

More than a game: An activity theory analysis of EFL learners' Duolingo-mediated vocabulary learning practices

ABSTRACT - Numerous studies examining Duolingo within English as a Foreign Language (EFL) contexts have primarily focused on learning outcomes and user satisfaction, yet they seldom elucidate how vocabulary acquisition is systematically organized and sustained in learners' daily routines. This gap is critical, as app-based language learning typically unfolds outside formal instructional environments. Guided by Activity Theory, this qualitative study conceptualizes Duolingo-mediated vocabulary learning as a dynamic activity system. Data were collected via an open-ended questionnaire administered to ten EFL learners recruited from an online language learning community, complemented by the researcher's autoethnographic notes to enrich contextual understanding. Findings reveal that learners consistently engage in short, micro-sessions shaped by the platform's segmented lesson structure. Sustained participation is enabled through self-imposed daily routines and the motivational affordance of socially visible progress indicators. Furthermore, learners actively negotiate contradictions—such as the tension between repetitive drills and meaningful use—by adjusting learning intensity or expanding their toolset to include external resources like personal notes and authentic media. These insights extend beyond descriptive accounts to inform more learning-centered design principles and pedagogical scaffolding strategies, ultimately fostering durable vocabulary development in technology-mediated, self-directed EFL environments.

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1. Introduction

Mobile-Assisted Language Learning (MALL) is increasingly understood as more than learning conducted through smartphones alone; rather, it refers to a mode of learning that moves across contexts and is shaped by interaction and mediation (Butarbutar et al., 2020). In this perspective, learning becomes a form of “conversation in context,” supported by semiotic resources such as language, symbols, and text, as well as technological tools including mobile phones and applications (Çakmak, 2019; Kim et al., 2017). Within this broader MALL landscape, Duolingo has emerged as a prominent platform because it offers flexible, app-based language learning that learners can engage with across settings such as home, campus, and online environments, rather than within the boundaries of formal classroom instruction alone (Aliakbari & Mardani, 2022). Previous studies have largely examined Duolingo in terms of vocabulary improvement, learner motivation, and usability, often highlighting its positive role in supporting vocabulary gains, engagement, and accessibility (Shortt et al., 2023; Ajisoko, 2020; Borang et al., 2023; Irzawati & Felisya Unamo, 2023; Dahlan & Nurbianta, 2020).

However, these studies do not sufficiently explain how vocabulary learning is actually organized and sustained through everyday Duolingo use. Much of the existing literature remains focused on outcomes, learner perceptions, and general evaluations of effectiveness, while giving less attention to the processes through which learners participate, exercise agency, and organize their learning across daily contexts (Loewen et al., 2019; Shortt et al., 2023). As a result, important questions remain regarding how learners make use of Duolingo in practice, why they adopt particular patterns of participation, and how app-based vocabulary learning is shaped by routine, context, and the conditions of use.

To address this gap, the present study adopts Activity Theory (AT) as a qualitative framework for examining Duolingo use as a culturally situated, tool-mediated activity (Hashim & Jones, 2007). AT supports analysis of an activity system through the relationships among subject, tools, object, rules, community, division of labor, and outcomes, enabling a holistic interpretation rather than fragmented feature evaluations (Hashim & Jones, 2007). Moreover, third-generation AT enables the study of activity systems (such as classroom norms and app-based educational methods) where conflicts can prompt transformation (Ali et al., 2015). This is especially pertinent because gamified elements might impact components of “control” and “communication” within learners’ habits (such as streaks and progress monitoring), possibly influencing motivation in ways (Sharples et al., 2005).

This study addresses an important gap in research on Duolingo and app-based language learning by examining how vocabulary learning is organized, sustained, and negotiated in everyday use, rather than treating Duolingo primarily as a source of measurable outcomes. In doing so, it seeks to explain how learners engage with the platform and why they adopt particular patterns of participation and strategy use (Loewen et al., 2019; Shortt et al., 2023). Activity Theory is employed as the analytical framework because it enables the study to account for the relationships among learners, tools, rules, social relations, and learning goals, as well as the contradictions that shape continued participation or adjustment over time (Ali et al., 2015; Hashim & Jones, 2007). The study also offers practical implications for situating Duolingo

within flexible, cross-context learning ecologies by showing how participation is shaped by routines, community influences, and contextual shifts across everyday settings (Sharples et al., 2005; Wali et al., 2008).

This study examines how EFL learners sustain Duolingo-mediated vocabulary learning in everyday contexts through an Activity Theory lens. The study is guided by the following research questions:

1. How do EFL students construct Duolingo-mediated vocabulary learning as an activity system (subjects, tools, object/outcomes)?
2. How do rules and social relations (e.g., streak goals, routines, online communities) mediate students' engagement with Duolingo for vocabulary learning?
3. What contradictions arise in this activity system, and how do students negotiate them through changes in strategies, participation, or goals?

2. Literature review

2.1. *Mobile-assisted language learning and app-based language learning*

Mobile-Assisted Language Learning (MALL) is commonly framed as learning that is mediated through mobile devices and therefore can move across places and moments rather than staying inside one fixed classroom setting (Sharples et al., 2005; Wali et al., 2008). In this view, learning is a “conversation in context” where meaning-making is supported by semiotic tools (texts, symbols, interface prompts) and by the affordances of the device itself (Sharples et al., 2005). Because learners often switch between home, campus, and online environments, MALL research emphasizes how context, mediation, and interaction shape what learners actually do while studying (Wali et al., 2008). This perspective matters for app-based language learning because the “same” activity (e.g., completing vocabulary drills) can function differently depending on when, where, and why it is done (Sharples et al., 2005; Wali et al., 2008).

2.2. *Duolingo in EFL vocabulary learning: Design features, learner engagement, and reported outcomes*

Previous research on Duolingo within MALL has largely focused on the platform's design features, motivational affordances, and reported learning benefits. In this literature, Duolingo is commonly presented as a platform that combines learning-science principles with gamified mechanisms to support repeated daily engagement (Freeman et al., 2023). Its design is often described through features such as interactive micro-practice with immediate feedback and adaptive sequencing, which suggest that app-based tools can structure learners' activity patterns over time (Freeman et al., 2023; Nushi & Eqbali, 2017). A recurring emphasis in this work is the role of motivation, with Duolingo portrayed as combining intrinsic supports, such as humor and a non-judgmental tone, and extrinsic supports, such as streaks, XP, leaderboards, and rewards, to stabilize participation (Ardhi, 2024). Taken together, these discussions suggest that Duolingo's design does not simply make language learning more attractive, but also shapes the goals toward which learners direct their attention, including consistency, competition, and visible progress (Anggraini et al., 2024).

Across EFL contexts, recurring findings in the literature indicate that Duolingo is often associated with vocabulary-related gains and positive learner engagement, particularly in short-term or structured interventions (Ajisoko, 2020; Apoko et al., 2023; Borang et al., 2023). Reported outcomes frequently include improvements in vocabulary scores, increased enthusiasm during practice, and greater willingness to engage in app-based learning activities (Ajisoko, 2020; Borang et al., 2023; Apoko et al., 2023). At the same time, these findings should be interpreted with caution, as many studies rely on local samples, brief treatment periods, or designs with limited controls, which make it difficult to draw strong causal conclusions from the reported gains (Ajisoko, 2020; Borang et al., 2023).

A similar pattern appears in studies of learner perception and usability. Repeatedly, learners describe Duolingo as enjoyable, motivating, and easy to use, suggesting that the platform may support persistence in out-of-class learning routines (Ajisoko, 2020; Apoko et al., 2023; Irzawati & Felisya Unamo, 2023). Usability-oriented studies likewise portray Duolingo as accessible and intuitive, while also noting concrete user concerns such as repetition, limited speaking practice, the heart system, and monetization pressures (Jeong, 2022; Chwo et al., 2018; Dahlan & Nurbianta, 2020). Overall, the literature consistently presents Duolingo as a motivating and usable platform with promising vocabulary-related benefits. However, these emphases also tend to privilege reported outcomes, positive perceptions, and interface strengths over closer examination of how participation is actually organized and sustained in practice.

2.3. Limitations of existing Duolingo literature

At the same time, a recurring issue across the literature is that motivation evidence is often dominated by self-report and short-term exposure, so claims about “lasting” motivational effects are still uncertain (Shortt et al., 2023). Another gap is that many studies do not isolate which specific gamification components (e.g., points vs streaks vs leaderboards) are responsible for observed engagement or outcomes, which makes it difficult to explain mechanisms rather than simply reporting improvements (Freeman et al., 2023; Shortt et al., 2023). Additionally, multiple sources raise concerns about limited opportunities for negotiation of meaning, pushed output, and transfer to real communication, suggesting that learners may “progress” in the app while still lacking productive-skill development (De Araújo & Eddine, 2020; Shortt et al., 2023). These limitations collectively point to a need for theory-driven investigations that can explain not only whether Duolingo correlates with gains, but also how learners organize their learning activity and what tensions they experience while using the tool (Ajisoko, 2020; Irzawati & Felisya Unamo, 2023; Shortt et al., 2023).

2.4. Activity theory as an analytical lens for Duolingo-mediated learning

Activity Theory (AT) is a theoretical framework for analysing human activity as a socially and historically situated process mediated by tools and artefacts. Rather than treating learning as an isolated mental event, AT views activity as the primary unit of analysis and explains human action in relation to a broader system involving participants, purposes, mediating tools, and social conditions (Hashim & Jones, 2007).

AT is particularly suitable for examining Duolingo-mediated EFL learning because app-based language learning does not occur in one fixed classroom context. Instead, it often unfolds across different times, places, and routines, such as at home, on campus, or during short moments in everyday life. Mobile learning research has emphasized that the learner, rather than the device alone, is mobile, and that learning is shaped by changing contexts, interaction, and mediation (Sharples et al., 2005; Wali et al., 2008). This makes AT especially relevant for Duolingo, where vocabulary learning is not determined only by the application itself, but also by learners' routines, goals, social influences, and the conditions under which they use the app (Hashim & Jones, 2007; Wali et al., 2008).

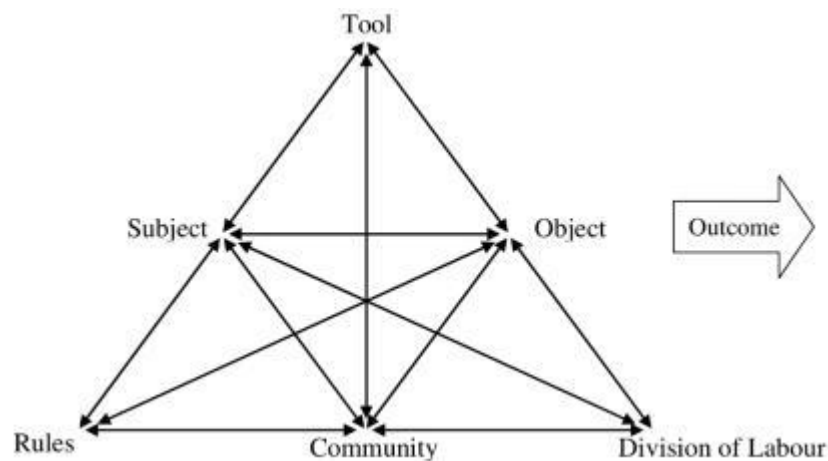


Figure 1. Engeström's expanded activity system (Hashim & Jones, 2007)

Figure 1 presents Engeström's expanded activity system, which is widely used in Activity Theory. In this model, an activity system consists of subject, tools, object, rules, community, division of labour, and outcome (Hashim & Jones, 2007). The subject refers to the learner, the tool refers to the mediating artefact used in the activity, the object refers to the purpose toward which the activity is directed, and the outcome refers to the transformed result of that activity. The social dimensions of the system are represented through rules, community, and division of labour, which explain how participation is shaped by norms, relationships, and the distribution of responsibilities (Hashim & Jones, 2007).

In the context of the present study, the subject is the EFL learner, the main tool is Duolingo, and the object is vocabulary development and sustained English practice. The rules may include daily goals, streak expectations, and self-imposed learning routines. The community may include peers, online friends, or Duolingo-related groups that influence participation. The division of labour refers to how learning support, encouragement, monitoring, and feedback are distributed among the learner, the app, peers, and possibly the teacher. The outcome may include improved vocabulary recognition, increased confidence, and more sustained engagement with English learning (Hashim & Jones, 2007).

Activity theory (AT) also distinguishes between activity, action, and operation. Activity is driven by a motive, action is directed by a goal, and operation is shaped by specific conditions (Hashim & Jones, 2007). Applied to this study, the broader activity is learning vocabulary

through Duolingo. The actions may include completing one lesson, reviewing errors, or maintaining a streak. The operations may include tapping answer options, replaying audio, typing translations, or choosing easier tasks when time is limited. This hierarchy is useful because it helps explain that learners' Duolingo participation is not a single flat behavior, but a layered process shaped by motives, goals, and contextual constraints (Hashim & Jones, 2007).

To explain how Duolingo-mediated vocabulary learning is organized in context, Activity Theory (AT) treats app use as a mediated activity system rather than a set of isolated app features (Hashim & Jones, 2007; Ali et al., 2015). AT emphasizes that learning outcomes emerge from the interaction among subject, tools, object, rules, community, and division of labour, meaning that the same application may function differently depending on the norms, expectations, and social arrangements surrounding its use (Hashim & Jones, 2007). Third-generation AT is especially relevant when multiple activity systems intersect, such as formal classroom expectations and app-based gamified routines, because contradictions between systems may drive changes in learners' behaviour, motivation, or strategy (Ali et al., 2015). In related studies of technology-mediated language learning, AT-informed analysis has been used to interpret learners' experiences by mapping their reflections onto activity-system components, allowing a deeper explanation of why particular tools or features motivate, constrain, or frustrate users (Kessler, 2020; Rouabhia & Kheder, 2024).

Taken together, AT provides a strong analytical lens for this study because it helps connect the major issues identified in previous Duolingo literature. Existing studies have often focused on outcomes, learner satisfaction, or motivation, but have paid less attention to how vocabulary learning is actually organized and sustained in everyday practice (Rouabhia & Kheder, 2024). By focusing on mediated activity, social relations, and contradictions within the activity system, AT allows the present study to examine how learners construct Duolingo-supported vocabulary learning across daily contexts, why they adopt certain routines, and how they adjust their strategies when tensions emerge between learning goals, app structures, and everyday conditions (Hashim & Jones, 2007; Wali et al., 2008; Kessler, 2020; Rouabhia & Kheder, 2024).

3. Method

3.1. Research design

This study employed a qualitative design guided by Activity Theory to examine how EFL learners organize, sustain, and interpret Duolingo-mediated vocabulary learning in everyday life. Rather than treating Duolingo as a set of isolated app features, the study approached its use as a mediated activity system (Engeström, 2001). The primary dataset consisted of open-ended questionnaire responses from learners, which served as the main basis for understanding participants' perspectives and practices. In addition, the study included the researcher's ongoing use of Duolingo as a supplementary autoethnographic dataset to support reflection on personal experiences and learning practices (Ellis et al., 2011). This secondary dataset was not intended to replace participant perspectives, but to strengthen reflexive awareness and deepen interpretation of how the activity system operated in practice.

3.2. *Participants and sampling*

Participants were recruited through an open invitation shared in a large and active Duolingo Discord community. Participation was voluntary, and respondents were invited to complete the questionnaire if they identified as EFL learners using Duolingo to learn English, had used the app consistently for at least four weeks, and were willing to provide narrative responses. A total of 24 responses were initially received. These responses were then screened according to the study's inclusion criteria and the adequacy of narrative detail. Responses that were too brief or minimally elaborated were excluded from the main analysis. The final analytic sample consisted of 10 participants (R1-R10), whose responses were retained because they provided sufficiently detailed and relevant accounts to address the study's research questions through the lens of Activity Theory. This process combined voluntary response recruitment at the initial stage with purposive selection of responses that offered adequate depth for qualitative interpretation. The study therefore does not claim statistical representativeness, but instead aims to generate context-specific insights into how Duolingo-mediated vocabulary learning is experienced and organized in practice.

3.3. *Data collection*

Data were collected through an open-ended online questionnaire distributed in the Duolingo Discord community. The invitation explained the purpose of the study, the participation criteria, and the general ethical basis of participation. The questionnaire served as the primary source of data and included two parts: brief background questions and reflective prompts. The background questions elicited information such as learning goals, frequency of use, and learning setting, while the reflective prompts invited participants to describe their motivations for continued use, features that shaped their routines, obstacles they encountered, strategies they used to address difficulties, and perceived changes in their English learning. These prompts were designed to generate responses that could be meaningfully examined through Activity Theory elements such as goals, tools, rules, and outcomes, while also surfacing tensions in independent Duolingo learning, including engagement versus frustration and convenience versus limited communicative practice (Loewen et al., 2019).

In addition to questionnaire responses, the study also drew on the researcher's personal experiences with Duolingo as a supplementary qualitative dataset. This autoethnographic dataset included a structured learning log and analytic memos documenting moments of motivation or difficulty during app use. These materials were not used to verify or generalize participant claims. Instead, they were used to clarify the researcher's standpoint as a Duolingo user, support reflexive awareness during analysis, and enrich interpretation when examining how components of the activity system interacted in practice (Ellis et al., 2011).

3.4. *Data analysis*

The analysis combined iterative qualitative coding with deductive mapping to Activity Theory concepts. First, the selected questionnaire responses were read repeatedly to build familiarity with the data. Initial inductive coding was then conducted to identify recurring

patterns and themes related to learners' routines, motivations, constraints, and perceived outcomes. The researcher's autoethnographic logs and memos were also coded, but their role remained supplementary and interpretive rather than evidentiary for participant experience. The two datasets were kept separate during the initial coding stage in order to preserve the distinction between participant accounts and researcher experience. They were brought together only during interpretation, where the autoethnographic data helped illuminate subtle app-related tensions, constraints, and mediational processes that supported a richer reading of the participant data. After initial coding, themes were mapped onto key Activity Theory elements, namely subject, tools, object, rules, community, division of labor, and outcomes, in order to produce an integrated account of Duolingo use as a mediated activity system (Braun & Clarke, 2023; Engeström, 2001). The analysis then focused on contradictions and tensions emerging across the dataset, such as enjoyment versus monotony, self-discipline versus pressure, and perceived progress versus limited transfer, treating such contradictions as analytically valuable for explaining why learners adjusted, resisted, or reshaped their participation over time (Braun & Clarke, 2021; Engeström, 2001).

3.5. Reflexivity, trustworthiness, and ethical considerations

Because the study included autoethnographic material alongside participant responses, reflexivity was treated as an important part of the analytic process. Reflexive notes were used to document how the researcher's dual role as analyst and Duolingo user might shape interpretation. This was intended to prevent the researcher's personal experience from overshadowing participant perspectives. Trustworthiness was further supported through a record of analytic decisions made during coding, theme development, and Activity Theory mapping, close grounding of claims in participant excerpts, and brief follow-up clarification when responses were unclear. These procedures followed practical guidance on maintaining coherence between data, codes, and claims in qualitative analysis (Nowell et al., 2017).

Participation in the questionnaire was voluntary, and completion of the questionnaire was treated as consent to participate. Participant identities were anonymized in reporting through labels such as R1-R10, and the response data were stored in a private Excel file accessible only to the researcher. When clarification was needed, follow-up communication was conducted only to confirm participants' intended meanings. Within this design, the findings are presented as context-specific qualitative interpretations rather than broad generalizations.

4. Findings

4.1. Duolingo as micro-learning: short sessions built around bite-sized lesson material

Participants described Duolingo vocabulary learning as short, repeatable sessions that fit into spare moments rather than long study blocks. This pattern was closely related to the platform's lesson design. The content was divided into small units that were easy to start and finish quickly, allowing learners to study without needing a formal setting or long uninterrupted time. "I usually open it when I'm free (waiting for class, in my boarding house before bed), and it lasts 10-20 minutes. I choose a lesson, work on it casually, and then review the mistakes I've

made" (R2), another participant also reports that "I make it a rule to open Duolingo every day, even if it's just for a short time; it keeps me going. But if I have a lot of assignments, sometimes I only do one lesson." (R8)

These excerpts show that learners often treated one small lesson as a complete study session. They tended to open the app, complete one short activity, and stop. In some cases, reviewing mistakes was included, but this was not always part of the routine. Many participants described vocabulary learning through Duolingo as repeated short exposure carried out consistently across days.

At the same time, the short-session format also shaped the pace of engagement. Learners often adjusted the number of lessons they completed according to their daily workload, energy, or available time. Taken together, these responses show that participants commonly used Duolingo in short and repeatable sessions that could be fitted into daily routines. Rather than being organized around long study periods, their vocabulary learning was usually carried out through small units of activity completed across different moments of the day.

4.2. Why learners start and stay: Gamified material that feels light and becomes socially energizing

Participants reported that they were drawn to Duolingo because it felt lighter and more enjoyable than conventional study. Vocabulary learning was presented through short interactive tasks, and this made the activity easier to start and continue. For some learners, motivation was also supported by visible indicators such as XP, rank, or other progress signals that could be compared with peers. Participant 2 (R2) states that "My classmates are really influential, because we like to compare ranks and XP, which makes me more committed." This is added by participant 6 (R6) saying that "Our role is usually to encourage each other through progress, not to study seriously together."

These responses indicate that learners were influenced not only by the language exercises themselves, but also by the visibility of progress. Progress indicators were easy to notice, share, and compare, so they became part of the learning experience. In this way, individual study could still feel socially connected.

Participants also showed that peer involvement was usually motivational rather than instructional. Friends or classmates encouraged one another through progress comparison, but they did not usually study together in a deep or collaborative way.

Overall, these findings show that participants were encouraged to begin and continue learning not only because the activities felt light and manageable, but also because progress was visible and socially shareable. In practice, peer involvement appeared to function mainly as encouragement to stay active rather than as direct support for deeper learning.

4.3. What counts as vocabulary learning: Basic everyday items dominate, while some learners pursue academic-functional use

Participants differed in how they defined the main purpose of Duolingo learning. Many described their goal as learning basic vocabulary that could support everyday understanding.

Others described a broader goal in which vocabulary would be useful for writing, discussion, and academic reading. Participant 1 reports that “I want to collect basic vocabulary (colors, numbers, objects, etc)” added by participant 6 (R6) asserting that “My goal is functional vocabulary: it can be used in writing, discussions, and academic reading.”

The first pattern showed a focus on building a basic vocabulary base through repetition and gradual accumulation. Learners with this goal generally viewed short drills as suitable because they helped them remember common words and expressions over time.

The second pattern reflected a broader expectation of vocabulary use. These learners were not only concerned with recognizing words, but also with using them in more extended and meaningful contexts. This difference suggests that participants entered Duolingo with different learning goals, and these goals shaped how they evaluated the usefulness of the app’s exercises. Taken together, these responses indicate that participants did not define vocabulary learning in the same way. While some focused on basic everyday words, others approached Duolingo with broader goals related to functional and academic language use.

4.4. Outcomes and progress: learners prioritize real-life comprehension over in-app metrics

Participants commonly described progress in terms of improved comprehension in everyday situations rather than in terms of app scores alone. Although Duolingo provided visible metrics such as streaks and XP, many learners said that their own sense of progress was based more on understanding English more quickly and with less anxiety. In this vein, participant 2 (R2) declares that "I feel like now when I come across words like confirm and schedule, I understand them more quickly and don't panic, even though I'm learning slowly" supported by participant 5 claiming that "I judge my progress by how often I can understand without opening a dictionary, plus the streak is just a sign of consistency."

These responses show that learners often valued real-life comprehension more than numerical indicators. For them, progress was meaningful when they could recognize words more easily, understand common expressions, or rely less on dictionaries and translation. Participants also distinguished between app-based indicators and personal indicators. While streaks and XP were often seen as useful signs of regular participation, they were not always treated as the main evidence of learning.

Overall, participants tended to describe progress more in terms of practical comprehension than in terms of app-based scores. Although streaks and XP were noticed and sometimes valued, many learners treated everyday understanding and reduced reliance on translation as the clearer signs of improvement.

4.5. Contradictions and negotiation: When material feels insufficient or pressuring, learners adjust participation and expand resources

Participants also described situations in which Duolingo did not fully match their needs or circumstances. These included repetition, limited depth for certain goals, and pressure to remain consistent. Rather than stopping completely, learners often adjusted how they used the app or combined it with other resources. Participant 9 asserts that "Besides Duolingo, I most often

encounter new words from movies, YouTube, and music. I then jot down notes if the word comes up frequently, so when I open Duolingo, I understand it better." At the same time, participant 10 adds that "If I start having trouble staying consistent, I reduce it to just 5 to 10 minutes, or I choose an easier exercise first, as long as I keep it open."

The first response shows that some learners connected Duolingo with other sources of vocabulary exposure, such as authentic media and personal notes. This suggests that app-based learning was sometimes supplemented by outside materials that learners found useful or relevant.

The second response shows how learners reduced the intensity of participation when they faced difficulty maintaining consistency. Instead of quitting, they shortened study time or chose easier tasks in order to keep using the app. Taken together, these findings show that participants did not respond to difficulty in the same way, but they often adjusted their routines rather than stopping altogether. Changes in duration, task choice, and the use of outside resources suggest that Duolingo learning was often modified to match learners' needs and circumstances.

5. Discussion

5.1. *Linking the findings to prior theory and research*

This study used Activity Theory (AT) to explain Duolingo vocabulary learning as an activity system rather than as isolated app use. The findings largely support mobile learning theory that views learning as distributed across contexts and time, where short engagements can still be meaningful (Sharpley et al., 2005). Participants described micro-sessions that fit spare moments, which reinforces the idea that mobile learning succeeds when it matches real-life rhythms rather than classroom schedules. At the same time, the findings also refine common claims in MALL research that flexibility is simply a benefit. Here, flexibility is better understood as a design effect produced by segmented, stoppable tasks that align with learners' shifting contexts and limited time windows. This supports Çakmak's (2019) argument that mobile learning effectiveness depends on the fit between learning process design and the practical conditions of mobile use.

More specifically, the findings suggest that Duolingo-mediated micro-learning is sustained not only by the portability of the device, but also by the structure of the activity itself. Because the smallest unit of participation is brief, clear, and easy to complete, learners can transform study into a repeated exposure cycle that remains compatible with fluctuating time, energy, and daily obligations. In this sense, continuity is supported not simply by motivation, but by the fit between modular lesson design and the practical conditions of mobile learning (Sharpley et al., 2005; Çakmak, 2019). At the same time, this pattern also reveals a tension. What makes participation sustainable does not always support depth equally well. A routine organized around minimal completion can preserve continuity, but it may also reinforce short engagement patterns that are less suitable for learners whose goals require richer contextual processing or longer concentration (Hashim & Jones, 2007; Sharpley et al., 2005).

The findings also support prior Duolingo research emphasizing gamification as a motivational factor, but they challenge overly simple interpretations that gamification

automatically improves learning. Participants' accounts show that gamified metrics, such as XP, rank, and streak, function as mediational artifacts that can strengthen engagement through social visibility, which aligns with existing discussions of Duolingo's design and classroom use (Freeman et al., 2023). However, the data also suggest that metrics can become a competing object if learners begin to treat visible progress as the main goal. Importantly, some participants resisted metric dominance by defining real progress through functional comprehension rather than app indicators. This nuance complicates the idea that motivation in Duolingo is mainly driven by rewards. Instead, motivation appears to be co-produced by platform metrics and learners' own outcome definitions.

A further point emerging from the findings is that Duolingo's gamified material appears to operate on two levels at once: linguistic content and visible progress artifacts. Vocabulary prompts and drills provide the immediate learning material, while XP, ranks, and similar indicators provide socially shareable signs of participation. As a result, the community does not merely accompany learning, but gives emotional weight to those metrics through comparison, encouragement, and informal accountability. This supports previous work that positions gamification as a participation-supporting mechanism, while also showing more clearly how social visibility shapes what learners come to treat as meaningful success (Freeman et al., 2023; Anggraini et al., 2024).

At the same time, the findings refine the role of community within app-based vocabulary learning. Peer involvement was typically motivational rather than instructional. Learners encouraged one another through progress updates, but they did not usually provide explanation, corrective feedback, or collaborative vocabulary practice. This suggests that the division of labour in this activity system is relatively light. The app structures the exercises, the learner performs the activity, and peers function mainly as sources of encouragement rather than as co-constructors of knowledge. This helps explain why Duolingo can effectively support persistence while still leaving deeper vocabulary development dependent on other forms of mediation beyond the peer group itself (Hashim & Jones, 2007; Freeman et al., 2023).

Another important implication of the findings is that the object of Duolingo learning is not uniform across learners. For some participants, the object remained relatively narrow, namely building a basic stock of everyday vocabulary through repetition and gradual accumulation. For others, the object expanded toward functional and academic use, including writing, discussion, and reading. This distinction matters because the same app material can be experienced very differently depending on the learner's object orientation. A short drill may feel efficient and satisfying for foundational vocabulary growth, yet feel insufficient for learners seeking transfer into extended discourse or academic literacy (Hashim & Jones, 2007).

From this perspective, the findings suggest that object expansion tends to require expanded mediation. When learners aim beyond recognition and toward productive or academic-functional vocabulary use, Duolingo alone often becomes insufficient as a complete learning environment. Learners then need to incorporate additional mediational resources, such as notes, authentic input, example-rich exposure, or deliberate production practice. This is not simply a weakness of the application. Rather, it reflects a predictable object-tool misalignment within the

activity system, where a tool designed for segmented practice supports foundational accumulation more effectively than transfer-oriented language use (Hashim & Jones, 2007; Kessler, 2020; Rouabhia & Kheder, 2024).

The findings also deepen the distinction between platform-defined and learner-defined indicators of progress. While the app foregrounds streaks, XP, and rank as visible signs of advancement, participants often assigned greater value to functional comprehension, such as understanding routine English without translation and experiencing less anxiety when encountering unfamiliar words. This suggests that outcomes become meaningful not when they are numerically visible, but when they alter the learner's experience of real-life language encounters. In this sense, learners do not passively accept the app's metrics as the only valid proof of progress, but actively renegotiate what counts as successful learning within the activity system (Engeström, 2001; Hashim & Jones, 2007).

From an Activity Theory perspective, the findings strongly support Engeström's view that contradictions are not merely obstacles but structural tensions that can trigger change in activity (Engeström, 2001). Participants experienced tensions such as depth versus brevity, meaningful learning versus metric pressure, and context-fit versus environmental constraints. Rather than abandoning the activity, learners commonly adapted by reducing intensity to preserve continuity or by expanding mediational resources beyond the app. This supports AT's explanatory value in MALL by showing how learner agency operates through the strategic reconfiguration of tools, rules, and participation under real-life constraints.

The contradiction data are especially important because they show that tension does not automatically produce disengagement. Instead, participants often responded through adaptation. Some expanded their learning ecology by bringing in authentic media and note-taking practices, while others reduced the intensity of participation in order to preserve routine during difficult periods. These responses indicate that learners were not simply shaped by Duolingo's mechanics, but actively reconfigured their activity in order to keep it viable. At the same time, the changes observed were mostly individual and tactical rather than collective and expansive in a broader institutional sense. This refines how AT may be applied in self-directed mobile learning settings, where community participation is often light and change occurs more through personal strategy than collective redesign (Engeström, 2001; Ali et al., 2015).

5.2. Contributions of the findings to knowledge

The main theoretical contribution of this study is an AT-based explanation of Duolingo learning that connects micro-learning routines, tool mediation, rules, social visibility, and contradictions into one coherent account. Prior MALL and Duolingo studies often report perceptions or outcomes, but this study explains how sustainability is produced through the interaction between segmented lesson material, self-imposed rules such as daily opening, socially amplified metrics such as rank and XP, and negotiation strategies when tensions appear. In AT terms, the findings suggest that the object of Duolingo learning is frequently dual. Many learners pursue vocabulary growth while also pursuing continuity maintenance. This dual object helps explain why learners can remain active even when learning depth varies.

The findings also extend this contribution by showing that differences in learner goals shape how the same tool is experienced. For learners focused on basic everyday vocabulary, segmented lessons and repetition align relatively well with their goals and can support functional outcomes such as faster recognition and reduced anxiety in daily encounters with English. For learners whose goals extend toward academic-functional vocabulary use, however, Duolingo more often functions as only one component within a wider tool ecology. In such cases, learners need additional mediational resources, such as notes and authentic input, to support deeper transfer. This helps explain why some learners experience a ceiling effect when their object expands toward more demanding language use. The app supports foundational accumulation well, but the expanded object demands richer mediation. This is not simply a complaint about the app, but a predictable object-tool misalignment within the activity system.

Conceptually, the study reframes micro-learning from a descriptive label into a mechanism linked to material design. The findings show that micro-learning is sustained not only by mobility, but by entry-exit learning made possible through modular tasks. This contributes to MALL discourse by specifying what makes micro-learning workable in real life: the smallest unit of action must be small enough to become a daily rule, and feedback must be quick enough to make short sessions feel complete. The findings also provide a clearer conceptual distinction between platform-defined indicators of progress, such as streaks and XP, and learner-defined indicators, such as comprehension without translation and reduced anxiety. This distinction helps explain why some learners resist becoming metric-driven even when the platform invites it.

Methodologically, the study demonstrates the usefulness of combining open-ended self-reports with Activity Theory as an analytic lens to capture process and meaning, not only perceived effectiveness. Instead of treating responses as general attitudes, the analysis mapped accounts onto activity system components and used contradictions and negotiation as interpretive anchors. This approach offers a structured way to analyze app-based learning experiences that are informal, individualized, and context-dependent. It also addresses a common limitation in MALL research, where claims about autonomy or flexibility are often made without specifying the mechanisms through which learners operationalize those claims in daily routines.

Practically, the findings clarify what Duolingo can and cannot do well depending on learner goals. Duolingo appears particularly effective for sustaining low-threshold vocabulary engagement through short, repeatable sessions, especially when learners value continuity and basic comprehension growth. However, the findings also identify an important risk. When continuity rules and visible metrics dominate, learners may protect engagement by choosing easier tasks, which preserves routine but may restrict growth. This suggests that sustaining engagement and developing vocabulary depth are not automatically aligned, and that learners may need intentional strategies to connect short app-based sessions to richer language use beyond the platform.

6. Conclusion and implication

This study examined Duolingo-supported vocabulary learning through the lens of Activity Theory, aiming to clarify not only what learners gain but also how the learning activity is organized, sustained, and adaptively reshaped in everyday contexts. Overall, participants constructed Duolingo use as a form of micro-learning, characterized by short, repeatable sessions embedded within transient moments of daily life. The platform's segmented lesson structure and immediate feedback mechanisms rendered this pattern viable under real-world temporal constraints. While gamified indicators and socially visible progress contributed to engagement, many learners attributed greater significance to functional outcomes—such as improved comprehension speed and reduced reliance on translation—than to in-app metrics alone. Interpreted through Activity Theory, these findings illustrate how subject conditions, tool affordances, self-imposed rules, and community dynamics interact to stabilize the activity system, whereas contradictions (e.g., depth versus brevity, learning versus metric-driven pressure) prompt learners to adapt their strategies. Theoretically, the study contributes by demonstrating that the object of Duolingo-mediated learning is often layered, simultaneously encompassing vocabulary growth and the maintenance of continuity—a duality that sustains participation but may constrain lexical depth when learners prioritize academic or functional vocabulary. Conceptually, it advances micro-learning as a practical mechanism emerging from modular tasks and short feedback loops. Methodologically, it illustrates how open-ended accounts can be analyzed through activity-system components to yield process-oriented explanations.

Several limitations warrant acknowledgment. The sample is small and self-selected from an online community; thus, the conclusions should be interpreted as context-specific insights rather than broadly generalizable claims. The study relies on self-reported experiences and lacks independent assessments of vocabulary development, which limits inferences regarding actual learning gains. Furthermore, the inclusion of autoethnographic reflections, while enhancing analytic sensitivity, necessitates reflexive caution due to the potential for researcher experience to shape interpretation.

Future research could extend these findings by integrating Activity Theory with longitudinal tracking to examine how the object orientation of learners evolves over time—specifically, whether routines focused primarily on continuity shift toward deeper vocabulary engagement. Mixed-method designs combining qualitative accounts with performance-based measures would enable more robust claims about learning outcomes. Comparative studies across proficiency levels and learning contexts (e.g., classroom-integrated versus fully self-directed use) would further elucidate how distinct rules and community configurations reshape the functioning of the same digital tool. Finally, targeted investigations into specific gamification features—such as streaks, leaderboards, or heart systems—could assess how these elements influence task choice, risk-taking behavior, and the depth of vocabulary acquisition.

Declaration on the use of AI

Artificial intelligence (AI) were used during the preparation of this manuscript to support language translation, paraphrasing, and the identification of possible weaknesses in clarity, coherence, and academic expression. All AI-assisted outputs were critically reviewed, verified, and edited by the authors. AI tools were not used to collect data, analyze data, generate findings, or replace the authors' scholarly judgment. The authors take full responsibility for the content, accuracy, and integrity of the manuscript.

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