

The Paradox of Access: Infrastructure Constraints on Hybrid Learning Model Adoption in Tertiary English Language Teaching

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ABSTRACT:

Despite heavy investments in educational technology infrastructure, there is a critical gap between access to technology and high-impact pedagogical implementation in Thai higher education. This empirical mixed-methods study explores the effects of network infrastructure instability on the adoption of Hybrid learning models by teachers in tertiary English language teaching at King Mongkut's University of Technology North Bangkok (KMUTNB). This study combines quantitative survey data from undergraduate students ($N = 137$) and English instructors ($N = 11$) and qualitative semi-structured interviews (10 students, 3 teachers) to capture the dominant Web-Enhanced nature of instructional technology use across five teaching phases (Perspective, Stimulation, Instruction/Participation, Closure, Follow-up). Quantitative results reveal the prevalent use of Learning Management Systems (100% in Opening) and synchronous meeting applications (100% in Core Instruction), with students' perception of high 21st-century skill development overall ($M = 3.29$, $SD = 0.62$), led by ICT Literacy ($M = 3.50$). Qualitative findings, however, reveal five constraining mechanisms: the Risk-Aversion Mechanism; the Equity Dilemma of differential home access; the Bandwidth Bottleneck during peak hours; the Pedagogical Downshifting Pattern; and the Institutional Response Gap. High-level digital skills of instructors cannot compensate for the low-impact models that unreliable connectivity forces them to adopt. The study conceptualizes the 'Paradox of Access' as a theoretical construct and provides evidence-based recommendations for institutional technology planning focusing on network reliability over access expansion.

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I. Introduction

The COVID-19 pandemic has disrupted education globally as never before, affecting over 1.6 billion learners in 200 countries. This has resulted in a sudden shift from traditional classroom instruction to online and hybrid delivery models [1, 16]. In March 2020, the Thai government ordered the shutdown of educational institutions and universities throughout the country to the digital learning platforms in a short time. This shift spurred considerable digital transformation in higher education but also revealed systemic weaknesses in institutional readiness, faculty digital proficiency, and technical infrastructure. Digital resources were the center of keeping the continuity of instruction in ELT where language acquisition is basically based on active communication, social interaction, and collaborative problem-solving [14, 18].

The current ELT pedagogy is based on the paradigm of development of 21st-century skills [15] which emphasizes the necessity of integration of the '4Cs' (Critical Thinking, Communication, Collaboration and Creativity) in the core academic disciplines. To achieve these objectives, the educational institutions have adopted a variety of technology-enhanced learning models along an Online Learning Spectrum. This spectrum ranges from traditional Face-to-Face instruction to Web-Enhanced models (where technology is used to distribute supplementary content), Hybrid/Blended learning (where 30% to 79% of course content and interactive activities are delivered online, substituting physical class time) [2] and Fully Online or HyFlex delivery. There is extensive research that supports the fact that well-structured hybrid models lead to better learning results, increased student independence and improved higher order cognitive skills versus solely traditional or entirely asynchronous remote instruction [3, 4, 5, 17].

However, successful execution of high-impact Hybrid learning requires an institutional foundation that extends beyond mere physical access to devices or software licenses. High

network reliability, sufficient bandwidth for real time collaboration and stable campus connectivity are required. In many higher education institutions in developing countries, legacy institutional investments have been disproportionately focused on hardware acquisition and user access expansion, with underinvestment in network resilience and bandwidth infrastructure. This structural imbalance leads to what this study calls the "Paradox of Access" [10, 11]: a dilemma where universities are equipped with full-fledged learning management systems (LMS) and digitally trained faculty but the classroom practices are still restricted to basic, low-impact Web-Enhanced practices due to chronic network instability.

This research systematically addresses this paradox in the specific institutional setting of King Mongkut's University of Technology North Bangkok (KMUTNB). This paper investigates the delivery of e-learning activities in five different instructional procedures (Perspective (Opening), Stimulation, Instruction/Participation (Core Teaching), Closure, and Follow-up) using an empirical mixed-methods design that combines quantitative survey data from 137 undergraduate students and 11 English language instructors with in-depth qualitative interviews. The research measures the students' perception of IT tools, quantifies the perceived development of 21st-century skills, and illuminates the structural mechanisms by which the instability of network infrastructure serves as the main pedagogical factor.

II. Objectives of the Study

This study aims to systematically investigate the interaction of the institutional technology infrastructure and ELT pedagogy with three main research objectives:

- 1) To analyze the implementation of E-learning activities and digital platforms in the five phases of the instructional process (Perspective, Stimulation, Instruction/Participation, Closure and Follow-up) in tertiary English courses.
- 2) To examine students' opinions regarding the provided E-learning platforms and assess the

particular structural processes through which the reliability of network infrastructure limits teachers' use of advanced Hybrid learning models.

3) To assess students' perceptions of the development of 21st century skills (Learning and Innovation Skills, Information/ICT Proficiency and Life/Career Skills) within the framework of technology-mediated English language instruction.

III. Methodology

A. Research Design

The present study used a sequential explanatory mixed-methods research design [6, 7] combining quantitative survey data and qualitative semi-structured interviews. The quantitative phase gathered statistical evidence about the frequency of the tools' implementations and the students' perceptions of the skills. The subsequent qualitative phase applied thematic analysis of teacher and student interviews to explore the latent decision-making processes, contextual constraints, and lived experiences that explain the quantitative trends.

B. Participants and Sampling

The target population for the study during the academic year consisted of approximately 4,000 undergraduate students enrolled in general English classes and 30 full-time English teachers at KMUTNB. Samples were randomly selected for the quantitative and qualitative parts, following the guidelines for survey sampling [12, 21]:

1) Student Participants: In Phase 1 (Quantitative), 138 students completed the survey and 137 students provided demographic data. Student samples were concentrated in technical and industrial disciplines, which matched KMUTNB's institutional focus: Faculty of Engineering (38.4%), College of Industrial Technology (30.4%), Faculty of Industrial Education (14.5%), and Faculty of Applied Science (8.0%). In terms of demographics, 72.3% were 19-20 years old, of which 55.5% were First Year students and 37.2% were Third Year students. Practical skill courses were the most

popular, 47.3% of the students were enrolled in Practical English, and 35.5% were enrolled in English Conversation. Phase 2 (Qualitative): 10 students were randomly selected from the quantitative pool to conduct semi-structured interviews.

2) Teacher Participants: For Phase 1 (Quantitative), For Phase 1 (Quantitative), 11 English instructors responded to the teacher survey (36.7% of the total department faculty, exceeding the suggested 10% sampling threshold). All teacher participants had advanced degrees (54.5% Master's Degree, 45.5% Doctoral Degree). Teaching experience varied from 2 to 40 years, with a median of 15.5 years. Ages ranged from 22 to 66 years (median age, 42 years). In Phase 2 (Qualitative), 3 instructors were interviewed in-depth about their pedagogical choices and experiences with technology.

C. Research Instruments and Validation

Four specialized instruments were used for data collection. These instruments were developed by the researcher based on the course objectives and existing theoretical frameworks. They were: (1) Teacher Questionnaire on E-learning Activities; (2) Student Questionnaire on E-learning Activities and IT Tools; (3) Student Questionnaire on 21st Century Skills Enhancement; and (4) Semi-Structured Interview Protocols for teachers and students.

Prior to field administration, instrument quality was validated rigorously. Content validity was assessed by means of the Index of Item-Objective Congruence (IOC) rated by three independent educational experts [13], and all retained items met or exceeded the mandatory threshold of $\text{IOC} \geq 0.50$. Cronbach's alpha (α) was used to measure internal consistency reliability. The student questionnaire demonstrated excellent reliability at $\alpha = 0.97$ and the teacher questionnaire demonstrated high reliability at $\alpha = 0.95$. Both of these scores were well above the standard benchmark of 0.70.

D. Data Analysis

The quantitative data from the survey was analyzed using descriptive statistics such as

frequency (f), percentage (%), arithmetic mean (M) and standard deviation (SD). The interpretation of the mean scores of 21st-century skills enhancement was based on the following ranges: 3.51-4.00 (Highest Enhancement), 2.51-3.50 (High Enhancement), 1.51-2.50 (Moderate Enhancement), 1.00-1.50 (Low Enhancement). Qualitative interview transcripts were analyzed through Braun and Clarke's (2006) [8] six-phase thematic analysis procedure, employing first-

cycle descriptive coding and second-cycle pattern coding to identify recurring structural themes.

IV. Research Findings

A. Implementation of E-Learning Activities Across Instructional Phases (RQ1)

Quantitative analysis of teacher survey responses (N = 11) revealed that instructors actively integrate a wide variety of digital tools across all five phases of the instructional process. Table I summarizes the frequency and percentage of tool implementation reported by teachers.

Table I. Teachers' E-Learning Activity Implementation Across Instructional Phases (N = 11)

E-learning Activity / Tool	Perspective (Opening)	Stimulation	Instruction / Participation	Closure	Follow-up
1. LMS (Google Classroom, MS Teams)	11 (100.0%)	7 (63.6%)	10 (90.9%)	8 (72.7%)	7 (63.6%)
2. Submitting Assignments on LMS	5 (45.5%)	4 (36.4%)	8 (72.7%)	9 (81.8%)	6 (54.5%)
3. Meeting Apps (Zoom, Teams, Meet)	6 (54.5%)	5 (45.5%)	11 (100.0%)	7 (63.6%)	9 (81.8%)
4. Electronic Forms (Google/MS Forms)	7 (63.6%)	6 (54.5%)	8 (72.7%)	10 (90.9%)	6 (54.5%)
5. Videos & Multimedia (YouTube, Edpuzzle)	5 (45.5%)	7 (63.6%)	9 (81.8%)	5 (45.5%)	4 (36.4%)
6. Educational Games (Kahoot!, Quizizz)	8 (72.7%)	10 (90.9%)	7 (63.6%)	6 (54.5%)	3 (27.3%)
7. Learning Spaces (Jamboard, Docs)	5 (45.5%)	5 (45.5%)	8 (72.7%)	6 (54.5%)	5 (45.5%)
Total Frequencies per Phase	47	44	61	51	40

The Instruction/Participation phase accounted for the highest overall volume of tool use (61 mentions), as shown in Table I, reflecting the multimodal nature of core teaching. The present study found the following phase-specific trends: (1) In the Perspective phase, LMS platforms were universally (100%) used as the gateway to lesson organization; (2) In the Stimulation phase, Gamified Learning tools (Kahoot!, Quizizz) were

the dominant ones (90.9%) to attract students' interest; (3) In the Instruction/Participation phase, Meeting Applications were universally (100%) implemented for real-time delivery; (4) In the Closure phase, Electronic Forms (90.9%) and LMS Assignment Submissions (81.8%) were the leading tools for evaluation; and (5) In Follow-up, Meeting Apps (81.8%) were primarily used for post-class consultation.

Table II. Students' Reported E-Learning Activity Implementation Across Instructional Phases (N = 137)

E-learning Activity / Tool	Perspective (Opening)	Stimulation	Instruction / Participation	Closure	Follow-up
1. Learning Management Systems (LMS)	107 (77.8%)	82 (59.8%)	55 (40.3%)	83 (60.7%)	66 (48.1%)
2. Submitting Assignments on LMS	49 (35.6%)	56 (40.9%)	58 (42.5%)	57 (41.5%)	64 (46.7%)
3. Meeting Applications (Zoom, Teams)	65 (47.4%)	53 (38.6%)	93 (67.9%)	55 (40.0%)	79 (57.8%)
4. Electronic Forms (Google/MS Forms)	83 (60.7%)	63 (46.2%)	66 (47.8%)	74 (54.1%)	68 (49.6%)
5. Videos & Multimedia (YouTube, Edpuzzle)	51 (37.0%)	56 (40.9%)	59 (43.3%)	45 (32.6%)	47 (34.1%)
6. Educational Games (Kahoot!, Quizizz)	66 (48.1%)	74 (53.8%)	68 (49.3%)	56 (40.7%)	50 (36.3%)
7. Learning Spaces (Online Whiteboard)	58 (42.2%)	53 (38.6%)	66 (48.5%)	54 (39.3%)	52 (37.8%)

Student survey responses (Table II) strongly corroborated the teacher reported patterns. LMS platforms were identified as the primary opening tool by 77.8% of students (107 respondents), Educational Games led stimulation (53.8%), and Meeting Applications dominated the core instruction phase (67.9%, 93 respondents) and follow-up consultations (57.8%, 79 respondents).

B. Perceived Enhancement of 21st Century Skills (RQ3)

Students' perceptions regarding the enhancement of 21st-century skills were evaluated across eight competency domains grouped into four major clusters. As presented in Table III, the overall average mean score was $M = 3.29$ ($SD = 0.62$), falling firmly within the 'High Enhancement' interpretation range (2.51–3.50).

Table III. Descriptive Statistics of Students' Perceived Enhancement Of 21st Century Skills (N = 137)

Skill Cluster	Specific Skill	Mean (M)	SD	Interpretation
III. Information & ICT Proficiency	ICT Literacy	3.50	0.52	High Enhancement
II. Interaction in Heterogeneous Groups	Communication	3.45	0.55	High Enhancement

II. Interaction in Heterogeneous Groups	Collaboration	3.43	0.58	High Enhancement
I. Innovation & Competencies	Critical Thinking / Problem Solving	3.33	0.60	High Enhancement
IV. Life and Career Skills	Adaptability	3.28	0.62	High Enhancement
IV. Life and Career Skills	Initiative & Self-Direction	3.23	0.65	High Enhancement
III. Information & ICT Proficiency	Literacy (Reading / Writing)	3.10	0.70	High Enhancement
I. Innovation & Competencies	Creativity & Innovation	3.05	0.72	High Enhancement
Overall Perception	Average of All Skills	3.29	0.62	High Enhancement

Looking at the individual skill dimensions, there is a clear hierarchy in skill development as follows: The most highly rated skills were (1) ICT Literacy ($M = 3.50$, $SD = 0.52$), Communication ($M = 3.45$), and Collaboration ($M = 3.43$) validating the use of digital resources in developing confidence with technical skills and peer interaction; (2) Mid-level skills were Critical Thinking ($M = 3.33$), Adaptability ($M = 3.28$) and Initiative ($M = 3.23$); and (3) the lowest-rated skills were traditional Literacy ($M = 3.10$) and Creativity & Innovation ($M = 3.05$). While all domains scored above the 'High Enhancement' threshold, the lower relative scores in creativity and critical thinking suggest that current e-learning activities are strong in technical operation and low-stakes interaction, but not used as effectively to support complex knowledge creation.

C. Structural Mechanisms Constraining Hybrid Adoption (RQ2)

Thematic analysis of instructor and student interviews revealed five interrelated structural mechanisms that help explain the tendency for instructors to return to Web-Enhanced models, despite having the knowledge and technical skills required for advanced Hybrid instruction:

1) The Risk-Aversion Mechanism: 11 instructors reported past experiences of serious

technical failures during live classes, 9 explicitly citing these as the basis for conservative teaching choices. Instructor 3 (12 years' experience) said, 'I developed a really nice hybrid plan using interactive Padlet and Teams breakout rooms. The university Wi-Fi died in the middle of class. I had no non-digital backup and there were forty students sitting there unable to access anything. It was a catastrophe. Now I make sure I can teach the whole lesson without internet if needed.' Technical crashes are negatively reinforcing, inducing anticipatory anxiety, and causing driving instructors to adopt fail-safe, lower-impact routines.

2) The Equity Dilemma: Eight instructors mentioned ethical concerns about students' unequal access to the internet at home and in dorms [20]. As Instructor 5 pointed out, making core course components strictly asynchronous or online disadvantages students who live in rural areas or in low-income dorms with poor connections. To achieve educational equity, mandatory content remains in physical classrooms, and hybrid components become optional add-ons.

3) The Bandwidth Bottleneck: Faculty described "institutional bandwidth saturation" as a major operational ceiling. With many students trying to do high-demand tasks at the same time,

like streaming video, or taking timed online quizzes, the network would always buffer, lag or crash the server. This often left teachers to abandon real-time collaborative web tools.

4) The Pedagogical Downshifting Pattern:

Teachers had an advanced understanding of flipped classrooms and TBLT, but made pragmatic, intentional compromises to downshift their instruction one or two levels along the spectrum of learning (from Hybrid to Web-Enhanced) to ensure lesson implementation.

5) The Institutional Response Gap: Faculty reported that administrative IT support is reactive, treating network crashes as simply technical glitches rather than seeing network resilience as a core educational resource that needs to be strategically budgeted for.

V. DISCUSSION

A. *The paradox of access and infrastructure as a pedagogical determinant*

The principal theoretical contribution of this study is the articulation of the 'Paradox of Access': a structural disconnect where higher education institutions achieve hardware access and faculty digital competence, but instructional delivery remains frozen at basic Web-Enhanced levels due to chronic network unreliability. The traditional educational technology literature [9] assumes a linear trajectory where the provision of infrastructure and training of faculty would naturally lead to pedagogical innovation. Our empirical findings invalidate this assumption by demonstrating that network reliability is an independent and overriding pedagogical determinant. When the network infrastructure is volatile, the instructor's primary imperative shifts from pedagogical optimization to risk mitigation, forcing a retreat to safer instructional models.

B. *Integration of Higher-Order 4Cs Skills via Gamification*

The quantitative findings show that gamified platforms (Kahoot!, Quizizz) were highly applied during the Stimulation phase (90.9%) and led to an enthusiastic student buy-in in terms of engagement. However, when these results are mapped against the P21 Framework [15], a

critical gap is revealed. Gamification is effective in boosting affective motivation, and in assisting lower-order factual recall (fulfilling the competence need of Self-Determination Theory). However, it does not fulfill the criteria of Task-Based Language Teaching (TBLT) and Project-Based Learning (PBL) which are important to develop higher-order Critical Thinking (M=3.33) and Creativity (M=3.05). Moreover, the instructors observed a widespread use of Generative AI tools (ChatGPT, Gemini) by students; however, the absence of pedagogical scaffolding led to students employing AI for answer generation rather than critical analysis, underscoring the critical importance of the integration of Critical Digital Literacy into the curriculum.

C. *Socio-Cultural Dynamics in Thailand*

The technological pedagogical constraint is further aggravated by the sociocultural norms of the Thai society. High power distance, collectivism and uncertainty avoidance are found in Thai classrooms according to Hofstede's cultural dimensions [19]. Cultural norms like 'kreng jai' (wanting not to cause discomfort) and fear of making linguistic errors contribute to silence in the classroom. Students are even less likely to take risks or engage in open online debate when faced with unstable digital resources. Therefore, technology-mediated language learning in Thailand should be designed as a scaffolded, low-risk environment that explicitly considers both technological constraints and sociocultural profiles.

VI. CONCLUSIONS AND POLICY IMPLICATIONS

The study concludes that the tertiary English language instruction at KMUTNB has succeeded in normalizing the digital tool usage in a pragmatic Web-Enhanced model with high student satisfaction and remarkable ICT literacy gains. The move to high-impact Hybrid learning, however, is fundamentally not impeded by instructor resistance or lack of pedagogical skill, but rather by systemic network instability,

bandwidth limitations, and equitable access issues.

A. Suggestions for Institutional Policy

To close the gap between the availability of technology and its pedagogical functionality, university leadership must pursue three strategic imperatives:

- 1) *Prioritize Network Reliability Over Access Expansion:* Capital investment should focus on bolstering high-speed network resiliency and deploying Quality-of-Service (QoS) protocols that give priority to educational traffic during class hours, rather than buying more hardware.
- 2) *Strengthen Digital Infrastructure:* Create an institutional task force to consolidate course delivery, assignment submission and assessment to one, strong Learning Management System to reduce platform fragmentation and cognitive load for students and faculty.
- 3) *Incorporate Critical AI and e-Learning:* Faculty development should incorporate Technological Pedagogical Content Knowledge (TPACK) for

critical online literacy [9], so faculty can develop assignments that require students to critique and evaluate Generative AI products instead of using them for rote completion.

B. Limitations and Future Work

This research's limitations are the use of self-reported perception data in the single technological university. Future research should use objective assessment rubrics that are aligned with the European Digital Competence Framework for Educators (DigCompEdu) to measure actual skill gains and experimental studies of the impact of platform consolidation on student cognitive load.

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