Language Production Environments under Digital Constraint: Adaptive Repertoires and Ethical AI Boundary-Making in a Mobile-First Multilingual and Inclusive Learners Context

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HOW TO CITE:
Marhada H. Paraman (2026). Language Production Environments under Digital Constraint: Adaptive Repertoires and Ethical AI Boundary-Making in a Mobile-First Multilingual and Inclusive Learners Context. International Journal of Special Education, 41(3s), 63-68.

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ABSTRACT:
This qualitative study examines how diverse undergraduate learners navigate systemic infrastructural barriers—such as poor connectivity and device inequality—to achieve equitable language production. Framed by Universal Design for Learning (UDL) and Self-Regulated Learning (SRL), the research explores adaptive practices in a mobile-first, multilingual higher education context. Data from semi-structured interviews and reflective journals with 30 English language students reveal that marginalized learners actively reorganize their production environments. Findings indicate students strategically adapt or abandon inaccessible digital workflows to preserve core academic standards. Furthermore, learners utilize multilingual repertoires and generative AI as critical, stage-specific assistive scaffolding during planning phases, while fiercely protecting their authorship in final outputs. This bounded AI engagement demonstrates a sophisticated inclusive digital literacy. Ultimately, the study argues that educational equity requires institutions to validate flexible, asynchronous workflows and support responsibility-driven AI engagement over rigid technological compliance.

Keywords: Inclusive Education, Universal Design for Learning (UDL), Digital Constraints, Ethical AI Engagement, Language Production Environments

1. INTRODUCTION

With 73% of institutions facing infrastructure limitations and platforms treating accessibility as a mere "technical add-on" (de Oliveira Fraga, 2026; Singh et al., 2026), a measurable digital divide persists despite the rapid proliferation of digital learning platforms prompting diverse learners to actively navigate inaccessible systems to achieve equitable academic language production.

To understand how students manage these systemic barriers, this study is anchored in the Universal Design for Learning (UDL) framework and Self-Regulated Learning (SRL) theory. UDL promotes adaptable methods to reduce educational barriers (Veytia Bucheli et al., 2024; Chick et al.,

2025), while SRL highlights the agency and resilience learners exercise when confronting technological disruptions (Tinajero et al., 2024; Pan et al., 2025).

The relocation of academic work to mobile devices and fluid spaces fundamentally reshapes language production (Naveed et al., 2023). In response to infrastructural constraints—such as low bandwidth or device inequality—learners construct micro-workflows, redistribute tasks, and strategically abandon inefficient tools that increase cognitive load (Galeo & Opino, 2025; Pérez-Juárez et al., 2023; Koudsia & Kirchner, 2024). In multilingual settings, learners also negotiate language choices dynamically, utilizing translanguaging as a vital communicative asset (Caires et al., 2024; Wang et al., 2021).

Simultaneously, the emergence of generative AI provides critical assistive scaffolding, particularly for neurodiverse learners navigating these environments (Zhao et al., 2025; Farhah et al., 2025). Rather than passively adopting these tools, students demonstrate responsibility-driven engagement by establishing stage-specific ethical boundaries—relying on AI during planning phases while disengaging during final drafting to preserve originality (Marzuki et al., 2023; Bleher et al., 2023).

Addressing a gap in inclusive pedagogical research, this study explores how language production unfolds within mobile-first, multilingual environments to provide a basis for policies that validate fragmented, asynchronous workflows as legitimate academic practices (Nordin et al., 2026). Specifically the study aims to:

1. Examine how undergraduate students construct and manage language production environments in a mobile-first, multilingual higher education context, focusing on how planning, drafting, revision, monitoring, and affect regulation are organized across writing, speaking, listening, and integrated academic tasks under variable digital access conditions.

2. Analyze how learners adapt to and strategically abandon specific digital tools, modalities, and workflows in response to constraints such as unstable connectivity, device limitations, and fragmented study spaces, while preserving core language production processes including coherence-building, accuracy, revision, and communicative effectiveness.

3. Explore how students articulate and enact ethical boundaries in the use of AI-mediated and digital language support, particularly how AI and translation tools are selectively integrated during early production stages (e.g., planning and clarification) while maintaining learner authorship, originality, and accountability in final academic outputs.

2. METHODOLOGY

This study employed a qualitative, interpretivist design framed by Universal Design for Learning (UDL) to examine language production as a situated process shaped by technological and systemic barriers. The research was conducted at Basilan State College (BaSC), Philippines, a multilingual institution with uneven digital infrastructure, making it an ideal context to study inclusive learning adaptations under digital constraints. Using purposive, maximum-variation sampling (Patton, 2015), 30 undergraduate English Language Studies students were selected to capture diverse production environments, access conditions, and linguistic repertoires rather than statistical representativeness.

Following ethics approval, data were collected through semi-structured interviews exploring planning and AI ethical reasoning, multi-day reflective journals documenting real-time adaptations to access constraints, and a background questionnaire establishing contextual technical data. Aligning with UDL principles of flexible expression, participants could code-switch during interviews and submit journals in audio or written formats. Data were analyzed using reflexive thematic analysis (Braun & Clarke, 2006, 2019), coding for observable practices like micro-drafting and interpretive dimensions such as protecting authorship. Trustworthiness was ensured through data triangulation, peer debriefing, an audit trail, and strict anonymization protocols.

Table 1. Interview guide questions

Objectives	Interview question
To identify deliberate teaching strategies used by Science, Math, and ICT teachers that aim to foster innovation among learners.	1. What specific teaching strategies do SMICT teachers intentionally implement to stimulate students' innovative thinking? 2. How do teachers integrate problem-solving, inquiry, and experimentation into daily lessons to support innovation?
To determine how SMICT learners respond to these strategies in terms of motivation and engagement in innovation.	1. How do Science, Math, and ICT learners perceive the effectiveness of these strategies in motivating them to innovate? 2. What aspects of the teaching approaches (hands-on tasks, real-world applications, project-based learning, technology integration) strengthen or weaken their desire to innovate? 3. What learner characteristics influence how they benefit from these strategies?

3. RESULTS

3.1. Objective 1: Managing Language Production Environments Under Constraint

Findings indicate that learners actively construct and regulate their language production environments through deliberate, staged workflows that remain resilient across mobile-first and multilingual conditions. Across tasks, participants demonstrated strong Self-Regulated Learning by utilizing structured routines to manage cognitive load, with one learner summarizing their process as: *"Outline first… clear claim and stance… revise cohesion and citation accuracy."* Furthermore, learners strategically deployed multilingual repertoires as temporary cognitive scaffolds during early ideation, noting they *"use [local language] to understand difficult ideas… But I switch back to English when writing."* Crucially, when confronted with infrastructural barriers, learners preserved essential cognitive processes like planning, monitoring, and revision despite restrictive digital access.

3.2. Objective 2: Adaptation and Strategic Abandonment of Digital Workflows

The data reveals that adaptation to digital constraints involves both calculated modification and the strategic abandonment of inaccessible practices, aligning with the necessity for flexible engagement outlined in UDL frameworks. Learners responded to bandwidth instability and device limitations with protective adjustments. To navigate poor connectivity, one participant noted they *"downloaded files; used captions when streaming failed,"* while others managing small screens *"typed short sections on phone; polished cohesion on a laptop later."* When persistent constraints threatened academic coherence, students selectively abandoned specific digital modalities entirely, instead relying on offline preparation: *"Prepared notes on paper, then typed and revised when a device became available."* These behaviors highlight a profound learner agency where structural accessibility barriers are navigated without compromising core academic standards.

3.3. Objective 3: Ethical Boundary-Making in AI and Digital Support

Finally, findings show that learners enacted clear, stage-specific ethical boundaries when utilizing generative AI and digital translation tools, treating them as supportive scaffolding rather than substantive substitutes. Operating within an environment of pervasive systemic barriers, participants integrated AI primarily during early production phases—seeking clarification for vague instructions or translating lexical gaps. They explicitly retained personal authorship,

argumentation, and citation integrity in their final submissions, a boundary summarized perfectly by one participant: *"Support for planning/clarity only; I keep my own wording and citations."* By deploying targeted cognitive strategies to verify AI-generated output against their own understanding, students maintained an internalized sense of academic responsibility, leveraging adaptive technologies to overcome learning constraints while preserving their originality.

4. DISCUSSION

This study shifts the discourse from general mobile learning to a critical examination of inclusive education, demonstrating that infrastructural deficits—such as poor connectivity and device inequality—function as profound systemic barriers equivalent to traditional accessibility challenges (Karageorgou et al., 2026; de Oliveira Fraga, 2026). By framing these constraints through Universal Design for Learning (UDL), the findings reveal a novel dynamic: when institutions treat accessibility as an afterthought, diverse learners independently engineer their own equitable spaces. Students did not merely cope with disruptions; they actively enacted UDL principles—such as finding multiple means of action and expression—to create their own supportive learning environments and mitigate cognitive load (Veytia Bucheli et al., 2024; Chick et al., 2025). This contributes a critical perspective to inclusive pedagogy, proving that marginalized learners actively preserve core academic standards by independently reorganizing their production processes to overcome systemic digital exclusion.

The observed strategies of workflow adaptation and digital tool abandonment further validate Self-Regulated Learning (SRL) as an essential mechanism for educational equity. Rather than persisting with inaccessible platforms that increase cognitive load, learners demonstrated resilience by strategically discarding them in favor of offline or buffered alternatives, effectively prioritizing communicative competence over rigid technological compliance (Koudsia & Kirchner, 2024; Pan et al., 2025). Furthermore, the deliberate integration of multilingual repertoires during early ideation reinforces translanguaging as a vital cognitive asset for diverse learners, directly countering persistent deficit narratives that frame language negotiation as an academic weakness (Caires et al., 2024; Wang et al., 2021). These process-preserving adaptations highlight the urgent need for assessment frameworks that validate flexible, asynchronous workflows as legitimate, inclusive academic practices rather than misinterpreting them as task-reducing deficiencies (Nordin et al., 2026).

Finally, this study provides a highly novel contribution to the intersection of inclusive education and AI ethics by reframing generative technologies as essential assistive scaffolding rather than mere academic shortcuts. For diverse learners navigating systemic barriers, AI tools provided critical external structure and personalized cognitive support during vulnerable planning and clarification stages, aligning with the needs of neurodivergent learners and those facing structural disadvantages (Zhao et al., 2025; Farhah et al., 2025). Importantly, learners demonstrated sophisticated digital literacy by establishing stage-specific boundaries, utilizing AI for structural support while fiercely protecting their own originality and authorship in final outputs (Marzuki et al., 2023). This indicates that ethical AI engagement is an embedded, reflective practice that empowers marginalized learners to bridge the digital divide (Bleher et al., 2023). Ultimately, these findings urge institutions to move beyond instrumentalist prohibition, instead designing inclusive policies that support responsible AI engagement and accommodate the diverse, adaptable realities of accessible language production.

5. CONCLUSION

This study demonstrates that infrastructural deficits and digital constraints function as profound systemic barriers to equitable language production. Viewed through the Universal Design for Learning (UDL) framework, findings reveal that marginalized learners do not passively accept inaccessible environments. Instead, they exercise self-regulation and agency by dynamically reorganizing workflows—including the strategic abandonment of restrictive tools—to preserve core academic standards. Furthermore, diverse learners utilize generative AI and multilingual resources not

as academic shortcuts, but as essential, stage-specific assistive scaffolding. By independently establishing ethical boundaries to protect their authorship, these students enact a sophisticated form of inclusive digital literacy. Ultimately, this research positions workflow adaptation and bounded AI engagement as vital expressions of learner resilience. To achieve true educational equity, institutions must move beyond rigid technological compliance and design flexible policies that recognize and support the adaptive realities of accessible language production.

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