

# How Informal Digital Engagement Shapes Vocabulary Growth Among Saudi EFL Learners

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## Abstract

While casual digital engagement, such as browsing social media, streaming videos, and gaming, has become an integral part of Saudi university students' daily lives, its role in English vocabulary development remains underexplored. This study investigates how learners' motivations for engaging in these digital activities and the strategies they employ during or after such experiences contribute to different dimensions of vocabulary knowledge. The research was conducted at one public Saudi university with 93 male EFL undergraduates who completed all study phases. Participants were randomly assigned to a treatment group, which received micro-prompts to save and use new words in sentences, or a control group. Data sources included vocabulary breadth and depth tests administered at three time points, a digital habits survey, experience-sampling prompts, and passive usage logs. Analyses using structural equation modeling and mixed ANOVA revealed that learners' depth of processing, particularly attention to form–meaning relationships and example generation, significantly predicted both short-term gains and retention. Effects differed between receptive and productive vocabulary knowledge, with deep processing emerging as the strongest predictor of sustained development.

*Keywords:* informal digital learning, vocabulary growth, Saudi EFL learners, self-regulated learning, processing depth

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## Introduction

Vocabulary learning remains central to second language acquisition (SLA). It underpins comprehension, communication, and coherent discourse. Learners with limited lexical knowledge often struggle to express meaning, even when their grammar is adequate. Traditionally, vocabulary development has relied on structured classroom instruction. However, digital technologies now extend learning beyond the classroom by providing authentic, spontaneous, and multimodal exposure, particularly for English as a Foreign Language (EFL) learners.

In Saudi Arabia, university students operate daily within hybrid Arabic–English digital spaces. They browse social media, watch subtitled videos, play online games, and communicate through mixed linguistic codes. These activities immerse them in authentic English use. Yet exposure alone does not guarantee learning. While digital environments provide abundant input, they also encourage passive scrolling and shallow processing. Learners may repeatedly encounter words without integrating them meaningfully (Godwin-Jones, 2020; Peters, 2019). In this study, informal digital learning of English (IDLE) refers to incidental, self-directed engagement with English through everyday digital activities outside formal instruction.

A key distinction in vocabulary research is between breadth (number of words known) and depth (quality of knowledge about those words). Breadth develops largely through frequency of exposure, whereas depth requires deliberate engagement with meaning, form, and use (Nation, 2001; Schmitt, 2014). Depth supports collocational knowledge, grammatical awareness, and subtle meaning distinctions. Digital environments often prioritize quantity over quality. The central issue, therefore, is not whether digital engagement supports vocabulary growth, but how and under what cognitive and motivational conditions it does so.

### Gaps of the Study

Despite growing interest in IDLE, important gaps remain. Much existing research relies on self-report surveys or correlational designs that limit causal interpretation. Digital engagement is often treated as a single construct, without examining the cognitive and affective processes that shape learning outcomes. In the Saudi context, empirical research remains limited. Few studies have explored how digital routines interact with strategy use, motivation, and processing depth to influence vocabulary development.

To address these gaps, this study examines whether informal digital engagement, enhanced through micro-prompts, leads to measurable gains in vocabulary depth among Saudi EFL learners. Micro-prompts are brief cues that encourage deeper processing during authentic digital activity. For example, learners may be asked to predict meanings, notice collocations, or paraphrase captions. These prompts aim to promote reflection without interrupting natural engagement.

The study combines ecological validity with experimental control by embedding structured micro-interventions within authentic digital routines and measuring development over time. This design allows closer examination of how informal digital engagement contributes to vocabulary learning.

## **Aims of the Study and Research Questions**

This study aims to:

- Examine whether integrating micro-prompts into informal digital routines enhances vocabulary depth.
- Investigate whether depth of processing predicts vocabulary growth across time.
- Explore the cognitive, motivational, and contextual mechanisms learners associate with vocabulary learning beyond the classroom.

Accordingly, the study addresses the following research questions:

RQ1: To what extent does integrating micro-prompts into informal digital routines enhance vocabulary depth among Saudi EFL undergraduates over time?

RQ2: To what extent does depth of processing predict longitudinal vocabulary growth across multiple assessment points?

RQ3: What cognitive, motivational, and contextual mechanisms do learners identify as contributing to vocabulary learning in informal digital environments?

## **Significance and Contribution**

This study contributes to SLA research by linking ecological authenticity with experimental rigor through a mixed-methods design. It moves beyond measuring exposure frequency to examine the quality and intentionality of engagement. Using structural equation modeling (SEM) alongside qualitative analysis, it models directional relationships while capturing learners' lived experiences. In doing so, it responds to calls for dynamic and context-sensitive research in underrepresented EFL contexts such as Saudi Arabia.

## **Theoretical Frameworks**

To explain how digital routines support vocabulary development, this study draws on four complementary frameworks. Together, they address cognitive, motivational, behavioral, and social dimensions of language learning.

### ***Depth of Processing***

Based on Craik and Lockhart (1972), vocabulary retention depends more on how words are processed than on how often they are encountered. Deeper processing occurs when learners create examples, notice collocations, and connect new words to prior knowledge. In contrast, simple recognition leads to weaker retention. The micro-prompts in this study were designed to encourage such elaboration. They asked learners to link word form, meaning, and use during everyday digital activities. Previous research (e.g., Peters et al., 2016) shows that tasks requiring semantic engagement promote vocabulary depth more effectively than passive exposure. This framework therefore positions strategic cognitive effort as central to durable lexical growth.

### ***Self-Regulated Learning***

Drawing on Zimmerman (2000), informal digital vocabulary learning is viewed as a self-directed process. Without teacher supervision, learners must set goals, monitor progress, and reflect on their learning. Simply encountering words online does not guarantee retention; learners need to notice, record, and revisit vocabulary intentionally. The micro-prompts

functioned as metacognitive scaffolds. They encouraged learners to pause, think, and evaluate their vocabulary use. In this way, the intervention aimed to shift learners from passive digital consumption to more regulated and strategic engagement.

### ***L2 Motivational Self System***

Dörnyei’s (2009) L2 Motivational Self System explains how learners’ future self-images shape engagement. Motivation is not fixed; it changes depending on how learning experiences connect to learners’ goals and identities. Digital environments that promote enjoyment, relevance, and autonomy may activate learners’ Ideal L2 Selves (Al-Hoorie, 2018; Dörnyei, 2009). In this study, micro-prompts encouraged learners to reflect on progress and align digital practices with long-term language goals. By strengthening the quality of the learning experience, the intervention sought to sustain motivation in informal contexts.

### ***Sociocultural Theory***

From a sociocultural perspective (Vygotsky, 1978), vocabulary learning is socially mediated. Interaction with peers, digital tools, and cultural practices shapes cognitive development. Messaging apps and shared platforms are not neutral spaces; they mediate meaning-making and collaboration (Lantolf & Thorne, 2006). Learners often negotiate meaning, share examples, and evaluate usage together. These exchanges create opportunities for repeated exposure and contextualized learning. Vocabulary development therefore occurs within socially embedded digital practices rather than in isolation.

### ***An Integrated Model***

Rather than treating these frameworks separately, this study adopts an integrated perspective. Depth of processing explains how words are elaborated. Self-regulation explains how learning is managed. Motivation explains why learners sustain engagement. Sociocultural mediation explains where and with whom learning occurs. Together, these dimensions capture vocabulary development as a dynamic and ecologically situated process. As shown in Table 1, this integrated model provides a foundation for examining how micro-prompt-supported digital practices can transform everyday online engagement into sustained vocabulary growth.

**Table 1**  
*Theoretical Frameworks Underpinning the Integrated Model*

<b>Theoretical Framework</b>	<b>Core Mechanism</b>	<b>Linked Research Question</b>
Depth of Processing Hypothesis	Semantic elaboration strengthens lexical retention	RQ1: Do micro-prompts enhance vocabulary depth?
Self-Regulated Learning (SRL)	Goal-setting, monitoring, and reflection structure engagement	RQ2: Does processing depth predict vocabulary growth?
L2 Motivational Self System (L2MSS)	Ideal L2 Self and motivational alignment sustain effort	RQ3a: What motivational factors shape engagement?
Sociocultural Theory (SCT)	Social mediation and peer interaction contextualize learning	RQ3b: What contextual factors contribute?

## **Literature Review**

### **Vocabulary Development in Informal Digital Contexts**

Vocabulary acquisition has long been recognized as central to second language proficiency (Nation, 2001; Schmitt, 2014). However, lexical learning increasingly extends beyond formal classrooms into informal digital environments. Research on informal digital learning of English (IDLE) examines how engagement with social media, streaming, messaging, and other online activities supports incidental vocabulary growth. Despite this expansion, findings remain mixed and fragmented. Several studies (e.g., Lee & Dressman, 2018; Peters, 2019; Sockett & Toffoli, 2021) suggest that digital exposure promotes lexical development by providing authentic, contextualized input. Yet exposure alone does not guarantee learning. Online engagement often lacks intentional focus on form–meaning connections. Learners may scroll through multimodal content or watch subtitled videos without processing words deeply. This gap between digital potential and cognitive engagement raises questions about how vocabulary is actually processed during informal use.

### **Depth of Processing and the Role of Strategy Use**

Research grounded in the Depth of Processing framework ( Craik & Lockhart, 1972) shows that retention improves when learners engage in elaborative tasks such as generating sentences, linking words to prior knowledge, and noticing collocations. However, many digital habits, especially multitasking or passive browsing, do not naturally promote such elaboration. Although digital platforms offer rich lexical input (Godwin-Jones, 2020; Kim & Gilman, 2008), learners frequently engage with it superficially. To address this issue, scholars have explored strategy-based interventions embedded within digital routines (Reinders & White, 2016; Rosell-Aguilar, 2020). These include prompts, reminders, and reflective tasks that encourage deeper engagement. While findings suggest that lightweight interventions can nudge learners toward elaboration, most studies remain exploratory and provide limited causal evidence.

### **Motivation, Identity, and Self-Regulation**

Beyond cognitive processing, recent research highlights the role of motivation and emotion in digital vocabulary learning. Drawing on the L2 Motivational Self System (Dörnyei, 2009), Liu et al. (2023) argue that learners with vivid Ideal L2 Selves are more likely to transform casual digital habits into meaningful learning experiences. Similarly, Ziegler et al. (2021) report that enjoyment and emotional investment are linked to stronger lexical outcomes. These findings suggest that affective engagement may reinforce deeper processing. Self-regulated learning (SRL) also plays a mediating role (Lai & Gu, 2011; Rezai et al., 2024). Learners differ not only in exposure but in their ability to monitor, evaluate, and adjust their learning strategies. However, as Lai (2021) notes, many learners lack the metacognitive awareness needed to regulate learning in informal digital contexts. This reinforces the need for scaffolded interventions that build strategic behavior.

### **Methodological Limitations in IDLE Research**

Despite conceptual advances, IDLE research remains methodologically limited. Many studies rely on cross-sectional self-report surveys (Lee, 2017; Liu et al., 2023; Smith, 2011), restricting causal interpretation and failing to capture dynamic engagement patterns.

Retrospective diaries and questionnaires are also vulnerable to recall bias. Experimental and longitudinal designs integrating behavioral traces and standardized lexical assessment remain relatively rare, particularly in non-Western contexts such as Saudi Arabia. Furthermore, contextual moderators, including cultural norms, institutional structures, and gendered access to digital resources, are often underexplored. This limits the transferability of findings across learning environments.

### **Addressing the Gaps: Contributions of the Current Study**

The present study seeks to address these limitations through four main contributions:

- **Clear Operationalization:** It distinguishes between vocabulary breadth and depth using validated testing instruments, moving beyond vague notions of “vocabulary knowledge.”
- **Ecologically Valid Mixed Methods:** The study embeds micro-prompts into real digital routines and triangulates outcomes using lexical assessments, digital logs, and learner reflections.
- **Causal Modelling:** It employs cross-lagged structural equation modelling (SEM) to examine the dynamic relationship between engagement, depth of processing, and lexical outcomes across time.
- **Contextual Relevance:** It focuses on Saudi EFL learners, a demographic underrepresented in IDLE research, while capturing sociocultural factors that shape vocabulary development.

By integrating experimental control with naturalistic design, the study offers a nuanced and context-sensitive understanding of informal digital routines. When these routines are scaffolded with strategic micro-interventions, they can promote deeper vocabulary learning.

### **Methodology**

A well-designed methodology ensures that research questions are addressed with clarity and rigor. The present study employed a convergent mixed-methods design (Creswell & Plano Clark, 2018), a robust approach for examining complex phenomena in applied linguistics. This design enabled simultaneous analysis of measurable vocabulary gains and learners’ lived experiences. Quantitative measures assessed lexical development, while qualitative tools explored processing depth, strategy use, and perceptions. The approach combined ecological validity with experimental structure, allowing investigation of causal pathways within authentic digital contexts.

### **Participants**

The sample included 93 Saudi male EFL undergraduates from a public university. All were English majors aged 18–24 who reported regular engagement with English digital media. Data collection was conducted at a male-only campus, consistent with Saudi gender-segregated educational structures. Although initial plans included female participants, access restrictions limited recruitment to male students. All participants met eligibility criteria (intermediate to upper-intermediate proficiency and active digital use) and completed all study phases. The sample size provided adequate statistical power for mixed ANOVA and SEM analyses. While homogeneous in gender and institutional context, this consistency reduced extraneous variation in digital engagement patterns, strengthening internal validity but limiting generalizability.

## **Instruments**

A multi-instrument strategy was adopted to minimise reliance on a single method and to enable cross-validation:

- Digital Habits Questionnaire (DHQ): Measured frequency, strategic behaviors, and affective engagement.
- Vocabulary Size Test (VST) and Word Associates Test (WAT): Two of the most widely used tools for assessing breadth and depth of lexical knowledge (Nation, 2001; Read, 2004).
- Learner Reflective Notes and Written Comments: Captured strategy use, motivation, and engagement without intrusive monitoring.
- Experience-Sampling Method (ESM): Recorded real-time engagement patterns. This variety of instruments ensured that the strengths of one method compensated for the limitations of another. Standardised tests provided objectivity and ESM enhanced ecological validity.

This combination minimized single-method bias and strengthened construct validity.

## **Procedure**

Data collection unfolded in sequential stages:

- Baseline Testing: VST and WAT administered during Week 0 to establish a benchmark.
- Survey Administration: DHQ distributed online to capture initial patterns of digital habits.
- Randomisation: Participants randomly assigned to a treatment group (receiving micro-prompts to save and sentence new words) or a control group (no prompts).
- Field Phase: Over 14 days, ESM prompts were completed three times daily; optional passive logs were also collected.
- Post-Testing: Vocabulary tests repeated in Week 2 and Week 4 (delayed retention).
- Written Reflections: A purposive subsample of 20 learners representing different proficiency bands submitted short written comments on their digital vocabulary learning experiences. These qualitative reflections were used to contextualize quantitative findings and to support methodological triangulation.

## **Micro-prompt Design and Delivery**

Micro-prompts were delivered manually via widely used messaging platforms (e.g., WhatsApp) to integrate smoothly into learners' digital routines. Participants in the treatment group received two to three prompts daily during the 14-day field phase. Prompts were brief, platform-agnostic, and non-intrusive. Learners were encouraged, but not required, to save unfamiliar words, generate example sentences, or reflect on usage. The prompts targeted distinct processing phases: noticing, semantic elaboration, and metacognitive reflection (see Table 2). Each prompt aligned with principles from the Depth of Processing and Self-Regulated Learning frameworks, functioning as cognitive nudges rather than formal tasks to preserve ecological validity.

**Table 2***Micro-prompt Types and Intended Functions*

<b>Prompt Type</b>	<b>Timing</b>	<b>Example</b>	<b>Intended Cognitive Process</b>
Noticing Prompt	During video/text viewing	“Pause and predict the meaning of this word”	Attention to form–meaning
Elaboration Prompt	After encounter	“Use this word in a sentence”	Semantic elaboration
Reflection Prompt	End of day	“Which new words did you remember today?”	Metacognitive monitoring

**Data Analysis*****Quantitative Strand***

Descriptive statistics (means, SDs, skewness, kurtosis) were calculated for all measures. Independent t-tests confirmed baseline equivalence between groups. A mixed ANOVA examined vocabulary gains across groups and time points (pre, post, delayed). Cross-lagged panel SEM tested directionality of effects, assessing whether processing depth (from ESM) predicted subsequent vocabulary outcomes. Reliability checks showed Cronbach’s alpha values for DHQ subscales ranging from .78 to .86, confirming internal consistency.

***Qualitative Strand***

Written learner comments and open-ended ESM responses were coded thematically using a systematic manual coding procedure. Deductive categories (depth, regulation, motivation, and context) were complemented by inductive themes emerging from learner accounts. To enhance analytic rigor, a subset of the data was independently coded by a second rater, yielding an inter-rater agreement of 87%, exceeding the 80% threshold commonly accepted in applied linguistics research. Findings from both strands were integrated during interpretation. Triangulation across surveys, tests, and logs strengthened construct validity and yielded a multi-layered account of learner engagement.

**Reliability and Validity**

Multiple safeguards ensured trustworthiness. Triangulation across tests, surveys, ESM, and reflections reduced bias. Statistical controls addressed false discovery risks. Inter-rater agreement and member validation reinforced qualitative credibility.

**Ethical Considerations**

Participants provided informed consent and could withdraw at any time. Passive logging required separate opt-in approval. All data were anonymized, and incentives were provided through course credit and digital vouchers. In sum, the mixed-methods design balanced experimental rigor with ecological authenticity, capturing digital vocabulary learning as a multidimensional process rather than reducing it to isolated variables.

## Results

This section reports quantitative and qualitative findings related to vocabulary development and depth of processing. Results are presented in five parts: descriptive trends, intervention effects, reliability analyses, longitudinal modelling, and qualitative evidence. All analyses are based on the final analytic sample of 93 participants with complete data.

### Descriptive Trends in Vocabulary Development

Table 3 presents mean scores for vocabulary breadth and depth across three testing points. Both measures improved from pre-test to post-test.

Vocabulary breadth increased from 53.1 (SD = 8.1) to 60.4 (SD = 8.7), a statistically significant gain ( $p < .001$ ). At delayed testing, breadth declined slightly to 58.9 (SD = 8.4), though the decrease remained significant ( $p < .05$ ).

Vocabulary depth followed a similar pattern. Mean WAT scores rose from 37.8 (SD = 6.9) to 44.6 (SD = 7.4) at post-test ( $p < .001$ ). At delayed testing, scores remained stable ( $M = 43.7$ ,  $SD = 7.2$ ), with no significant decline.

These findings suggest that vocabulary depth gains were more resistant to attrition than breadth gains.

**Table 3**

*Vocabulary Scores Across Time (N = 93)*

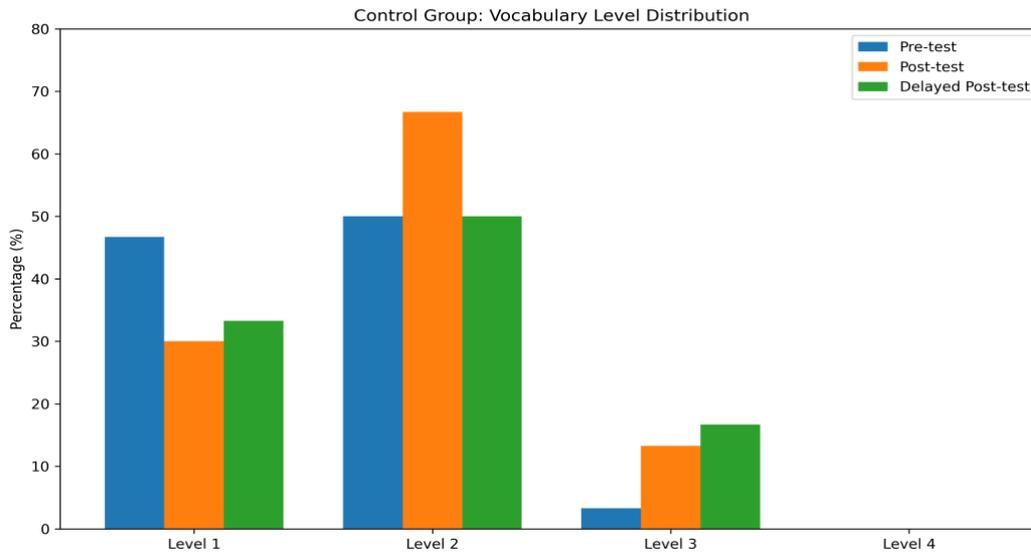
<b>Measure</b>	<b>Pre-test (M, SD)</b>	<b>Post-test (M, SD)</b>	<b>Delayed Test (M, SD)</b>
Vocabulary Breadth (VST)	53.1 (8.1)	60.4 (8.7)	58.9 (8.4)
Vocabulary Depth (WAT)	37.8 (6.9)	44.6 (7.4)	43.7 (7.2)

*Note.* \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ ; ns = not significant.

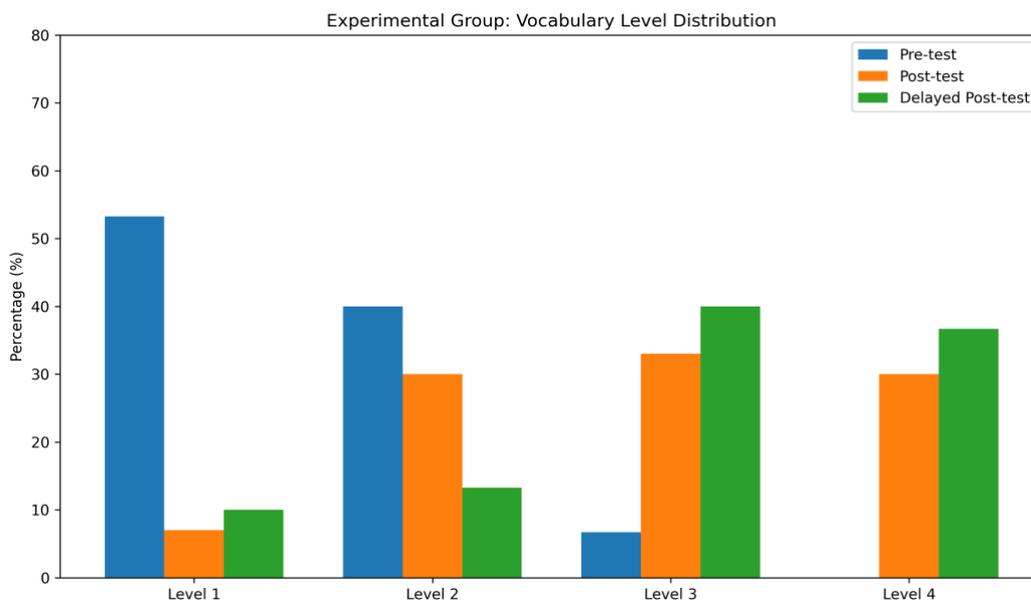
### Intervention Effects

A  $2 \times 3$  mixed ANOVA examined group and time effects on vocabulary depth. A significant main effect of Time confirmed overall development. A significant Group  $\times$  Time interaction,  $F(2, 182) = 6.4$ ,  $p = .002$ , indicated stronger gains for the treatment group. Participants receiving micro-prompts showed larger improvements from pre-test to post-test and maintained higher delayed scores than the control group (see Figure 1 and Figure 2). These results suggest that micro-prompts enhanced durable lexical depth rather than producing short-term gains only.

**Figure 1**  
*Control Group: Vocabulary Level Distribution*



**Figure 2**  
*Experimental Group: Vocabulary Level Distribution*



### Reliability of Instruments

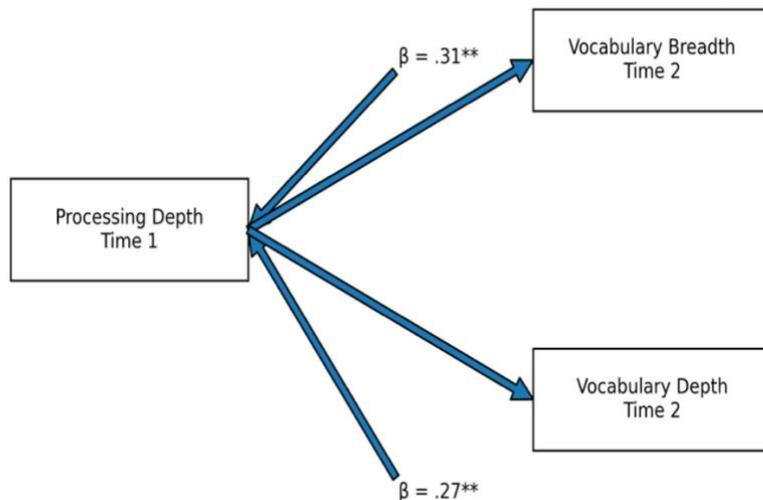
Cronbach's alpha values ranged from .78 to .84 across questionnaire subscales (Table 4), exceeding the .70 threshold for acceptable reliability. These results support the internal consistency of engagement, regulation, and affective orientation measures.

**Table 4***Reliability Statistics (N = 93)*

Subscale	Items	Cronbach's $\alpha$
Engagement	8	.80
Regulation	7	.83
Affective orientation	6	.79

### Cross-Lagged SEM: Directional Relationships

A cross-lagged structural equation model (SEM) was conducted to examine directional relationships between processing depth and vocabulary knowledge across time (see Figure 3). As shown in Figure 3, processing depth at Time 1 significantly predicted vocabulary breadth ( $\beta = .31, p < .01$ ) and vocabulary depth ( $\beta = .27, p < .01$ ) at Time 2. In contrast, the reverse paths were not statistically significant. Vocabulary knowledge at Time 1 did not predict subsequent processing depth, indicating that elaborative engagement preceded lexical development rather than resulting from it. These findings remained stable despite the reduced sample size.

**Figure 3***Cross-Lagged SEM of Processing Depth and Vocabulary Outcomes (N = 93)*

### Qualitative Insights: Mechanisms of Engagement

A thematic analysis of 72 student reflections was conducted using grounded theory principles. Three dominant themes emerged.

#### *Strategic Engagement*

Learners who paused to check meanings, generated example sentences, or saved unfamiliar words demonstrated stronger vocabulary gains. This pattern aligns with the SEM findings, reinforcing the role of deeper processing in lexical development.

### ***Motivational Anchors***

Many participants linked their engagement to positive L2 self-perceptions and emotional investment. Students in the treatment group described micro-prompts as useful reminders that encouraged intentional focus during digital activities.

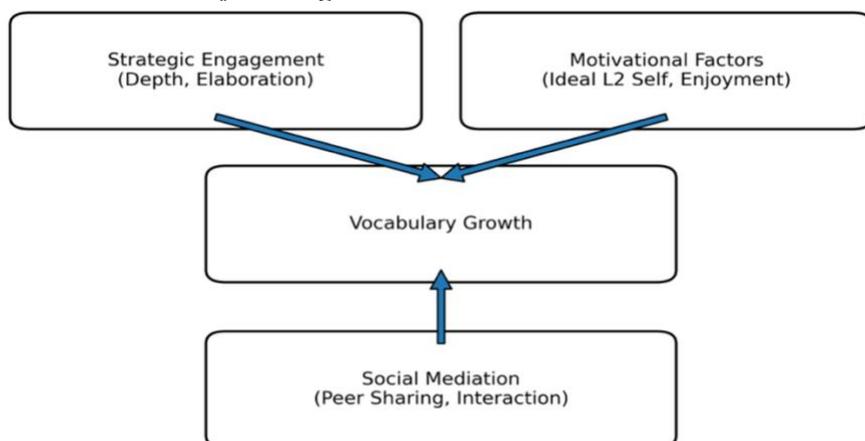
### ***Social Reinforcement***

Vocabulary learning was often supported through peer interaction, including sharing captions, memes, and jokes. These exchanges provided contextualized repetition and strengthened retention.

Collectively, the themes indicate that vocabulary growth is enhanced when cognitive effort is supported by motivation and socially embedded interaction. The relationships among these themes are illustrated in Figure 4.

**Figure 4**

*Thematic Model of Strategic, Motivational, and Social Factors*



Taken together, the findings present a coherent account of informal digital vocabulary learning. Quantitative results show gains in both breadth and depth, with stronger durability in depth. Experimental comparisons confirm the effectiveness of micro-prompts in enhancing collocational knowledge. Reliability analyses support the consistency of self-report measures, while SEM modelling identifies processing depth as a directional predictor rather than a byproduct. Qualitative evidence further clarifies the cognitive and social mechanisms underlying these outcomes.

Overall, the results indicate that digital exposure alone does not ensure robust vocabulary growth. What matters is how learners process input, strategically, reflectively, and socially. These findings carry clear implications for EFL pedagogy in digitally mediated environments where engagement quality varies.

## **Discussion**

### **Depth of Processing as the Central Mechanism of Lexical Development**

The findings indicate that vocabulary growth in digital environments depends less on exposure frequency and more on how learners process lexical input. Although both groups

improved in vocabulary breadth, only the treatment group maintained stable gains in depth at delayed testing. This pattern suggests that micro-prompts supported sustained elaboration rather than short-term recognition. Breadth gains, while evident, were more vulnerable to attrition.

These results align with Craik and Lockhart's (1972) Depth of Processing framework. In contrast to studies that equate digital learning with time spent online (Lee, 2017; Peters, 2019), the present findings show that surface interaction may support short-term breadth growth, but durable lexical development requires deeper engagement. Learners exposed to identical digital input achieved different outcomes depending on how they processed it. This underscores the limits of quantity-based indicators, such as screen time or content volume, as reliable predictors of vocabulary learning. The results therefore support a shift from exposure-driven models toward quality-oriented accounts of informal digital engagement. Vocabulary development appears shaped primarily by elaboration, reflection, and strategic reuse rather than passive consumption.

### **Self-Regulated Learning and Strategy Activation**

The study also highlights the role of self-regulatory behavior in digital vocabulary learning. Learners in the treatment group who paused to save, reuse, and reflect on unfamiliar words demonstrated more stable depth gains at delayed testing. These patterns are consistent with Zimmerman's (2000) Self-Regulated Learning (SRL) model, which conceptualizes learning as a cyclical process involving planning, monitoring, and evaluation.

However, regulatory behaviors did not consistently emerge spontaneously. Instead, they were often triggered by scaffolded micro-prompts. This suggests that learners may not automatically interpret digital engagement as a learning opportunity without explicit cues. Micro-prompts functioned as catalysts, encouraging learners to notice, monitor, and revisit vocabulary in real time.

At the same time, SRL does not operate in isolation. Regulatory behaviors interacted with cognitive elaboration and motivational orientation. Self-regulation therefore appears as a facilitating mechanism within a broader network of processes rather than a singular explanation for vocabulary retention.

### **Motivation and the Affective Dimension of Engagement**

Motivation also shaped how learners responded to digital vocabulary encounters. Reflections indicated that learners with future-oriented aspirations related to English proficiency were more likely to pause and engage with unfamiliar words. These patterns resemble features of the Ideal L2 Self, although they were inferred qualitatively rather than measured through validated scales. Emotional engagement further influenced vocabulary processing. Many learners described digital content as enjoyable, humorous, or personally meaningful. Such positive affect appeared to increase attentional focus and willingness to engage with lexical input. These observations are consistent with Dewaele and MacIntyre's (2014) argument that enjoyment facilitates deeper processing and communicative engagement. Importantly, motivation was not purely internal. Learners frequently referenced peer expectations, academic advancement, and professional aspirations within the Saudi higher education context. English proficiency was associated with social mobility and institutional recognition. This layered motivational ecology challenges individualistic accounts of digital learning and

highlights the intersection of personal goals and sociocultural pressures. Although affect and motivation were not quantitatively measured in this study, the qualitative evidence suggests that emotional investment enhances responsiveness to strategic scaffolds. Motivation, enjoyment, and regulatory behavior appear to operate in interaction rather than independently.

### **Social Mediation and Cultural Embeddedness**

A notable contribution of this study is its attention to social mediation in informal digital learning. Participants frequently engaged with vocabulary through socially situated practices, including sharing memes, captions, and humorous exchanges. These interactions provided contextualized repetition and reinforced retention beyond solitary exposure. These patterns align with Vygotsky's (1978) Sociocultural Theory, which emphasizes the mediating role of interaction in cognitive development. Digital platforms functioned not only as input channels but also as spaces for collaborative meaning-making. Learners negotiated meaning, personalized language, and responded to peers' usage, embedding vocabulary within communicative practice. Within the Saudi context, digital engagement often occurs within peer networks and shared routines. Reflections suggested a preference for collaborative humor and collective participation. While cultural interpretations remain tentative, the findings challenge assumptions that informal digital learning is primarily individualistic. Instead, vocabulary development appears socially distributed and culturally situated.

### **Toward an Integrated Model of Digital Vocabulary Learning**

The findings highlight the limitations of relying on a single theoretical framework. Depth of Processing explains how lexical items are elaborated but does not fully account for sustained engagement. Self-regulated learning clarifies strategic behavior yet may underestimate the role of contextual scaffolding. Motivational models illuminate aspiration and identity but overlook social mediation. Sociocultural perspectives foreground interaction but may underplay individual variation in strategy and affect. The present study integrates these dimensions within a unified analytical framework. Vocabulary growth emerged from the interaction of cognitive elaboration, regulatory scaffolding, motivational alignment, and social reinforcement. These processes were mutually reinforcing rather than independent.

Accordingly, vocabulary development in informal digital contexts cannot be reduced to time online or volume of exposure. Durable learning occurs when exposure is accompanied by strategic processing, emotional investment, and socially mediated reinforcement. Future digital interventions should therefore activate this multidimensional synergy rather than focusing solely on input frequency.

### **Conclusion**

This study examined how informal digital habits shape vocabulary growth among Saudi EFL learners through a convergent mixed-methods design involving 93 participants. Three key findings emerged. First, both vocabulary breadth and depth improved over time, with stronger and more durable gains in depth among the treatment group. This highlights the importance of engagement quality over exposure quantity and supports the Depth of Processing framework. Second, cross-lagged SEM showed that processing depth predicted subsequent vocabulary growth, positioning elaboration and strategic engagement as likely causal mechanisms. Third, qualitative findings revealed that vocabulary learning was

motivationally and socially mediated, with enjoyment, peer interaction, and future-oriented L2 self-concepts shaping sustained engagement.

Collectively, these findings contribute both pedagogically and theoretically. Pedagogically, they underscore the value of scaffolding self-regulation in informal digital contexts through micro-prompts, reflective activities, and socially embedded practices. Theoretically, the study integrates Depth of Processing, Self-Regulated Learning, the L2 Motivational Self System, and Sociocultural Theory into a multidimensional model of digital vocabulary development.

### **Limitations**

Several limitations should be acknowledged. Reliance on self-report instruments may have introduced subjectivity and recall bias. The 14-day intervention limited insight into long-term development, and optional passive logging reduced the availability of behavioral data. The use of a single-institution convenience sample and the exclusive focus on male learners constrain generalizability. Nevertheless, triangulation across tests, surveys, experience sampling, and usage logs strengthened internal validity. Future research should employ longer interventions, multi-site and mixed-gender samples, fully randomized designs, and systematic behavioral tracking to enhance ecological and external validity.

### **Practical Implications**

For teachers, digital exposure alone is insufficient; embedding micro-prompts, reflection tasks, and sentence-generation activities can deepen processing and support retention. For learners, active elaboration and strategic reuse of vocabulary are essential for durable gains. For institutions and policymakers, self-access platforms should incorporate regulatory and motivational scaffolds aligned with broader educational priorities. For researchers, greater use of ecologically grounded tools is needed to examine how motivation, regulation, and social mediation interact across contexts.

### **Acknowledgements**

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### **Declaration of Generative AI and AI-Assisted Technologies in the Writing Process**

Generative AI tools (ChatGPT, OpenAI) were used in a limited manner for language editing and stylistic refinement. They were not used for data analysis, interpretation, or content generation. The author remains fully responsible for the accuracy and integrity of the manuscript.

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