

# Measuring the Development of Pre-Service EFL Teachers’ Professional Competences in Digital Adaptive Learning Context: Indicators and Evaluation Criteria

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**Abstract:** *The preparation of English as a Foreign Language (EFL) teachers increasingly demands competences that extend beyond linguistic proficiency to include the ability to design and facilitate digitally mediated instruction. Digital adaptive learning systems, which individualize teaching through technology-driven mechanisms, require future teachers to demonstrate flexibility in lesson planning, learner support, and ongoing professional adaptation. Yet, criteria for assessing such competences remain insufficiently developed, creating a gap in teacher training. The present study addresses this gap by developing and validating a set of indicators for evaluating pre-service EFL teachers’ professional competences in digital adaptive learning contexts. A two-round Delphi method was employed with twelve expert participants who reviewed, refined, and expanded an initial pool of eighteen indicators. Through iterative consensus-building, the panel validated a final framework consisting of twenty-two competences organized across four domains: conceptual knowledge, methodological application, organizational capacity, and digital literacy. This framework provides a structured basis for integrating adaptive learning practices into teacher education curricula, offering teacher educators a practical tool for guiding competence development. The findings not only contribute to ongoing discussions about digital readiness in teacher preparation but also highlight the necessity of aligning pedagogical innovation with assessment mechanisms to ensure sustainable and effective implementation.*

**Keywords:** *Pre-Service EFL Teachers, Professional Competences, Digital Adaptive Learning, Delphi Method, Competence Indicators, Teacher Education.*

## 1. Introduction

The preparation of English as a Foreign Language (EFL) teachers has long been recognized as a complex endeavor requiring more than subject knowledge or linguistic proficiency. As globalized societies increasingly demand flexible, digitally literate educators, the professional profile of the EFL teacher has expanded considerably [1]. The expectation today is not only that teachers can navigate communicative methodologies, but also that they are capable of working in technology-enriched environments, aligning their pedagogical practice with innovations such as digital adaptive learning (DAL) systems. These systems are characterized by their capacity to personalize instruction through algorithmic adjustments and learning analytics, which present both opportunities and challenges for teacher education [2], [3].

One pressing issue is the extent to which pre-service teachers develop the competences necessary to teach effectively in adaptive environments. While digital literacy frameworks such as DigCompEdu [4] or UNESCO’s [5] ICT Competency Framework provide valuable guidance, they tend to remain broad, focusing on generic uses of technology rather than on the specific affordances of adaptive learning platforms. Yet, adaptive systems require teachers to interpret complex learner data, balance individualized pathways with whole-class goals, and integrate algorithmic recommendations into broader pedagogical strategies [6], [7].

Without explicit indicators and criteria to assess competence in these areas, teacher educators risk overlooking crucial aspects of professional growth.

This paper responds to this challenge by examining how pre-service EFL teachers' professional competences can be conceptualized, measured, and evaluated within digital adaptive learning contexts. The contribution is twofold: first, to synthesize the growing but fragmented body of scholarship on teacher competences, digital pedagogy, and adaptive learning; and second, to propose a framework of indicators and evaluation criteria that can guide teacher educators and researchers in monitoring competence development. Accordingly, the study addresses the following research questions:

1. What indicators can be identified to evaluate pre-service EFL teachers' professional competences in digital adaptive learning environments?
2. How do these indicators align with the key dimensions of professional competence in teacher education?

## **2. Literature Review**

### **2.1. Conceptualizing Professional Competence in Teacher Education**

Professional competence is a contested but central construct in educational research. Early work by Shulman [8] emphasized pedagogical content knowledge (PCK) as the nexus of disciplinary and pedagogical expertise. Later frameworks underscored its multidimensionality, including cognitive, affective, and practical elements [9, 10]. For EFL teachers specifically, competences are expected to extend beyond classroom methodology to encompass intercultural awareness, language proficiency, reflective practice, and the ability to mediate between learners' diverse needs [11].

Competence, however, should not be conceived as static. Rather, it evolves as pre-service teachers engage in coursework, practicum experiences, and reflective inquiry [12]. The developmental nature of competence has been foregrounded in discussions of teacher identity, agency, and resilience [13]. In recent years, digital transformation has added yet another dimension, compelling teacher educators to revisit what counts as professional competence. It is no longer sufficient to prepare teachers who can "use" technology; rather, they must be able to integrate digital tools in pedagogically purposeful ways that foster equitable learning opportunities [14], [15].

### **2.2. The Emergence of Digital and Adaptive Learning Competences**

Digital competence frameworks have proliferated, reflecting global recognition of technology's role in education. The DigCompEdu framework [4] outlines domains ranging from professional engagement to learner empowerment, while UNESCO's [5] guidelines emphasize inclusivity and sustainable development. These models highlight the importance of teachers' capacity to select, adapt, and evaluate digital tools in alignment with pedagogical goals.

Yet adaptive learning introduces distinct pedagogical demands. Unlike conventional e-learning, adaptive platforms analyze learner data to dynamically adjust pacing, content, and feedback. Research suggests that these systems may enhance learner autonomy and engagement [2], [16]. However, their effective use hinges on teachers' ability to interpret data, design adaptive tasks, and ensure that personalization does not fragment collective classroom dynamics [17]. Teachers must also maintain a balance between algorithm-driven individualization and the human dimensions of teaching, such as empathy, collaboration, and cultural mediation [7].

Empirical studies indicate that teacher readiness for adaptive learning remains uneven. Moltudal et al. [18], for instance, found that teachers in primary education contexts often lacked the professional knowledge necessary to manage adaptive platforms effectively, raising questions about the adequacy of teacher preparation programs. Similarly, Duong et al. [19] reported that Vietnamese university instructors expressed both optimism and concern regarding adaptive learning, pointing to the need for professional development and clearer evaluation frameworks. These findings underscore the importance of embedding adaptive learning

competences into initial teacher education, not as optional enhancements but as core components of professional formation.

### **2.3. Indicators and Evaluation Criteria in Competence Measurement**

Assessing professional competence has historically involved a range of tools: observation rubrics, portfolios, reflective journals, and performance-based assessments [13]. While these methods remain valuable, they often fail to capture competences that are specific to digital adaptive contexts. For example, traditional observation checklists rarely account for how teachers interpret learning analytics dashboards or integrate system-generated insights into their instructional design.

Recent research supports the use of indicators (i.e., observable behaviours that indicate competence) and criteria (i.e., standards by which these indicators are evaluated) [20]. In DAL environments, relevant indicators might include how a pre-service teacher designs differentiated tasks within an adaptive platform, interprets learner progression data, or balances adaptive individualization with collaborative learning. Evaluation criteria could involve not only technical accuracy but also pedagogical intentionality and ethical awareness.

Fernández-Morante et al. [17] proposed that learning analytics can be leveraged to provide personalized feedback to student teachers during practicum experiences, highlighting observable practices such as the alignment of adaptive tasks with curricular goals. Similarly, Rincon-Flores et al. [16] demonstrated how adaptive strategies improved both teaching and learning processes, suggesting measurable indicators such as responsiveness to learner needs and adaptability in instructional pacing. These studies highlight the potential for evaluation frameworks that integrate data-informed indicators with qualitative assessments of pedagogical practice.

Nonetheless, debates persist about what should be prioritized in measuring competences. Should evaluation focus on outcomes (e.g., learner performance), on observable practices, or on teachers' reflective dispositions? Some argue for outcome-based models [6], while others emphasize process-oriented assessments that capture teachers' interpretive and decision-making skills [21]. The lack of consensus reflects broader tensions between accountability and professional autonomy in teacher education.

### **2.4. Gaps and Emerging Directions**

Despite a growing literature, significant gaps remain. First, much of the empirical research on adaptive learning focuses on learners rather than on teachers, leaving questions about pre-service teacher preparation underexplored [7]. Second, existing frameworks often apply to in-service teachers, with limited attention to how competences develop during initial training. Third, while there is widespread recognition of the need for indicators and evaluation criteria, few studies have operationalized these constructs in ways that are both valid and practicable across contexts.

Emerging research points to several promising directions. One is the integration of learning analytics into competence assessment, enabling data-rich feedback on pre-service teachers' instructional decisions [17]. Another is the use of scoping reviews and teacher perspective studies to map how educators experience adaptive technologies, which can inform the development of realistic evaluation tools [7], [19]. A third is the alignment of competence measurement with ethical and equity considerations, recognizing that adaptive learning systems raise questions about data privacy, algorithmic bias, and learner agency.

Taken together, these insights suggest that measuring competences in DAL contexts requires a mixed approach: one that combines quantitative indicators (e.g., frequency of data-informed interventions) with qualitative judgments (e.g., the pedagogical rationale for using adaptive feedback). For pre-service EFL teachers, such frameworks must also account for discipline-specific demands, including the mediation of linguistic diversity, the fostering of communicative skills, and the navigation of intercultural contexts.

### **3. Methodology**

#### **3.1. Research Design**

This study employed a qualitative exploratory design using the Delphi method to identify and validate indicators for measuring the professional competences of pre-service EFL teachers in the context of digital adaptive learning. The Delphi technique was selected because it is particularly effective for building consensus among experts on complex or emerging issues where empirical benchmarks are not yet firmly established [22]. By engaging experts iteratively, the method allows for refinement of ideas, ensuring that the resulting framework of indicators is both theoretically grounded and practically applicable.

#### **3.2. Participants**

A purposive sample of 12 experts was recruited to participate in the Delphi panel. The panel included EFL teacher educators, specialists in digital pedagogy, and researchers in adaptive learning from universities and teacher training institutions. All participants had at least five years of professional experience in teacher education and/or digital learning design, ensuring their ability to make informed judgments about competence indicators. Diversity of academic and geographical backgrounds was sought to enhance the validity of the findings.

#### **3.3. Procedure**

The Delphi study was conducted over two iterative rounds:

- *Round 1:* Experts were provided with an initial list of competence indicators drawn from the literature review and theoretical models of teacher professional competence. They were invited to (a) rate the relevance of each indicator on a five-point Likert scale, and (b) suggest additional indicators not captured in the preliminary list. Open-ended responses were encouraged to allow for richer qualitative input.
- *Round 2:* A summary of Round 1 responses, including median ratings and thematic synthesis of qualitative comments, was shared with participants. Experts were then asked to re-evaluate the indicators, considering the group feedback. At this stage, they also rated each indicator in terms of clarity and feasibility for measurement in teacher education contexts. Indicators reaching at least 75% agreement among panel members were retained in the final framework.

A third round was deemed unnecessary as stability in ratings was achieved by the end of Round 2, consistent with methodological recommendations [23].

#### **3.4. Data Analysis**

Quantitative ratings were analyzed using measures of central tendency (median) and dispersion (interquartile range) to determine consensus levels. Qualitative responses from open-ended items were analyzed thematically to capture nuanced perspectives and to integrate suggested indicators into subsequent rounds. Triangulation of statistical consensus with thematic insights ensured that both numerical agreement and expert reasoning were reflected in the final framework.

### **4. Findings**

#### **4.1. Round 1: Initial Ratings and Open-Ended Input**

In the first round of the Delphi study, experts rated 18 preliminary competence indicators derived from the literature review. Descriptive statistics (median, interquartile range, and percentage agreement) were used to determine the relative importance of each indicator. Table 1 summarizes the results.

TABLE I. Round 1 descriptive statistics of competence indicators (n = 12 experts)

Competence Indicator	Median	IQR	% Agreement (“important” or “very important”)
<b>Define and explain DAL</b>	5.0	0.0	100%
<b>Theoretical/pedagogical foundations</b>	5.0	0.0	100%
<b>Familiarity with digital infrastructures (AI, LMS, analytics)</b>	5.0	1.0	92%
<b>Selecting and evaluating digital tools</b>	5.0	1.0	92%
<b>Ethical challenges/digital divide</b>	4.5	1.0	83%
<b>Designing adaptive EFL lessons</b>	5.0	0.0	100%
<b>Creating learner profiles</b>	5.0	1.0	92%
<b>Adaptive methods in skills (R/W/L/S)</b>	5.0	1.0	92%
<b>Flipped, blended, hybrid models</b>	4.5	1.0	83%
<b>Gamification tools</b>	4.5	1.0	83%
<b>Formative and summative assessment</b>	5.0	1.0	92%
<b>Interpreting learner data</b>	5.0	0.0	100%
<b>Designing adaptive quizzes and feedback</b>	5.0	0.0	100%
<b>Awareness of data-driven pedagogy limitations</b>	4.0	1.0	75%
<b>Shifting to facilitator/mentor roles</b>	5.0	1.0	92%
<b>Reflective practice and continuous growth</b>	4.5	1.0	83%
<b>Organising classroom time, space, pacing</b>	4.5	1.0	83%
<b>Institutional/policy-level awareness</b>	4.0	1.0	75%

The results show that competences related to conceptual knowledge (e.g., defining DAL, understanding theoretical foundations) and methodical application (e.g., designing adaptive lessons, interpreting learner data, designing adaptive tasks) were unanimously endorsed as critical, with median scores of 5.0 and 100% agreement. By contrast, competences tied to contextual awareness (e.g., institutional/policy issues, data-driven pedagogy limitations) received lower but still acceptable levels of consensus (median 4.0; 75% agreement).

Additionally, open-ended responses yielded several new competence indicators not included in the initial list, particularly emphasizing the importance of supporting learner autonomy, reflective practice, and awareness of emerging technologies. These were carried forward into Round 2 for further validation.

#### 4.2. Round 2: Consensus Building and Validation

In the second round, experts were provided with a synthesis of Round 1 results, including statistical summaries and thematic groupings of qualitative feedback. After reviewing the group consensus, participants re-rated the competence indicators in terms of clarity and feasibility of measurement. By the end of Round 2, stability in ratings was observed, with at least 75% agreement reached on all retained indicators.

Indicators connected with conceptual understanding (e.g., defining DAL, theoretical frameworks) and methodical application (e.g., designing adaptive lessons, creating learner profiles, interpreting learner data) reached the highest levels of consensus, with most panelists considering them indispensable for evaluating professional competence. Meanwhile, items relating to emerging technologies (e.g., VR, AI tutors) and policy-

level challenges achieved slightly lower agreement (between 75–78%), suggesting that while these competences are valued, their measurement is considered less immediate or more context-dependent.

### **Final Validated Set of Competence Indicators**

The Delphi process produced a validated set of 22 indicators judged to represent the professional competences required of pre-service EFL teachers in digital adaptive learning contexts. These include:

1. Ability to define and explain the concept of digital adaptive learning.
2. Understanding of the theoretical and pedagogical foundations of adaptive learning.
3. Familiarity with digital infrastructures supporting adaptive learning (AI tools, LMS platforms, analytics systems).
4. Competence in selecting and critically evaluating digital tools for EFL teaching.
5. Awareness of ethical challenges and digital divide issues in adaptive environments.
6. Capacity to design adaptive EFL lessons that align with curriculum objectives.
7. Ability to create learner profiles and use them for tailoring instruction.
8. Skills in applying adaptive methods across reading, writing, listening, and speaking activities.
9. Familiarity with flipped, blended, and hybrid adaptive learning models.
10. Ability to use gamification tools to support adaptive pathways.
11. Competence in applying formative and summative assessments in adaptive contexts.
12. Ability to interpret learner data from adaptive platforms and adjust instruction accordingly.
13. Capacity to design adaptive quizzes, tasks, and real-time feedback mechanisms.
14. Awareness of limitations of data-driven pedagogy and its ethical implications.
15. Ability to shift from traditional instructor roles to facilitator and data-informed mentor roles.
16. Evidence of reflective practice and readiness for continuous professional growth.
17. Skills in organising classroom time, space, and pacing under adaptive learning conditions.
18. Awareness of institutional, policy-level, and organisational challenges in implementing adaptive approaches.
19. Commitment to supporting learner autonomy, self-regulation, and digital agency.
20. Ability to integrate project-based and task-based adaptive scenarios into EFL lessons.
21. Familiarity with emerging trends and technologies (e.g., AI tutors, VR) relevant to adaptive futures.
22. Ability to adapt lesson plans to meet the needs of diverse learners.

Taken together, these indicators provide a comprehensive and validated framework for assessing how pre-service EFL teachers develop the competences necessary to work effectively in digital adaptive learning environments.

## **5. Discussion**

The Delphi study produced a validated set of 22 competence indicators that collectively define the professional profile of pre-service EFL teachers in digital adaptive learning contexts. These findings extend existing models of teacher digital competence by highlighting the dual emphasis on conceptual clarity and methodical application. The consistently high agreement on indicators such as defining DAL, understanding theoretical foundations, designing adaptive lessons, and interpreting learner data suggests that the panel of experts views professional readiness as dependent on both the ability to *grasp the pedagogical logic of adaptivity* and to *translate it into classroom practice*. This pattern aligns with prior scholarship emphasizing the inseparability of knowledge and application in teacher education [14], [24].

Interestingly, competences tied to broader institutional or policy-level awareness received comparatively lower endorsement, although still meeting consensus thresholds. This result may reflect a pragmatic orientation among experts, who prioritized competences that directly influence classroom-level instruction. Previous studies have reported similar tendencies: while macro-level awareness is recognized as important, pre-service training often concentrates on pedagogical skills and immediate technological affordances [25], [26]. However, their inclusion in the final validated list highlights the fact that if adaptive approaches are to be

sustainable, structural and ethical issues, such as the digital divide or the limitations of data-driven pedagogy, cannot be ignored.

Another notable outcome is the prominence of reflective practice and learner autonomy, which emerged from open-ended responses rather than the initial literature-derived list. Their elevation to validated indicators suggests a shift in how adaptive learning is being conceptualized: not merely as a set of technological interventions, but as a pedagogical paradigm that requires teachers to foster agency, metacognition, and continuous professional growth. This resonates with ongoing debates in the field of learner-centered pedagogy and digital education [27], [28].

The moderate consensus on emerging technologies such as AI tutors and VR reveals both enthusiasm and caution. On the one hand, their inclusion acknowledges the rapidly changing technological ecosystem shaping adaptive learning. On the other hand, experts' reservations about feasibility and measurement echo concerns raised in the literature that such innovations, while promising, remain under-theorized and unevenly implemented [29], [2]. For pre-service teacher education, this means programs must strike a balance between equipping future teachers with foundational competences and preparing them for emergent, context-dependent challenges.

Overall, the findings suggest that professional competence in adaptive learning cannot be reduced to technical proficiency alone. It requires a constellation of interrelated indicators spanning conceptual, methodological, digital, and organisational dimensions. While consensus has been achieved on the core set of competences, the diversity of indicators points to an evolving landscape in which teacher education must remain responsive and adaptive itself.

## 6. Conclusion

This study set out to identify and validate competence indicators that capture the professional readiness of pre-service EFL teachers to work effectively in digital adaptive learning environments. Using a two-round Delphi process, a diverse panel of experts reached consensus on a comprehensive framework of 22 indicators, spanning conceptual knowledge, methodological application, organizational skills, and contextual adaptability. The high levels of agreement on competences such as defining digital adaptive learning, designing adaptive lessons, and interpreting learner data underscore the field's recognition that both theoretical grounding and practical design capacities are essential for teacher preparation in the digital age.

At the same time, the more moderate levels of consensus observed for competences linked to emerging technologies and policy-level challenges suggest that these areas remain contested and context-dependent. Their inclusion, however, reflects the forward-looking orientation of the panel and highlights the need for teacher education curricula to remain responsive to evolving technological and institutional landscapes.

The framework developed here contributes to ongoing scholarly and professional debates on how to conceptualize and assess teacher competences in digitally mediated environments. It provides a validated set of indicators that can inform curriculum design, assessment strategies, and professional development initiatives in teacher education programs. By articulating a set of validated competences, this research offers both a foundation for further empirical inquiry and a practical tool for guiding teacher preparation in a rapidly changing educational landscape.

Despite its contributions, the study has several limitations. First, the Delphi panel was relatively small ( $n = 12$ ) and limited to experts with established experience in EFL and digital pedagogy. Although this ensured informed input, it also restricts the generalizability of the findings to other educational contexts or disciplines. Second, the validation of competence indicators was carried out in a conceptual rather than empirical classroom setting; the extent to which these indicators translate into observable teaching practices remains to be tested. Finally, the dynamic nature of adaptive learning technologies means that some competences identified here may evolve rapidly or require periodic revision.

Future research could address these limitations by (a) expanding the panel to include a wider range of stakeholders, such as novice teachers, policymakers, and technologists; (b) conducting empirical studies to test

how the indicators manifest in classroom practice; and (c) developing measurement instruments or rubrics aligned with the framework. Such work would not only refine the indicators further but also strengthen their practical utility in shaping teacher education curricula, professional development programs, and institutional policies that prepare educators for the realities of digital adaptive learning.

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