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Teacher practices and challenges in AI-integrated EFL instruction: A case study from an underdeveloped region

Nasai DANZENG

Shanghai International Studies University, Shanghai 201620, China

Abstract: Despite the rapid proliferation of artificial intelligence (AI) in education, its implementation in underdeveloped regions remains under-explored, creating a significant knowledge gap regarding digital equity. This qualitative case study investigates how an EFL teacher in Shigatse, Tibet, engages with AI throughout the instructional process. Adopting a unified analytical framework that integrates the multidimensional construct of engagement (behavioral, emotional, cognitive) with the ADDIE instructional design model (Analysis, Design, Development, Implementation, Evaluation), this study offers a process-oriented examination of teacher practices under resource constraints. Findings reveal that the teacher's engagement is non-linear and front-loaded: while Behavioral Engagement peaked during the Design and Development phases through active material generation, it significantly declined during the Implementation phase due to infrastructural anxiety and instability. Furthermore, the teacher's Emotional Engagement evolved from blind optimism to rational pragmatism, shaped by the paradoxical burden of AI-induced supervision. These results challenge the assumption of seamless AI integration, highlighting that in underdeveloped contexts, teachers must navigate a dichotomy between high preparation hopes and low implementation realities.

Keywords: AI-integrated EFL instruction; engagement; ADDIE model; underdeveloped regions; case study

1 Introduction

Artificial intelligence (AI) has become an important driver of educational innovation and has increasingly been integrated into English as a foreign language (EFL) instruction [1-2]. AI tools, including automated feedback systems and generative language models, are reshaping lesson planning, classroom instruction, and assessment [3-4]. These technologies enable teachers to generate instructional materials efficiently, automate routine tasks, and provide individualized learning support, thereby improving instructional quality and flexibility [3][5].

However, these benefits are unevenly distributed. In underdeveloped regions, unstable electricity, limited internet access, outdated equipment, insufficient institutional support, and inadequate teacher training continue to constrain AI adoption [6]. Consequently, AI may reinforce rather than reduce existing educational inequalities.

These disparities are also evident in China. While economically developed cities have increasingly adopted AI-supported instruction, many remote areas, including parts of the Xizang Autonomous Region, continue to face infrastructural and pedagogical constraints [7]. Teachers in these contexts must balance technological opportunities with contextual limitations.

Existing research has primarily examined the effects of AI on student learning, including motivation, agency, engagement, and language development [5][8][9]. Although growing attention has been paid to teachers' attitudes toward AI, few studies have explored how teachers integrate AI throughout the instructional process, particularly across different stages of teaching.

To address this gap, the present study investigates how an EFL teacher in an underdeveloped region integrates AI throughout the instructional process. Guided by the ADDIE instructional design model, it examines teacher engagement during the Analysis, Design, Development, Implementation, and Evaluation stages. The findings aim to deepen understanding of teachers' AI integration under resource-constrained conditions and provide implications for future teacher development and educational policy.

2 Literature review

2.1 AI-integrated EFL instruction

Recent studies consistently demonstrate that AI benefits student learning by improving motivation, engagement, agency, adaptability, and language development [4][5][[9][10][11]. At the same time, AI supports teachers in lesson preparation, assessment, classroom interaction, and personalized instruction [3][12][13][14]. Generative AI can efficiently produce instructional materials, quizzes, reading tasks, and automated feedback, reducing teachers' workload and supporting more individualized learning.

Despite these benefits, AI integration also introduces substantial challenges. Ethical concerns—including privacy, surveillance, bias, and academic integrity—remain prominent [15]. In addition, many teachers lack sufficient AI literacy and professional training to integrate AI meaningfully into classroom instruction [16][17]. Although previous studies have examined either teachers' attitudes or specific AI applications, relatively little is known about how teachers engage with AI throughout the complete instructional process. Understanding this dynamic requires a broader theoretical perspective that captures teachers' behavioral, emotional, and cognitive involvement.

2.2 Engagement

Engagement has traditionally been viewed as a key predictor of educational outcomes. Fredricks et al. (2004) [18] conceptualized engagement as a multidimensional construct consisting of three interrelated dimensions: behavioral, emotional, and cognitive engagement. Behavioral engagement refers to observable participation and effort; emotional engagement concerns affective responses such as interest, enjoyment, or anxiety; cognitive engagement reflects psychological investment in learning through planning, reflection, and strategic thinking.

Although originally developed for students, this framework is also applicable to teachers. During AI integration, teachers become continuous learners who must acquire new technological competencies while adapting their instructional practices [19]. Previous studies similarly emphasize that effective teaching requires behavioral participation, emotional commitment, and cognitive investment [20].

Accordingly, this study reconceptualizes teacher engagement within AI-integrated EFL instruction. Behavioral engagement refers to teachers' observable AI use and resource investment throughout instruction. Emotional engagement captures teachers' attitudes, self-efficacy, and emotional responses toward AI integration. Cognitive engagement reflects teachers' strategic planning, critical evaluation of AI outputs, and pedagogical decision-making.

Recent educational technology research further suggests that teacher engagement varies across instructional stages rather than remaining constant. Teachers often devote greater behavioral and cognitive effort during lesson planning and material development, while classroom implementation is constrained by contextual uncertainty and technological risks [21][22]. This stage-sensitive pattern provides an important perspective for understanding AI integration in underdeveloped

educational settings.

2.3 ADDIE

To examine engagement across the instructional process, this study adopts the ADDIE instructional design model [23], which consists of five sequential stages:

Analysis: identifying learner needs, instructional goals, and contextual constraints;

Design: planning learning objectives, instructional strategies, and assessments;

Development: producing and refining instructional materials;

Implementation: delivering instruction in authentic classrooms;

Evaluation: assessing instructional effectiveness and informing subsequent improvement.

The ADDIE model has been widely applied in instructional design research and provides a systematic framework for examining teachers' AI use across different instructional stages [24]. Integrating the Engagement framework with ADDIE enables a process-oriented analysis of how teachers' behavioral, emotional, and cognitive engagement changes throughout AI-supported instruction.

2.4 Research gaps and research questions

Despite the rapid expansion of AI in education, research on AI-integrated instruction remains concentrated in well-resourced contexts. Comparatively little is known about teachers' experiences in underdeveloped regions, where infrastructural limitations, limited institutional support, and contextual constraints substantially influence AI adoption [25].

Existing studies also tend to examine isolated aspects of AI use, such as automated feedback, content generation, or teachers' general attitudes, rather than investigating teachers' engagement throughout the entire instructional process [23][18]. Consequently, a comprehensive process-oriented understanding of teacher engagement with AI is still lacking.

To address these gaps, this study investigates an EFL teacher's AI-integrated instructional practices in an underdeveloped region using a unified analytical framework that combines the Engagement model with the ADDIE instructional design model. Specifically, it addresses the following research questions:

RQ1. How did Teacher L employ AI in different stages of her EFL instruction?

RQ2. How did Teacher L perceive the utility of AI tools in EFL instruction?

RQ3. What challenges influence Teacher L's engagement with AI in EFL instruction?

3 Methods

3.1 Research context and participant

This study was conducted in a rural public high school in Shigatse, Tibet, where unstable internet access, limited digital infrastructure, and insufficient technical support constrain AI-assisted instruction. Although national policies encourage AI integration, implementation remains uneven in underdeveloped regions.

The participant, Teacher L (a pseudonym), was selected through purposeful criterion sampling [26]. She is a 24-year-old novice EFL teacher with one year of teaching experience, holding a bachelor's degree in English education and currently pursuing an in-service master's degree in English pedagogy. She had completed provincial AI-related training and possessed basic experience using generative AI tools. Her profile represents an early-career teacher attempting to integrate AI within a resource-constrained context.

Data were collected through three semi-structured interviews, classroom observations, lesson plans, and AI-related instructional artifacts, with informed consent obtained throughout the study.

3.2 Data collection

To obtain a comprehensive understanding of Teacher L's AI-integrated instruction, four data sources were collected [27]:

Semi-structured interviews explored Teacher L's beliefs, experiences, and reflections across the five ADDIE stages. Classroom observations documented AI use, teacher-student interaction, and classroom implementation. Lesson plans and teaching documents provided evidence of instructional planning and AI-supported material development [28]. AI-generated artifacts, including prompts, generated materials, and revised outputs, illustrated how AI was adapted to instructional purposes.

All research instruments were designed according to the unified Engagement × ADDIE analytical framework.

3.3 Data analysis

Data analysis followed a three-stage thematic analysis procedure [29]. Interview recordings were transcribed, observation notes digitized, and all materials organized for analysis.

Deductive coding was first conducted using the proposed 3 × 5 analytical matrix, which combined the three engagement dimensions (behavioral, emotional, cognitive) with the five ADDIE stages (e.g., Beh_Design, Cog_Implementation). Table 1 presents the operational definitions and coding indicators.

Subsequently, inductive coding identified emerging themes related to contextual challenges and support mechanisms, providing evidence for RQ3. Figure 1 illustrates the coding process.

Table 1. The unified analytical matrix: operationalizing teacher engagement across ADDIE stages

ADDIE Stage	Behavioral Engagement (Action, Usage, Resource Investment)	Emotional Engagement (Affect, Attitude, Self-Efficacy)	Cognitive Engagement (Planning, Reflection, Strategy)
Analysis	N/A	Expectation for Equity: Desire to bridge the resource gap; "Blind expectation" for AI capabilities.	Needs Assessment: Analyzing student deficits; Identifying repetitive tasks suitable for AI.
Design	Tool Selection: Using translation tools to comprehend academic texts efficiently.	Shift in Philosophy: Anxiety about student dependency; Motivation to shift from "knowledge transmitter" to "guide"	Strategic Planning: Designing "cheat-proof" tasks; Planning to integrate local culture where AI fails.
Development	Material Generation: Creating graded exercises, reading materials, and prompts using Generative AI.	Mixed Feelings: Relief at efficiency vs. Frustration with "stiff" or "spiritless" AI feedback on subjective tasks.	Critical Filtering: Evaluating AI output accuracy; Recognizing AI's inability to handle cultural nuances.
Implementation	Limited Usage: Minimal real-time AI use; Playing AI-subtitled videos; Reverting to traditional methods.	Infrastructural Anxiety: Fear of power outages/disconnection destroying class momentum; Nervousness about device limitations.	Adaptive Decision Making: Deciding not to use complex AI live in class due to risk of failure; Real-time management of student attention.
Evaluation	Automated Grading: Using AI for objective tests (dictation, multiple-choice) to reduce workload	Rational Acceptance: Shift from blind optimism to "rational view"; Appreciation of immediate feedback's effect on student motivation.	Ethical Reflection: Deep concern over "laziness" and loss of critical thinking; distinguishing between "help" and "plagiarism".

Note: The indicators listed above are derived from the thematic analysis of the interview data and observation records.

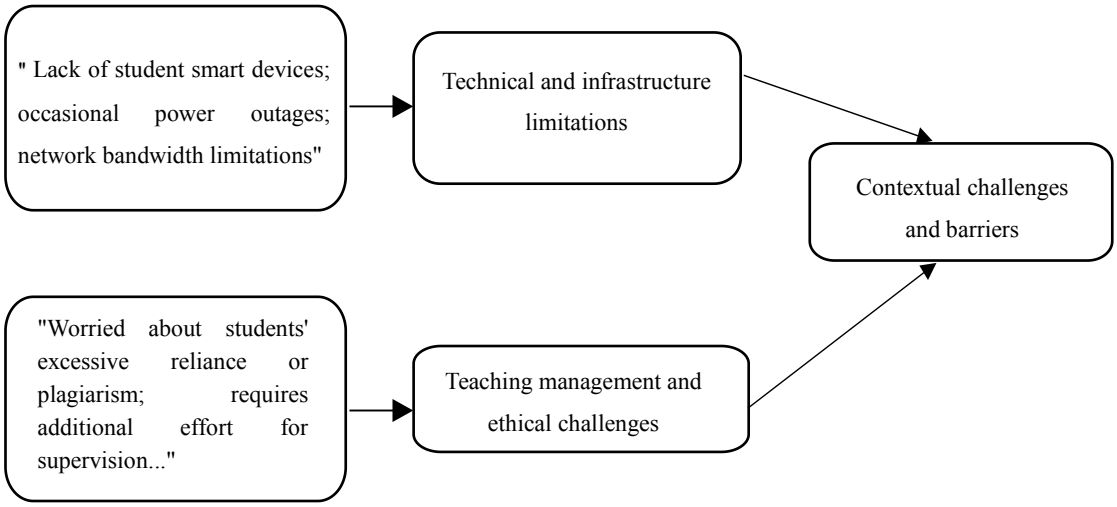

Figure 1. The inductive coding process for RQ3: challenges and supports

4 Findings

4.1 Dynamics of engagement across the ADDIE

Teacher L's engagement varied considerably across instructional stages, demonstrating different patterns of behavioral, emotional, and cognitive engagement throughout the ADDIE cycle.

- Analysis:

Teacher L showed no observable behavioral engagement during the Analysis stage because AI was not used to analyze learner needs. However, she demonstrated strong emotional engagement, expressing optimism that AI could reduce educational inequality by providing students in Shigatse with access to high-quality learning resources.

At the same time, she displayed substantial cognitive engagement by identifying students' limited exposure to authentic English and recognizing AI's value in oral practice and repetitive administrative tasks such as grading and dictation. She viewed AI primarily as an instructional assistant rather than a classroom replacement.

- Design:

During the Design stage, Teacher L exhibited the highest levels of behavioral and cognitive engagement.

Cognitively, she reconsidered her professional role, arguing that teachers should shift from knowledge transmitters to facilitators of thinking. To reduce students' dependence on AI, she deliberately designed tasks requiring reflection and local cultural knowledge that AI could not easily generate.

Behaviorally, AI became an essential lesson-planning tool. She used translation and generative AI applications to retrieve teaching materials, design grammar exercises, generate reading tasks, and repeatedly refine AI outputs before incorporating them into lesson plans. However, these applications remained largely confined to lesson preparation rather than classroom teaching.

- Development:

The Development stage represented Teacher L's highest level of AI use.

Behaviorally, she extensively employed generative AI to produce graded reading materials, grammar exercises, vocabulary explanations, and differentiated instructional tasks. Rather than accepting AI outputs directly, she repeatedly revised prompts to improve instructional quality (Figure 2, Figure 3).

Cognitively, she critically evaluated AI-generated content and recognized its limitations in providing culturally appropriate and logically sophisticated writing feedback.

Emotionally, AI simultaneously reduced preparation time while generating frustration because its feedback on creative writing was often mechanical and lacked cultural sensitivity.

Prompt: Please design a reading exercise based on this article, ensuring that it is suitable for high school students' level.

Figure 2. The first prompt given by Teacher L to AI (Doubao)

Prompt: Please design reading exercises for three different types of students based on their ability to fully understand the article, their ability to grasp the general idea of the article, and their difficulty in understanding the article.

Figure 3. The prompt given by Teacher L to the AI after modification

- Implementation:

Teacher L's behavioral engagement declined sharply during classroom implementation.

Although lesson plans included AI-supported activities, classroom observations showed that these were often abandoned because of limited instructional time or concerns about technological failure. She described frequent anxiety over unstable electricity and occasional network interruptions, leading her to prepare traditional backup activities and avoid real-time AI applications whenever possible.

Consequently, the classroom remained largely dependent on conventional teaching methods despite extensive AI use during preparation.

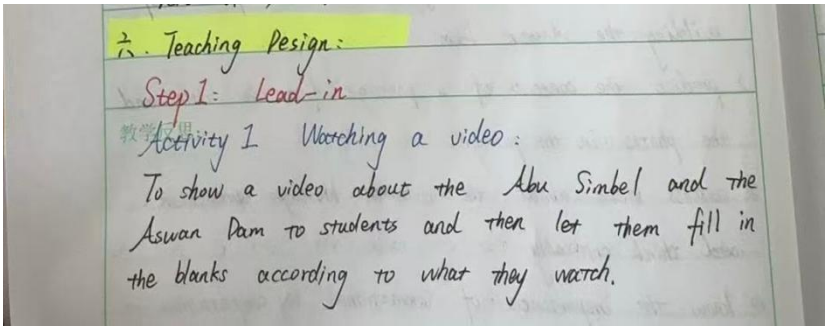

Figure 4. Teacher L's teaching plan

- Evaluation:

During the Evaluation stage, Teacher L's engagement became increasingly reflective.

Behaviorally, she regularly used AI to grade objective assessments, reducing routine workload.

Emotionally and cognitively, her attitude evolved from initial optimism to a more balanced perspective. While recognizing AI's value in providing timely feedback, she became increasingly concerned about students' overreliance on AI,

plagiarism, and declining critical thinking. She also acknowledged AI's occasional inaccuracies and concluded that teachers must devote more effort to supervision, guidance, and ethical instruction rather than simply adopting AI tools.

4.2 Constraints and challenges influencing engagement

4.2.1 Challenges

Three major challenges constrained Teacher L's engagement.

First, infrastructural limitations—including unstable electricity, limited student devices, and occasional network failures—restricted classroom AI implementation despite adequate preparation.

Second, professional development opportunities were insufficient. Existing AI training mainly reflected well-resourced classrooms and provided limited guidance for teachers working in underdeveloped contexts.

Third, AI increased rather than reduced part of Teacher L's workload. Considerable time was devoted to designing plagiarism-resistant assignments and monitoring students' AI use, creating an additional supervisory burden.

Figure 5. The function of grading assignments in Doubao

4.2.2 Supports

Despite these constraints, several factors supported Teacher L's continued AI integration.

Students generally responded positively to AI-assisted learning, particularly less confident learners who appreciated AI's non-judgmental feedback.

Teacher L also demonstrated considerable professional resilience by actively exploring free AI tools such as Doubao and DeepSeek and adapting them to local teaching conditions. Rather than viewing AI as a replacement for teachers, she gradually positioned it as a supportive instructional resource.

5 Discussion

5.1 A front-loaded pattern of teacher engagement

Regarding RQ1 and RQ2, the findings reveal a distinctly front-loaded pattern of teacher engagement across the ADDIE process. Teacher L invested most of her behavioral and cognitive effort during the Design and Development stages, where AI substantially improved lesson preparation by supporting material generation and instructional planning. This finding is consistent with previous research demonstrating AI's capacity to enhance teachers' preparation efficiency [3].

However, this engagement did not extend to classroom implementation. Although Teacher L recognized AI's pedagogical value, infrastructural instability and technological uncertainty discouraged real-time classroom use. As a result, AI primarily functioned as a preparation tool rather than an instructional tool. This finding suggests that, in underdeveloped regions, infrastructure influences not only access to AI but also teachers' willingness to integrate it into classroom practice.

Teacher L's emotional engagement also evolved throughout the instructional cycle. Initial optimism gradually shifted toward a more balanced understanding as AI introduced additional supervisory responsibilities, including monitoring plagiarism and maintaining academic integrity. The findings therefore indicate that teachers' perceptions of AI are shaped not only by its instructional benefits but also by the hidden labor associated with its responsible use.

5.2 Contextual constraints and teacher resilience

Regarding RQ3, the findings demonstrate that AI integration in underdeveloped regions is constrained less by complete technological absence than by limited reliability and contextual compatibility. Occasional power interruptions, insufficient student devices, and unstable classroom conditions reduced teachers' confidence in using AI during instruction, encouraging continued reliance on traditional teaching approaches.

Nevertheless, Teacher L demonstrated considerable professional resilience. Rather than passively accepting AI outputs, she critically evaluated generated materials, adapted free AI tools to local teaching needs, and continuously adjusted her instructional strategies. These findings challenge deficit-oriented perspectives on teachers in underdeveloped regions by showing that successful AI integration depends not only on technological resources but also on teachers' professional agency and adaptive decision-making.

6 Limitations and future research

This study has several limitations. First, as a single-case study conducted in Shigatse, the findings provide analytical rather than statistical generalizability. Second, the data were collected during one instructional cycle; longitudinal research could better capture how teachers' engagement develops over time. Third, although interview data were triangulated with classroom observations and teaching artifacts, teachers' emotional engagement inevitably relied partly on self-report.

Future studies should expand the sample across multiple underdeveloped regions and employ mixed-methods designs to examine whether the front-loaded engagement pattern identified here is consistently observed in broader educational contexts.

7 Conclusion

This study examined how an EFL teacher in an underdeveloped region integrated AI throughout the instructional process by combining the Engagement framework with the ADDIE model.

The findings reveal that teacher engagement was highly stage-dependent. Behavioral and cognitive engagement were strongest during lesson preparation but declined substantially during classroom implementation because of infrastructural instability and contextual constraints. Emotional engagement also evolved from initial optimism to a more balanced understanding as the ethical and supervisory demands of AI became increasingly evident.

These findings suggest that the digital divide extends beyond technological access to include the sustainability of AI-supported teaching throughout the instructional process. Promoting equitable AI integration therefore requires not only improved infrastructure but also context-sensitive professional development and practical support that enables teachers to use AI confidently in authentic classroom settings.

Although based on a single case, this study provides an initial process-oriented account of AI-integrated EFL instruction in an underdeveloped region and offers empirical evidence for future research and policy development.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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About the author

Nasai Danzeng, female, is a postgraduate student majoring in Curriculum and Instruction at Shanghai International Studies University. She graduated from Shanghai International Studies, majoring in English, and holds a Bachelor of Arts degree. E-mail: danzengnasai_17@163.com