Supporting learners self-management for self-directed language learning: a study within Duolingo

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Abstract

Purpose – This study aims to investigate a unique approach to learning languages through self-directed online learning. Specifically, it explores the self-management abilities and skills learners need while learning a language outside traditional classroom settings when using mobile-assisted learning technology.

Design/methodology/approach – A mixed-methods approach was used in this study, including an online survey of 84 people and 10 semi-structured interviews.

Findings – Findings reveal the significant role of specific and well-defined learning goals in enhancing learners' performance. These goals can be either self-initiated by the learners themselves or defined by the technological features of the learning platform. However, the presence of distractions in learners' daily lives presents challenges to effective time management, affecting learners both physically and psychologically. A key aspect of self-directed language learning lies in the learners' ability to seek out relevant human and material resources beyond the confines of a single mobile-assisted language learning (MALL) tool. The authenticity of these resources is crucial in ensuring meaningful and effective learning experiences.

Research limitations/implications – Understanding how learners navigate and discover valuable resources is a central focus of this study. This research offers valuable insights into the field of self-directed language learning, revealing the pivotal role of self-management skills with mobile-assisted learning technology. The findings contribute to the broader field of language education and offer practical implications for educators and developers seeking to optimize self-directed language learning experiences through innovative and technologically driven approaches.

Originality/value – MALL is often ideal for individualized informal learning, but the existing literature focuses heavily on formal learning situations, underestimating the importance of MALL practices in various informal settings. Most research reports on MALL-based self-directed learning primarily sample traditional

This paper is part of our extensive research on SDLL through Duolingo. The current paper builds upon our prior publication titled "Self-directed language learning with Duolingo in an out-of-class context," published in the *Computer Assisted Language Learning* journal in 2023. In addition, aspects of this research have been presented at several conferences, including Ed Media + Innovate Learning Conference in New York in June 2022, the International Symposium on Sustainable Development of Education in China in December 2022 and the International Conference on Education Research (ICER) in Korea in October 2021.

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English-learning university students. Therefore, there is a need for research on how nontraditional older adult learners self-direct their language learning with mobile technology outside the classroom.

Keywords Self-directed learning, Mobile-assisted language learning, Informal learning, Self-management, Mixed method research, Computer software, Online applications, E-learning, Lifelong learning

Paper type Research paper

Introduction

As learning technology advances and Web-based learning is increasingly accessible, technology-assisted learning can occur wherever the learner is located, and, in the process, alters the landscape of both formal and informal e-learning (Bonk, 2009; Bonk *et al.*, 2016; Cox, 2013). A wide range of technologies have been developed and made available to facilitate language acquisition in both formal and informal learning contexts. Some examples include computer-assisted language learning (CALL), mobile-assisted language learning (MALL), chats, online language courses, virtual reality applications, podcasts and even email messages (Bahrani and Sim, 2012; Indahsari, 2020; Lan, 2020; Lin *et al.*, 2017).

A systematic review of 54 MALL studies exposed that existing research mostly focuses on MALL in formal learning, particularly in higher education and primary school (Persson and Nouri, 2018). However, in reality, adult language learners outside formal schooling contexts often face significant challenges due to limited learning opportunities caused by time, resource and location or geographic restrictions. Mobile learning encompasses both the mobility of technology as well as increased mobility in terms of time, space and learning experiences (Lai and Zheng, 2018).

Despite a recent increase in research reports on MALL-based self-directed learning, the majority of the reports sampled traditional learners (e.g. university students) who specifically were learning English (Wang and Christiansen, 2019; see Huang and Yu, 2019; Jeong, 2022; Lai *et al.*, 2022; Saienko and Lavrysh, 2020; Yang *et al.*, 2019). Consequently, there is a need for research on how nontraditional older adult learners outside classroom settings self-direct their language learning with mobile technology (Wang and Christiansen, 2019).

Furthermore, adult language learners often face various challenges throughout their language learning journey. For instance, adult learners need a high level of motivation to learn because they carry more responsibilities and stressors from families and work life (Lieb, 1991). More specifically, De Vito (2009) discussed three key barriers in adult learning in the terms of:

(1) accessibility (e.g. time constraints, flexibility and instructional methods);

(2) accountability (e.g. enrollment and completion rate); and

(3) affordability (e.g. college attendance cost).

Particularly in language learning, some psychological concerns, such as fears and anxieties toward an unfamiliar language, may also pose significant obstacles (Cohen and Norst, 1989; Lou and Noels, 2019; Madkur, 2018). Therefore, due to the complex nature of adult learning, language acquisition through MALL is often realized through informal learning, encompassing self-directed, incidental, intentional, nonintentional or social learning experiences (Lucas and Moreira, 2009).

In such informal learning environments, self-directed learning (SDL) plays a pivotal role in learner success. Given the widespread prevalence of informal learning in society (Cross, 2007), SDL has emerged as a fundamental aspect of adult education (Merriam, 2001). In fact, famed adult learning theorist Malcolm Knowles (1975) regards SDL as a "basic human

competence" (p. 17). Hence, to close the research gap stated above, the present study uses Duolingo as an example of mobile-assisted technology to understand learners' out-of-school self-directed language learning (SDLL) experience with educational technology.

The study was guided by the following research questions:

RQ1. How do learners use self-management strategies for SDLL when learning with mobile educational technology tools and resources such as Duolingo?

RQ2. What types of learning goals do learners have when they engage in SDLL?

RQ3. How do learners plan and self-monitor their learning time and activities when they engage in SDLL?

RQ4. What resources or supports do learners search and use to complement their SDLL?

Literature review

Mobile-assisted language learning

Although MALL is often ideal for individualized informal learning (Godwin-Jones, 2011), the existing MALL literature has primarily focused on formal learning situations (Persson and Nouri, 2018). Such a heavy focus on formal learning may mask or lead to an underestimation of the importance of MALL practices that occur in various informal settings (Kukulska-Hulme, 2016). Furthermore, existing research heavily focuses on the effectiveness of MALL to develop specific language skills as well as learners' attitudes about MALL (Duman *et al.*, 2015).

Though there has been growing research literature on MALL-based self-directed learning, in recent years, most studies have been conducted with participants who are university students learning English (Huang and Yu, 2019; Jeong, 2022; Lai *et al.*, 2022; Yang *et al.*, 2019). For example, Huang and Yu (2019) used quantitative methods to explore the effects of perceived flexibility advantage (PFA) of online learning, personal learning initiatives (PLI) and learners' self-management learning (SML) when learning a language with mobile technologies. That study used a survey instrument that was derived from psychological research and mobile learning studies. It collected data from 323 undergraduate students who had mobile-assisted English language learning experiences. Findings suggested that PFA and SML have positive impacts on mobile English learners' intention to continue to learn a language with their mobile devices as well as their ultimate performance; furthermore, PLI play an important moderating role to reinforce the positive relationship between PFA and continuance intention in mobile English learning.

Lai *et al.* (2022) explored SDL outside classroom contexts by collecting survey data from 676 English learners in Chinese universities, measuring their actual behavior, behavioral intension, attitude, self-efficacy, self-regulation skills, facilitating conditions and subjective norms. Results indicated that these students were highly extrinsically motivated. In addition, over 37% of survey respondents claimed that they never used mobile for SDL.

Wang and Christiansen (2019) conducted a study on self-directed English learning through mobile apps among English learners aged 40–95 years old outside traditional classrooms in China. Unlike traditional college students, older adult learners outside classroom settings do not have as many resources. This study identified four themes related to adults' SDL experiences with mobile technologies, namely:

(1) learner motivation and individual aspects of learning;

(2) sharing one's learning progress;

(3) learners taking their responsibility to learn and self-monitor their learning progress; and
(4) problem-solving.

Survey responses from 55 participants suggested that 58% of older adult learners outside school were motivated to learn language with mobile devices for traveling abroad, 33% for family visiting abroad, 33% for liking English, 25% for improving memory, 2% for job expansion and 2% for teaching children English. Results from this study also indicated that participants shared their learning progress in social media groups to create learning communities and punch cards (tracking and demonstrating attendance). Punching cards also reinforce their learning habits and improve accountability and self-monitoring. Furthermore, as adult learners experienced both language and technology challenges while using mobile devices to learn by themselves, they actively seek help from other people and self-evaluate their learning to solve these problems. The study highlighted the unique needs and strategies of nontraditional adult learners, emphasizing the importance of investigating app selection and its impacts on English learning outside traditional classrooms. Clearly, there are many open research gaps related to adults informally learning English. Our research attempted to address the research gap related to English learners who are not traditional classroom students, but who attempt to learn a new language in a more informal and on demand manner.

Furthermore, Shortt *et al.* (2023) conducted a comprehensive literature review encompassing studies published between 2012 and early 2020 that investigated the use of Duolingo as a gamified application in MALL. The findings indicated that a significant majority of the articles (over 90%) primarily featured research questions centered around the design aspects of Duolingo. In contrast, a smaller proportion of studies (approximately 30%) focused on questions related to performance and attitudes. Only one study in the reviewed literature explored the influence of Duolingo's usage on learners' beliefs; that particular study used self-efficacy beliefs as the variable in exploring learners' beliefs. The findings from this literature review strongly underscored the need for future research to explore how Duolingo affects informal language learning, how learners align their expectations with Duolingo and how the impact of Duolingo differs when used as a stand-alone technology versus a supplemental mode of instruction.

Self-directed learning

Loeng (2020) conducted a review of major concepts and theories related to SDL, revealing that SDL is a multifaceted concept with diverse approaches. Nevertheless, scholars widely agree that the propensity for self-direction serves as a fundamental differentiating factor between adults and children in the context of learning. Knowles (1975) recognized SDL as a key feature of successful adult learning. Moreover, adults have a profound psychological inclination to be perceived by others as self-directed individuals (Knowles, 1970, 1980), though they do not necessarily have innate self-directness (Brookfield, 1985). According to Brookfield (1995), SDL contributes to the success of learning by affording learners control over their learning outcomes as well as the flexibility to monitor their learning process. In addition, SDL allows learners to decide on the best approaches given their learning preferences. It also promotes the ability to self-assess their learning results. Given these features and functions, SDL has been regarded as the essence of adult learning for many decades (Caffarella, 1993).

Garrison (1997) developed an SDL framework that incorporates three dimensions: self-management, self-monitoring and motivation. According to Garrison (1997), self-management

relates to the capacity to govern tasks, including goal planning, time management and resource allocation and support. Second, self-monitoring is the cognitive and metacognitive process of developing learning methods and tactics while setting the learning pace. In other words, self-monitoring is the process where learners actively observe and assess their learning progress, strategies and outcomes. Third, motivation, by definition, can both drive and maintain learning attempts aimed toward cognitive goals.

While Li and Bonk (2023) reported how the three dimensions of SDL played a role in MALL with Duolingo, this particular study attempts to fill in the research needs implied by Shortt *et al.* (2023) on the alignment of learners' expectations and goals when learning with Duolingo as well as resources that supplement Duolingo learning. Therefore, this study was intended to provide an in-depth understanding of how learners self-manage their learning goals, time, resources and support when they are learning a language using MALL technologies out of the classroom. Results of this study can be used for practitioners to improve MALL design to better facilitate SDL, whereas language learners can recognize SDL strategies and enhance learning effectiveness. Furthermore, educators may seek a way to bridge learners' formal language learning requirement and informal learning motivation.

Goal management. A goal is something that an individual is intentionally attempting to achieve, whereas goal-setting refers to establishing a goal and adjusting it as needed (Bandura, 1986, 1988; Lunenburg, 2011). Goals with specific standards can enhance learning because they specify the amount of effort required to succeed and the self-satisfaction anticipated (Schunk, 1990). Furthermore, goal setting leads to task assessment and considerations of the appropriate learning strategies from a metacognitive perspective (Ridley *et al.*, 1992). In MALL, timescales influence the dynamic nature of the learning ecology and so influence the learning goals. In effect, learners lose motivation when there are not enough accomplishments in a reasonable time toward the learning goals (Isbell *et al.*, 2017). Therefore, to promote successful SDL, it is crucial to establish realistic and achievable goals that are more likely to lead to a successful SDL.

Tsai (2016) examines the role of Duolingo in learners' autonomous learning. Her research highlights that learners demonstrate the ability to manage their leisure time and establish daily learning goals effectively. However, it is essential to note that the learners' autonomy is influenced to a considerable extent by Duolingo's reminder feature, which involves sending email reminders or push notifications when the daily learning goal is not achieved. This reminder system plays a significant role in guiding learners and ensuring they stay on track with their language learning progress. Similarly, many studies have suggested that mobile language applications such as Duolingo make the goal-setting process more easily realized than traditional methods (Kacetl and Klímová, 2019; Yu *et al.*, 2023). Such research informs the current study on Duolingo by emphasizing the importance of learners intentionally establishing and adjusting their language learning goals beyond language learning platforms. Figure 1 demonstrates the daily goal setting feature in Duolingo.

Time management. Time management is the strategic planning and organization of study schedules, encompassing decisions on when and for how long learners engage in their study activities (Alario-Hoyos *et al.*, 2017; Andrade and Bunker, 2009). It is particularly important in MALL because it allows learning to occur anytime and anywhere (De Jong *et al.*, 2010). MALL provides high flexibility of time management so that learners may coordinate their learning with personal activities at their convenience (Huang *et al.*, 2014) and support learner information seeking whenever it aligns with learner needs (Wang *et al.*, 2009).

Al-Adwan *et al.*'s (2018) study suggests that a user-friendly learning management system that explicitly indicates one's learning progress and is embedded with time control

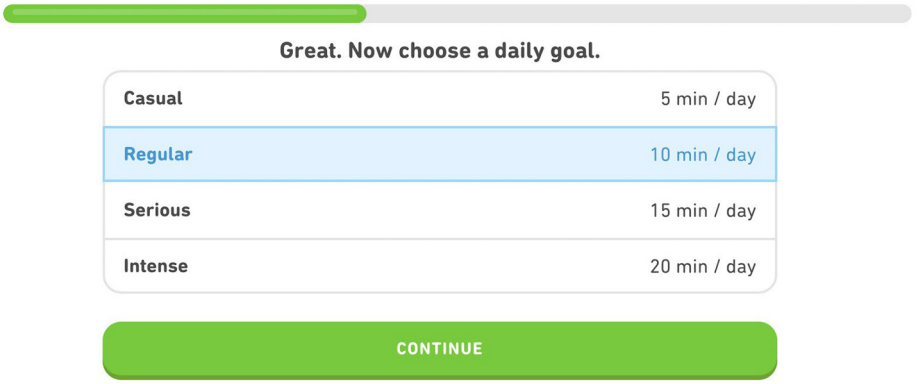


Figure 1.
Duolingo's feature of setting a daily goal

Source: As captured in a screenshot by authors

features can motivate and enhance learning. However, Loewen *et al.*'s (2019) recent study reveals that time management can also be challenged by the flexibility of MALL when the free learning time conflicts with other personal desires. Research further indicates that too often learners lack sustainable motivation and time management skills due to daily life distractions and busy situations, such as schoolwork and deadlines (García Botero *et al.*, 2018; Inayah *et al.*, 2020). Some research suggests that learners cannot consistently learn in a MALL environment without a certain level of extrinsic incentives (García Botero *et al.*, 2019).

Previous studies (García Botero *et al.*, 2018; Inayah *et al.*, 2020; Loewen *et al.*, 2019) have identified the challenges concerning time management when learning a language using mobile technologies like Duolingo. These challenges highlight the need for further research to explore how learners effectively use the flexibility of Duolingo to integrate language learning with their personal activities. Understanding this aspect is crucial to investigating how learners' time management practices influence their motivation levels and overall progress in language learning.

Resource management. Knowles (1975) argues that identifying human and material resources is an important component of SDL. As Brookfield (2013) explained, self-directed learning does not mean no involvement of other people in the learning process. On the contrary, others in a learning community can serve as important resources that support learning, including experts and more knowledgeable peers (Bonk *et al.*, 2004; Wenger, 1998). From Vygotsky's (1978) sociocultural perspective, learners can construct a deeper meaning or understanding of new knowledge through social interactions with tutors, mentors, instructors and other experts as well as with more knowledgeable peers. One key element of this learning theory is the zone of proximal development (ZPD). The ZPD defines the learner's ability to do something with and without external help (Vygotsky, 1978).

By observing and understanding how people develop expertise, novices start to grasp the potential pathways to successful learning (Bransford *et al.*, 2000). In the process of exchanging knowledge and information, experts facilitate novice learning through varying degrees of scaffolding (Lee, 2008). At the same time, knowledge transfer occurs with the creation of new knowledge (Wilkesmann and Wilkesmann, 2011). In fact, a recent study by La Russa and Nuzzo (2021) explored the linguistic phenomenon that native speakers pointed out errors after giving corrective feedback to non-native language learning partners. Such research suggested that feedback-discussing tasks encouraged both native and

non-native peers to reflect on source and target languages, which improved cross-linguistic knowledge. Ozfidan *et al.* (2014) also reported that peer interaction and feedback had significant impact among adult language learners.

In addition to scaffolded support from others, authentic resources are a crucial motivation factor in language learning (Cross, 1984; Gilmore, 2007). A vast amount of available online resources can support just-in-time learning needs, particularly in an informal learning environment (Bonk *et al.*, 2016). Authentic material resources, such as music and literature, can support meaningful language practice because they provide a setting that is similar to the real language usage context (Baird and Redmond, 2004). It is important to note that, according to Lombardi and Oblinger (2007), authentic material should include multiple sources and perspectives.

In conclusion, the previous research underscores the significance of recognizing and leveraging human and material resources to enhance the learning process. This insight provides valuable insights into the current research, which aims to explore how learners using Duolingo effectively engage with a diverse range of resources to address the challenges associated with mobile learning outside the traditional classroom context. Ultimately, this research will contribute to the advancement of MALL practices, enabling learners to access a wide array of resources beyond the confines of traditional classroom settings.

Method

This study is based on an explanatory sequential mixed methods design (Creswell and Plano-Clark, 2017; Ivankova *et al.*, 2006) to investigate learners' self-management when using technology like Duolingo to learn a language out of the classroom.

Duolingo platform

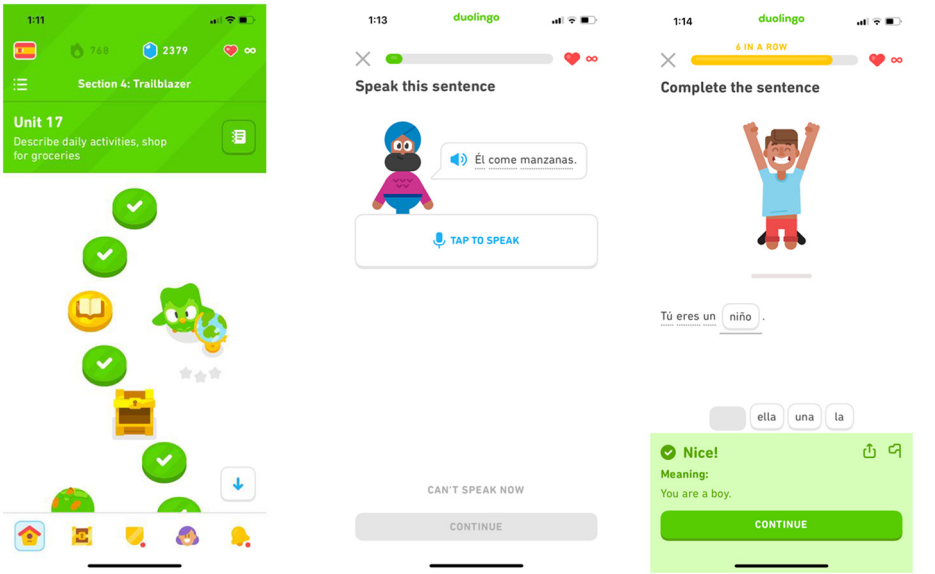
Duolingo is a free online learning platform that is designed based on CALL/MALL. It supports language learning through translation, matching, pairing, listening and speaking exercises (Nushi and Eqbali, 2017). The main features include lessons, practice, events (now is known as "classes," where learners can create or join meetups with other language learners), podcasts, stories and discussions forums. Duolingo has gained particular popularity during the COVID-19 period. Reported by Blanco (2020), 30 million new learners began language learning with Duolingo during the first week of the 2020 March shutdown, representing a 67% growth over the same period during the year before. Figure 2 demonstrates the interface of Duolingo lessons from a phone application view. Figure 3 shows the desktop view of Duolingo Events.

Data collection

The data collection process included:

- an online survey of Duolingo learners from another study (84 respondents fully completed the survey); and
- interviews with 10 Duolingo learners.

The survey gathered basic information about users' demographics, motivations and strategies. It was exploratory in nature and was primarily used to screen and recruit interviewees as well as refine the interview questions. It included Likert-scale questions, open-ended questions and closed-ended questions regarding learners' self-management



Notes: The left screenshot illustrates the lesson structure of Duolingo, providing an overview of how the platform is organized. The middle screenshot showcases a speaking practice activity in a Spanish lesson, where users engage in oral language practice. On the right, the screenshot displays a "complete the sentence" practice within a Spanish lesson, followed by feedback provided by the system after providing the correct answer
Source: As captured in screenshots by authors

Figure 2.
Duolingo's interface of lessons (phone application view)

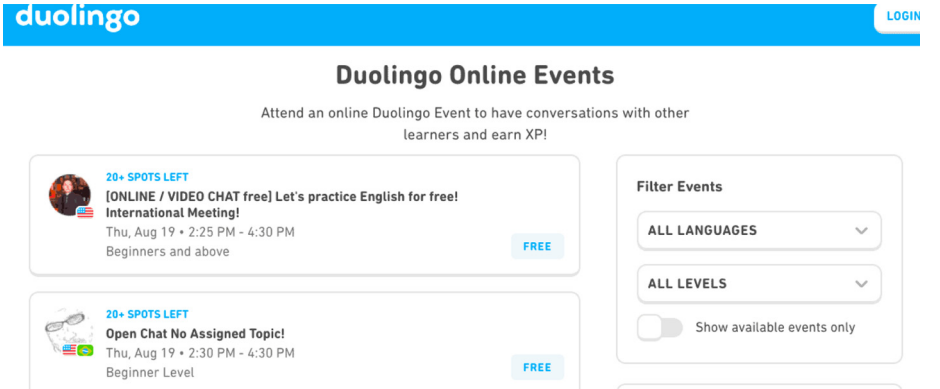


Figure 3.
Interface of Duolingo's events (desktop view) as captured in a screenshot by Brockbank (2023)

strategies using Duolingo. The survey design was consulted with one survey expert and revised based on four pilot studies.

The survey was distributed through multiple social media and Duolingo-related forums, including the Duolingo Forum, Discord, Facebook pages, WeChat groups and

emails. At the end of the survey, we asked whether participants were interested in being interviewed. Ten survey participants indicated their willingness to participate in the interviews. We contacted all of them through email for interview consent and confirmation. Using this procedure, a convenience sampling method was used and all ten participants were interviewed. The one-to-one interviews took place using Zoom, an online video conferencing platform. Each interview lasted for approximately 45 min. After the interviews were transcribed mechanically using Kaltura, the researchers manually checked the transcripts and made the necessary corrections. To increase the validity of the data, member-checking was used with the interviewees. Eight of the ten interviewees responded to the researchers with minor clarifications and revisions.

Participants

As shown in Table 1, interviewees were from China ($n = 2$), Costa Rica ($n = 1$), Germany ($n = 1$), Indonesia ($n = 1$), Mexico ($n = 1$), Singapore ($n = 1$), the UK ($n = 1$) and the USA ($n = 2$). These individuals used Duolingo to learn Arabic ($n = 1$), Chinese ($n = 2$), English ($n = 1$), French ($n = 2$), German ($n = 1$), Japanese ($n = 3$), Portuguese ($n = 1$) and Spanish ($n = 2$). Interview participants also had different years of experience with Duolingo, including five participants who used Duolingo for six months to one year, two individuals who used it for less than six months, two people who used it for one to three years and one person used for more than five years.

Data analysis

The survey data was analyzed in Qualtrics, using descriptive statistics such as percentages and means (Larson-Hall and Plonsky, 2015). The research study used a pie chart to visually present the distribution of learning motivation factors, whereas a table was used to demonstrate the relationship between study participant motivations and the frequency of using Duolingo for learning, providing counts and percentages as relevant data.

The interview data was analyzed in Miro, a visual collaboration tool. A thematic analysis was used to open-code the interview data. Researchers used an inductive coding approach by reading through raw data, finding repeated phrases and developing themes. One researcher individually coded all the data to enhance the consistency of coding while the other researcher went through codes and themes to improve the reliability of the analysis. Both researchers maintained individual memos from the interviews and engaged in comparative discussions after each interview to reach a consensus on coding. In addition, to improve intra-rater reliability, a single researcher conducted three repetitions of coding of the same data over time. The resulting themes are presented in Table 2.

Findings

Key survey finding

The pie chart in Figure 4 shows different factors that motivate people to learn language on Duolingo. We broke the integrated responses from a multiple-choice question into six types of individual elements: culture, travel, brain training, school, family and friends and job opportunities and calculated the proportion of each element regarding the frequency that it appears in responses. As shown in Figure 4, culture (24%) and travel (23%) accounted for the highest proportions, followed by brain training (16%) and school (10%), whereas job opportunities (8%) and family and friends (9%) were the

Table 1.
Duolingo interviewee demographic and language learning information

Interviewee	Gender	Age	Country	Highest education level	Native language	No. of years using Duolingo	Languages learned through Duolingo
P1	M	31–45	Mexico	PhD	Spanish	More than five years	English, French
P2	M	31–45	USA	Some college	English	One to three years	Japanese
P3	F	18–30	China	Master's	Chinese	Less than six months	Japanese
P4	F	31–45	Costa Rica	Master's	Spanish	Six months to one year	Portuguese
P5	F	18–30	China	Master's	Chinese	One to three years	French
P6	F	18–30	Indonesia	Undergraduate	Indonesian	Six months to one year	French, German, Spanish
P7	M	18–30	Germany	High school	German	Six months to one year	Chinese
P8	F	31–45	USA	Undergraduate	English, French, Spanish	Six months to one year	Arabic
P9	M	60+	UK/Singapore	Undergraduate	English	Six months to one year	Chinese, Indonesian, Spanish
P10	F	46–60	Singapore	Undergraduate	Malay	Less than six months	Japanese

Source: By authors

Themes	Subthemes
Goal management	• Long-term outcome goals • Short-term performance goals • Procedural goals • Goals and outcomes • Other
Time management	• Daily life activities are constraints – Physical challenges – Physiological challenges – Time commitment according to goal • Rely on technology • Have a self-developed time management system • Flexible learning time • Other
Resource management	• Seek authentic materials and resources – Engagement of experts – Realistic and meaningful learning context – Valid content • Reasons of need other resources – Duolingo does not provide cultural information or representations – A single MALL tool is not enough – Human resource is complementary – Integrate material resources • Other

Source: By authors

Table 2. Themes and subthemes

least reported. In addition, approximately 10% of participants mentioned other reasons as motivators for their language learning on Duolingo while some respondents did not provide specific responses.

As shown in Table 3, the findings revealed that a significant proportion of survey participants (65%) reported having a "everyday or more often" language study schedule with Duolingo. Among the many motives for daily use of Duolingo, nearly 76% of individuals with a primary goal of brain training maintained a high learning frequency and used Duolingo daily or even more frequently. Notably, participants using Duolingo to learn a language daily or more frequently were doing so for job opportunities (73%), followed by cultural (68%) and travel (66%) reasons. The frequency of using Duolingo daily or more often for family and friends motivation was 56%. School-related motivators, which might foster regular use of a language learning app, were the least significant factor in using Duolingo, aside from individuals choosing "other." Specifically, only about 53% of those who use Duolingo for school use it daily or more frequently.

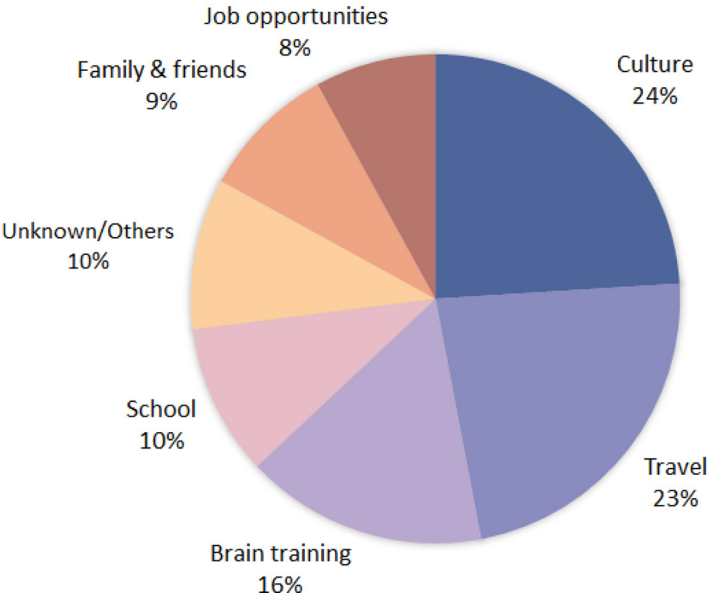


Figure 4.
Distribution of learning motivation factors in a pie chart

Source: By authors

Frequency of Duolingo learning	Total count	Culture	Travel	Brain training	School	Family and friends	Job opportunities	Other
Total count	178.0	44.0	41.0	29.0	19.0	16.0	15.0	14.0
Every day or more often	65.2%	68.2%	65.9%	75.9%	52.6%	56.3%	73.3%	50.0%
Two to six times a week	8.4%	6.8%	9.8%	10.3%	12.5%	12.5%	0.0%	7.1%
Once a week	10.1%	4.5%	9.8%	10.3%	18.8%	18.8%	13.3%	7.1%
Less than once per week	10.7%	11.4%	12.2%	3.4%	0.0%	0.0%	13.3%	21.4%
Never	5.6%	9.1%	2.4%	0.0%	12.5%	12.5%	0.0%	14.3%

Source: By authors

Table 3.
The Relationship between motivation and frequency of Duolingo learning

To understand what influences the frequency of language learning with Duolingo, we incorporate qualitative data to investigate the reasons behind our statistical findings. It is important to point out that based on the survey data from the previous study, we further refined our interview protocol and explored in-depth reasoning behind the quantitative data.

Goals

All interviewees ($n = 10$) had at least vague goals related to their online language learning. Their goals were classified into long-term outcome goals, short-term performance goals and procedural goals. Short-term performance goals and procedural goals are considered as subgoals that contributed to outcome goals. All three types of goals can be very specific or very vague. An example of a specific goal is as follows:

> My future goal is to get the C1 CEFR, because I must have it to enter the German university, though the study is completely taught in English. I need this C1 CEFR level of German language to earn my student visa and the government required this C1 CEFR. (P6, Indonesia)

As stated in the quote above, P6's goal is specific and highly outcome-oriented. Specific outcome goals, as opposed to vague goals, are more likely to lead to explicit short-term performance goals. As she mentioned, "I'm more into like in six months, I must read the complete structure (of Duolingo)." To achieve the specified performance goal that she wanted, she broke the process down into small procedural goals that prepared and equipped her with the necessary skills to meet the higher-level goals. As she explained, "And it's more like I have a goal that I must complete the tree in German. So yeah, I have to make myself discipline[d]."

Similarly, while more than half of the interviewees ($n = 8$) had specific outcome goals, many of them ($n = 5$) could state procedures that would take them to the final outcome and set explicit subgoals. P10 is another example whose outcome goal is being able to communicate with her Japanese neighbor. To achieve this goal, she claimed, "So my target, hopefully by the end of the year, [is that] I can participate in intermediate conversation groups."

Learners who claim that they do not have specific goals are more likely to follow a goal generated by language learning software rather than a goal initiated by themselves. In other words, goals can be self-initiated by the learner as well as defined by the learning technology. Even if learners begin with a hazy goal, tools like Duolingo can serve as a steppingstone to developing concrete performance and process goals:

> Yes, it's something to look forward to, right? Yes, I don't have a specific goal except to keep doing that. I think that it really matters to me to insist on doing something every single day. So it is actually through streak [a feature to record the number of days in row that a learner has completed a course in Duolingo] and achievement, especially when you felt you did nothing today. (P5, China)

Importantly, half of the interviewees ($n = 5$) indicated that Duolingo was an effective way to start to learn a language, providing sustainable and accountable learning experiences. For them, it had the potential to assist learners to convert technology-defined goals to self-initiated goals. For example, P8's outcome goal was mastering Arabic to foster children to become bilingual. However, she was also affected by a technology-defined goal to hit daily streaks. She claimed:

> So for someone like that, to build the habit of doing it every day, but I guess that's kind of what's kept me doing it is the goal of the 365 days. I am telling myself, so what I was saying was like, I'm going to hit 100 days. Then after that, we're gonna go find another app or find or start other resources. But Duolingo does hold you accountable. (P8, USA)

Apparently, although P8 set specific performance goals of hitting streaks, she also reflected on her learning process and considered the next goal. As she explained, "I think that for me, self-directed learning is going to direct me away from Duolingo eventually" (P8). Therefore, though Duolingo can generate practical goals for learners in the early stage of SDLL, it triggers the meaningful reshaping of goals in and out of Duolingo. Through this example and numerous similar cases, researchers found many different types of goals can be combined to guide learning, particularly when the outcome goal was linked to personal interest and experience.

Time

The majority of interviewees ($n = 8$) stated that daily life activities are a constraint to their time management. The significant obstacles that interviewees faced related to time

constraints for studying a language due to work and life demands have an impact on their physical and emotional ability to complete their learning goals on a consistent basis. P10, for example, stated, "Because my schedule can be busy. Sometimes, especially during the exam period in school, I really have no time. I'm just busy completing my markings." P7 also described the psychological difficulties of daily practice with Duolingo, saying:

> Frustration, yes. I have my downs and highs. And sometimes I didn't learn Chinese for like a month. And then again, the month after that, I learned half an hour a day momentarily.

Despite the fact that learners face a variety of physical and physiological challenges when it comes to time management, eight interviewees ($n = 8$) either use technology-assisted time management or a self-developed time management system to overcome time constraints. To cope with the problem, four of them ($n = 4$) even use a combination of technology and individual planning systems to facilitate time management. Six interviewees ($n = 6$) reported that Duolingo notifications via phone push and emails are effective at reminding them to devote time to language learning. As P7 from Germany noted, "Because I was getting notified and I knew, okay, I have to do something now."

To handle the physical challenges, such as tiredness due to other life activities, learners plan and manage their Duolingo time strategically. Three interviewees ($n = 3$) plan their Duolingo learning as the last task of the day. They preferred to finish their Duolingo daily goal right before bedtime because it is a peaceful time for them. P4 from Costa Rica explained, "So the first thing is your time. Maybe do Duolingo at the end of the day. Because it is the way you relax. Learning a language is not stressful."

However, there are also exceptions. P2 from the USA claimed that, "one of the things I do recommend is, you know, being able to set up a schedule for yourself and stick to it." He preferred to do Duolingo at the beginning of a day because, as he explained, "I will start out every day doing my daily Duolingo stuff and then go from that to doing various other jobs and other forms of learning as well." In addition, some interviewees revealed that they have a longer-term strategy to intensively learn languages during vacations and holidays. An example provided by P10 is that, "I joined [Duolingo Events] only in December because it was during school break."

To deal with psychological challenges, surprisingly, three interviewees ($n = 3$) suggested making a practical learning schedule from the beginning to prevent emotional frustrations. For example, P9 from the UK contended:

> I believe is you've gotta have patience because it takes a long time to learn a language. And many people don't have the stamina. It's taken me two years to get to some point of conversational Spanish. A lot of people would like to speak after three months, just unrealistic.

Three interviewees also claimed that language learning should be fun and enjoyable. Therefore, even if stress occurred due to time constraints, learners should prioritize stress release instead of forcing inefficient learning. As P4 admitted, "When you are stressed, you cannot produce very well. When you are unstressful, you are ready to think in more languages." Similarly, P6 also recommended that:

> But sometimes I am also busy with my studies here. So at the time I didn't use Duolingo for like one day or two days, but I took that as a chance till the next day that I spent more time on that. So just exchange the time.

To summarize, there are things in everyday life that can distract SDLL by causing both physical and psychological problems. However, as interviewees pointed out, strategic and

pragmatic time management that suits an individual's schedule can help to mitigate the effects of these constraints.

Resources

One of the significant findings is that authenticity of resources is prioritized in language learning. Eight interviewees ($n = 8$) mentioned that they consistently sought authentic materials and resources when learning a foreign language. Three primary indicators of authentic resources are engagement of experts, providing a realistic and meaningful learning context and valid content. The engagement of experts often refers to native speakers. It is the most critical indicator that was reported by five interviewees ($n = 5$). Such native speakers are regarded as reliable human resources who can provide authentic feedback and guidance. P9 from Singapore recommended, "talk to somebody who's a native speaker. And then you figure out whether they understand you."

The second indicator, realistic and meaningful learning context, can provide an immersive learning experience where learners bridge the gap between knowing and doing. P9 claimed, "I would randomly ask people for directions to go to the post office, for example, purely to test out whether they understood my Japanese and to understand their response."

The third indicator, valid content, is based on whether Duolingo knowledge makes sense in real-life conversations for native speakers, which, in effect, connects the first and second indicators. P8 reflected on her experience using Duolingo to learn Arabic, which is her fiancé's native language. She stated that:

> I don't want to learn a combination of sounds that isn't possible in Arabic and isn't a word. But literally I've played a sound clip to my fiance and I'm like, is this an actual word in Arabic, for [this] is nonsense.

Besides authenticity of resources, more than half of the interviewees ($n = 6$) highly valued the importance of cultural information and representations in the various learning resources in Duolingo. These interview responses confirmed a finding from the survey data as indicated in Figure 4. When asked what motivated learners to learn foreign languages, the most selected option was culture (24.72%) followed by travel (23.03%). Both qualitative and quantitative evidence indicates that learners are likely to expect some aspects of culture or cultural studies while learning a language with Duolingo.

Unfortunately, this component is largely missing in Duolingo. As P5 mentioned, "I would say there's no language without cultural background. And so to elicit the cultural elements will make it a good way to learn a language." Although language and culture are interconnected, Duolingo generally failed in addressing culture in their lessons. As an example, P8 argued:

> And there's no culture. I mean, they could be like, here's a traditional Middle Eastern dish from xxx area [. . .] But then they also have sentences with people named Bob and Sam. Why? Just use all Arabic names. Like why, why people go somewhere and talk about Sam. Sam, yeah, which is Arabic, but why do I need to talk about Bob?

Because Duolingo has limited cultural information or representations in their materials, learners have to seek additional external resources that meet their expectations. Notably, P2 stated that:

> So, but then there's also, there's various things I sometimes recommend, such as there's a couple of blog sites out there that are just about living in Japan. And they don't really have anything specifically to do about the language. But it's often useful to get more into the Japanese culture to help more with understanding some aspects of the language or just get more into it.

Another significant finding is that most interview participants ($n = 7$) also indicated that a single MALL tool is not enough to facilitate learners to achieve a sufficient level of language proficiency or competency; however, five of them ($n = 5$) claimed that tools like Duolingo offer a quality starting point with a sufficient beginner-level knowledge base. P7 from Germany suggested that:

> So I just like to combine it with my other resources like from Google. I think when I only use Duolingo, it's not enough for me to learn the language because it's very beginner level.

P10 from Singapore also expressed this sentiment. As she stated:

> Possibly not to just use Duolingo alone, use it as a starter base to just get sufficient vocabularies to take you to the next level of crafting sentences. But once you get to the level, you need to go beyond Duolingo and find out the alternatives of upping the language skills.

P6 even claimed, "I think that for me, self-directed learning is going to direct me away from Duolingo eventually." Therefore, although a single MALL tool is not sufficient to typically complete one's language learning goals, it can be used as a key motivational tool to entice people to start learning a language and build basic language skills with it.

In addition, Duolingo's extended social-based features are a possible human resource for learners to supplement their learning. In fact, more than half of the participants ($n = 6$) indicated that they engaged in Duolingo events and forums to improve their language through community-based learning. As P6 from Indonesia commented:

> I'm looking for Duolingo events as well because we can be more active, like talking with other people, learning with other people as well [. . .] We just talk with informal words or ask them a question in Indonesia[n] and so they just answer and we'll learn together.

Despite the positive comments and observations, half of interviewees ($n = 5$) reported a number of criticisms regarding the social aspects of Duolingo. In particular, to meet their social demands, users expect more user-friendly and integrated social features. For example, P8 claimed that, "the forum that they have [is] [sic] really not user-friendly and they're not super integrated into the [Duolingo] platform." Similarly, P2 sent the following comment via email to the researchers after the interview:

> There's also really no way to communicate with anyone on the platform except via the public forums (which have fairly strict "no chit-chat" rules, etc.), which really inhibits encouraging/helping friends, or friendly competitions, etc.

When the researchers followed up with questions about what kind of social resource and engagement tools or features that they expected, interviewee opinions were mixed. The main issues expressed were internet security and the lack of well-structured social activities.

Discussion

Goals, time and resource management are the three main components of self-management. Consequently, the important findings of this particular study are organized in a way that addresses all three of these components. Regarding goals, all interviewees had at least vague goals for their online language learning that related to long-term outcomes, short-term performance and procedurally related goals. All three types of goals may stand alone or be combined to guide learning. In addition, they can either be specific or vague. Specific outcome goals are more likely to lead to explicit short-term performance goals than vague outcome goals. This finding matches the popular goal-setting theory that claims specific and

difficult goals provide guidance for one's behavior and motivate learners for performance achievement (Locke and Latham, 2019).

Our findings also suggested that learners who do not have clear goals are more likely to follow a goal provided by language learning software rather than a goal that they establish. Such technology-based goals can also serve as strong motivators that guide learners to create desired learning experiences. Fortunately, goal setting increases the effectiveness of learning by providing guidance to make rational decisions on what and when to learn (Ram and Leake, 1995). As long as the technology-generated goals can support such decision-making, it can effectively support meaningful learning to fulfill one's learning needs.

From the perspective of time, García Botero *et al.*'s (2019) study reveals that Duolingo encourages out-of-class SDLL. However, learning is challenged by the lack of sustainable motivation and time management skills due to daily life distractions. Inayah *et al.*'s (2020) study reveals that hectic schedules in and out of academic life pose critical barriers to learning even if Duolingo is used as a part of the curriculum design. The present study also confirmed that learners are likely to lose their control of time management due to daily life activities, such as study and work, which causes both physical and emotional challenges in one's SDLL. In addition to exposing these challenges related to time management, the findings of this study further reveal strategies that learners use to overcome these challenges. It suggests that learners may overcome physical challenges related to time management by strategically integrating their MALL time within their daily life schedule. For instance, they might engage in Duolingo activities at the beginning or end of a day. However, emotional challenges are often harder to resolve. To avoid emotional conflicts, creating a feasible learning agenda from the start seems to be crucial.

Regarding resources, Lai and Zheng (2018) report that learners use mobile devices mainly because they seek personalized learning experiences rather than looking for authenticity and social events in learning. However, in an informal learning environment, our findings suggest that learners continuously seek out authentic materials and resources when they use mobile-assisted technology. Based on the results of this study, it is apparent that three major indicators of authentic resources are the involvement of experts, accurate content and the establishment of meaningful and achievable learning tasks.

Given that interviewees indicated that because Duolingo does not have resident or on-demand instructors available, native speakers and peer tutors in Duolingo Events are often regarded as language experts. Our research results reveal that even when peer experts poorly design Duolingo Event sessions that are not regarded as ideal resources, they still provide valuable authentic learning settings and accurate content. This finding aligns with La Russa and Nuzzo (2021), suggesting the interactive learning between native and non-native peers benefit both parties by inspiring self-reflections on source and target languages, promoting metalinguistic discussions, and developing cross-linguistic knowledge.

In addition, as Mazari and Derraz (2016) pointed out, culture is the foundational to language. Unfortunately, our study discovered that, while understanding culture is one of the most important motivators for Duolingo learners, Duolingo failed to integrate cultural components in its lessons, leading to a search for external resources to supplement learning. The absence of significant cultural information and representations also raises doubt on the authenticity of Duolingo lessons. This finding suggests instructional designers integrate cultural elements in the lesson plans so that learners with goals and interests in culture will be able to connect the language they are learning with the authentic context of language use.

Limitation and future research

Despite the fact that subject recruiting occurred across several platforms, users who used Duolingo Event, Forum and Discord were far more likely to discover the recruitment to this study than those who solely used Duolingo lessons. To eliminate bias, four of the ten interview participants ($n = 4$) selected were recruited using personal emails rather than social media, whereas the other six ($n = 6$) interviewees were recruited through postings on Duolingo-related social media. However, based on our survey data, we know that 62% of the survey participants never used Duolingo Events and 30% never accessed Duolingo Forum. As a result, the findings may be biased because more interviewees actively participate in Duolingo socializations, resulting in conclusions related to a desire for social events and collaboration-based human resources. Future research may use comparison groups to understand how those who use social features engage in different self-management practices from those who do not use such features.

In addition, our interview sample size is comparatively small. Despite attempting to include interviewees from different regions and backgrounds, our primary data source was from participants in Asia, North America, South America and Europe. The mobile-based SDLL needs and preferences of those using Duolingo in Africa and Australia remain an open question.

Conclusion

This study takes a novel approach to SDL, focusing on what self-management abilities and skills learners are required while learning a language outside of the classroom using mobile-assisted learning technologies. Findings suggest that a MALL tool can improve learning by facilitating learners to define specific goals. Though learners can encounter significantly time-bound situations that influence the consistency and impact of SDLL in an informal learning environment, they may overcome time constraints by planning Duolingo usage time ahead and establishing practical schedules. Mobile-assisted SDLL has significant value when it provides various authentic resources as well as culturally valuable and insightful information that excites learners into the learning process in a meaningful and personally impactful way.

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