site, or an assessment design—captures enacted practice but requires expertise to judge. Classroom observation captures interaction but is costly and context-dependent. Peer nomination captures reputation but may reproduce existing hierarchies. A defensible diagnosis therefore triangulates at least two sources, with self-report as a starting point and artifact review as a corrective.

Three design choices follow from the literature. First, the diagnosis should be low-stakes. If results are tied to evaluation or promotion, teachers will present a favourable configuration, and the information will lose validity. Second, it should be repeated. Configurations change as teachers complete training and as tools evolve, so an annual or semester-based re-profiling is more useful than a one-off survey. Third, it should be transparent. Teachers should see their own profile, understand what it implies, and be able to contest or revise it. This preserves autonomy and turns diagnosis into a reflective activity rather than an administrative classification.

Data governance is part of diagnostic alignment, not an afterthought. Profiles are sensitive: they can stigmatize teachers or be used to justify exclusion from opportunities. Institutions should specify who sees the data, how long it is retained, and what decisions it may and may not inform. The framework treats these safeguards as constitutive of ethical differentiation rather than as administrative overhead.

4.3 Curricular Alignment

Curricular alignment is the mechanism most directly under the control of programme designers. It has four components: entry points, task demand, task authenticity, and sequencing. Entry points determine where a teacher begins. In a modular architecture, all teachers might complete a foundational module on purposes and ethics, after which Cautious Novices enter a scaffolded tools module, Tool-Oriented Practitioners enter a pedagogical design module, Pedagogy-Led Integrators enter a targeted technical module organized around a design intention, and AI-Empowered Designers enter an advanced module focused on critique and leadership.

Task demand should be calibrated to the zone of proximal development and to cognitive load. For novices, tasks should be bounded, with worked examples, templates, and clear criteria; the goal is a successful first experience, not an open-ended project. For experts, the same scaffolding becomes extraneous load and can provoke the expertise reversal effect. Differentiation therefore requires not only different content but different degrees of structure—a point that uniform “advanced” workshops often miss, because they assume that more complex content is always more appropriate for more experienced teachers.

Task authenticity is the third component. Tasks should be anchored in the teacher's own course and discipline. A generic task—“design a digital lesson”—invites generic responses. A disciplinary task—“redesign the assessment of this unit so that students' reasoning becomes visible, using a digital tool that fits the discipline's evidentiary norms”—requires the teacher to integrate technology, pedagogy, and content in a way that is meaningful. Authentic tasks also function as boundary objects between the training setting and the workplace, allowing teachers to carry the artifact back into their teaching [34].

Sequencing is the fourth component. A useful heuristic is to move from augmentation to transformation: first, use technology to do existing tasks more efficiently; then, use it to redesign tasks in ways that were previously impossible. This heuristic resembles the substitution–augmentation–modification–redefinition progression [35], but the framework treats it as a design sequence rather than a maturity ladder. The point is not that every teacher must reach redefinition, but that the sequence gives each configuration a plausible next step.

Finally, curricular alignment requires that assessment mirror the tasks. If the training asks teachers to design technology-integrated lessons but assesses them with a multiple-choice test about tools, the curriculum teaches one thing and rewards another. Artifact-based assessment—scored against transparent criteria such as alignment, cognitive demand, accessibility, and ethical judgment—keeps the curriculum honest and produces evidence that can feed back into diagnosis.

4.4 Relational Alignment

Relational alignment addresses a dimension that content-focused models often neglect: the social configuration of learning. Teachers learn from people as much as from materials. A colleague who teaches the same course and has solved a similar problem is a more persuasive model than an external expert demonstrating a tool. This is consistent with situated learning and with the literature on communities of practice [26-27].

The framework specifies three relational arrangements. The first is near-peer mentoring: pairing teachers with colleagues who are one step ahead in the relevant configuration rather than with the most advanced expert. Near-peer models are credible and attainable; they demonstrate that the next step is possible without implying that the learner should already be an expert. The second is cross-configuration collaboration: bringing a Tool-Oriented Practitioner together with a Pedagogy-Led Integrator on a shared design task, so that each contributes what the other lacks. The third is a sustained community of practice, meeting regularly around authentic design problems, in which expertise is distributed rather than concentrated.

Relational alignment also protects against two failure modes. The first is dependence: if teachers rely on a single mentor, the relationship ends when the mentor leaves. Rotating roles and building a community reduces this risk. The second is hierarchy: if only senior staff mentor, the arrangement reproduces existing status differences and discourages the reciprocal learning that the framework requires. Near-peer arrangements are deliberately non-hierarchical in this sense.

Finally, relational alignment supports the affective conditions of learning. Self-efficacy grows through mastery experiences and vicarious success [29], and self-determination theory emphasizes competence, autonomy, and relatedness [28]. A teacher who feels safe to experiment, who sees a credible peer succeed, and who experiences choice over what to work on is more likely to persist. Relational design is therefore not a soft supplement to curriculum; it is a condition of transfer.

4.5 The Institutional Layer

The three alignments depend on institutional conditions. Time is the most immediate: if training is added to an already full teaching load, attendance may be high but engagement will be low. Recognition is the second: if participation in differentiated training is invisible in workload models and promotion criteria, teachers will rationally prioritize other activities. Leadership is the third: programme directors must protect the design from pressure to standardize, which often comes from a desire for administrative simplicity. Data governance is the fourth: profiles must be used for support, not surveillance.

Implementation fidelity is the bridge between design and outcome. A differentiated programme can be diluted in delivery—mentors may revert to lectures, tasks may be simplified to fit time constraints, and entry rules may be ignored in the interest of filling rooms. Institutions therefore need lightweight fidelity monitoring: session logs, sample artifact

review, and periodic conversations with mentors. Fidelity is not about rigid compliance; it is about preserving the design logic that makes differentiation meaningful.

This view of implementation follows the logic of educational change rather than compliance: innovations are adapted as they travel through organizations, and the task is to preserve the core design while allowing surface adaptation [36]. Differentiation is no exception.

4.6 How the Mechanisms Interact

The three alignments are multiplicative rather than additive. Strong curriculum with weak diagnosis produces well-designed training for the wrong teachers. Strong diagnosis with weak curriculum produces accurate labels and little learning. Strong diagnosis and curriculum with weak relational support may produce short-term gains that fade when the training ends. Each mechanism compensates for a limitation of the others, and the framework predicts that the effects of any one are conditional on the presence of the other two.

This interaction has a practical implication: institutions should not attempt to implement the framework in fragments. Adding a diagnostic survey without changing curriculum produces disillusionment; changing curriculum without preparing mentors produces uneven delivery. A minimum viable implementation includes all three, even if each is initially modest in scope.

5 DESIGN PRINCIPLES

The framework yields seven design principles. Each is stated as a directive, followed by its theoretical justification, its operational implication, and the failure mode it is intended to prevent. The principles are intended to be used as an audit instrument: an institution can ask, for each principle, whether its current programme enacts it, and if not, what would need to change.

5.1 Principle 1: Diagnose Configurations, not Deficits

Professional development should begin with a multidimensional diagnosis that identifies the relative strength of technological fluency and pedagogical integration, rather than with a single score that ranks teachers on a deficit. The justification is conceptual: digital literacy is multidimensional and situated, so a single score conflates qualitatively different profiles. Operationally, the principle requires at least two data sources—typically self-report plus artifact review—and a formative purpose. The failure mode it prevents is the “remedial” framing, in which training is designed for those who are “behind” and the majority of teachers experience it as irrelevant.

5.2 Principle 2: Calibrate Demand to the Zone of Proximal Development

Tasks should be pitched slightly beyond current independent capability but achievable with support. Cognitive load theory explains why: intrinsic load depends on the relation between task complexity and prior knowledge, and scaffolding that helps novices becomes extraneous load for experts [24]. Operationally, the same design problem should be offered at different levels of structure—worked example, partially completed template, open brief—with the level determined by configuration rather than by seniority. The failure mode it prevents is the familiar pattern in which advanced teachers are bored by basic content while novices are overwhelmed by open-ended tasks.

5.3 Principle 3: Anchor Tasks in Disciplinary Practice

Every training task should require teachers to work on their own course, with their own content, and according to their discipline's evidentiary and communicative norms. The justification draws on situated learning: competence is acquired through participation in disciplinary practice, not through abstract instruction [26]. Operationally, this means replacing generic tool demonstrations with design briefs tied to specific units, and asking teachers to justify their choices in disciplinary terms. The failure mode it prevents is the “tool tour” workshop, in which teachers learn what buttons do but not what the buttons are for.

5.4 Principle 4: Make Artifacts the Unit of Learning and Assessment

Teachers should leave each module with a usable artifact—a redesigned lesson, an assessment plan, a course site, a data dashboard—and that artifact should be the primary object of assessment. The justification is twofold: artifacts externalize design reasoning, making it visible to peers and mentors; and they function as boundary objects that travel between the training setting and the workplace [34]. Operationally, assessment should use transparent criteria such as alignment, cognitive demand, accessibility, and ethical judgment. The failure mode it prevents is the gap between “knowing about” a practice and being able to enact it.

5.5 Principle 5: Distribute Expertise Through Near-Peer Structures

Support should be organized so that teachers learn from colleagues who are one step ahead, not only from experts who are far ahead. The justification combines self-efficacy theory—vicarious success by a credible model raises belief in one's

own capability [29]—with communities of practice, in which knowledge is distributed and identity is formed through participation [27]. Operationally, this means near-peer mentoring, rotating roles, and cross-configuration collaboration on shared design tasks. The failure mode it prevents is dependence on a small number of experts, which makes the programme fragile and reproduces hierarchy.

5.6 Principle 6: Sequence from Augmentation to Transformation

Training should begin with tasks that use technology to do existing work more efficiently, and gradually move to tasks that redesign learning in ways that were previously impossible. The justification is developmental: transformation requires a foundation of operational confidence and pedagogical clarity, and asking teachers to redefine practice before they can use the tools reliably invites failure. Operationally, modules should be sequenced so that augmentation tasks precede redefinition tasks, with explicit reflection on the difference. The failure mode it prevents is “innovation theatre”—ambitious projects that look novel but do not change what students learn.

5.7 Principle 7: Institutionalize Critical Reflexivity and Iterative Review

Every module should include structured opportunities to question whether a technology should be used, for whom, and at what cost, and the programme as a whole should be reviewed iteratively against evidence of practice change. The justification is ethical and epistemic: capability without judgment can amplify error and inequity, and programmes drift when they are not reviewed. Operationally, this means cases, peer critique, design justifications, and an annual review that uses artifacts and feedback rather than attendance data alone. The failure mode it prevents is the reduction of digital literacy to tool proficiency, and the reduction of programme quality to satisfaction scores. Table 3 consolidates the seven principles, specifying for each the theoretical basis, the operational implication for programme design, and the failure mode it is intended to prevent.

Table 3 Seven Design Principles, Their Theoretical Basis, Operational Implications, and Failure Modes

Principle	Theoretical basis	Operational implication	Failure mode prevented
P1 Diagnose configurations	Multidimensional, situated construct	Multi-source formative profiling; no high-stakes ranking	Remedial framing; irrelevant training
P2 Calibrate demand	Cognitive load; zone of proximal development	Same problem at different levels of structure	Boredom for experts; overload for novices
P3 Anchor in discipline	Situated learning; legitimate peripheral participation	Design briefs tied to the teacher's own unit	Generic tool tours
P4 Artifacts as unit	Boundary objects; externalized reasoning	Artifact-based assessment with transparent criteria	Knowing about without enacting
P5 Distribute expertise	Self-efficacy; communities of practice	Near-peer mentoring; rotating roles	Dependence on experts; hierarchy
P6 Augmentation to transformation	Developmental sequencing	Augmentation tasks before redefinition tasks	Innovation theatre
P7 Critical reflexivity	Ethics; epistemic humility; iterative review	Cases, peer critique, annual review	Tool proficiency without judgment

6 PROPOSITIONS AND A RESEARCH AGENDA

A conceptual framework becomes useful for research when it generates statements that can be tested and, if necessary, rejected. The six propositions below are stated at a level of abstraction that permits different operationalizations. They are not claims about the present study, because there is no present study; they are commitments that future work can examine.

6.1 Proposition 1: Configuration Beats Level

Training differentiated by configuration produces larger gains in digital literacy than training differentiated only by level (low, medium, high) or delivered uniformly. The rationale is that configurations capture qualitative differences in what teachers need, whereas levels capture only how much they are assumed to need. A level-based programme may place a Tool-Oriented Practitioner and a Pedagogy-Led Integrator in the same advanced group, even though their needs are opposite. Testing Proposition 1 requires a design that compares configuration-based allocation with level-based allocation while holding content and duration constant.

6.2 Proposition 2: Relevance and Self-Efficacy Mediate

The effect of configuration-based differentiation on outcomes is mediated by perceived relevance and self-efficacy. The rationale draws on adult learning theory and social-cognitive theory: teachers invest in learning when they see it as relevant to their practice and when they believe they can succeed [17, 29]. Differentiation works partly because it increases both. Testing Proposition 2 requires repeated measures of relevance and self-efficacy during the programme, ideally at multiple points, so that temporal precedence can be examined.

6.3 Proposition 3: Mechanisms Have Differential Value

Curricular alignment contributes more to gains for teachers with low technological fluency, whereas relational alignment contributes more for teachers with high fluency but low pedagogical integration. The rationale is that low-fluency teachers need calibrated structure and successful mastery experiences, while high-fluency teachers need pedagogical challenge and credible models of integration rather than more tool instruction. Testing Proposition 3 requires varying the intensity of each alignment independently, which is demanding but feasible in a multi-site design.

6.4 Proposition 4: Artifacts Promote Transfer

Programmes that make artifacts the unit of learning and assessment produce greater transfer to classroom practice than programmes that assess declarative knowledge. The rationale is that artifacts externalize design reasoning and function as boundary objects between training and work [34]. Transfer should be measured through independent analysis of subsequent lesson designs or classroom observations, not only through self-report.

6.5 Proposition 5: Near-Peer Mentoring Sustains Engagement

Near-peer mentoring increases engagement and persistence, with the strongest effects for Cautious Novices. The rationale combines vicarious learning and relatedness: a credible peer demonstrates that the next step is achievable, and the relationship reduces the isolation that often accompanies technological change [28-29]. Testing P5 requires distinguishing near-peer from expert mentoring and measuring engagement through behavioural indicators such as artifact completion and attendance patterns, not satisfaction alone.

6.6 Proposition 6: Institutions Moderate Implementation

Institutional conditions—protected time, recognition in workload and promotion, leadership support, and data governance—moderate the relationship between programme design and outcomes, through their effect on implementation fidelity. The rationale is that even a well-designed programme can be diluted in delivery. Testing Proposition 6 requires multi-level modelling with institutional characteristics as Level 2 predictors and fidelity as a mediator. Table 4 summarizes the six propositions, restates each core claim, and suggests an empirical strategy through which the claim could be tested.

Table 4 Propositions, Rationales, and Suggested Empirical Strategies

Proposition	Core claim	Suggested strategy
Proposition 1	Configuration-based allocation outperforms level-based or uniform allocation	Comparative quasi-experiment with content and duration held constant
Proposition 2	Relevance and self-efficacy mediate the effect	Repeated mediation with temporal separation of measures
Proposition 3	Curricular alignment matters more for low fluency; relational alignment for high fluency / low integration	Factorial or adaptive design varying alignment intensity
Proposition 4	Artifact-based learning increases transfer	Independent artifact review and classroom observation at follow-up
Proposition 5	Near-peer mentoring improves engagement and persistence, especially for novices	Comparison of mentoring structures; behavioural engagement measures
Proposition 6	Institutional conditions moderate outcomes through fidelity	Multi-site multilevel modelling with fidelity as mediator

6.7 A Research Agenda

The propositions point to a research programme with four priorities. The first is configurational measurement: developing and validating instruments that identify configurations rather than levels, and examining their stability over time. The second is design-based research: iterating the framework in real programmes, documenting adaptations, and studying how the three alignments interact under institutional constraints. The third is longitudinal and multi-site work: following teachers beyond the end of training, across institutions with different missions and resources, to test the boundary conditions of the framework. The fourth is equity: examining who benefits from differentiation and who is inadvertently excluded, particularly teachers in remote campuses, part-time faculty, and those with heavy teaching loads.

These priorities imply methodological pluralism. Configurational questions call for person-centred quantitative methods; design questions call for qualitative and design-based approaches; implementation questions call for mixed methods and fidelity measurement. The framework does not privilege one method; it specifies what needs to be known and leaves the choice of method to the research question.

6.8 Boundary Conditions

The framework has boundaries that should be stated explicitly. It assumes a minimum of institutional capacity: someone to coordinate diagnosis, a cadre of mentors, and the authority to adjust schedules. Where these are absent, the first priority

is capacity building rather than differentiation. It also assumes that teachers have some discretion over their teaching; in highly standardized programmes, differentiation may be constrained by syllabus requirements and prescribed assessments. Cultural conditions matter as well. In systems where seniority confers authority, near-peer mentoring may require careful framing to avoid a perceived inversion of status, and profiles may be read as evaluations rather than as design information. Finally, the framework addresses training design, not the broader political economy of academic work. It cannot compensate for chronic underfunding, excessive casualization, or teaching loads that leave no time for learning. These conditions should be treated as scope conditions, not as excuses: within them, differentiation remains a more defensible allocation of scarce developmental resources than uniform provision.

7 DISCUSSION

7.1 Theoretical Contributions

The paper makes three theoretical contributions. First, it reframes teacher digital literacy as a configuration rather than a level. This reframing is more than a metaphor: it changes what counts as a useful diagnosis, what counts as an appropriate training task, and what counts as evidence of progress. A level-based account treats progress as movement up a single scale; a configurational account treats progress as movement toward a more integrated pattern of capability, which may involve developing a weak dimension rather than adding more of a strong one.

Second, the paper offers a design theory rather than another descriptive framework. Existing frameworks answer the question “what should a digitally literate teacher be able to do?” The three-alignment framework answers a different question: “given a particular configuration, what should a programme do?” This shift from description to design is the paper's central contribution, and it is what makes the framework usable by programme directors who are not researchers. Third, the paper integrates affective and social dimensions into the design of digital literacy training. Much of the literature treats confidence, belonging, and identity as by-products of competence. The framework treats them as design variables: near-peer structures, mastery experiences, and autonomy-supportive tasks are not motivational extras but conditions of transfer. This integration draws on self-determination theory, self-efficacy research, and situated learning, and it gives those traditions a concrete role in programme design.

The framework is also a response to the critique of digital solutionism in higher education. That critique warns that technology adoption can become an end in itself, driven by institutional image rather than pedagogical need [37]. By making critical reflexivity a cross-cutting dimension and by requiring teachers to justify technological choices in disciplinary terms, the framework builds that critique into the design of training rather than treating it as an external caution.

7.2 Practical Implications

For programme directors, the framework implies a shift in the unit of planning. Instead of asking “what should we teach this year?” the planning question becomes “which configurations are present among our teachers, and what does each need next?” This requires a diagnostic routine, a modular architecture, and a mentoring structure. None of these is expensive in itself; the cost lies in coordination and in resisting the temptation to standardize.

For institutions, the framework implies that professional development should be treated as an organizational design problem, not only as a scheduling problem. Protected time, recognition in workload models, and leadership support are not peripheral conditions; they determine whether differentiation can be enacted. An institution that invests in a sophisticated diagnostic instrument but does not protect time for mentoring has invested in measurement without investing in change.

For teachers, the framework offers a way to think about their own development that is less hierarchical than the language of levels. A teacher who is strong in pedagogy but anxious about tools is not “behind”; she is in a different configuration with a specific next step. This reframing can reduce the defensiveness that often accompanies digital training and make participation more attractive to experienced staff.

7.3 Policy Implications

National standards are necessary but not sufficient. A standard that specifies dimensions of digital literacy without specifying how institutions should diagnose and develop them risks becoming a compliance document. The framework suggests that policy should incentivize diagnostic routines, modular provision, and mentoring capacity, rather than attendance hours or uniform certification. It also suggests that evaluation should focus on artifacts and practice change rather than on satisfaction surveys, which are weakly related to learning.

There is a risk that “precision” becomes a bureaucratic slogan. The framework resists this by insisting that diagnosis is formative, that profiles are revisable, and that differentiation is a design decision rather than an identity. Policy instruments that turn profiles into high-stakes classifications would undermine the very logic they claim to support.

7.4 Limitations

The paper is conceptual, and its propositions have not been tested. The typology is a heuristic: the two dimensions are analytically justified but empirically overlapping, and some teachers will not fit neatly into any archetype. The framework

is developed with local applied universities in China in mind, although its theoretical foundations are international; transfer to other contexts requires attention to institutional differences in resources, governance, and academic culture. There is also a normative risk. Differentiation can be used to sort teachers rather than to support them, and the language of profiles can harden into labels. The safeguards proposed in Section 4.2—formative purpose, transparency, revisability, and data governance—are intended to mitigate this risk, but they depend on institutional commitment. Future work should examine how teachers experience being profiled, and whether differentiation increases or decreases their sense of agency. Finally, the framework says little about cost. Differentiated provision is likely to be more expensive per teacher than a large lecture, at least in the short term, because it requires more mentors, more artifacts, and more coordination. Whether the additional cost is justified depends on the alternatives, and on whether the institution treats professional development as an investment in teaching quality or as a compliance cost.

7.5 Conclusion

Local applied universities do not have a single digital literacy problem, and they cannot solve it with a single training programme. Their teachers differ in the configuration of their capabilities, and those differences are systematic enough to design for. This paper has proposed a configuration-based typology, a three-alignment framework, seven design principles, and six propositions. The framework is deliberately modest in its claims: it does not promise that differentiation will solve the problem of teacher digital competence, only that it offers a more defensible way of allocating attention, time, and support. If the propositions are tested and refined, the framework can become a practical alternative to the uniform training that currently dominates, and a bridge between national standards and the everyday work of teaching.

COMPETING INTERESTS

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