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Mobile Vocabulary Learning and Sociolinguistic Practices in Cross-Cultural Contexts

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Abstract
The linguistic context, characterised by the predominantly monolingual setting of Mainland China and the multilingual milieu of Malaysia, significantly influences the development of productive vocabulary among university students engaged in mobile-assisted vocabulary learning (MAVL) frameworks. Drawing on Vygotsky's sociocultural theory, vocabulary acquisition is understood as a socially mediated process that emerges through interaction with mobile technologies and the sociolinguistic strategies utilised by peers. This investigation employed a convergent mixed-methods design, integrating quantitative data derived from surveys and vocabulary assessments (n = 400) alongside qualitative insights gathered through semi-structured interviews (n = 24). The findings indicate that multilingual learners exhibited greater engagement in output-oriented MAVL activities and attained superior proficiency in productive vocabulary. Thematic analysis identified key mediational practices, including peer scaffolding, audience-aware lexical modification, and code-switching. Furthermore, regression analysis demonstrated that the combined effects of output-focused MAVL usage and active sociolinguistic participation served as significant predictors of productive vocabulary enhancement. This study introduces a novel Sociolinguistic Practices Index (SPI) and proposes a sociocultural framework that synthesises the mobile lexical environment with sociolinguistic behaviours. The outcomes offer both theoretical insights and practical recommendations for designing interventions that foster embedded socially responsive contexts conducive to vocabulary acquisition within mobile learning platforms.

Keywords: Productive Vocabulary Development; Mobile-Assisted Vocabulary Learning (MAVL); Sociocultural Theory; Peer-Mediated Language Learning; Linguistic Environment; Sociolinguistic Practices

Introduction

Mobile technology has transformed how students engage with linguistic content by providing adaptable and personalised learning experiences in both formal and informal environments (Kukulska-Hulme & Shield, 2008; Stockwell & Wang, 2024). MAVL, a specialised domain within Mobile-Assisted Language Learning (MALL), enhances vocabulary acquisition through various digital tools, such as flashcards, spaced repetition systems, interactive quizzes, and voice-based applications (Burston, 2015; Klimova, 2018). While empirical

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evidence supports MAVL's effectiveness in receptive vocabulary acquisition (Alemi et al., 2012; Mahdi, 2018), its impact on productive vocabulary remains relatively underexplored (Schmitt, 2014; Webb, 2008).

Most existing research on MAVL adopts a techno-functionalist viewpoint, concentrating on the features of applications without adequately considering the social and cultural factors that influence vocabulary learning behaviours (Lantolf & Thorne, 2006; Van Lier, 2004). Productive vocabulary development surpasses cognitive processes and software functionalities as it relies heavily on sociolinguistic norms, cultural practices, and learners' social positions within their communities. In Malaysia's multilingual environment, students employ sociolinguistic strategies such as code-switching, audience-sensitive lexical choices, and collaborative meaning construction to facilitate contextualised language production (Canagarajah, 2012; Duff, 2013; García & Wei, 2014). Conversely, the monolingual environment in Mainland China (MC), characterised by an exam-oriented teaching approach and minimal spontaneous exposure to English, offers limited opportunities for students to engage with peers in authentic vocabulary use (Hu, 2002; Lei et al., 2022).

Although recent scholarship acknowledges social mediation in language learning, research examining how MAVL influences productive vocabulary development across different linguistic contexts remains scarce. The relationship between linguistic environment (monolingual versus multilingual), output-oriented MAVL activities—such as digital journaling and voice recording—and peer-mediated sociolinguistic practices has not been sufficiently investigated. This gap is critical because productive vocabulary development entails more than memorisation; it involves internalisation through meaningful interaction, negotiation of meaning, and adaptive language use, all of which are extensively theorised within Vygotsky's Sociocultural Theory (SCT) (Lantolf & Thorne, 2006; Vygotsky, 1978). SCT highlights that learning is mediated by cultural artefacts, peer collaboration, and interaction within the learner's Zone of Proximal Development (ZPD), rendering it a compelling framework for conceptualising digital language learning. Against this background, the current study investigates how university students from MC (a monolingual English as a Foreign Language (EFL) context) and Malaysia (a multilingual English as a Second Language (ESL) context) engage with MAVL, and how sociolinguistic practices influence their productive vocabulary development. The study addresses three key research questions:

(1) How does linguistic environment influence students' input- and output-oriented MAVL usage?
(2) In what ways do sociolinguistic practices mediate the relationship between environment and productive vocabulary development?
(3) To what extent do MAVL engagement and sociolinguistic practices predict productive vocabulary outcomes?

This study makes three significant contributions to the field of digital language learning. From a theoretical perspective, it expands Sociocultural Theory by conceptualising productive vocabulary development as a process mediated by both social interaction and technological tools. Methodologically, it proposes the SPI as an innovative measure to quantify learners' peer-driven adaptive language strategies. Empirically, it presents one of the earliest cross-context comparative analyses linking patterns of MAVL usage, sociolinguistic mediation, and productive vocabulary outcomes. By framing vocabulary acquisition within the interplay of linguistic environments and digital affordances, the study provides valuable insights for designing culturally sensitive, output-focused MAVL interventions in varied educational contexts (Akman & Karahan, 2023; Godwin-Jones, 2022).

Literature Review

This section synthesises existing scholarship concerning vocabulary development in the context of second language acquisition (SLA), MAVL, sociocultural mediation, and linguistic environments. It examines peer interaction, mobile technologies, and sociocultural contexts as components of social mediation within the framework of productive vocabulary development, which is understood as a socially mediated process facilitated by mobile technologies and informed by Vygotsky's SCT.

Productive Vocabulary Development in SLA

Knowledge of specialised vocabulary is fundamental to SLA and significantly influences learners' reading, writing, and communicative skills (Nation, 2013; Schmitt, 2008). Vocabulary is commonly categorised into two types: receptive, which involves recognition, and productive, which entails active use. Productive vocabulary proficiency requires not only retrieval but also contextual integration, reflecting a higher degree of mastery (Webb, 2009). Metalinguistic reflection and language production are closely connected, as explained by the Output Hypothesis (Swain, 2005), which posits that language production typically lags behind comprehension. Output that is scaffolded by peer interaction encourages negotiation and correction, enabling learners to internalise lexical knowledge through collaborative support (Dewaele & Wei, 2013; Swain & Lapkin, 2000). Despite its critical role in SLA, vocabulary production remains under-investigated and is frequently excluded from standardised assessments (Su et al., 2018). Within mobile learning environments, activities tend to prioritise recognition through quizzes and matching tasks, while

output-oriented exercises are relatively neglected (Kukulska-Hulme & Viberg, 2018). Recently, there has been a resurgence of focus on peer interaction and reflection in MAVL contexts (Akman & Karahan, 2023; Li & Lan, 2022), which supports the notion that productive vocabulary develops as an outcome of interaction rather than through solitary effort (Godwin-Jones, 2022; Lantolf & Thorne, 2006).

Mobile-Assisted Vocabulary Learning (MAVL): Affordances and Constraints

MAVL tools support learners by providing individualised and multimodal vocabulary resources (Burston, 2015; Kukulska-Hulme & Viberg, 2018). Through mobile devices, learners receive tailored feedback and interactive input. Nevertheless, the majority of MAVL research has concentrated on input-driven tasks such as word review and quizzes (Stockwell, 2013). Activities emphasising output, including writing or voice recording, represent an underexplored area within mobile-assisted language learning research (Reinders & White, 2016). From a sociocultural standpoint, learners situated in exam-oriented contexts tend to utilise apps primarily for rote memorisation, whereas those in dynamic, interaction-rich environments employ these tools more creatively (Reinders & Benson, 2017). This study examines MAVL within diverse linguistic environments characterised by varying contextual factors.

Linguistic Environment as Sociocultural Context

Contextual settings influence vocabulary breadth and activation, usage patterns, and social interaction norms. In MC, English is taught as EFL under an English-only policy, limiting its use primarily to teaching and examinations (Hu, 2002; Lei et al., 2022). In contrast, Malaysia's multilingual environment, encompassing Malay, English, and Mandarin, provides learners with greater opportunities to manage shifting registers and code-switch between languages with relative ease (Gill, 2005; Grosjean, 2010; Then & Ting, 2011). These linguistic differences result in distinct vocabulary practices, with informal, peer-based vocabulary use prevalent among Malaysian learners, while learners in MC rely more on curriculum-driven, structured, and form-focused tasks.

Sociolinguistic Practices as Mediational Tools

Sociolinguistic practices, including code-switching, adapting to particular registers, and selecting vocabulary appropriate to the audience, function as mediational strategies in vocabulary acquisition (Canagarajah, 2012; García & Wei, 2014). In multilingual interactions, these sociolinguistic strategies facilitate meaning-making and identity expression (Li & Wang, 2024). According to SCT, these practices are viewed as semiotic resources situated within the ZPD, shaped by contextually bound social relationships (Vygotsky, 1978; Wertsch, 1991). Within MAVL contexts, such interactions take the form of collective authorship, peer editing, and collaborative digital discourse. This study introduces the SPI to quantify learners' engagement in code-switching, peer vocabulary construction, and adaptive vocabulary use that is sensitive to contextual demands.

Theoretical Framework: Sociocultural Theory in MAVL Contexts

Vygotsky's SCT posits that human cognition emerges through social interaction and is subsequently internalised via mediated activity. This theory is founded upon three core elements: mediation, the ZPD, and internalisation (Vygotsky, 1978; Wertsch, 1991). Mediation involves the use of culturally and socially constructed psychological and technological tools—including language, peers, and digital platforms—that facilitate cognitive development. The ZPD delineates the scope between what learners can achieve independently and what they can accomplish with instructional support. Internalisation refers to the transformation from external collaborative processes to autonomous psychological functioning. Within MAVL contexts, digital technologies act as mediational artefacts, providing scaffolding through multimodal input, contextualised vocabulary tasks, and corrective feedback (Burston, 2015; Kukulska-Hulme & Viberg, 2018). Crucially, peer interaction—particularly in multilingual sociolinguistic settings—functions as a powerful interpersonal mediator. Learners actively negotiate word meanings, co-construct definitions, and offer corrective feedback, thereby facilitating the internalisation of vocabulary knowledge (Li & Lan, 2022; Swain & Lapkin, 2000).

The productive dimension of vocabulary acquisition aligns closely with SCT. As (Swain, 2005) and (Lantolf & Poehner, 2014) assert, internalisation is fostered through production-oriented practices such as dialogic writing, peer correction, and code-switching. These socially supported interactions—especially when embedded within mobile learning environments—form fluid and dynamic ZPDs that enable learners to engage in cultural and social mediation far beyond their independent capacities. Thus, SCT provides a critical theoretical lens for understanding the utilisation of MAVL tools alongside peer collaboration to advance productive vocabulary development across diverse language contexts.

While grounded in SCT with its emphasis on mediation, the ZPD, and internalisation, the conceptual framework fulfils a distinct but complementary role. It operationalises these theoretical constructs by defining precise, measurable variables and delineating the relationships among them for empirical scrutiny. This framework systematically articulates the causal and mediational pathways that underpin the research

inquiry. Collectively, the theoretical and conceptual frameworks construct an integrated model that elucidates MAVL processes across varied sociolinguistic landscapes and learning environments (See Figure 1)

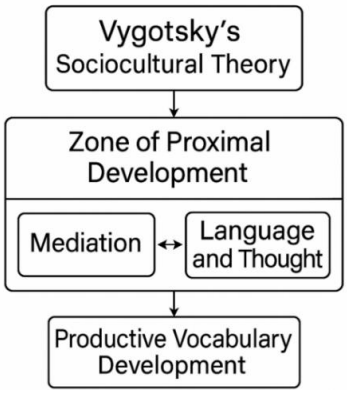

Figure 1: *Theoretical Framework: A Sociocultural Model of Productive Vocabulary Development*
Note: *This framework illustrates how mediation, guided interaction within the ZPD, and the reciprocal relationship between language and thought enable the internalization of vocabulary in MAVL contexts.*

Conceptual Framework: Sociocultural Mediation Toward Productive Vocabulary

Building upon the constructs detailed in the theoretical framework, this study's conceptual framework depicts the mediated process whereby sociolinguistic engagement and mobile-assisted technological tools impact the learners' context, subsequently influencing their productive vocabulary development. As presented in Figure 2, the framework posits that the linguistic environment's multilingual or monolingual nature functions as a contextual factor that shapes learners' interaction with two principal mediational variables:

1. Strands of MAVL usage focused on: *input activities*, that is, word review and definitions lookup; and *output activities*, like voice recording and sentence generation.
2. Social and linguistic behaviours of the user such as code-switching, lexical shifts for the audience, peer scaffolding, and others.

The construct of productive vocabulary development, which represents the primary outcome of interest, encapsulates learners' ability to produce spoken and written language that appropriately employs vocabulary selected and positioned in line with communicative intent. This variable is measured through contextually pertinent vocabulary production assessments, which are evaluated for complexity, accuracy, and appropriateness relative to the communicative purpose. The framework hypothesises that multilingual settings, such as Malaysia, provide a broader range and greater frequency of opportunities for both sociolinguistic and technological mediation, thereby fostering more extensive mobile engagement and intricate sociolinguistic practices. Conversely, monolingual environments, exemplified by MC, may constrain learners' exposure to these mediational resources, leading to more restricted productive vocabulary abilities. The directional arrows depicted in Figure 2 represent the causal relationships under investigation, which are empirically tested via a mixed-methods design employing regression analysis and thematic coding using NVivo.

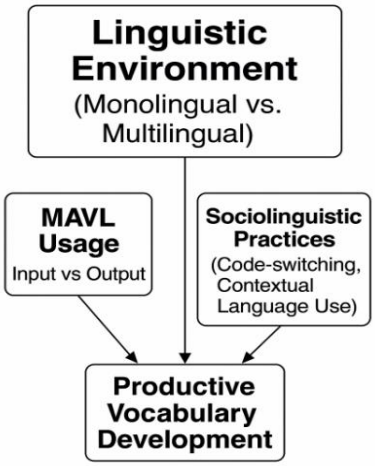

Figure 2: *Conceptual Framework: Sociocultural Mediation in Mobile-Assisted Vocabulary Development*
Note: *This model depicts how linguistic environment shapes MAVL usage and sociolinguistic practices, which jointly predict productive vocabulary development. Arrows indicate mediational pathways tested in the study.*

Methodology

Research Design

This methodology is particularly well-suited for investigating both observable linguistic behaviours and the sociocultural mechanisms emphasised by SCT. Beyond its structural appropriateness, the convergent parallel design aligns with the theoretical and empirical aims of this study. Guided by SCT's focus on the interplay between external social interaction and internally driven development, the research examines not only learner behaviours related to mobile vocabulary tools but also the sociocultural processes of peer scaffolding and contextual adaptation that mediate these behaviours. Such mediation would be overlooked by purely quantitative methods, while a solely qualitative approach might lack generalisability. Therefore, the mixed-methods design serves two principal purposes. Firstly, it enables the triangulation of productive vocabulary performance (quantitative) and sociolinguistic engagement (qualitative), offering a comprehensive account of mediation. Secondly, it supports investigation within the ZPD, addressing both learner performance and the scaffolding facilitating it. This approach captures the dynamic co-construction of lexical knowledge occurring through mobile and peer interactions. This rationale reflects recent trends in applied linguistics advocating for integrated, multifaceted methodologies to explore complex phenomena involving digitised, multilingual, and layered language use (Akman & Karahan, 2023; Reinders & Benson, 2017).

Research Contexts

The study was conducted within two distinct national contexts: MC and Malaysia, which present markedly different linguistic ecologies. In MC, English is taught as EFL in a predominantly monolingual Mandarin-speaking environment, where instructional emphasis centres on grammar and reading comprehension, often employing rote memorisation and mechanistic test-taking practices. Conversely, Malaysia's multilingual society—comprising Malay, Mandarin, and Tamil—positions English as an ESL. Here, English is widely utilised across educational settings, media, and everyday communication, allowing learners to develop language skills within a more comprehensive and contextually rich framework (Gill, 2005; Tai, 2025).

Participants

The research involved a total of 400 undergraduate participants, equally divided with 200 students recruited from three public universities in MC and 200 from three public universities in Malaysia. The sample size of 400 was determined through a rigorous methodological and theoretical framework. Specifically, G*Power software (version 3.1) was utilised to estimate the required sample for multiple linear regression involving three predictors, based on the conceptual framework. The calculations indicated a minimum of 119 participants per group to detect a medium effect size ($f^2 = 0.15$) with an alpha of .05 and statistical power of 0.95. To enhance the generalisability of findings and account for potential attrition, the sample size was increased to 200 per country.

Conceptually, this sample size was intended to capture a broad spectrum of learner experiences across distinct linguistic ecologies. The selection of three public universities per country was designed to ensure diversity across institutional, geographical, and demographic dimensions. In MC, one university was selected from each of the Eastern, Central, and Western regions to reflect variation in educational traditions and levels of English exposure. In Malaysia, the universities were chosen from different states characterised by multicultural urban centres with robust ESL ecosystems. Selection criteria included: (1) institutional willingness to participate, (2) implementation of English-medium instruction or English language programmes at the tertiary level, and (3) availability of students using mobile learning tools. Stratified random sampling was employed to achieve proportional representation based on gender, academic year (Years 1–4), and major. Eligibility criteria for participants included: (a) a minimum of six years' English study, (b) current academic use of mobile devices, and (c) prior experience with language-learning mobile applications for vocabulary acquisition, such as Quizlet, Baicizhan, Memrise, and Shanbay. These criteria ensured that all participants were at least somewhat familiar with MAVL and situated within either monolingual or multilingual sociolinguistic environments, as defined by the study.

Instruments

Aligned with the three research questions and developed in accordance with the conceptual framework, the instruments employed in this study were meticulously chosen. Each instrument was designed to measure a specific mediating construct—namely, MAVL usage or sociolinguistic practice—or the outcome variable of productive vocabulary development, all situated within the students' respective linguistic contexts. The interrelations among the research questions, data sources, and analytical techniques are detailed in Table 1.

The development of each instrument was informed by established validated scales, adapted specifically to the bilingual and monolingual contexts of Chinese and Malaysian undergraduate cohorts.

(1) The MAVL Usage Questionnaire comprised 28 items encompassing both input-oriented activities, such

as consulting definitions and reviewing word lists, and output-oriented tasks, including journal writing and voice recording. Responses were collected via a 5-point Likert scale, with expert evaluation conducted to verify content validity.

(2) The Sociolinguistic Practices Inventory assessed participants' frequency of informal code-switching, use of casual registers, and context-sensitive lexical shifts in daily communication. Open-ended questions enabled respondents to elaborate on complex sociolinguistic behaviours beyond predefined categories.

(3) The Productive Vocabulary Assessment required students to construct sentences or paragraphs employing designated vocabulary within a given context. Scoring was based on a rubric that evaluated vocabulary quantity, contextual appropriateness, and lexical sophistication.

Table 1: *Research Questions and Corresponding Instruments*

Research Question	**Instrument**
1. How does the linguistic environment influence MAVL usage patterns (input vs. output)?	MAVL Usage Questionnaire
2. In what ways do sociolinguistic practices mediate the relationship between environment and productive vocabulary development?	Sociolinguistic Practices Inventory
3. To what extent do MAVL usage and sociolinguistic practices predict productive vocabulary development?	Productive Vocabulary Assessment; MAVL & Sociolinguistic Inventories
Supplementary insights into learner motivation, app preferences, and sociolinguistic awareness	Semi-structured Interviews

The study's design facilitated the quantification of MAVL utilisation and monitoring of vocabulary development, while concurrently enabling an examination of how learners' social environments shaped these patterns through complex mediational processes. In particular, the SPI encompassed both qualitative and quantitative assessments of peer lexical behaviours, including but not limited to code-switching, register variation, and audience-sensitive vocabulary selection. While this index provided a valuable context-aware lens for analysing learner engagement, its development presented notable methodological challenges.

Despite maintaining high inter-coder reliability through dual coding and negotiated consensus ($\kappa = .82$), the interpretive nature of qualitative NVivo coding introduced subjectivity. Cross-cultural comparability of sociolinguistic behaviours remains problematic, given that local norms governing "appropriate register" or "collaborative scaffolding" may vary substantially between Malaysia and MC. Moreover, although the SPI quantified observable adaptive behaviours, it was limited in capturing the subtle complexities of learners' metalinguistic awareness and intentionality, which are central to sociocultural mediation. The integration of stimulated recall protocols or real-time screen recordings alongside SPI data could enhance ecological validity (Godwin-Jones, 2022). Nonetheless, the SPI represents a significant advancement in operationalising sociolinguistic mediation within MAVL, shifting emphasis from self-report measures to interactional vocabulary use as an indicator of productive vocabulary development.

Data Collection Procedures

Data collection was conducted over ten weeks at three public universities in MC and three in Malaysia. Prior to the study, ethical approval was obtained from institutional research ethics committees and faculty gatekeepers at each site. Informed consent forms and participant information sheets were provided in English, Mandarin, and Malay to ensure ethical compliance, including anonymity, confidentiality, and voluntary participation. Quantitative data collection employed the MAVL Usage Questionnaire, SPI, and Productive Vocabulary Assessment, supervised by instructors and the researcher. Data in MC were gathered from elective English courses and language workshops. Procedures followed a strict 40-minute protocol to ensure consistency and minimise disruption, with some universities using digital tablets for administration. The vocabulary assessment required timed written production of paragraphs using specified vocabulary in contextualised prompts, simulating lexical retrieval without checklist aids. Procedures were standardised across both contexts.

Qualitative data were collected via semi-structured interviews with 24 purposively sampled participants (12 per country) representing high, medium, and low MAVL engagement across disciplines and gender. Interviews, conducted in participants' chosen languages (English, Mandarin, Malay), were transcribed and translated via a forward–backward approach to preserve linguistic and contextual integrity. Each interview lasted 30–45 minutes and was held on campus or via Zoom depending on circumstances. Thematic guidelines focused on mobile learning patterns, sociolinguistic behaviours, and self-reported vocabulary development. Member checking enhanced qualitative data credibility by allowing participants to review and amend responses. Quantitative data were anonymised, coded, and analysed using SPSS, while qualitative analysis used NVivo 14. Confidential digital data were securely encrypted and accessible only to the researcher. Aligned with SCT principles, efforts to maintain ecological validity included adapting administrative procedures to local customs and educational contexts. This ensured genuine observation of peer scaffolding, engagement with MAVL tools, and sociolinguistic adaptations within learners' zones of proximal development as conceptualised in the framework supporting productive vocabulary growth.

Data Analysis

This study employed a rigorous integration of quantitative and qualitative data through triangulation and explanatory complementarity analysis. The three research questions were addressed using a convergent parallel mixed-methods design for data collection and analysis. Each methodological strand was analysed independently before being merged to enable triangulation and corroborate findings via explanatory complementarity. All analyses were underpinned by the conceptual framework grounded in SCT (Vygotsky, 1978). Participants' engagement levels with MAVL were quantitatively measured using the MAVL Usage Questionnaire. Quantitative data were processed with IBM SPSS Statistics (Version 28), where descriptive statistics including means, standard deviations, and frequencies were calculated and examined. Two independent samples t-tests compared monolingual learners from MC with their multilingual Malaysian counterparts concerning MAVL activities, distinguishing between input-driven (computational) and output-oriented (expressive) tasks. Assumptions of normality and homogeneity of variances were tested using the Shapiro–Wilk and Levene's tests, respectively. Effect sizes for group differences were quantified using Cohen's d (Cohen, 1988).

To assess the predictive influence of sociocultural and behavioural variables, multiple linear regression analysis was performed with three predictors: linguistic environment (dummy-coded), output-oriented MAVL usage, and SPI. The SPI, operationalised through thematically coded qualitative data (see Section 4.2), enabled the incorporation of context-sensitive peer engagement measures alongside behavioural variables to evaluate their combined impact on productive vocabulary performance. Qualitative data from 20 semi-structured interviews were analysed with NVivo 14, utilising Braun and Clarke (2006) six-phase thematic analysis protocol. This analysis focused on SCT-informed concepts such as peer mediation, code-switching, and ZPD to identify broad sociolinguistic mediation patterns. The resultant themes comprised three key dimensions: peer code-switching, audience-sensitive lexical adjustment, and collaborative scaffolding. Coding reliability was confirmed through inter-rater agreement ($\kappa = 0.82$). Finally, convergence and divergence of findings were explored through the synthesis of qualitative and quantitative data via triangulation. The SPI and vocabulary achievement metrics highlighted sociolinguistic participation as a critical mediator between MAVL engagement and productive vocabulary development. This integrated approach aligns with the theoretical framework illustrated in Figure 2 and will be elaborated in the forthcoming results section.

Validity, Reliability, and Trustworthiness

Validity of the quantitative instruments was established through expert review, with internal consistency confirmed by Cronbach's alpha values exceeding 0.80. All assumptions underpinning the regression analyses were evaluated and met satisfactorily. In the qualitative component, credibility was ensured via member checking, while dependability was reinforced through comprehensive audit trails. Inter-coder reliability was maintained at $\kappa = 0.82$. Integration of data was conducted following a triangulation protocol, which facilitated the coherent synthesis of quantitative and qualitative findings, thereby enhancing explanatory power across methodological approaches.

Ethical Considerations

Institutional ethical approval was secured from review boards in both Malaysia and China. Informed consent was systematically obtained from all participants, who were clearly informed of their right to withdraw at any stage of the study. Anonymity and confidentiality were rigorously upheld through the use of pseudonyms, secure data storage protocols, and restricted data access. All research materials were carefully designed to be relevant and appropriate for the target populations. Ethnological materials were culturally adapted and linguistically aligned to suit the specific needs of the participants.

Results and Findings

This section presents findings derived from both quantitative and qualitative data sources, structured around the study's three research questions. The results are organised thematically into three distinct sections. Interpretations are informed by descriptive and inferential statistical analyses, qualitative coding conducted with NVivo, and the theoretical framework grounded in SCT. All figures and tables are integrated within the discussion to cohesively illustrate the influence of sociolinguistic context, MAVL, and sociocultural mediation on productive vocabulary development.

Patterns of MAVL Usage in Monolingual and Multilingual Contexts

This section focuses on Research Question 1, which inquires: *How does the linguistic environment (monolingual vs. multilingual) influence university students' MAVL usage patterns (input vs. output)?*

As outlined in preceding chapters, responses to the MAVL Usage Questionnaire were analysed through a sequential process, beginning with the segmentation of input and output activities. Receptive practices, such as word review, digital reading, and vocabulary quizzes, were classified as input-oriented, while output-

oriented use encompassed productive tasks including vocabulary journaling, voice recording, and collaborative writing. Analysis of input-oriented activity engagement revealed similar levels across both groups. For example, the mean score for participants from MC was 3.87, compared to 3.79 for those from Malaysia. The difference between these means was not statistically significant ($t = 1.29$, $p = .198$), indicating comparable responsiveness to MAVL activities among monolingual and multilingual learners. However, a marked divergence emerged in output-oriented engagement, reflecting MAVL use in productive tasks. Malaysian students demonstrated significantly greater participation, with a mean score of 3.45, compared to 2.91 among Chinese students. (See Table 2) This difference was statistically significant ($t = 7.32$, $p < .001$) and represented a large effect size (Cohen's $d = 0.80$).

Table 2: *Descriptive Statistics of MAVL Usage Patterns by Group*

Group	Input-Oriented Use (M)	Output-Oriented Use (M)
Mainland China	3.87 (SD = 0.62)	2.91 (SD = 0.70)
Malaysia	3.79 (SD = 0.58)	3.45 (SD = 0.65)

Note: Independent-samples t-tests revealed no significant difference in input-oriented MAVL use ($t = 1.29$, $p = .198$). A significant difference was found for output-oriented use ($t = 7.32$, $p < .001$), with a large effect size ($d = 0.80$).

To provide additional granularity, participants' responses were categorised into three frequency bands: high usage (scores 4–5), medium usage (score 3), and low usage (scores 1–2). This categorisation further elucidates engagement patterns across the distinct learner groups. The frequency analysis corroborated the finding that input-oriented usage was both high and comparable across groups, whereas output-oriented usage revealed a pronounced divergence. Specifically, 81 Malaysian participants reported high-frequency engagement in output-oriented activities, compared to only 48 among Chinese learners. Conversely, 80 Chinese students were classified as low-frequency users, nearly twice the number of low-frequency Malaysian participants (43). This disparity reflects distinct patterns of mobile and sociolinguistic engagement shaped by the respective learning environments. (See Table 3)

Table 3: *Frequency Distribution of MAVL Usage*

Group	Type	High (4–5)	Medium (3)	Low (1–2)
Mainland China	Input-Oriented	112	63	25
Mainland China	Output-Oriented	48	72	80
Malaysia	Input-Oriented	106	69	25
Malaysia	Output-Oriented	81	76	43

Note: Frequency scores represent participant counts for each rating band (1–5) from the MAVL Usage Questionnaire.

As depicted in Figure 3, this pattern transcends mere quantitative differences, linking qualitatively to environmental mediation. Malaysian learners, immersed in a multilingual context, appeared to employ MAVL for productive tasks with greater confidence and consistency, suggesting that sociocultural demands had fostered a more sophisticated integration of digital tools and output-oriented activities. By contrast, Chinese students exhibited a predominantly passive, receptive engagement with MAVL, seldom extending vocabulary learning beyond structured, app-based exercises to more spontaneous or conversational language use.

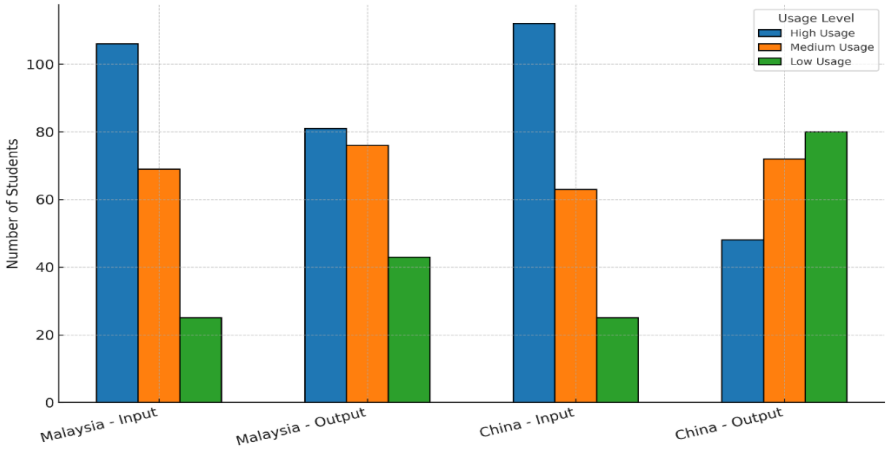

Figure 3: *MAVL Usage Frequency by Group and Category*

Note: *Input-Oriented = Receptive Tasks (e.g., reading, reviewing); Output-Oriented = Productive Tasks (e.g., writing, speaking); High/Medium/Low Usage = Self-Reported Frequency based on a 5-Point Likert Scale (5 = Very Frequent, 1 = Very Rare).*

This observation substantiates the conceptual framework presented in Figure 2, wherein the linguistic environment influences productive vocabulary development by shaping output-oriented MAVL behaviours. Within a multilingual setting, learners are more likely to engage in authentic peer interactions, informal vocabulary exchanges, and audience-responsive performances, all of which contribute to the expansion of the Zone of Proximal Development (Vygotsky, 1978). These social interactions provide essential scaffolding, encouraging learners to move beyond mere rote memorization towards the contextual and adaptive use of language. Consequently, despite both groups having access to mobile learning tools, the extent and focus of task engagement were markedly influenced by the prevailing sociolinguistic contexts, which in turn affected the internalization process necessary for productive vocabulary use. This dynamic underpins the rationale that will be further elaborated in subsequent sections.

Sociolinguistic Mediation in Digital Vocabulary Practices

This section presents the findings pertaining to Research Question 2: *In what ways do sociolinguistic practices such as code-switching and contextual vocabulary choice mediate the relationship between linguistic environment and productive vocabulary development?*

To investigate this question, twenty semi-structured interviews were subjected to thematic analysis using NVivo 14. The coding process identified three interconnected themes illustrating how learners employed sociocultural strategies to facilitate vocabulary development in digital environments: (1) peer code-switching, (2) audience-sensitive lexical adjustment, and (3) peer-based sociolinguistic scaffolding. These themes are depicted in Figure 4, which encapsulates the comprehensive framework of sociolinguistic mediation.

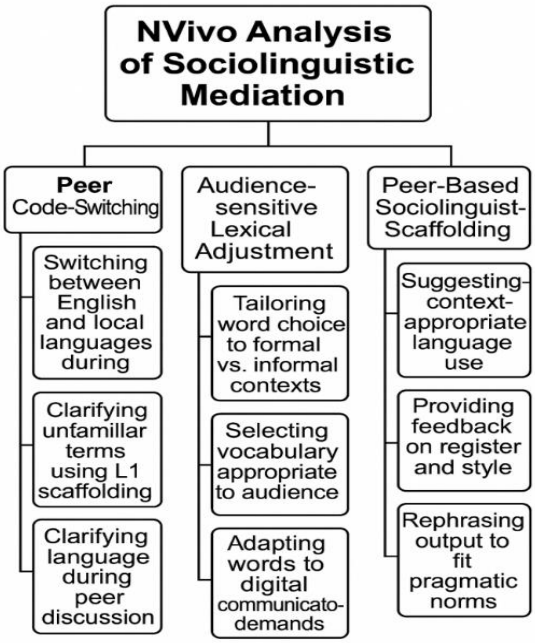

Figure 4: *NVivo Analysis of Sociolinguistic Mediation*

The first theme, Peer Code-Switching, describes participants' habitual shifts between English, Malay, and Mandarin to aid their peers' comprehension during MAVL activities. These language switches were deliberate and strategic, employed to negotiate unfamiliar terms and clarify meanings. This practice fostered a translanguaging environment that deepened their understanding of vocabulary.

"Sometimes I use Mandarin first to explain the meaning to my friend, then we switch back to English to complete the app task. It helps both of us understand faster."— Malaysian participant, Interview 07

"If a word is too hard in English, I quickly explain it in Malay in the group chat, so they get the idea."— Malaysian participant, Interview 11.

The second theme, Audience-Sensitive Lexical Adjustment, highlights learners' attentiveness to contextual factors such as register and formality. Malaysian participants frequently tailored their lexical choices based on whether interactions occurred within academic applications, casual conversations, or collaborative forums. In contrast, Chinese learners exhibited this adaptive lexical behaviour less frequently, adhering more strictly to conventional language use.

"On the app's public board, I choose more academic words, but I keep it casual when texting classmates."— Malaysian participant, Interview 02.

"Some words are too informal for teacher tasks, so I switch them when I write."— Chinese participant,

Interview 13.

The third theme, Peer-Based Sociolinguistic Scaffolding, emphasises peer interaction as a crucial mediational resource. Learners recounted instances where their peers actively edited, refined, or enhanced their vocabulary, providing real-time iterative feedback that supported language development.

"My friend told me 'say "applicable" instead of "can use"'—she said it sounds more professional."— Malaysian participant, Interview 04.

"When I phrased it wrong, my classmate corrected it to match the task style."— Chinese participant, Interview 16.

To examine environmental influences, the coded themes were disaggregated by nationality. As shown in Figure 5, multilingual learners exhibited greater engagement across all three sociolinguistic interaction practices and demonstrated more diverse participation compared to monolingual learners, who predominantly relied on solitary strategies with limited peer negotiation. These contrasting patterns highlight the spatial variability of sociolinguistic practices, which depend heavily on learners' linguistic ecologies and institutional norms. Chinese learners concentrated more on strict grammatical accuracy and teacher-imposed correctness, whereas Malaysian learners prioritised more fluid, pragmatically derived meaning-making.

From a sociocultural theoretical perspective, these practices act as both semiotic and social-interpersonal mediators within learners' Zones of Proximal Development. Rather than being viewed as mere boundaries, code-switching and register adjustment are crucial for guided, interaction-based vocabulary internalisation involving peers within digital contexts, providing responsive, collaboratively constructed, and seamless scaffolding support. Importantly, these themes align with the mediational variables outlined in the conceptual framework (Figure 2), where sociolinguistic practices function as process-based support for vocabulary development, contextualised within enabling conditions. The observed differences across linguistic contexts confirm that productive vocabulary is not innate but is socially constructed, contextually mediated, embedded in peer relationships, and part of a cultural repertoire. The subsequent section utilises the SPI to quantitatively capture these qualitative patterns and examines its relationship with productive vocabulary outcomes.

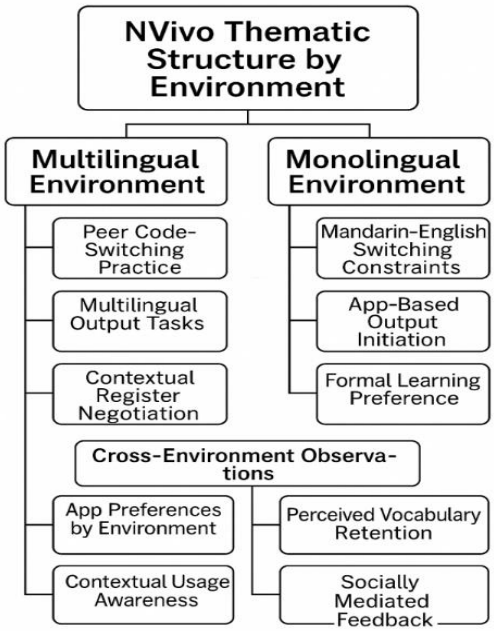

Figure 5: *NVivo Thematic Structure by Environment*

Predictive Factors of Productive Vocabulary Development

This section addresses Research Question 3, which investigates: *To what extent do MAVL usage and sociolinguistic practices predict productive vocabulary development?*

To examine this further, a multiple regression analysis was conducted with three predictors: (1) linguistic environment, coded as 0 for Mainland China and 1 for Malaysia; (2) output-oriented MAVL usage, measured by self-reported frequency scores; and (3) SPI, derived from NVivo-coded interviews.

The SPI captures learners' context-sensitive lexical behaviours, specifically peer code-switching, audience-sensitive lexical adjustment, and collaborative scaffolding. These categories emerged from thematic

analysis following Braun and Clarke (2006) six-phase framework. Each behaviour was quantified according to its frequency within participants' interview transcripts. Inter-coder reliability was secured through double coding and consensus on the codebook (κ = 0.82), enhancing the index's analytic credibility. The SPI bridges the gap between sociocultural theory and empirical analysis by transforming narrative interaction sequences into quantifiable data, offering a robust method for comparing mobile-mediated language learning across contexts. The regression model was statistically significant overall, explaining 41.3% of the variance in productive vocabulary performance (R^2 = .413, Adjusted R^2 = .408, $F(3, 396) = 92.94$, $p < .001$). As shown in Table 4, each of the three predictors made significant and distinct contributions.

Table 4: *Regression Coefficients for Productive Vocabulary Development*

Predictor	B	SE	β	t	P-Value
Linguistic Environment (Malaysia)	2.37	0.39	0.28	6.08	<.001
Output-Oriented MAVL Usage	1.94	0.34	0.32	5.71	<.001
Sociolinguistic Practices Index	1.51	0.29	0.26	5.21	<.001

In terms of predictive strength, output-oriented MAVL usage emerged as the most influential predictor (β = .32), followed by linguistic environment (β = .28) and SPI (β = .26). These results demonstrate that both behavioural engagement with mobile applications and sociocultural vocabulary enrichment through peer scaffolding and adaptation significantly affect learners' lexical production, albeit via different mechanisms. To facilitate meaningful use of SPI as a continuous predictor variable in statistical modelling and graphical analyses such as regression and trend correlation, the raw frequency counts derived from NVivo coding required normalization. For each participant, an SPI value was calculated by summing the total observed sociolinguistic behaviours across the three categories of peer code-switching, audience-sensitive lexical adjustment, and peer scaffolding. These raw SPI scores typically ranged from 0 to 15 within the dataset. To enable comparability across participants while fulfilling linear regression assumptions, a min-max normalisation was applied to transform all raw SPI values to a continuous scale between 1.5 and 5.0. This range was chosen to maintain visual similarity and statistical alignment with other Likert-type variables in the dataset, such as MAVL usage. The normalisation formula is as follows:

$$SPI_{normalized} = \left(\frac{SPI_{raw} - \min(SPI_{raw})}{\max(SPI_{raw}) - \min(SPI_{raw})} \right) \times 3.5 + 1.5$$

Within this transformed index:

(1) A score of 1.5 indicates minimal or no evidence of sociolinguistic mediation (i.e., observed behaviours).
(2) A score of 5.0 reflects extensive and frequent use of sociocultural adaptive vocabulary strategies.

The regression model fit for SPI as a continuous variable improved after this transformation, facilitating meaningful visual interpretation through scatterplots (see Figure 6). Additionally, this normalisation ensured a consistent scale for comparing peer-mediated vocabulary development behaviours across monolingual and multilingual groups. Building upon this figure, participants' normalised SPI scores were plotted alongside their productive vocabulary assessment results in a scatterplot. The plot reveals a positive linear correlation, particularly pronounced among Malaysian participants who clustered towards the higher ends of both axes. Conversely, Chinese participants exhibited greater score dispersion and generally lower values. This pattern corroborates the interpretation that sociolinguistic engagement, as measured by SPI, operates significantly as a mediating factor linking mobile vocabulary engagement and productive lexical output.

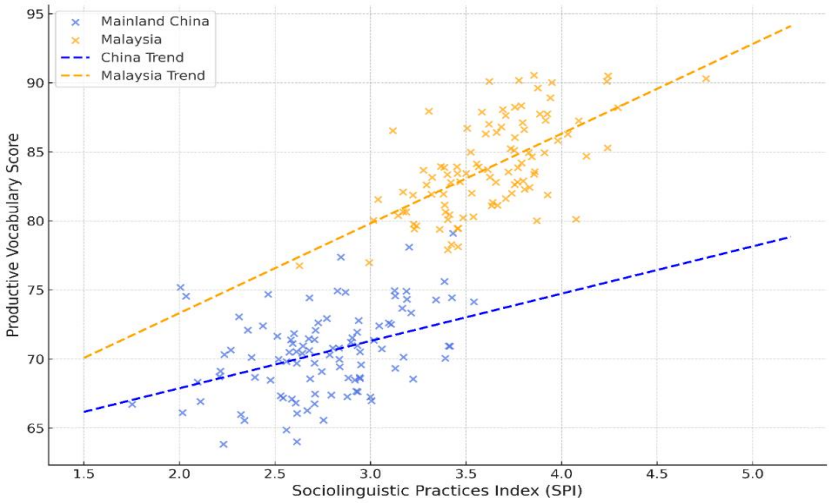

Figure 6: *Correlation between SPI and Productive Vocabulary Scores*

The observed pattern indicates that in multilingual sociolinguistic contexts, where interaction is frequent and socially supported, heightened sociolinguistic engagement correlates with superior vocabulary performance. Conversely, students exhibiting low SPI scores, despite relatively frequent MAVL use, tend to perform below the group average in productive vocabulary tasks. This suggests that limited peer interaction alone is insufficient for effective vocabulary development. An integrated analysis of MAVL usage and SPI revealed a noteworthy convergence among Malaysian learners: those demonstrating high levels of engagement with output-oriented mobile tools alongside active sociolinguistic practices achieved the highest scores on vocabulary assessments. In marked contrast, Chinese learners frequently showed low output engagement combined with minimal SPI activity, resulting in moderate or stagnant performance outcomes. These findings align with the ZPD, whereby learners in multilingual environments experience socially constructed enrichment through peer scaffolding, audience-sensitive lexical adjustment, and translanguaging, allowing them to operate beyond their unaided capabilities. By comparison, monolingual learners often function within more constrained, instructionally limited ZPDs, characterised by teacher-centred drills and reduced peer interaction.

Figure 7 illustrates the distinct developmental trajectories observed between the two learner groups. Multilingual learners, represented by the dashed curve, exhibit accelerated progress, benefiting from mediation deeply embedded in their contextual environment that supports productive vocabulary growth. Conversely, the solid curve reflects the slower advancement of monolingual learners, who mainly receive individualised, didactic instruction. Collectively, these results reinforce the conceptual framework outlined in Figure 2, demonstrating that productive vocabulary development is not merely a consequence of technology use. Instead, it unfolds through a mediated process shaped by sociocultural influences and the surrounding linguistic context. Optimal learner engagement occurs when MAVL is integrated with peer collaboration, dynamic language practices, and culturally relevant usage patterns.

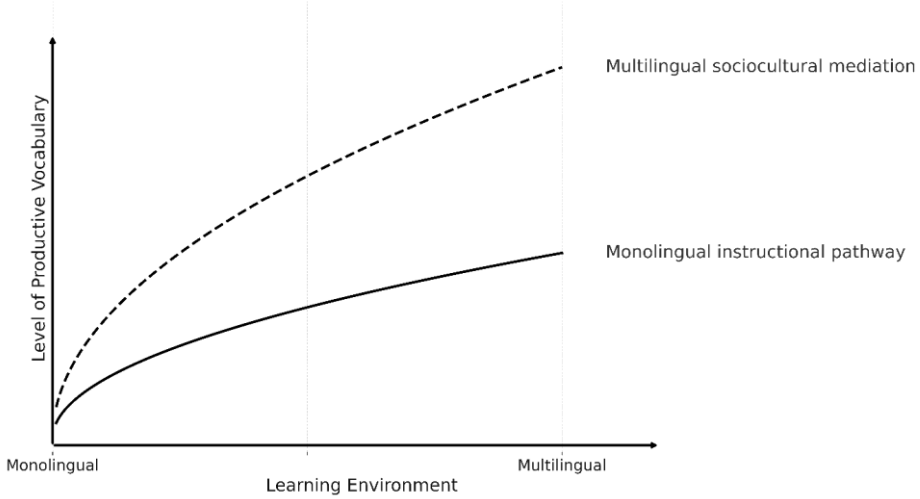

Figure 7: *ZPD Pathways across Learning Contexts*

Discussion

This section examines SCT, ZPD, and the current functions of sociolinguistic mediation in MAVL to interpret the empirical findings within the study's context. The discussion centers on three key insights: (1) the effect of the sociolinguistic environment on learners' engagement with MAVL, (2) the role of sociocultural dynamics in mobile-mediated input and output, and (3) the sociocultural implications of vocabulary development as shaped by contextual factors.

Linguistic Environment as a Mediating Context for MAVL Engagement

The findings revealed that access to MAVL tools was comparable between the two groups; however, the degree and nature of engagement varied significantly according to the linguistic context. Malaysian students exhibited considerably greater output-oriented use of mobile tools, incorporating them into collaborative peer activities, journaling, and audio reflection. This observation aligns with the SCT tenet that learning is contextually situated and shaped by the opportunities and constraints inherent in the sociolinguistic environment (Lantolf & Thorne, 2006). In contrast, Chinese learners, operating within a predominantly test-focused, monolingual setting, engaged primarily in input-centred activities and showed limited output interaction. Their learning context appeared to restrict informal use of advanced vocabulary, which according to (Vygotsky, 1978) can be interpreted as a constricted ZPD, where external mediation is largely formal, instructor-led, and not socially distributed. These results support the hypothesis illustrated in Figure 2, which

posits that the linguistic environment not only provides the backdrop for learning but also actively mediates the extent and quality of lexical scaffolding available. The variation in MAVL output behaviours reflects differences not only in digital culture but also in broader classroom cultures, assessment pressures, and peer communication norms.

Sociolinguistic Mediation as a Driver of Vocabulary Development

The analysis further demonstrates that sociolinguistic engagement, rather than mere time spent using mobile applications, is the strongest predictor of productive vocabulary development. This is evidenced by the Malaysian learners' high SPI scores alongside their superior vocabulary performance. Within this group, peer code-switching, audience-sensitive lexical adjustment, and collaborative scaffolding emerged as key interpersonal strategies operating within learners' ZPDs. This finding aligns with recent research on translanguaging and distributed agency, which argues that multilingual learners actively and simultaneously utilise their languages as resources in meaning-making processes (Canagarajah, 2012; García & Wei, 2014). The fact that Malaysian learners achieved the highest outcomes when both SPI and output-oriented MAVL use converged provides further support for the notion that vocabulary awareness is fundamentally interactionally mediated. Conversely, Chinese learners who did not employ such mediational strategies—even though they reported moderate engagement with MAVL—exhibited considerably more limited lexical development. This indicates that productive vocabulary growth requires both sociocultural engagement and technological input. This distinction offers a conceptual advancement beyond previous MALL research, which often treated technology integration as a uniform factor rather than one influenced by sociocultural variables.

Conceptualizing Vocabulary Learning as a Mediated Process

The proposed conceptual model (Figure 2) is empirically validated by the alignment between observed data patterns and the hypothesised pathways. Both output-oriented behaviours and sociolinguistic interaction practices significantly predict productive vocabulary development. Additionally, the visualisation of learners' ZPD trajectories (Figure 7) compellingly illustrates the substantial lexical growth enabled by sociocultural affordances. These MAVL findings indicate that mobile-assisted vocabulary learning should not be viewed merely as a discrete intervention but rather as a contextually situated process with distinct pedagogical roles across different environments. In multilingual settings, mobile tools function as platforms for peer dialogue and authentic language use, whereas in monolingual settings, their role is often limited to test review and rote memorisation. Therefore, this study not only addresses an empirical gap but also repositions MAVL as a socially mediated practice, highlighting its culturally contingent nature. This perspective supports the development of more nuanced MAVL interventions that integrate learners' linguistic ecologies, social identities, and agency, thereby redefining the potential and design of mobile learning tools.

Conclusion

Summary of Key Findings

This research examined the influence of linguistic setting and sociocultural mediation on MAVL, with a particular focus on productive vocabulary skills. Grounded in Vygotsky's Sociocultural Theory and an associated conceptual framework, the study yielded three principal findings. First, learners situated in multilingual contexts demonstrated more active engagement in output-oriented MAVL activities such as journaling and paired speaking, reflecting higher levels of self-confidence. This highlights the crucial role of context not only in the availability of tools but also in shaping the depth and extent of lexical engagement. Second, sociolinguistic practices—including code-switching, audience-sensitive lexical adjustment, and peer scaffolding—emerged as significant predictors of vocabulary outcomes. These strategies were notably more prevalent and sophisticated among Malaysian learners in relation to their productive vocabulary tasks. Third, regression analysis confirmed that productive vocabulary development is best explained by the interaction of output-oriented behaviours, sociocultural strategies, and the linguistic environment. The conceptual model proposed in this study received empirical support, demonstrating that vocabulary acquisition is not a straightforward process but rather a socially mediated, context-dependent phenomenon.

Theoretical Contributions

The theoretical contributions of this study centre on Vygotsky's Sociocultural Theory, applying it to MAVL to illustrate how technologies function as mediational tools within learners' ZPDs. By introducing the SPI, the study offers a means to quantitatively capture peer lexical interactions, thereby bridging the gap between qualitative insights and predictive modelling. Moreover, the proposed framework advances the understanding of MAVL from a predominantly "techno-behavioural" perspective to a sociocultural one, conceptualising vocabulary growth as a product of interaction, adaptation, and cultural negotiation. This paradigm shift supports emerging research that views digital learning as a socially situated and regulated practice rather than an isolated, context-independent activity.

Pedagogical and Practical Implications

The findings hold practical implications for educators, curriculum designers, and language policy stakeholders. In multilingual environments, pedagogical practices should leverage learners' sociolinguistic assets by incorporating translanguaging strategies, audience-responsive language tasks, and collaborative multilingual engagements. MAVL platforms must evolve beyond static flashcard-based tools, embedding features such as peer-interactive scenarios, context-sensitive role-play prompts, and adaptive multilingual user interfaces to enhance learner engagement. In monolingual settings, instructional design should prioritise communicative authenticity through digitally mediated dialogues, task-based exchanges, and mixed-code online forums that simulate real-life interaction. Additionally, institutional frameworks should equip educators with a clear understanding of sociocultural mediation, ensuring curriculum design and assessment frameworks are aligned with interactional and contextually grounded language development goals.

Limitations and Future Directions

While this research contributes meaningful empirical and theoretical insights, several limitations must be acknowledged. Firstly, the majority of data concerning MAVL engagement was self-reported, which introduces the potential for response bias. Future investigations would benefit from integrating app-based usage analytics to enhance ecological validity. Moreover, although the SPI was validated through thematic analysis and regression modelling, its broader pedagogical applicability across diverse cultural contexts remains to be examined. Future research could explore the scalability of the proposed model in varied linguistic environments, including bilingual, diglossic, and resource-constrained contexts. Additionally, employing longitudinal designs may provide insights into how learners' sociolinguistic practices evolve over extended engagement with MAVL. Finally, the role of teacher mediation and institutional policy in shaping and extending learners' ZPDs within mobile learning environments represents a promising direction for further inquiry.

Disclosure Statement

The authors report there are no competing interests to declare.

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