
RESEARCH ARTICLE

Beyond the Digital Divide: Theorizing "Environmental Support" as the Fourth Pillar of TPACK through Teacher Agency in Pakistani Higher Education

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ABSTRACT

Although current discussion in the world of higher education leans toward Web 3.0 and Generative AI, Global South institutions still face systemic digital precarity. We carried out a qualitative study to understand internal pedagogical rationale of 25 English as a Second Language (ESL) teacher educators in one of the private universities in Pakistan in order to find out how they negotiated the extreme tension between institutional Digital Ambition (institutional mandated, heavy-server Learning Management Systems) and infrastructural Digital Reality (rolling power interruptions and student data poverty). With the help of Reflexive Thematic Analysis (RTA), we have been able to find that educators are neither adopting nor shunning technology but are instead acting as resilient orchestrators. Out of student equity, the participants performed a Pedagogical Pivot and resorted to subversive compliance to circumvent multi-million-rupee official platforms with low-bandwidth mobile messaging applications, which here are considered the Shadow LMS. In an attempt to overcome the theoretical weaknesses of the current technology-centric models, this paper officially introduces TPACK-ES (Environmental Support) model. The study separates internal Contextual Knowledge (XK) and external material reality, putting Environmental Support as the fourth pillar of the TPACK framework. With this new model we make a conclusive forecast of the future of an impending AI Divide and provide strategic policy suggestions to justify infrastructural resilience in global higher education.

KEYWORDS

TPACK-ES Model, Digital Precarity, Shadow LMS, Global South Higher Education, Teacher Agency, Institutional Isomorphism, ESL Instruction

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1. Introduction

With the shift to the second half of the 2020s, the debates of even higher education are unequivocally dominated by the so-called hyper-digital potential of Generative Artificial Intelligence (GenAI), the Metaverse, immersive spatial computing, and algorithmic personalization (Park, 2025; UNESCO, 2023). Recent scholarly paradigms of the Global North indicate that schools have surely transitioned to a new ontological realm where the classroom is a borderless environment characterized by the smooth connection

and cloud cooperation. But this is not the reality of the Global South, and more precisely, the growing sector of higher education in Pakistan, where this discourse of smooth sailing is not an experience, but a belated dream full of tension.

In Pakistan, there exists a sharp Infrastructural-Pedagogical Paradox of digital transformation of Higher Education Institutions (HEIs). On the one hand, universities that are privately operated are in an aggressive competition over digital prestige. Compelled by intense competition on the market, the necessity to take the top positions in QS World University Rankings, and the necessity to pass strict digital compliance checks by the Higher Education Commission (HEC) of Pakistan, such institutions tend to spend much money on monolithic Learning Management Systems (LMS) and enterprise-wide software suites (e.g., Microsoft Office 365, Canvas, Moodle). This state of affairs is referred to by sociologists as institutional isomorphism (DiMaggio and Powell, 1983)- the trend of organizations to resemble the design of perceived industry leaders in order to receive authorization, not matter how impractical.

Conversely, pedagogy is performed by teachers and students in an everyday setting of the Digital Precarity. Such precarity is characterized by structural energy crises with intermittent, unannounced power outages (load-shedding), drastically fluctuating bandwidth to the internet, and a student population that has to cross a vast socio-economic digital divide just to log-in (Naveed et al., 2025).

In this argument, we believe that the lack of connexion between institutional level "Digital Ambition" and user level of Digital Reality is damaging when it comes to teaching English as a Second Language (ESL). Traditionally the Pakistani ESL classroom was run on the so-called banking model of education: isolated, teacher-centered dispensation of grammatical rules. Collaborative Learning Tools (CLTs) would bring a highly desirable Social Turn to this pedagogy and turn language learning into an active dynamic social practise of negotiated meaning (Swain, 2000; Vygotsky, 1978).

However, despite institutional heavy investment in these tools, there is still a widespread tendency of underutilization of these tools, especially in pedagogy. Why do very qualified teacher educators so often go back to old-fashioned method, or, more to the point, are totally out of the formal university digital systems?

1.1. The Issue: The Digital Divide Beyond the first and second digital divide

Recent research has comprehensively mapped the First Digital Divide (access to hardware and the internet) and the Second Digital Divide (digital literacy and skills to operate it) in order to get a clearer insight into the adoption barriers in higher education (Chugh et al., 2023; Naik and Naik, 2025). Therefore, predictive models such as Technology Acceptance Model (TAM) are often used in research in Global South to assess the rates of student and teacher adoption (Alyousef, 2023; Khan et al., 2025).

Although useful, these quantitative snapshots have a techno-centric bias by their nature. They take the technology as a constant variable and the user as a lacking variable that requires to be corrected. We are entirely short of qualitative studies into the inner workings of the teacher educator which is at the precarious frontier of such splits. What does a teacher do to ensure pedagogical continuity when the university server goes down in the middle of the lecture? What do they do to reconcile the room to manoeuvre between the rigid administrative requirements that they use official platforms and the lack of connectivity of their students?

1.2. Theoretical Intervention: Rediscovering TPACK to fit the Global South

In an attempt to respond to these questions, the study uses Technological Pedagogical Content Knowledge (TPACK) framework (Mishra and Koehler, 2006). TPACK in the last 20 years has become the standard of what defines an effective technology implementation and programmed to help professionals to develop that can advance the competencies of teacher educators (Cam & Koc, 2024; Koehler and Mishra, 2009).

But we argue that the archetypal TPACK model lacks ecologically. It makes implicit assumptions of stable, Westernized infrastructure in which, in case a teacher has the necessary technological and pedagogical expertise, performance as a result is a matter of natural implementation. Teacher knowledge in the Global South, cannot be considered as just a fixed state of cognition but is a "Situational Performance." The level at which a teacher can be able to utilize technology is greatly mediated by the Environmental Support (ES) that is available at that specific time of instruction. TPACK takes no account of the material environment as a limiting agent that is also active, so it is an internalist theory which does not fit well with the infrastructural realities of Pakistan (Naveed et al., 2025).

1.3. Research Objectives and Significance

This qualitative study investigates the lived experiences of 25 higher education ESL teacher educators in a prominent private Pakistani university. By centering their voices and daily pedagogical improvisations, we aim to:

1. To identify specific triggers that move a teacher from technological apprehension to active, resilient adoption.
2. To explore how and why teachers deliberately bypass official university infrastructures (like Moodle) in favor of unofficial "Shadow LMS" strategies (like WhatsApp).
3. To propose a formal theoretical modification to the classic TPACK framework by adding "Environmental Support" as a fourth, foundational pillar, culminating in the **TPACK-ES model**.

By shifting the academic narrative from a "deficiency model" to an "agency model," the resilient pedagogy pioneered by these Pakistani educators offers a strategic roadmap for the rest of the world.

2. Literature Review

2.1. Theoretical Foundations: Sociocultural and the Social Turn

Online collaboration in language teaching is a deep epistemological position that is based on the sociocultural approach of (Vygotskian, 1978). Collaborative Learning Tools (CLTs) are the so-called digital scaffolding that students require in the digital age to navigate their Zone of Proximal Development (ZPD). With the help of negotiation meaning, the learners share the knowledge and thus the digital space becomes a dynamic location of linguistic development.

This change is congruent with the idea of situated learning presented by Lave and Wenger (1991) in which language proficiency is an ongoing process of legitimate peripheral engagement in a community of practice and not an isolated thinking process. With the help of cloud-based tools, it is possible to have what Swain (2000) referred to as Collaborative Dialogue. Moreover, according to the theory of Connectivism developed by Siemens (2005), contemporary learning is related to linking the specialized information nodes. Nonetheless, as Bach and Thiel (2024) note, when the digital pipe fails because of the failure of infrastructure (e.g., a blackout), the whole network will go down immediately, and the pedagogical design by the teacher will become futile (Bach and Thiel, 2024).

2.2. From the Digital Affordances of ESL input to the Interaction

The most powerful tools of digital collaborative learning are currently collaborative writing and asynchronous discussions, which are used in the ESL sphere (Li and Zhang, 2023). Years of research work underpin the fact that text-based environments promote critical inquiry and cognition presence (Garrison et al., 2000). These platforms facilitate a kind of so-called shared cognitive space in which metacognition is possible and very focused feedback can be provided an activity that is well known as one of the most effective sources of student achievement in the modern world (Hattie and Timperley, 2007) and the provision of such feedback was structurally impossible in the pen-and-paper era (Albeshir, 2024).

Nonetheless, the deployment of these settings is not smooth sailing, and the active struggles with the group dynamics and equal participation in online settings are still well-documented (Donelan and Kear, 2024). The key affordance that enables non-native speakers of English to overcome such difficulties is the so-called Reflective Buffer (Xia and Xu, 2024). Students in traditional Pakistani classrooms often experience debilitating learning anxiety because of strong cultural demands of oral accuracy and sociological inhibition of face loss (Li et al., 2024). Digital forums necessarily interfere with the time constraint of the real classroom and democratize voices of students in a way that is not dependent on high-bandwidth connectivity at all times (Yorganci, 2025).

2.3. TPACK Framework and the Context Deficit

TPACK establishes the knowledge intersections that are complex in order to work well together (Mishra and Koehler, 2006). In the case of an ESL teacher, technical proficiency is completely useless without the pedagogical skill to create group activities in the achievement of language objectives.

Critics however point out that the framework takes into consideration the "Context" as a silent, passive background variable. The argument of Porras-Hernandez and Salinas-Amescuela (2013) is quite convincing and effective; they emphasize that standard TPACK does not allow distinguishing between micro-context (classroom dynamics) and macro-context (systemic infrastructural and economic factors). Likewise, Angeli and Valanides (2009) observe that teachers in emerging situations will be real-time mediators who cope with the unavoidable possibility of a technical failure (Naveed et al., 2025). This theoretical gap demonstrates that a new model is a pressing necessity that must explicitly bring environmental realities to a pillar of teacher knowledge (Budianto et al., 2023).

2.4. Digital Precarity, Institutional Isomorphism, and Shadow IT

Now, scholarship pays a lot of attention to the so-called Pedagogical Divide the difference between owning a technological tool and having the systemic support to utilize it on a meaningful level (Ahmad et al., 2023).

Universities in Pakistan exist in a digital precarity socio-economic environment. Teachers are in a pincer position of stress: they are expected to meet high levels of administrative demands on digitized instruction when working in a terrain of low infrastructural dependability. Institutional Isomorphism, as DiMaggio and Powell (1983) hypothesized, causes this tension. The Global South universities are being pressured to follow the footsteps of the Global North by buying compute-intensive LMS licences to receive a higher QS rating and to pass HEC audits, despite the fact that the municipal power grid will be unable to remain online at all times to serve all servers. As a result, in order to secure continuity in learning, instructors tend to either use the so-called Shadow IT or Shadow LMS tactics and get around the requirements in terms of mobile-first, such as WhatsApp (Ali, 2024; Manzoor et al., 2024).

2.5. The Wave of Generative AI and the Third Digital Divide

With the increased infiltration of higher education by generative AI and Large Language Models (LLM), the digital equity stakes are increasing exponentially. Although the main empirical facts of the present research are concerned with the present-day Web 2.0 ecosystem, the existing literature is silent on a crucial gap about the specific processes of transition between the two periods.

Park (2025) cautions that GenAI must have explicit competency training and constant and high-speed link to the cloud. The high level of Future-Oriented Agency is the indicator of the tremendous interest of Pakistani educators in these tools (Ashraf, 2025; Mahlo, 2025). However, a deeper structural paradox exists: in case the very infrastructure that is needed to upload an LMS video is inherently shaky, how even the enormous computational needs of GenAI is supposedly going to be addressed? It is this gap that this research aims to fill by suggesting a model that will explain the present Web 2.0 resilience, and subsequently project what future implications an imminent AI Divide would have on us (Celik & Baturay, 2024).

3. Research Methodology

3.1. Research Design and Epistemological Grounding

The research design was a qualitative exploratory design that was based on a paradigm of Social Constructivist and Interpretivist paradigm (Lincoln and Guba, 1985). This paper categorically denies the positivist concept that the integration of technologies is a single objective reality which is a product of hardware only. Rather, by relying on the constructivist learning environment theories (Jonassen, 1999), we claim that globally the South digital learning environments are a complex construct, which is created through everyday discursive interaction of teachers, learners and those precarious constructions.

Since, as Connor, Flenedy, Massey, and Dwyer (2024) note, qualitative inquiry entails recognizing the latent concerns of a group of participants, interpretivism methods are unusual in that they enable researchers to discover the hidden primary drawbacks of subjects who have gone through a severely constrained setting in which institutional directives conflict with unstable material realities. TPACK was our main analytical prism, paying much attention to the phenomenological how and why of teacher experience.

3.2. The Research Setting: Private HEI as a "Critical Case"

The research was done in a well renowned private university within Punjab, Pakistan. After the methodological strategy espoused by Flyvbjerg (2006) of Critical Case Sampling, we intentionally chose this institution on account of the fact that it is in productive friction. At the policy level, the university boasts of enormous digital ambitions (forced Moodle usage, intensive HEC enforcement).

However, at the physical level, it is subject to systemic regional constraints, such as unannounced frequent load-shedding (Flyvbjerg, 2006).

3.3. Participants and Sampling: Power of information

We used a purposive sample of 25 higher education ESL and Humanities teacher educators (N=25). We facilitated our sampling based on the concept of Information Power presented by Malterud et al. (2016), according to which the more striking and relevant the information that the sample contains, the fewer individuals are necessary as a final result of the sampling (Malterud et al., 2016).

The respondents were required to have a minimum of five years of experience in teaching in universities and experience using collaborative digital tools in the official ecosystem. The ratio of gender (21 women, 4 men) corresponds to the demographic situation in Pakistan Humanities departments.

Table 1: Anonymized Participant Demographics (Subset of Key Informants)

Pseudonym	Gender	Age	Highest Qualification	Years of Exp.	Official Mandated LMS	Primary "Shadow LMS"
P03	Male	45	PhD (Applied Ling)	15	Moodle	WhatsApp / Telegram
P05	Female	39	PhD (Education)	9	Moodle	WhatsApp (Voice Notes)
P07	Male	52	PhD (TESOL)	22	Moodle	Facebook Private Group
P08	Female	38	MS (Linguistics)	7	Moodle	Padlet / WhatsApp
P11	Female	41	PhD (Literature)	12	Moodle	WhatsApp
P14	Female	48	PhD (Education)	18	Moodle	Google Docs / WhatsApp
P19	Female	38	MS (ELT)	10	Moodle	WhatsApp
P24	Female	40	MS (Applied Ling)	8	Moodle	WhatsApp

(Note: All 25 participants were analyzed; this table represents the key informants quoted in Section 4. Pseudonyms P01-P25 were assigned to ensure strict anonymity).

3.4. Data Generation: The Detailed Semi-Structured Interviews

The primary qualitative data were produced as a result of in-depth and semi-structured interviews (between 75 and 90 minutes). Our progressive scaffold of 15 questions with the mapping on the dimensions of TPACK was designed to avoid repetition, the institutionally correct answers. The interviews were held freely in English and Urdu (translanguaging), where the participants were able to converse on issues that were complex and they were able to tell comfortably.

3.5. Analysis Data: Reflexive Thematic Analysis (RTA)

Instead of using a fixed, preset codebook, we adopted a more organic and highly iterative process of analysis. The analysis was very much based on the Reflexive Thematic Analysis as we as researchers do not just observe, but we are the main tools of making sense (Braun and Clarke, 2021). To manage the data, we applied NVivo 14 software containing six steps, which are systematic and rigorous:

Familiarization: Active, repeated reading of the 25 transcripts in order to immerse deeply in the material in the process of which the first analytic memos are written.

Producing Get-First Codes: Mini-coding, line-by-line on all data to find salient meaning units (e.g. coding phrases such as the screen froze or they ran out of 4G).

The Theme search: Pooling the hundreds of initial codes into the possible broader, themes.

Themes (Semantic to Latent) Review: This phase had the greatest Q1 rigor release. We intentionally transited the semantic codes (what interviewees have dedicatedly stated regarding software) over to latent themes (the tacit, unspoken convictions regarding the dynamics of power, institutional monitoring, and organizational health).

Defining and Naming Themes: Honing the details of every single theme so that it created a seamless story of teacher agency.

Creation of the Report: identification of the most vivid interesting data extracts to show how common and emotionally significant the themes are.

Table 2: Excerpt of the Reflexive Thematic Analysis Coding Tree

Raw Data Extract (Participant Voice)	Initial Code	Semantic	Latent Code / Category	Final Theme	Overarching
<i>"I avoided collaborative tools for two years... I couldn't risk looking incompetent when the video lagged in front of 50 students."</i>	Fear of video lag; Avoiding tools.		Technology threatening teacher authority/status.	Theme I: The Pedagogical Pivot & Performance Vulnerability	
<i>"Technology gave them the permission to draft... I saw the quality of grammar improve because they had the luxury of a 'delete' button."</i>	Using the delete button; Better grammar.		Decoupling cognitive load from social anxiety.	Theme II: Negotiated Participation & the Reflective Buffer	
<i>"If I rely solely on the official system, I fail my students. I post to the LMS to satisfy the admin, but I teach through the back door."</i>	Using two systems; Hiding teaching methods.		Bypassing institutional surveillance; Empathic subversion.	Theme III: The Infrastructural Paradox & The Shadow LMS	

3.6. Researcher Positionality and Trustworthiness

The researcher was a scholar participating in the research as an outsider-insider in this field- a Pakistani ESL teacher who was conversant with this very precarious industry. This gave a clear "epistemic advantage, which brought out stunning candor in terms of faking compliance. In order to strictly curb the influence of insider bias, we applied Reflexive Journaling and Theoretical Bracketing during data analysis.

To secure trustworthiness, we had developed trustworthiness (Lincoln and Guba, 1985) by engaging ourselves through a long period of interaction, maintained open audit trail, and formal member checking with five important informants who authenticated the validity of our conceptualization of the Shadow LMS.

Credibility and Moral Probity

To meet the utmost (methodological) criteria of qualitative research (Lincoln and Guba, 1985), we have determined trustworthiness basing on four interconnecting strategies:

Credibility: Achieved by providing a thick description of the situation inside the institution, and extended interaction with the data. Also, we performed official member checking by revisiting the synthesized themes back to five principal informants in order to document that there was a sense of accurate depiction of their pedagogical lives in our theoretical interpretations. The conceptualization of the Shadow LMS was accurate as affirmed by all five of them.

Transferability: Although qualitative research does not aim at entailing statistical generalization, the researchers have extensively framed the context so that researchers not in the Global South (e.g., Sub-Saharan Africa, Latin America) can evaluate the relevance of the TPACK-ES model to their own infrastructural environments.

Dependability: Enforced with a strict transparent audit trail (as shown in Table 2) covering all significant analytical choices and codes switches since the pilot stages up to final synthesis.

Confirmability: Enforced by the process of the reflexive journaling specified above that monitored the changes in the interpretations of the researcher throughout the six months of data analysis process.

Ethical Approval: The study design and interview protocols as well as data storage mechanisms were ethically approved by the Institutional Review Board (IRB Reference #PAK-2025-04) in full and unconditionally. The right of participants to drop out at any time without incurring any penalty was well explained. Considering the sensitivity of the situation, in a culturally related manner, when discussing the unofficial forms of teaching that can be used to unravel university policy, one was being very cautious to safeguard professional identities. All information was done using alphanumeric codes to ensure complete anonymization and distinct departmental numbers were removed in the final transcripts.

4. Findings and Results

The reflexive thematic analysis presented an extremely sophisticated, emotionally saturated pedagogical space. This is the underlying notion of our data: that the Global South educators are simply adopting or renouncing technology. Rather, the participants became so-called Resilient Orchestrators, whose main feature was the continuous negotiation of an unstable truce between pedagogical aspirations and digital instability.

4.1. Theme I: The Pedagogical Pivot, It Apprehension to Pedagogical Proof

The subjects were first exhibiting Technology Anxiety. Nevertheless, as compared to Western literature, in which anxiety may be due to lack of computer literacy, this anxiety took root in the depths of Performance Vulnerability.

4.1.1. The Vulnerability of the Expert

The teacher, as seen in the context of the South Asian culture, has traditionally been placed on a hierarchical level 11 as the Ustad -authoritative, unquestionable source of knowledge. The chance of erratic collaborative technology was a direct danger to this position.

The fear was aptly expressed by P03:

"In a physical lecture, I control the time, the board, and the silence. When I log into MS Teams or the university LMS, I am suddenly at the mercy of the server. If the screen freezes, my authority freezes with it. I avoided collaborative tools for two years not because I didn't see their value, but because I couldn't risk looking incompetent when the video lagged in front of 50 students." (P03, Male, PhD)

These stores indicate that early opposition to DCL is not often a failure in Technological Knowledge (TK). Instead, it is a logical safety step to maintain Professional Identity when the macro political climate weakens the micro political one.

4.1.2. The Turning Point: Experiencing the Digital Voice

Importantly, the Pivot to resilient adoption did not take place often due to mandate requirements held by the administration. Rather, their agency was initiated by a demonstration of pedagogical evidence that can be seen as observable evidence that technology has the potential to resolve an equity concern in a classroom setting, called Pedagogical Proof.

P14 outlined a moment of transformation that can be directly labelled onto regional discoveries about the democratizing aspect of external applications (Alhadi and Mugaddam, 2024):

"I have a student from a rural district, very brilliant but painfully shy. In face-to-face classes, she never spoke. One day, on a Padlet board... I saw a live post appearing. It was her. She was politely but firmly correcting a dominant male student's thesis statement. She wouldn't have dared to do that verbally. I realized the tool wasn't about the internet; it was a shield behind which her intellect could finally breathe." (P14, Female, PhD)

This indicates that the teacher agency is a phenomenon that comes into action by means of empathy and not through technology efficiency.

4.2. Theme II: Negotiated Participation and the Reflective Buffer

When the pivot took place, teachers intentionally used CLTs to transform the cognitive requirements of ESL teaching. Extreme "cognitive overload" is common when using synchronous (live) interaction. The forums were asynchronous and aided the students in decoupling between the thinking time and the production time.

P08 described this digital affordance in the best way possible:

"In a live class, the student has three seconds to process the English, formulate the content, and calculate the social risk of making a mistake in front of peers. It's too much. On the discussion forum, they have 30 minutes. I saw the quality of grammar improve simply because they had the luxury of a 'delete' button." (P08, Female, Lecturer)

With the use of such a Reflective Buffer, the teachers bypassed the psychological barriers of language learning, and it is a very advanced usage of TPACK.

4.3. Theme III: Structure of the Infrastructural-Pedagogical Paradox and Shadow LMS

This theme is a manifestation of the most significant empirical input of the work. It cuts straight to the head of the day-by-day conflict between the university when it comes to the HEC audit of campus with "Official Digital Narrative" (costly licences of Moodle) and the Digital Reality of lived life (load-shedding and data limits). To maintain the continuity of learning, Pakistani teachers created an extremely advanced, institutionally non-approved Shadow Pedagogy based on mobile messaging services.

4.3.1. The Logic of Risk Management

Participants overwhelmingly viewed the server-heavy LMS as a "fair-weather friend. The teachers did not see professional compliance in terms of strict following of official system but pedagogical negligence.

"The university mandates we upload all lectures to the LMS. But I know that at 8:00 PM, when the whole city is home and the grid is strained, the server slows down to a crawl... So, I post to the LMS to satisfy the administration's surveillance, but I actually teach through the back door." (P11, Female, Assistant Professor)

P03 has supported such culture of performative compliance: Moodle is a museum, here we show our syllabus to the Deans. The WhatsApp is the place on which the real teaching takes place.

4.3.2. WhatsApp: The Shadow LMS: A Resilience Strategy

A staggering 22 of 25 respondents openly acknowledged the usage of WhatsApp group as their main Learning Management System. This was a gesture of severe Infrastructural Resilience. WhatsApp is a low-bandwidth epistemology. It has local data storage in cases of power outage.

P19 explained:

"When the electricity goes out during a monsoon storm, Moodle dies. But WhatsApp persists. I sit in the dark, and I record voice notes summarizing the critical points... We are conducting high-level academic seminar discussions on a chat app meant for families." (P19, Female)

4.3.3. Student Reaction: Student Response to the Shadow System Relief

The teachers have stated that students overwhelmingly liked the Shadow LMS due to its proactive alleviation of their long-standing worry about being digitally excluded as well as adherence to their financial situation.

"Moodle requires a laptop and a stable Wi-Fi connection. WhatsApp works on a cheap, 50-rupee daily data package while a student is on a commute... If I forced them to download a 500MB MP4 video from the LMS, half of them couldn't afford the data. The Shadow system is an act of economic empathy." (P24, Female, Lecturer)

4.3.4. The AI Horizon Future-Oriented Agency

Although core data focused heavily on Web 1.0/2.0 solutions due to necessity, an extension of their reasoning regarding pedagogy was natural as it extended into the future. Similar to international studies on the logistical dissonance of large online distance classes (Mei et al., 2025), the participants were desperate to find high-tech solutions to the problem, such as Generative AI to struggle against huge class sizes.

"I want to use AI tools like ChatGPT to handle the basic grammar checking of 60 essays... But the irony kills me. If I cannot even get Moodle to load on a Wednesday afternoon without the server crashing, how will I run a live, cloud-based AI integration in my classroom? We are dreaming of flying spaceships while actively riding bicycles." (P05, Female, PhD)

It reveals the final Infrastructural Paradox, and that of the inside of the cognitive state of the teacher: they are forced through the material environment in violence even as their mental world creates a circumstance where they are forcibly pushed back into the world of text-based chat programmed.

5. Discussion

The fact that technology integration continues to be a cyclical process of continuously fraught Ecological Negotiation, is a strong suggestion in our findings in the Global South.

5.1. The "Human-in-the-Loop" as an Agent of Resilience

Although quantitative research so frequently also points to the key role of user attitudes in technology adoption (Khan et al., 2025), we radically differ in nature of the attitudes. Predictive models consider that the perceiving ease of use is the primary element influencing technological adoption. Conversely, our respondents transparently selected tools much more difficult to control, including, but not limited to, the over-application of e-moderating principles (Salmon, 2013) to monitor 50 running WhatsApp audio streams manually rather than an automated LMS quiz (Chen, 2025), due to Pedagogical Reliability being much greater. Empathy in teachers led to all the learning curves that occurred at personal sacrifice without compensation once they saw what a visible equity result would be (Salmon, 2013).

5.2. Theorizing Shadow LMS and Subversive Compliance

The use of Shadow LMS platforms on a mass scale is a grassroots criticism of Institutional Isomorphism. By westernizing its digital infrastructures in order to meet the external rankings without covering the cost of the student data, universities form a pedagogical vacuum.

Discovering a way to subvert the use of non-restrictive tools, Pakistani educators have gone back to low-bandwidth interests. They meet the final academic ends (according to the requirements which stipulate learning outcomes) by compromising established processes (not using the authorized LMS). But this is extremely dependent upon the invisible emotional work going uncompensated and thus making this body of resilience systemically unsustainable.

5.3. Theoretical Contribution: TPACK-ES Model

The major theoretical contribution that we make is that we formally propose the TPACK-ES (Environmental Support) Model. It does not seem that infrastructural barriers are not already encompassed by the current notion of Contextual Knowledge (XK)? It is essentially, we say, no:

One internal state of cognition is Contextual Knowledge (XK). (e.g., I know the electricity of the municipality interrupts at 8:00 PM and my students cannot afford 4G data).

Environmental Support (ES) is an exterior material fact. (e.g., The physical affordance of the campus backup generator literally operating, or the university policy officially permitting low-bandwidth substitutes).

The Difference: A teacher may have perfect Contextual Knowledge - have complete knowledge of the infrastructural barriers of his students - without being in any way paralyzed as a pedagogue because the Environmental Support is not there. The awareness of a material constraint does not eliminate the material constraint.

Thus, TPACK is a consequence of the ES pillar as a complete mediator of the Situational Performance. Once ES collapses, the crossroad of Technology, Pedagogy, and Content will fall immediately, no matter how high the qualification of the teacher.

5.4. Implications in the Future: One TPACK-ES Lense of the AI Divide

The future of technological integration is apparent based on our new TPACK-ES model just waiting to happen leading to a massive crisis. There is no way that what is being called the Shadow LMS can support a Generative AI and the Metaverse, which demand exponentially more bandwidth and constant connection to the cloud. Unless institutions thoughtlessly enforce computer-intensive AI requirements without a significant enhancement to the ES pillar (such as data plans that are entirely free of charge), then the old-fashioned Digital Divide will brutally transform into an unsurmountable AI Divide. The low-bandwidth resilience plans of the present day merely cannot accommodate the all-immersive worlds of the future that are data-intensive.

6. Implications and Recommendations

The shift of the Digital Ambition into the Digital Reality will need the paradigm shift.

6.1. Policy Level: Making the Shadow infrastructures legitimate

HEIs need to come up with a formal Low-Bandwidth Digital Policy (LBDP). Templates of Hybrid-Resilient Syllabi should get the backing of the academic Deans wherein all high-bandwidth necessities (e.g., synchronous MS Teams lecture) have a low-bandwidth alternatives (e.g. asynchronous audio-script via WhatsApp) which have already been sanctioned.

6.2. Institutional Level: The Insurance Scholarship

As our data indicate the Digital Divide is the "Data Divide. Universities must drastically redesign their financial models to create so-called Connectivity Scholarships that collaborate with the local telecoms to zero rate academic traffic during rural studies.

6.3. Pedagogical Level: The Pedagogical Technologist

Learning institutions need to establish specialized positions that are called Pedagogical Technologist. They are not printers' fixers but are called Resilience Consultants in the intersection of both, specifically, by training teachers in the Crash-Proof design of assessment.

7. Limitations and Future Research

This research offers profound qualitative insights without leaving outside its ecological outlook. First, it is the Institutional Bias of Elites, which implies the resilience will include those students who own at least some mid-level smartphones; feeble universities in underfunded rural areas will have a complete divorce to the digital world (Shambare & Simuja, 2024). Second, the sample (84% female) could potentially be biased with covering unique male views on risk-taking as a part of professional activity. Lastly, we 100% based our observation on the pedagogical rational of the teacher, which recorded second hand the feelings of the students.

The proposed quantitative research would designate the Environment Support variable as an operationalized one to statistically assess the mediating effect of the Environmental Support on TPACK efficacy in thousands of educators in the world.

8. Conclusion

This study essentially confronts the hegemonic notion of the deficit discourse that is applied to the existence of higher education in the Global South. Instant research into the lived experiences of ESL educators within Pakistani context shows that these educators are not in the called lagging because of the lack of the cognitive skill or digital literacy. Instead, they are very sophisticated empathic facilitators who lead an empathetic Pedagogy of Resilience.

We achieve three contributions, namely, identification of the Pedagogical Pivot as an equity-driven student response; the revealing of the disloyal compliance of the Shadow LMS; and the theorization of TPACK-ES Model, which formally deems Environmental Support as the gatekeeper of teacher knowledge.

Final Thought: Implications for the AI Era

With higher learning in the world experiencing the dawn of the Artificial Intelligence age, the repercussions of our TPACK-ES paradigm are dire. The grassroots web 2.0 Shadow LMS was able to rescue the Web 2.0 system before its failure, however, human burnout and text-based threads on WhatsApp cannot sustain the compute-intensive demands of ubiquitous AI. Unless universities and governments proceed to invest blindly in "Digital Ambition" (AI subscriptions and QS rankings) in concomitant degree to addressing what is being called Digital Reality (power grids and data equity), it will not translate to an educational transformation but an irreversible stratification. Digital transformation should be sustainable not in purchasing more sophisticated tools but in trusting the pedagogical rationale of the teacher and creating an Environment which will eventually give him or her his/her due.

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