

DIGITAL LITERACY, COGNITIVE GROWTH, AND LANGUAGE ACQUISITION IN PAKISTAN'S MULTILINGUAL CONTEXT

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Abstract

In contemporary multilingual societies, digital literacy has emerged as a critical competency shaping language learning and cognitive development. This qualitative study investigates the role of digital literacy in mediating cognitive growth and language acquisition within Pakistan's multilingual educational context. Drawing on sociocultural theory and multiliteracies perspectives, the study explores how digitally mediated practices influence learners' linguistic engagement, cognitive processing, and meaning-making across multiple languages. Data were collected from undergraduate students and language instructors in urban and semi-urban institutions through semi-structured interviews, focus group discussions, and reflective narratives. Thematic analysis revealed that digital technologies function as mediational tools that extend language learning beyond formal classrooms by enabling access to authentic input, collaborative interaction, and scaffolded learning. Findings further indicate that multilingual digital practices and translanguaging serve as cognitive resources that enhance comprehension, confidence, and communicative competence. Engagement with multimodal digital texts was found to promote deeper cognitive processing, including improved inferencing, memory retention, and analytical thinking. Additionally, digital literacy fostered learner autonomy and metacognitive awareness by supporting self-directed and reflective learning practices. However, the study also identified structural and pedagogical challenges—such as unequal access to technology, limited institutional support, and insufficient teacher training—that constrain the effective integration of digital literacy in language education. Overall, the findings suggest that digital literacy plays a pivotal role in bridging cognitive development and language acquisition in multilingual settings, provided it is embedded within context-sensitive, pedagogically informed, and equitable educational frameworks.

Keywords

Digital literacy; Multilingualism; Language acquisition; Cognitive development; Translanguaging; Multimodal learning; Sociocultural theory; Pakistan

Introduction

In the digital age, literacy and language learning definitions have broadened to include not only the ability to read and write in traditional ways, but also the ability to engage with digital texts and environments (Li & Akram, 2023, 2024; Ramzan et al., 2023; Nawaz et al., 2021, 2022), along with the ability to access, evaluate, and interact with it (Jones, 2022). In multilingual societies like Pakistan where people regularly switch between languages in both formal and informal bases, digital literacy competency is beginning to be realized as a highly vital competency (Zhang et al, 2023) that intersects with cognition and language acquisition. Digital literacy allows learners to

interact with a variety of digital tools (Ma et al., 2024, 2025) and resources that support language development through things like online reading, multimedia interaction, and auto-learning (Jones, 2022).

Research demonstrates that digital technologies can have a profound impact on cognitive development of learners (Ramzan et al., 2020, 2023, 2025) such as their executive functions and information processing which are building stones for learning other languages (Isnaini et al., 2025). Furthermore, evidence from meta-analysis has suggested that digital reading can be useful for improving vocabulary learning and language learning outcomes in second language contexts by offering flexible, adaptive, and multimodal learning environments. In multilingual environments, such as those of Pakistan in terms of its varied linguistic availability, such digital affordances show the potential to contribute to first and additional language development due to exposing learners to multiple linguistic inputs and contexts, thus promoting greater language awareness and proficiency (Chen & Ramzan, 2024).

Despite these potential benefits, disparity in digital access and varying degrees of digital competence of educators and learners as well as contextual socio-economical constraints are important challenges that can impact the fair integration of digital literacy in language learning curriculum. Integrating digital literacy into formal education, especially in multilingual settings, therefore demands a careful consideration of pedagogical design, professional development of teachers as well as culturally relevant digital resources. This study seeks to examine the role of digital literacy in cognitive development and language acquisition in multilingual learners in Pakistan focusing on possibilities and challenges of this socio-educational context.

Literature Review

Digital literacy has become a key structure supporting educational attainment in the twenty-first century, which involves skills beyond mere technical proficiency and includes the critical construction, evaluation, communication, and creation of digital texts in a variety of contexts (Akram et al., 2021, 2022). Scholars believe digital literacy fundamentally transforms the way people interact with language learning, making digital activities inextricable from the communicative competence within multilingual/multimodal contexts (Jones, 2022).

Several studies point out the role played by digital literacy in promoting the development of a second and further language (Akram & Abdelrady, 2023, 2025). A meta-analysis study was published by Springer that showed that digital reading dramatically improves second and foreign language (L2) vocabulary acquisition, and shows measurable gains in learning for digital reading when compared to traditional print-based methods. This effect is due to the fact that digital resources tend to embed multimedia cues, adaptive glosses and interactive elements to facilitate deeper engagement with linguistic forms and meanings (Abdelrady et al., 2025). Research in online multilingual environments has shown that students with higher digital literacy have a stronger behavior, emotional and cognitive engagement in language learning, suggesting that digital competence is more than a tool to engage students in language learning, it is also a part of motivation, autonomy and interactional participation in multilingual language learning tasks (Akram & Sohail, 2024). Moreover, the language learning in digital spaces often encompasses multilingual translanguaging practices where users strategically mix two or more languages when interacting with each other and in the process enriches lexical exposure and promote pragmatic negotiation of meaning - especially relevant in linguistically diverse contexts like Pakistan (Congman et al., 2019; Jalalzai et al., 2025). The study is also about making digital literacies in language education dynamic; literacies in the literature are described as socially situated communicative practices that are shaped by the very technologies the learners use, and so language learning needs are changed, and other semiotic needs related to online and multimodal communication are exposed (Javaid et al., 2024; Ramzan & Alahmadi, 2024). This point of view highlights that digital literacy is not only an instrumental skill, but a set of practices in constant evolution that are necessary in the exercise of a language and its learning in digital environments. The impact of digital engagement is significant from a cognitive perspective. Digital literacies demand that learners have to deal with complex texts, identify relevant information across platforms, and communicate strategically - tasks that are aligned with higher order cognitive functions, like effective thinking and metacognition. A systematic review of digital literacy research reported by Springer brought to the attention of cognitive skills as integral components within digital literacy frameworks e.g. problem-solving and information evaluation and how closely it relates to effective language learning and concept formation. Recent work in cognitive psychology has shown the extent to which digital reading dispositions such as confidence and self-human relations like self-efficiency in working with texts can function as cognitive bridges between digital engagements and writing practices and deeper linguistic processing. This leads to the suggestion that digital literacy not only supports surface-level reading, but may also affect the way learners process and produce language cognitively and therefore foster a more holistic development of linguistic proficiency.

The multilingual context of Pakistan (where Urdu, regional languages, and English are present at the educational and social levels) offers special opportunities and challenges for learning about digital literacy and language (Akram & Yingxiu, 2019). The concept of multiliteracies goes beyond the traditional framework of literacy practices by incorporating linguistic diversity and multimodal communication as shaped through digital media practices and thereby highlights that literacy development in multilingual environments needs to be supported through engaging with multiple modes of meaning-making (Aslam et al., 2020). In such settings, digital literacy functions as both a medium and a catalyst for language learning in that it allows learners to access multiple linguistic inputs and interactive environments that mirror real world communicative practices. Furthermore, research in digital communication across languages reveals the potential for translanguaging (i.e. language switching within a discourse) to maximize communicative efficiency and negotiation of identity, which in turn enables learners to use their entire repertoire of languages online. This sociocultural lens is compatible with perspectives that understand digital literacy and the acquisition of language as embedded in social practice rather than situated around individual, cognitive skills, and therefore emphasize the role of the learner identities and cultural contexts (Parveen & Akram, 2021) has in contexts of engagement with digital texts.

A type of challenging issues Digital literacy has been shown to have compelling evidence in terms of supporting language acquisition and cognitive growth, yet research has also identified persistent challenges in digital literacy- ranging from digital divides, lack of teacher training and lack of access to technology- which can constrain effective implementation in multilingual educational contexts. Studies in Pakistan report: structural barriers, including infrastructure limitations and professional development gaps, prevent equitable integration of digital tools in language learning. Addressing these challenges will not only involve technological investments but also pedagogically informed frameworks to contextualize and incorporate digital literacy into a curriculum that is responsive to local multilingual realities.

Sociocultural Theory and Language Learning Theory

Sociocultural Theory initially a proposal by Vygotsky, based on the idea that cognitive development and language learning is through social interaction and mediated activity. Language is a cultural instrument and a cognitive mediator, which can influence thinking processes by interacting with others with greater knowledge and with cultural objects (Vygotsky, 1978). In digital environments, technological tools such as mobile applications, online platforms and multimedia texts are meditational means that enhance language learning and cognitive development. Research highlights the way in which using digital technologies develops learners' zones of proximal development because it allows collaborative learning, interaction with others, scaffolded language exposure through multilingualism (Hafner & Chik, 2015; Jones & Hafner, 2021). In Pakistan's language diversified society, multi-linguistic interactions within learners often occur online, making digital spaces critical sociocultural spaces of language development.

Methodology

Research Design

This research study followed qualitative research methodology to determine the impact of digital literacy on cognitive development as well as language acquisition in Multi-lingual Pakistan. A qualitative approach was considered appropriate because of its ability to support an in-depth study of participants' experiences, perceptions and processes of meaning making in the context of their natural sociocultural environments. Considering the complex and social nature of digital literacy and multilingual linguistic acquisition, through this design the researcher was able to gather rich, contextualized data which cannot be fully explained using quantitative measures alone.

Research Context

The research was located in urban and semi-urban educational setting of both urban and semi-urban educational institutions across the country of Pakistan, where the educational practice of multilingualism is a salient feature of academic and social interaction. Participants regularly used multiple languages - Urdu, English and one or more regional tongues - in and out of formal learning contexts. Digital technologies including smartphones, learning management systems, social media platforms and online educational resources were an integral part in the everyday language and literacy practices of participants.

Participants and Sampling

Participants were recruited using purposive sampling in order to achieve the goals of the research. The sample included undergraduate students and language instructors who had routine uses for digital technologies for academic and communicative purposes. Inclusion criteria included the fact that participants had experience with the use of digital tools in language learning or teaching in multilingual contexts. This sampling strategy ensured that cases that provided different perspectives on digital literacy and language acquisition were identified with information rich.

Data Collection Methods

Data were collected through semi structured interviews, focus group discussions and reflective narratives. Semi-structured interviews allowed participants to describe their experiences with digital tools, cognitive engagement, and language learning practices and allowed the flexibility to explore emergent themes. Focus group discussions helped participants collectively reflect and engage with one another allowing practices and contrasting perspectives in multilingual digital environments to be identified. Reflective stories allowed the participants to narrate their trajectories in digital literacy, which gives insight into their cognitive and linguistic development over time. All interviews and discussions were held in languages of preferences to the participants including English and Urdu, to comfort and make the responses more authentic. With the consent of the participants, data recordings were made and then transcribed verbatim.

Data Analysis

The nature of the data was analyzed through thematic analysis, following an iterative approach including familiarization, coding, categorization and theme elaboration. Initial open coding came up with some recurrent patterns related to digital literacy practices, to cognitive processes, and to language learning experiences. These codes were then organized into more general categories, which corresponded to the theoretical framework, including sociocultural mediation, multiliteracies and cognitive engagement. Themes were refined by constant comparisons across the sources of data to ensure coherence and depth to interpretation.

Trustworthiness

To strengthen the trustworthiness of the study, various strategies were gratefully used. Triangulation was done by gathering data from diverse sources and groups of participants. Member checking, sharing preliminary findings with selected participants to ensure correct interpretation. Thick description was used to provide rich description of the context of the events, thereby allowing the reader to judge the transferability of findings. Additionally, an audit trail documenting analysis choices also added to the credibility and tractability of the study.

Ethical Considerations

Ethical approval was given before data collection. Participants were informed of the purpose of the study, their voluntary participation, and their opportunity to leave the study at any time. Informed consent was obtained and the confidentiality was maintained through the use of pseudonyms and anonymisation of identifiable information. All data were stored securely and were only used for academic purposes.

Data Analysis

Data analysis was conducted using a thematic analysis approach, allowing for systematic identification, interpretation, and reporting of patterns within the qualitative data. The analysis followed an iterative and reflexive process informed by Braun and Clarke's six-phase model: familiarization with the data, initial coding, theme generation, theme review, theme definition, and final reporting.

All interview transcripts, focus group discussions, and reflective narratives were read multiple times to achieve immersion and familiarity. Initial open coding was carried out manually to capture participants' meanings related to digital literacy practices, cognitive engagement, and multilingual language use. Codes were data-driven but guided by the study's theoretical framework, particularly concepts drawn from sociocultural mediation, multiliteracies, and cognitive information processing.

During the second phase, related codes were clustered into **axial categories**, reflecting connections between digital tools, cognitive processes, and language learning experiences. Through constant comparison across participants and data sources, broader themes were identified and refined. These themes were reviewed to ensure internal coherence and external distinction and were subsequently defined to reflect their conceptual significance.

To enhance analytic rigor, reflexive memos were maintained throughout the process to document interpretive decisions and emerging insights. Triangulation across data sources and participant groups further strengthened the credibility of the analysis.

Sample Themes Identified

1. Digital Technologies as Mediational Tools for Language Learning
2. Multilingual Digital Practices and Translanguaging
3. Cognitive Engagement through Multimodal Digital Texts
4. Learner Autonomy and Metacognitive Awareness
5. Structural and Pedagogical Constraints in Digital Language Learning

Findings

The findings are presented thematically and interpreted in relation to the study's theoretical framework. The analysis reveals how digital literacy mediates cognitive growth and language acquisition in Pakistan's multilingual context through socially situated and cognitively engaging practices.

Theme 1: Digital Technologies as Mediational Tools for Language Learning

Participants consistently described digital tools—such as mobile applications, online videos, and social media platforms—as mediational resources that supported language learning. These tools facilitated access to authentic linguistic input, opportunities for interaction, and immediate feedback. Learners reported using digital platforms to practice vocabulary, pronunciation, and writing beyond classroom boundaries.

From a sociocultural perspective, these technologies functioned as cultural artifacts that extended learning opportunities through collaboration and guided participation. Teachers noted that digital tools enabled scaffolding by allowing learners to revisit content, interact with peers, and seek support independently, thereby expanding their zones of proximal development.

Theme 2: Multilingual Digital Practices and Translanguaging

The data revealed widespread translanguaging practices in digital environments. Participants frequently moved fluidly between English, Urdu, and regional languages when engaging in online discussions, note-taking, or content creation. Rather than viewing this linguistic mixing as a deficit, learners perceived it as a strategic resource for meaning-making and comprehension.

This finding aligns with the multiliteracies framework, which emphasizes linguistic diversity as central to literacy development. Digital spaces allowed learners to draw on their full linguistic repertoires, enhancing confidence and communicative competence. Translanguaging practices also supported deeper understanding of complex concepts by enabling cognitive bridging across languages.

Theme 3: Cognitive Engagement through Multimodal Digital Texts

Participants reported heightened cognitive engagement when interacting with **multimodal digital texts**, including videos, infographics, podcasts, and interactive reading materials. These formats were described as more engaging and cognitively stimulating than traditional print-based texts.

Learners highlighted how visual and auditory elements supported comprehension, memory retention, and inference-making. From a cognitive information processing perspective, multimodal input reduced cognitive load and facilitated deeper processing of linguistic information. Teachers observed improved analytical thinking and inferencing skills when students engaged with multimodal resources.

Theme 4: Learner Autonomy and Metacognitive Awareness

Digital literacy practices were found to foster **learner autonomy and metacognitive awareness**. Participants described becoming more self-directed in planning, monitoring, and evaluating their

language learning through digital tools. Online resources enabled learners to identify personal weaknesses, select appropriate materials, and track their progress over time.

This theme reflects the cognitive dimension of the framework, highlighting how digital environments support metacognitive regulation. Learners' increased awareness of learning strategies contributed to improved language performance and confidence, particularly in multilingual contexts where learners negotiated multiple linguistic systems.

Theme 5: Structural and Pedagogical Constraints in Digital Language Learning

Despite the benefits, participants identified significant challenges affecting digital literacy integration. These included unequal access to reliable internet, limited institutional support, and insufficient teacher training in digital pedagogy. Some learners reported that digital tools were underutilized or used superficially, limiting their potential cognitive and linguistic impact. These constraints underscore the sociocultural reality of digital literacy development in Pakistan, where broader structural factors shape educational practices. Participants emphasized the need for context-sensitive pedagogical models and professional development initiatives that align digital literacy with multilingual teaching goals.

Summary of Findings

Collectively, the findings demonstrate that digital literacy serves as a mediating bridge between cognitive growth and language acquisition in Pakistan's multilingual context. Through socially mediated interaction, multimodal engagement, and metacognitive regulation, digital practices enhance learners' linguistic and cognitive development. However, the effectiveness of these practices is contingent upon supportive institutional structures and pedagogically informed integration.

Discussion

This study set out to examine the role of digital literacy in mediating cognitive development and language acquisition within Pakistan's multilingual educational context. The findings reveal that digital literacy functions as a powerful sociocultural and cognitive resource that shapes how learners engage with language, knowledge, and meaning-making in digitally mediated environments. Overall, the results affirm that digital literacy is not merely a technical skill but a complex set of social, cognitive, and linguistic practices that interact dynamically with multilingualism.

One of the most salient findings of this study is the role of digital technologies as mediational tools that extend learners' language development beyond traditional classroom boundaries. Participants' accounts illustrate how mobile applications, online platforms, and social media served as cultural artifacts that enabled interaction, scaffolding, and independent learning. This finding strongly aligns with Vygotsky's sociocultural theory, which posits that learning occurs through mediated social interaction and the use of cultural tools (Vygotsky, 1978).

Digital tools allowed learners to revisit content, receive immediate feedback, and engage in collaborative practices, thereby expanding their zones of proximal development. Consistent with Hafner and Chik (2015) and Jones and Hafner (2021), the findings suggest that digital environments provide affordances for guided participation and peer-supported learning, especially in multilingual contexts where learners draw on diverse linguistic resources. In Pakistan's educational landscape, where formal classroom interaction may be limited by time, curriculum constraints, or language hierarchies, digital spaces appear to offer alternative sites for meaningful language engagement.

The widespread use of translanguaging in digital contexts emerged as a key theme, highlighting how learners strategically navigated between English, Urdu, and regional languages to support comprehension and expression. Rather than hindering language development, these practices facilitated cognitive bridging across linguistic systems, allowing learners to negotiate meaning more effectively. This finding challenges deficit-oriented views of code-switching and supports contemporary perspectives within the multiliteracies framework, which recognize linguistic diversity as a central component of literacy development. In digitally mediated environments, translanguaging enabled learners to access complex content, clarify concepts, and participate more confidently in communicative tasks. This aligns with research suggesting that multilingual digital practices enhance language awareness, pragmatic competence, and identity negotiation. In Pakistan's multilingual context, digital platforms appear to legitimize flexible language use in ways that formal educational settings may not, thereby fostering inclusive and cognitively supportive language learning practices.

The findings also demonstrate that multimodal digital texts significantly enhanced learners' cognitive engagement. Participants consistently reported that videos, infographics, podcasts, and interactive materials were more stimulating and accessible than traditional print-based texts. From a cognitive information processing perspective, these multimodal resources appear to reduce cognitive load by distributing information across visual, auditory, and textual channels, thereby facilitating deeper comprehension and retention.

These findings corroborate previous research indicating that digital reading environments support vocabulary acquisition and inferential skills through embedded multimedia cues and interactive features. Importantly, the study extends this understanding by showing how multimodality supports not only linguistic development but also higher-order cognitive processes such as analytical thinking and inference-making. In multilingual contexts, multimodal texts may be particularly effective in supporting learners who are processing content across multiple languages simultaneously.

Another significant contribution of this study lies in its identification of digital literacy as a catalyst for learner autonomy and metacognitive awareness. Participants described becoming more self-directed in their language learning, using digital tools to plan, monitor, and evaluate their progress. This aligns with cognitive theories that emphasize metacognition as a critical component of effective learning and language acquisition.

Digital environments enabled learners to personalize their learning trajectories, select resources aligned with their needs, and reflect on their performance. In multilingual settings, where learners must navigate multiple linguistic systems, such metacognitive regulation becomes particularly important. The findings suggest that digital literacy supports not only linguistic outcomes but also the development of self-regulated learning skills that are transferable across languages and contexts.

Despite the positive affordances of digital literacy, the study also highlights persistent structural and pedagogical challenges that constrain its effective integration. Unequal access to reliable internet, limited institutional infrastructure, and insufficient teacher training emerged as significant barriers. These findings reflect broader socio-economic and educational inequalities within Pakistan and echo previous research documenting the digital divide in developing contexts.

Moreover, participants noted that digital tools were often used superficially, without pedagogical alignment with multilingual language learning goals. This underscores the importance of moving

beyond technology adoption toward pedagogically informed integration. Without adequate professional development and context-sensitive curricular frameworks, the transformative potential of digital literacy for cognitive and linguistic development remains underutilized.

The findings of this study contribute to theoretical discussions by reinforcing sociocultural and multiliteracies perspectives that conceptualize digital literacy and language learning as socially situated practices. They also highlight the cognitive dimensions of digital engagement, demonstrating how digital literacy mediates executive functions, metacognition, and deeper linguistic processing.

Practically, the study suggests that educators should intentionally incorporate digital literacy practices that value multilingualism, translanguaging, and multimodal engagement. Teacher training programs need to emphasize digital pedagogy that aligns with local linguistic realities rather than adopting monolingual or technology-centric models. At the policy level, equitable access to digital resources and infrastructure must be prioritized to ensure that digital literacy benefits are distributed fairly across educational contexts.

While this qualitative study provides rich insights into digital literacy practices, its findings are limited by the scope of the sample and its focus on urban and semi-urban settings. Future research could adopt mixed-methods or longitudinal designs to examine how digital literacy influences language acquisition and cognitive development over time. Additionally, further studies could explore rural contexts, younger learners, or specific digital interventions to better understand variability in digital literacy outcomes across Pakistan's diverse educational landscape.

Conclusion

In sum, this study demonstrates that digital literacy plays a pivotal role in mediating cognitive growth and language acquisition in Pakistan's multilingual context. Through sociocultural mediation, translanguaging, multimodal engagement, and metacognitive regulation, digital practices enhance learners' linguistic competence and cognitive development. However, realizing the full potential of digital literacy requires addressing structural inequalities and embedding technology within pedagogically and culturally responsive frameworks. By doing so, digital literacy can serve as a transformative force in multilingual education rather than a peripheral or unevenly distributed resource.

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