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Exploring a self-directed interactive app for informal EFL learning: a self-determination theory perspective

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Abstract

The landscape of self-directed learning in mobile-assisted language learning (MALL) is changing from mechanical and repetitive to communicative and meaningful learning. This is due to the development and integration of conversational agents into mobile devices. Students can learn a language via a self-directed interactive app (SIA) where they can experience oral and textual two-way interaction with a conversational agent through their mobile devices anywhere and at any time using the target language. Despite this change, we know very little about students' actual use of this type of app in an informal setting or their level of motivation to use these apps. This study investigated students' usage patterns of an SIA in an informal setting and how the app supported students' basic psychological needs (BPNs) by drawing on the lens of self-determination theory (SDT). One hundred and seventy-nine Korean EFL primary students were introduced to an SIA, and their usage was tracked for eight weeks. An analysis of the data identified students' continuous or discontinuous app usage patterns, and a following SDT survey indicated that continuous students reported a more enhanced satisfaction of BPNs than discontinuous students. Additionally, findings from in-depth interviews provided further insight into how elements of the app supported or thwarted their BPNs. This study sheds light on the potential of SIAs as valuable tools for L2 learning in an informal setting. Future recommendations regarding using or developing SIAs for language learning were presented from both pedagogical and technological perspectives.

Keywords Mobile-assisted language learning · Artificial intelligence · Conversational agent · Informal learning · Gamification · Self-determination theory

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1 Introduction

In the last few years, there has been a dramatic increase in the number of applications (apps) created to promote effective language learning (Godwin-Jones, 2017). The reason for this growth is apparent: smartphones have become increasingly prevalent and have the potential to provide more effective and efficient affordances for language learning. The ownership rate of smartphones for students aged 6-19 in South Korea is 94.7% as of 2020 (Yoon, 2021), and around 1,600 literacy-related apps are available on the market (Xu & Warschauer, 2020a). In other words, language learners can now easily access mobile apps anywhere and at any time and can initiate mobile-assisted language learning (MALL) independently whenever they have 'pockets of time.' (Steel, 2012, p. 3).

When using self-directed apps for language learning outside the classroom, learners initiate and then manage their learning independently. Examples of these apps include Duolingo or Busuu. These types of apps, called self-directed language learning apps, provide benefits for language learners such as ubiquity and flexibility (Klimova, 2018; Rosell-Aguilar, 2017). However, research has pointed out that learning activities conducted through these apps lack the type of communicative practice generally valued in the L2 classroom (Burston, 2015; Shortt et al., 2021). For example, it was reported that learners perceived these activities as not motivating because they were repetitive and mechanical (Loewen et al., 2019) and that some learners expressed their desire for a human element (Kessler, 2021).

Recently, the focus of activities in self-directed language learning apps seems to have shifted from *mechanical and repetitive* to *communicative and meaningful* language practice. This is due to the development of artificial intelligence (AI) technology (e.g., machine learning or natural language processing) integrated with mobile devices. That is, it is now possible for learners to learn a language via a self-directed interactive app (SIA) where language learners can experience oral and textual two-way interaction with a conversational agent through their mobile devices anywhere and at any time using L2. Heift and Chapelle (2012) stated that "The need exists to better understand the new conditions for second language acquisition (SLA) brought about by the real language related capabilities of technologies that many learners have access to on a daily basis" (p. 565).

Enhancing learners' autonomous motivation is another significant issue in informal MALL settings (Ryan & Deci, 2020). Informal language learning with apps is different from formal language learning in that learners, rather than teachers, initiate their learning and sustain the process afterward (García Botero et al., 2019). This difference indicates that a different approach is required for research; researchers should reflect on the unique features of these environments (Ryan & Deci, 2020). In language learning, a general question regarding motivation is *how can a teacher motivate language learners?* (Calvo & Peters, 2017; Chiu, 2021); but for informal language learning through apps, the question should be based on *how can language learners motivate themselves for the learning process when using an app?* (García Botero et al., 2019; Jeno, Adachi, et al., 2019).

Addressing this question, previous literature has emphasized the importance of creating psychological theory-based apps and has provided plenty of empirical evidence regarding their positive impact on sustaining motivation and enhancing learning outcomes (Alamer & Al Khateeb, 2021; Jeno, Adachi, et al., 2019). However, research about students' use of an SIA and its motivational effect remains significantly limited. To contribute to this limited knowledge base, this study will explore how students use an SIA in an informal setting and will use the lens of self-determination theory (SDT; Ryan & Deci, 2017) to examine how elements of the app sustained or undermined learner motivation to use the app.

2 Literature review

2.1 SDT in technology-enriched environments

Many education studies have embraced SDT as a research framework as it provides a powerful theoretical backdrop for understanding student motivation. A central assumption of this theory is that people have an inherent propensity for learning and that this propensity can either be supported or thwarted by the social environment (Ryan & Deci, 2000). SDT posits that students' enhanced, sustained motivation for learning is significantly related to how much three basic psychological needs (BPNs) are satisfied in the environment: the needs of autonomy, competence, and relatedness (Ryan & Deci, 2017). Autonomy is related to willingness and volition concerning a learner's behavior, competence refers to the feeling of effectiveness when a learner interacts with the environment, and relatedness is the feeling regarding a sense of belonging and connection (see Ryan & Deci, 2020). That is, SDT argues that creating need-supportive environments is critical to one's optimal motivation and growth (Deci & Ryan, 2000).

Recently, with the emergence of new technologies, scholars started to pay more attention to SDT to explain motivation in online environments (e.g., Chiu, 2021; Hsu et al., 2019). Specifically, SDT-based studies in the field of technology have provided robust evidence regarding how BPN-supportive technologies successfully motivate users to achieve desired goals (e.g., Ryan et al., 2006). For example, Choi et al. (2014) examined 175 smoking cessation apps and found that while about 90% did not support BPNs, all four of the top-ranked apps supported BPNs. In a more recent study, Villalobos-Zúñiga and Cherubini (2020) analyzed 208 habit-changing apps and highlighted the importance of satisfying BPNs for motivating users toward their desired behavior.

This trend has gained more momentum from recent calls for research on the role of BPNs in education technology by the founders of the theory (Ryan & Deci, 2020). For example, research has revealed that online settings effectively support students' autonomy (Chiu, 2021). It was also indicated that learners perceive enhanced autonomy and relatedness in a virtual reality environment (Huang et al., 2019) and that a mobile learning app provides significantly higher levels of perceived competence and autonomy than a traditional textbook provides (Jeno, Adachi, et al., 2019). This

line of research is meaningful in that it has presented empirical evidence regarding how the support of BPNs contributes to an increase in students' motivation to learn.

Clearly, it is reasonable to assume that MALL will also positively impact student motivation and engagement if the mobile technology used supports students' BPNs. Attempts have been made within the MALL research field to examine motivation to use mobile apps for language learning by drawing on the SDT framework. For example, Alamer and Al Khateeb (2021) analyzed students' BPNs when using a social networking mobile app and revealed how the use of the app supported each psychological need and therefore led to an increase in student motivation. Fathali and Okada (2016) highlighted the importance of BPN satisfaction in the informal context of technology-enhanced language learning by showing the positive effects of BPN support on learning intention. Similarly, research indicates that language learning apps should foster positive psychological factors (e.g., a sense of autonomy or competence) by allowing students to select the activities appropriate for their needs or by presenting challenging tasks; thus, apps can facilitate students' intrinsic motivation to use mobile technology for language learning (Hsu & Lin, 2021; Refat et al., 2020). Despite these efforts, little is known about how self-directed apps, especially apps that provide interactional opportunities with a conversational agent, affect student motivation. Given the rapidly developing landscape of MALL and the potential of AI technology, exploring students' use of SIAs from the motivational perspective is a timely and significant issue for both language scholars and practitioners.

2.2 Gamification and conversational agents in MALL

MALL has garnered much attention from language learning professionals due to the growing popularity and ownership of mobile devices among students. Previous MALL literature has identified two specific research themes that can be categorized depending on the role that mobile devices play in language learning: the first is the use of a mobile device as a communication tool between learners (e.g., Fang et al., 2021; Zou et al., 2018); the second is the use of a mobile device as a learning tool itself rather than as a communication medium between users (e.g., García Botero et al., 2019; Loewen et al., 2019). The first line of research has mainly been conducted in a classroom or teacher-initiated setting and has focused on how the device supports communication between participants. The latter has been conducted in an informal or student-initiated setting and examined learners' self-direction in that learners could access their mobile device at any time and anywhere and could manage their learning independently.

This research expands on the second line of research but explores another technology, a conversational agent in the MALL context. In the literature, self-directed apps have been introduced as tools with which learners could spend spare time to learn a language, especially focusing on grammar or vocabulary learning (Klimova, 2018; Shortt et al., 2021); but relatively overlooking spoken communication skills (Xu & Warschauer, 2020a). For example, Duolingo, the most popular self-directed app, mainly focuses on receptive activities, primarily at the lexical level, such as word translation or vocabulary practice (García Botero et al., 2019; Kessler, 2021). This might be because

reliable communication partners who share a common time block and the same learning goal are difficult to find in an informal setting (Castañeda & Cho, 2016).

Alternatively, in recent years, language scholars have believed that conversational agents could potentially provide learners with language use opportunities, as they have become more powerful and capable of sustaining L2 spoken interaction (Xu et al., 2021). Furthermore, by being integrated with mobile devices, conversational agents are available anytime and anywhere and provide ubiquitous L2 interactional opportunities (Jeon, 2021). That is, self-directed, informal language learning via apps is changing the landscape from *mechanical and repetitive* to *communicative and meaningful* language learning. Indeed, an emerging yet limited line of research has already started to explore the use of conversational agents in language learning in classroom or laboratory settings (Jeon, 2021; Xu et al., 2021; Xu & Warschauer, 2020b), yet more research is needed to understand how learners utilize new affordances provided by conversational agents available in the form of an SIA.

In informal and voluntary MALL settings, sustaining students' motivation is another significant issue given the fact that self-directed apps are initiated and managed by learners without teacher support (García Botero et al., 2021). Clearly, learners' autonomous motivation will play a more crucial role when students use a self-directed app outside the classroom (Rigby & Ryan, 2017). To address this issue, previous literature has mainly drawn on gamification as a technique to sustain learner motivation when they use apps (Castañeda & Cho, 2016; Shortt et al., 2021; van Roy & Zaman, 2018). Gamification is defined as the utilization of game-based elements such as a leaderboard, badges, or characters in a non-game context to engage people, motivate action, and promote learning (Kapp, 2012). Most self-directed apps (e.g., Duolingo or Busuu) use this technique to enhance and sustain users' motivation. However, it remains inconclusive whether gamified elements effectively motivate learners for language learning (García Botero et al., 2021; Shortt et al., 2021). For example, Dehganzadeh et al. (2019), synthesizing research on gamification in the field of CALL, have revealed that a gamified environment enhances students' motivation and engagement. In other literature, however, students stated that activities in gamified language learning apps were rather mechanical and repetitive, which clearly indicates a decrease in their motivation (Loewen et al., 2019). Further research needs to investigate the effect of gamified MALL on students' motivation. Indeed, Dehganzadeh et al. (2019) emphasized that how each learner perceives gamified elements and how this perception affects learner motivation needs to be examined in further detail.

Therefore, drawing on SDT as a research framework, this research will examine how the experience of an SIA satisfies or thwarts students' BPNs and thus enhances or obstructs sustained engagement, affecting learners' experience and motivation. The research questions (RQ) are as follows:

1. What are learners' specific usage patterns when using a self-directed interactive app in an informal, voluntary setting?
2. How do learners with different usage patterns perceive basic psychological needs when using a self-directed interactive app?
3. How do the gamified elements of a self-directed interactive app enhance or undermine learners' basic psychological needs?

3 Methods

3.1 Participants and procedure

This research was carried out at a public primary school in South Korea. The participants were 179 EFL learners (81 females, 98 males) aged 11 to 12 studying at the school. Following a communicative approach based on the Korean national standard English curriculum, learners at this school study English for real-life situations, focusing on improving four skills (listening, speaking, reading, and writing). All participants were registered in the same EFL course provided by the school. After receiving formal permission for the entire process of the study from the school and each learner and their parents, a demographic survey was first implemented. The survey confirmed that all participants had not previously utilized any SIA or chatbot for language learning purposes, but most of them (n = 165) had used smart speakers or intelligent systems such as Siri for Apple on smartphones. All of the participants had around three years of EFL learning experience. The students' overall English proficiency varied from novice (n = 131) to intermediate (n = 48) according to ACTFL guidelines.

Figure 1 shows the procedure of this research. After the demographic survey and official consent process, an introduction to the target app, PengTalk, was given to the participants. The introduction session lasted for 20 minutes and included instructions about downloading the app, activities, specific features, and several rounds of interaction demonstration by an instructor. Given that the purpose of this research was to explore informal, voluntary MALL use, special attention was paid to ensuring that students did not feel forced to download or use the app. They were also informed that their usage history would automatically be saved and could be tracked by the researcher whenever they used the app. During an eight-week experimental period, the participants did not meet in person, and the researcher tracked and recorded individual learners' usage history for analysis. Immediately after the experimental period, learners who actually used the app more than once were divided into two groups depending on their usage patterns: continuous or discontinuous. Non-users were excluded from subsequent analysis. Next, an SDT survey was distributed online to the two groups one day after the experimental period, and all of them completed it. Finally, ten learners from each group were selected and invited to participate in individual, in-depth interviews.

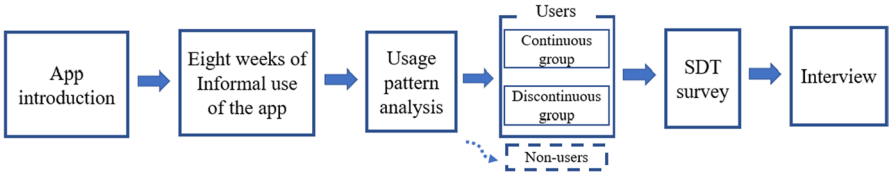

Fig. 1 Study procedure

3.2 App description

PengTalk was chosen as the experimental tool for this research. The app's name is made from a combination of Pengsu, a popular character's name (see Tan & Kim, 2019), and the word talk. PengTalk represents the concept of SIA in that it uses an interactive agent with which students can interact using L2. The app was developed by the Korean Education Broadcasting System (EBS) in collaboration with the Korean Ministry of Education, targeting primary EFL students studying within the Korean public school system. Learning activities in the app focus on L2 pragmatics based on the Korean national standard English curriculum, which enables students to review or preview the public-school system's EFL course at their own pace using the app.

The researcher chose this app for the following reasons. First, this app is one of few apps that focus on providing L2 speaking practice using a conversational agent. As shown in Fig. 2, this app provides three speaking activities: word and sentence practice, dialogue practice, and conversation with the agent. Second, multiple gamified elements are used in the app to motivate learners, allowing the researcher to examine how these elements affected learner psychology. Last, this app automatically saves student learning history. For example, a teacher can access student attendance logs, time data, and the number of lessons completed, all of which can be used as reliable data to explore student engagement in informal settings.

PengTalk is available in Android and Apple app markets but can only be activated using a personal code. Students can receive a code from their English teacher after the

Fig. 2 App screenshots. **a**. Main screen **b.** Conversation with the agent **c.** Leaderboard **d.** Word, sentence, and dialogue practice

teacher applies for the code through an official code management site; the researcher registered for the service with the support of a public school teacher. Speaking activities in the app operate using a natural language understanding module based on a generic pre-trained model built in an engine provided by the companies ETRI and NHN. The engine consists of Korean students' utterance data; thus, it ensures more accurate speech recognition.

3.3 Data collection and analysis

The researcher adopted a mix-methods approach to examine students' usage patterns for an SIA and their motivation to use the app in an informal, voluntary context. Data were collected from three sources to achieve the objectives: student app usage logs, an SDT survey, and a semi-structured interview. By basing the current investigation on the students' actual app usage data and their responses to the survey and interview questions, the researcher was able to gain a thorough picture of the students' SIA use and motivation. The steps taken to investigate each RQ are explained below, along with details about each data source that was employed.

In accordance with RQ1 regarding students' specific usage patterns in an informal, voluntary MALL context, students' app usage logs were quantitatively analyzed. Among available data sets (students' attendance logs, time usage, the number of completed units), the attendance logs were selected as the primary data source and time usage data as the supplementary source to outline students' usage patterns and determine whether their pattern belonged to continuous or discontinuous usage. Regarding their time data, the average amount of time that learners spent on the app was 11.2 min when only calculated using active days, but it significantly varied depending on the day. For example, one student spent 131 min one day and spent only two minutes another day; thus, averaging or combining the time data would not be representative of sustained motivation; instead, this data set was only used to exclude days when learners did not use the app for more than two minutes, considering that one activity in the app takes at least two minutes. Furthermore, the number of lessons completed for student engagement was not considered because students with different levels of language proficiency could complete a varied number of lessons during the same amount of time.

Next, for RQ2, the researcher adapted the version of the Player Experience of Need Satisfaction scale (PENS; Ryan et al., 2006) used in Jeno, Vandvik, et al. (2019). PENS was designed to measure a gamer's phycological states, including BPNs; it has been validated in previous research and extensively used in a variety of fields, including education. The version utilized in Jeno, Vandvik, et al. (2019) was chosen because it was designed and tested under comparable research conditions to the current study; the survey comprises of three BPN constructs and measures learners' need-satisfaction when using a biology app. For this study, the version was modified by the researcher to suit the content of the app used in the present investigation (i.e., English learning) (see Appendix). For instance, the item "I feel competent at speaking in English when using the app" was modified from "I feel competent at identifying species." Consequently, the modified survey consisted of three BPNs: perceived competence, perceived autonomy, and perceived relatedness. Each construct included

three statements that ranged from "strongly disagree" to "strongly agree" on a 5-point Likert scale. Two EFL professionals were invited to examine the revised survey to confirm content validity. Following that, the survey was piloted with five learners and finalized by taking their comments into account to avoid any misinterpretation by young learners. Internal reliability was determined by examining Cronbach's alpha scores for each construct, which were verified to surpass the criterion of 0.80. (Lance et al., 2006).

Last, to address RQ3 about the interplay between gamified app elements and BPNs, semi-structured interviews were administered to 20 participants individually (10 from the continuous group and the other 10 from the discontinuous group). The interview questions were focused on how their BPNs were supported in relation to specific app elements. All the interviews were audio-taped and transcribed verbatim for subsequent analysis. The transcripts were coded following content analysis procedures to identify repeated patterns of meaning concerning RQ3 (Braun & Clarke, 2006). This qualitative finding was presented to supplement and shed more light on the quantitative results of RQ1 and RQ2 (Riazi, 2016).

4 Findings

4.1 Learners' specific usage patterns of an SIA in a voluntary, informal setting (RQ1)

Out of 179 participants, 59 learners (32.9%) did not use the app after the introduction session; therefore, only usage data from 120 learners (67.1%) were further analyzed. The first graph in Fig. 3 displays how many days these learners utilized the app throughout the experimental period. Among the 120 users, most learners (78 learners, 65%) used the app for less than 10 days. Nine learners (7.5%) utilized the app for more than 30 days out of eight weeks. The second graph in Fig. 3 provides further insights regarding the learners' usage patterns. It shows how many learners used the app as the weeks progressed. All 120 users tried the app for the first week. After the first week, the number of users gradually decreased and dropped to 20 learners during week 4. The number stabilized for the last four weeks, remaining around 14-18 learners per week.

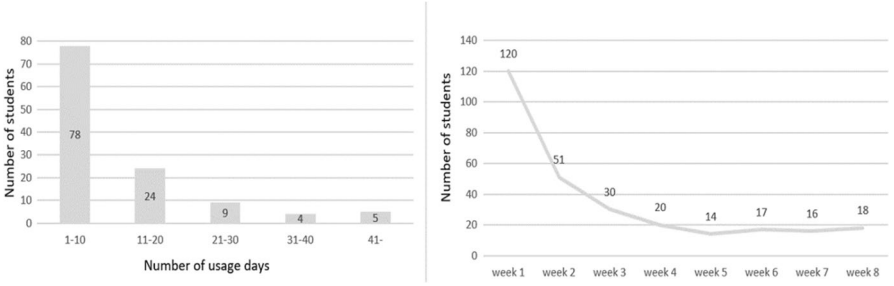

Fig. 3 Students' app usage data

To gain a further understanding of learners' motivation regarding the use of the app, the users were divided into two groups based on outlines of mobile usage patterns presented in the previous MALL studies (García Botero et al., 2019; Stockwell, 2008). Accordingly, students were categorized into either discontinuous or continuous groups depending on their overall usage pattern, as described below.

4.1.1 *Discontinuous group* (n = 87)

Among the 120 users, 87 learners (72.5%) belonged to this group. This group of learners actually used the app after the app introduction but stopped using the app at some point during the experimental period. They fit one of the following three criteria (Stockwell, 2008): learners who tried the app during only one short block of time, either as a single attempt (15 learners) or one short block of attempts (32 learners); learners who tried the app for a couple of short, isolated sessions (3-5 days per session) (19 learners); and learners who used the app for one to two longer sessions (6-7 days per session) (10 learners). In all cases, learners decided not to continue using the app and did not use it for the last two weeks.

4.1.2 *Continuous group* (n = 33)

These learners are distinguished from the learners in the discontinuous group in that they continued to use the app toward the end of the experimental period. These learners regularly used the app to a varying degree. These learners fit one of two criteria: learners who completed three to five longer sessions (5-7 days per session) with several intermittent single-day attempts (28 learners); and learners who used the app almost every day (5 learners). In all cases, learners used the app regularly toward the end.

4.2 BPN satisfaction in an SIA depending on usage patterns (RQ2)

An SDT survey was administered one day after the experimental period and analyzed to specifically discover group characteristics regarding motivation. Given that the collected data from the survey were not normally distributed and that each group had unequal numbers of students, Mann-Whitney *U*-tests were administered for comparing BPNs between the two groups (Hatch & Lazaraton, 1991). Table 1 shows the statistical descriptions of the survey results for each BPN.

Table 1 Statistical description of BPNs by group

	Discontinuous group			Continuous group		
BPNs	*N*	*M*	*SD*	*N*	*M*	*SD*
Perceived autonomy	87	2.86	0.80	33	3.02	0.66
Perceived competence	87	2.65	0.81	33	4.09	0.48
Perceived relatedness	87	3.22	0.74	33	4.31	0.56

Overall, students in the continuous group outscored students in the discontinuous group for each construct. The Mann-Whitney *U*-tests were conducted to make further statistical comparisons. The results showed a significant difference in the perceived competence scores ($U = 211.50$, $p = .00$, $Z = -7.257$). That is, students in the continuous group (mean rank = 97.59) perceived more enhanced competence than students in the discontinuous group (mean rank = 46.43). Similarly, the results identified a significant difference in the relatedness construct ($U = 333.00$, $p = .00$, $Z = -6.548$) between the groups. The students in the continuous group (mean rank = 93.91) had more enhanced feelings of relatedness than those in the discontinuous group (mean rank = 47.83). In contrast, no significant difference was identified in the perceived autonomy scores of the two groups ($p = .19$).

4.3 Interplay between gamified elements of an SIA and students' BPNs (RQ3)

Further exploration was implemented through in-depth interviews with 20 students (10 students from each group). The interviews focused on how gamified elements of the app affected students' BPNs, and ultimately, how the satisfaction of BPNs resulted in different motivations and engagement for each group when using the app. Finally, three main themes emerged regarding the interplay between gamified elements and students' BPN satisfaction.

4.3.1 Enhanced relatedness: An AI character as a conversational partner

Using the app, learners participated in a conversation with a characterized agent in an informal MALL context. Discontinuous users did not describe the agent as a conversational or learning partner. In contrast, continuous users expressed their positive perceptions of the agent as a conversational partner, which facilitated their perceptions of relatedness. To be more specific, being described as comfortable, the agent reduced their L2 anxiety; the learners said that they could practice L2 speaking without worrying about reactions from human partners such as peers or teachers in the classroom. S1 commented on this as follows:

> Pengsu (the agent) did not get annoyed even though I made mistakes. If I had been in the classroom, I would have tried to speak in English just once, but with the app, I tried many times to check if my speaking was correct or not. I would feel uncomfortable doing the same thing with my friends or teachers. (S1, *continuous user*)

In addition, eight learners in the continuous group expressed their special, personal affection toward the character. These learners described the agent not only as comfortable but also as adorable and reliable. Some learners directly mentioned that this preference motivated them to use the app more often. Related comments are as follows:

> I had liked the character Pengsu even before I knew this app. I thought the character in the app was adorable. I wanted to make him happy or smile; so, I used the app more often. (S2, *continuous user*)

> Pengsu is an AI-based character. That's why I thought he would never speak incorrect English. I tried to memorize what he said and speak to him when I wanted to know if my English would be understandable to a foreigner. (S3, *continuous user*)

4.3.2 Enhanced competence and relatedness or undermined competence: A leaderboard as a double edge sword

In the app, learners receive points according to their studying time, and the points are displayed in a ranking format on a leaderboard. The leaderboard only shows the top 10 learners' chosen nicknames, and the rankings are renewed every Monday. Learners had abundant but different opinions about the leaderboard and their motivation to use the app.

First, the leaderboard played a significant role in enhancing learners' perceptions of competence and relatedness in the continuous group. All of these students mentioned that they checked the leaderboard every time they used the app. They said that when their nicknames were on the rankings, it provided a sense of accomplishment and that they could confirm that they were performing well. In addition, three students specifically mentioned that the ranking system was the most interesting element of the app.

Another psychological benefit of the leaderboard is related to a sense of belonging. Students felt that they were studying together with their friends because they could see if other students were studying through the leaderboard. In addition, students created interesting nicknames that they wanted to share with other students through the leaderboard, which further facilitated their engagement in the app. Positive comments regarding the leaderboard are as follows:

> I think the most interesting part of the app is the rankings. Even though I was studying alone at home, I could know that other friends were also studying together with me by checking the leaderboard. That made me use the app more and study harder. (S5*, continuous user*)

> It was amusing to see friends' nicknames on the leaderboard. I tried my best to put my nickname on the rankings and show it to friends. (S6*, continuous user*)

However, for most discontinuous learners, the leaderboard undermined their perceived competence and thus thwarted their motivation to use the app. Specifically, among the 10 students in the group, two learners said they did not care about the leaderboard at all, and eight learners described it as frustrating or discouraging. These learners mentioned that the rankings were interesting at first, but at some point, they felt that putting their name on the rankings was difficult and not even possible. A comment was as follows:

> I only had limited time to use the app. I tried the app a few times, but it was not enough to be on the rankings, and it was discouraging. I did not want to use the app anymore unless I could be on the rankings. (S7*, discontinuous user*)

4.3.3 Enhanced competence but undermined relatedness and autonomy: Predictable interaction with an AI partner

As described in the App description section, this app focused on fostering basic pragmatics for primary EFL learners. Although the conversational agent was designed to provide different verbal and nonverbal feedback, the feedback was limited compared to one from a human partner. All interviewees (n = 20) said interactions with the agent were relatively predictable. However, this predictable flow of interaction designed to foster basic pragmatics was perceived differently depending on the group.

Most continuous users valued these speaking opportunities. They expressed their hope for future communication opportunities with human interlocutors where they could apply what they practiced with the conversational agent. S9 evidenced this by stating, "It was good to know what I have to say in a given situation. I think I will be able to talk to foreigners with confidence when I am in a similar situation." In addition, nine students in the group gained confidence in speaking English through pronunciation feedback, as shown in Fig. 2. The students received specific feedback through the pronunciation bar and audio-recording, which increased perceived competence. A comment about the feedback was as follows:

> I think I could develop my speaking and pronunciation. This is due to the feedback that I received from the app. I could find and fix my errors quickly by using the app. (S9*, continuous user*)

However, limited interaction patterns decreased the authenticity of the conversation with the agent. Specifically, seven discontinuous learners considered this agent as just a machine; thus, they did not feel any sense of attachment to the agent, which significantly decreased their motivation to use the app. Furthermore, this negative perception of the agent as a machine also negatively impacted students' perceived autonomy. The students stated that they were not motivated to continue to use the app because they could not actually affect the agent or make any significant changes to the conversation with the agent due to technological limits.

> I lost my interest in using the app because the conversations in the app were quite predictable, and the character was not as dynamic as a real human. (S10*, discontinuous user*)

5 Discussion and implications

Among 179 participants introduced to the target app in this study, 120 actually utilized the app. During the experimental period, 87 users stopped using the app at a certain point, and 33 users showed a relatively regular usage pattern until the end. According to the results of an SDT survey, the continuous group perceived statistically more significant competence and relatedness in the app than the discontinuous

group. This study provides several pedagogical insights regarding learner motivation and the use of a conversational agent in an informal, voluntary MALL context.

First, there was a dramatic decrease in app usage following the first week of the experimental period. This novelty effect was also reported in other similar publications in the field of MALL (García Botero et al., 2019; Stockwell, 2008). However, compared to the findings of those studies, the ratio of users to non-users was confirmed to be significantly higher in this study. For example, in García Botero et al.'s study, which was also conducted in an informal, voluntary MALL context, only 149 out of 422 students (35.3%) actually used the app after the introduction session of a self-directed app. In another informal MALL context, Stockwell (2008) reported participants' similar mobile use rate (38.7%). In contrast, after the introduction to the SIA in the current study, 67.1% of the participants (120 out of 179 students) tried the app more than once. Although it would be difficult to directly compare the results due to the different contexts of each research, at least, it can be argued that these considerable differences imply that SIA-type apps can generate more substantial initial interest in students.

Clearly, this type of app needs to be further developed in order to transform this initial interest into sustained motivation. However, the app in this study did not motivate all users. Students' initial interest was either sustained or undermined throughout the experimental period, depending on how the app satisfied or thwarted each learner's BPNs; it successfully satisfied some learners' BPNs but thwarted those of many others. These perception differences should be considered when attempts are made to update or create more motivating SIAs in the future. Overall, learners in the continuous group showed more enhanced BPN satisfaction than ones in the discontinuous group, which supports the basic tenet of SDT (Ryan & Deci, 2020) and the findings of other empirical studies (e.g., Jeno, Adachi, et al., 2019; Villalobos-Zúñiga & Cherubini, 2020). A qualitative investigation was conducted to explore the specific effects of the app on the satisfaction of BPNs.

Findings from interviews confirmed that different perceptions of BPN satisfaction resulted from how learners perceived gamified elements of the app, such as using a character and leaderboard. Specifically, when the agent was perceived as a comfortable conversational partner, the perception facilitated perceived relatedness and thus enhanced motivation in using the app. This finding echoes Xu and Warschauer (2020b). They showed that young students perceived intelligent agents as similar to living beings due to their psychological properties, and thus, they engaged more actively in conversations with the agents. Similarly, this study found that perceived relatedness was further facilitated by students' affection toward the characterized agent. For example, some students described the agent as reliable or adorable, expressing willingness to continue using the app. Next, the leaderboard also played an essential role in enhancing relatedness and competence. Learners could see that other peers were also studying through the rankings on the leaderboard, which provided a sense of belonging and thus facilitated their engagement. The ranking system enabled by the leaderboard further promoted perceived competence by providing a sense of accomplishment to some learners, which supports the idea that incorporating a competitive element in MALL would promote a sense of achievement and motivate students to learn (Castañeda & Cho, 2016). Furthermore,

echoing the findings of previous studies in other mobile-learning contexts (e.g., van Roy & Zaman, 2018), this study showed that predictable interaction patterns and evaluative feedback from the agent satisfied perceived competence in students.

However, not all students reported positive perceptions toward the gamified elements of the app. Unlike the constructs of perceived competence and relatedness, the SIA in this study did not successfully satisfy autonomy. This is evidenced by the survey results for perceived autonomy remaining relatively lower (3.0 and 3.2 out of 5 for each group) than other constructs, as shown in Table 1. This finding is inconsistent with previous studies that examined self-directed apps that did not include the use of agents (e.g., Jeno, Adachi, et al., 2019; Jeno, Vandvik, et al., 2019). Specifically, when interviewed, most of the discontinuous users perceived the agent as just a machine rather than a conversational partner, which significantly decreased their motivation to use the app. One main reason for this perception resulted from limited and predictable interaction provided by the agent, which decreased their sense of volition and, in turn, perceived autonomy. As shown in Fig. 2, PengTalk has multiple self-directed features, such as activity choice options or a tap to see translation function, which could enhance the sense of volition or help students experience choice and freedom regarding their behavior (Jeno, Adachi, et al., 2019). However, similar to participants in García Botero et al. (2021), interview data revealed that learners in the current study also did not use or value those functions. Instead, their autonomy was affected by the agent rather than the self-directed features in the app. The leaderboard also decreased some students' perceived competence. These students felt discouraged from using the app because their low ranking on the leaderboard provided them a feeling of incompetence, which they said could not be compensated for with effort.

The findings of this study provide critical pedagogical implications regarding the future development of SIAs. According to the interviews, when perceived as simply a machine, the agent significantly thwarted students' perception of relatedness to the app. To solve this concern, using different types of social reactions such as providing empathy and trust can be employed, even in the case of repetitive input from a student (Purington et al., 2017). This does not mean that conversational agents should fully simulate a human partner in terms of linguistic abilities (Xu et al., 2021). For example, simply remembering students' names or repeating their utterances can immensely increase the psychological bonds with the agent (Xu & Warschauer, 2020b). These types of social responses will further enhance students' relatedness in conjunction with the existing psychological benefits of artificial partners, such as providing an anxiety-free atmosphere (Fryer et al., 2020). In addition, providing elaborative feedback on students' linguistic or pragmatic errors will enhance perceived competence (van Roy & Zaman, 2018). Although this might challenge the technical aspect due to the decreased predictability of responses, the educational benefits will increase.

Along with the interactive side mentioned above, other gamified elements can be designed to enhance BPN satisfaction effectively. First, characterized agents with personalized customization may facilitate more perceived relatedness. As suggested in the comments of S2 and S3, when students felt affection toward the agent, they perceived relatedness and expressed their desire to keep using the app. In this study, the only available character, Pengsu, was perceived as likable by some learners;

thus, successfully motivating them to use the app. In contrast, some learners did not consider the character as interesting or did not reveal any affection toward it. Therefore, future studies need to explore ways to make students feel more connected toward agents and provide more empirical evidence regarding the relationship between affection toward agents and engagement.

Further, leaderboards can be designed to facilitate feelings of relatedness and competence. As shown in the comment from S7, at a certain point of use, competition through the leaderboard provided a feeling of incompetence to some learners who could not outperform their peers because they were unable to use the app sufficiently or unable to complete conversations with the agent as successfully as other advanced students. To solve this problem, leaderboards can include a cooperative element integrated into the ranking system. For example, students can be grouped and compete with other groups rather than individually; thus, even low-usage or low-proficiency students can contribute to their team's growth. Further methods regarding effectively incorporating cooperative and competitive elements in a MALL context need to be investigated more in future studies.

Last, similar to participants in the previous study (e.g., García Botero et al., 2019), in this study, self-directed features in the app were not valued by the participants; the features seemed to fail to facilitate the feeling of autonomy. When interviewed about their perceptions of autonomy, students mainly attributed their perceptions to their interaction experiences with the conversational agent rather than to self-directed features. They possessed diminished feelings of autonomy because they were aware that they could not actually affect the agent or make any significant changes to the flow of the conversation with the agent due to technological limits. Clearly, the diversification of conversation scenarios and agents' reactions should be considered first. However, given that students should manage their learning in an informal context absent of specific teacher instruction, students may also need to be aware of ways to self-direct their learning by effectively using self-directed functionalities (Hew & Cheung, 2014). In this vein, the need for training in self-direction is also significant, especially in an informal, voluntary MALL context (Hubbard, 2004). García Botero et al. (2021) empirically revealed that this type of training could be more effective in facilitating engagement in the MALL context.

Significant implications for the future direction of informal EFL learning research and teaching can also be drawn from this study. To begin, unlike previous research on language learning apps that have concentrated on vocabulary or grammar (e.g., Rosell-Aguilar, 2016), the current study examined an app that included a conversational agent capable of orally interacting with students. The use of an agent effectively motivated some students to use the app autonomously in an informal setting. The more AI technology advances, the more viable it will be to develop SIAs with agents capable of considerably more sophisticated interaction. The advancement in agent technology can potentially change the landscape of informal EFL learning, particularly informal MALL. This study may act as an initial step in this emerging field, and future research is suggested to explore the possibilities provided by conversational agents in areas other than learner motivation.

Additionally, this study sheds light on the potential role of SIAs as a bridge between formal and informal EFL learning. EFL teachers may wish to integrate an

SIA into students' voluntary, out-of-class MALL to supplement for insufficient L2 interaction opportunities, which is a problem inherent in EFL settings. To achieve the active incorporation of SIAs into EFL learning, more SIAs should be developed so that teachers can easily choose and utilize an SIA for complementing their language classes. App creation might be conducted by the private sector or through governmental support as was the case with the target app in this study. Another viable option is for a teacher to create an SIA tailored to their students' specific needs by utilizing a chatbot builder (Jeon, 2021). Most importantly, teachers' decisions should be supported by educational policies that encourage students to interact with technology outside of the classroom.

6 Conclusion

This study explored primary EFL students' use of an SIA in an informal, voluntary MALL context by drawing on an SDT framework. Specifically, three aspects were investigated: students' app usage patterns, their perception of BPN satisfaction, and the specific psychological effects of gamified elements in the app in terms of BPN satisfaction. Findings shed light on the potential of SIAs as one more valuable tool for L2 learning in an informal, voluntary MALL context. Furthermore, this research revealed that the target app did not motivate all users; we identified students' continuous and discontinuous app usage patterns and further showed how elements of the app satisfied or thwarted students' BPN satisfaction. In addition, thoroughly grounded in comments provided by the students, future directions for further development were suggested concerning specific elements of the app. This study diversified avenues for future research in the MALL community by introducing the concept of SIAs and also advanced our understanding of students' informal, voluntary MALL engagement and motivation by providing empirical data.

Despite the contributions, this study suffers from some limitations. First, this study focused on attitudinal variables regarding the use of an SIA; as a result, no data on the extent to which the SIA enhanced the participants' L2 language proficiency was provided. It is advised that future research include a pre-and post-test of L2 ability to measure the effect of SIAs on L2 performance. Second, the participants were young EFL students in a single context. This may not be representative of a larger population with different demographic characteristics. Third, the findings were derived from the implementation of an eight-week experimental session. It is suggested that future researchers conduct a more extended experimental session to generalize the results. Last, the target app used for this study features one specific, well-known characterized agent, which might have affected students' perceptions depending on preferences that may have been formed before participation in the study. Future studies need to explore other SIAs with multiple or different agents to see if similar motivation or usage patterns are observed in other SIA contexts.

Appendix

SDT survey

(Participants received a Korean version of the survey.)

Perceived competence.

- My ability to speak English is well-matched with the activities in the app.
- I feel competent at speaking in English when using the app.
- I feel capable and effective in speaking English when using the app.

Perceived autonomy.

- I experience a lot of freedom when using this app.
- I can find something interesting to do in this app.
- This app provides me with interesting options and choices.

Perceived relatedness.

- I receive support from this app.
- This app provides me with meaningful information that I can rely on.
- I feel attached to and comfortable with this app.

Declarations

Conflict of interest None

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