INSTITUTIONAL AND INFRASTRUCTURAL BARRIERS TO AI INTEGRATION IN TEACHING: A QUALITATIVE STUDY FROM UZBEKISTAN

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Abstract. While AI technologies promise to transform educational practices, successful integration depends heavily on contextual conditions often overlooked in technology-acceptance research. Drawing on semi-structured interviews with 12 educators and IT coordinators in Uzbekistan, this study examines how institutional support, training availability, and infrastructural reliability shape the relationship between teacher AI competence and actual classroom adoption. The findings show that technical competence is necessary but not sufficient for AI integration. Insufficient professional development, weak administrative backing, and unreliable internet connectivity consistently moderate the competence–adoption link, often neutralizing teachers' positive perceptions of AI tools. Teachers with high competence but low institutional support reported frustration and gradual disengagement. The study proposes a Contextual Readiness Framework (CRF) that positions institutional factors as critical moderators rather than peripheral variables. These findings offer practical implications for educational policymakers and administrators in emerging economies, emphasizing that technology investment must be paired with sustained capacity-building and infrastructure upgrades to realize pedagogical benefits.

Keywords: AI integration, institutional barriers, teacher competence, infrastructure, professional development, emerging economies, Uzbekistan.

Introduction. The global push for digital transformation in education has placed artificial intelligence at the forefront of pedagogical innovation. However, the gap between AI availability and effective classroom use remains wide, particularly in emerging economies (World Bank, 2026). While teacher in emerging economies (World Bank, 2023). While teacher ***competence in AI is widely acknowledged as a prerequisite (UNESCO, 2026),***

empirical evidence suggests that competence alone does not guarantee usage; contextual factors often determine whether skills translate into practice (Ertmer, 1999). This study addresses the question: "How do institutional and infrastructural factors moderate the relationship between teacher AI competence and AI integration in teaching?" Unlike prior studies that treat barriers as secondary, we position them as central moderators that can override individual capability.

Theoretical Background. We draw on Ertmer's (1999) first-order (external) and second-order (internal) barriers framework. First-order barriers include lack of resources, training, and technical support; second-order barriers involve beliefs and attitudes. While most TAM-based studies focus on internal perceptions (Davis, 1989), this study emphasizes that first-order barriers often determine whether internal perceptions can materialize into behavior (Tondeur et al., 2017). In emerging contexts like Uzbekistan, first-order barriers are particularly pronounced due to transitional infrastructure and centralized but unevenly implemented educational policies (OECD, 2022). Thus, we hypothesize a moderating role: institutional readiness shapes the strength of the competence–adoption relationship.

Methodology

*Research Design***.** This qualitative study employed an interpretivist paradigm to explore how institutional and infrastructural factors shape AI integration in teaching. An interpretivist approach was chosen because the research aim was to understand participants' lived experiences, perceptions, and the meanings they attach to barriers and enablers of AI use.

Participants and Sampling

Purposive sampling yielded 12 participants: 9 teachers and 3 IT coordinators from private schools, universities, and an EdTech firm in Uzbekistan. Participants had between 3 and 10 years of professional experience. Inclusion criteria were: (a) active involvement in teaching or educational technology support, (b) familiarity

with AI tools, and (c) willingness to reflect on institutional and infrastructural challenges. The sample size is consistent with qualitative research that prioritizes depth over breadth and is sufficient for thematic saturation (Braun & Clarke, 2006).

Data Collection

Data were collected through semi-structured interviews lasting between 20 and 40 minutes. The interview guide covered four broad areas: (1) current use of AI tools in teaching, (2) perceived institutional support and training availability, (3) infrastructural reliability and technical challenges, and (4) the relationship between competence and actual classroom adoption. Interviews were audio-recorded with informed consent, transcribed verbatim, and translated into English for analysis. To protect anonymity, participants are referred to as T-1 through T-12.

Data Analysis

The data were analyzed using thematic analysis following the six-phase procedure outlined by Braun and Clarke (2006): familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the final report. Thematic saturation was reached after 10 interviews. Four core themes emerged regarding institutional barriers.

Trustworthiness and Ethical Considerations

Several strategies enhanced trustworthiness. Credibility was supported through iterative questioning during interviews and by maintaining a clear audit trail of coding decisions. The study addressed transferability by providing contextual details about the educational setting in Uzbekistan. The study strengthened dependability by consistently applying the thematic analysis procedure. Ethical approval was obtained from the relevant institutional review board. All participants provided informed consent, were assured of confidentiality, and retained the right to withdraw at any time.

Findings

Four core themes emerged regarding institutional barriers:

Theme 1: Competence as a Baseline -Teachers acknowledged that basic AI skills are essential, but most felt their competence was self-taught and fragmented. “I know the tools exist, but I learned them on my own” (T-4).

Theme 2: Training Deficiency-The most frequently cited barrier was the lack of systematic, ongoing training. “We had one workshop six months ago; nothing since then” (T-7). IT coordinators confirmed that sporadic training fails to build sustainable capacity.

Theme 3: Infrastructure Unreliability- Teachers reported unstable internet and outdated hardware as daily obstacles. “I plan an AI-based activity, but the network drops, and I lose 15 minutes” (T-1). This unpredictability discourages teachers from risking classroom time.

Theme 4: Weak Institutional Culture- Participants noted that school leadership often expects AI use without providing time for exploration or peer collaboration. “They want us to innovate, but they don’t give us time to learn” (T-8).

Crucially, teachers with higher competence were more frustrated by these barriers than those with lower competence, because they saw the potential but were blocked from realizing it. This suggests that barriers do not merely delay adoption but actively erode motivation.

Discussion and Proposed Framework. We propose the Contextual Readiness Framework (CRF), which argues that institutional and infrastructural factors moderate the effect of teacher AI competence. Without reliable infrastructure, structured training, and administrative support, even highly competent teachers revert to traditional methods. Conversely, when contextual conditions are favorable, moderate competence can be rapidly upgraded through experiential learning. This finding extends Ertmer (1999) by demonstrating that

first-order barriers can suppress the behavioral translation of second-order positive attitudes.

Conclusion & Implications. This study concludes that investments in AI teacher training are unlikely to yield returns unless simultaneously matched with institutional readiness. For policymakers, this means prioritizing reliable internet, hardware maintenance, and time-embedded professional development (not one-off workshops). For school administrators, establishing peer-support networks and dedicated experimentation time is critical. The CRF provides a diagnostic tool for institutions to assess their readiness before launching AI initiatives. Limitations include a small sample confined to urban areas; future research could explore rural–urban disparities.

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