Self-directed language learning using mobile technology in higher education

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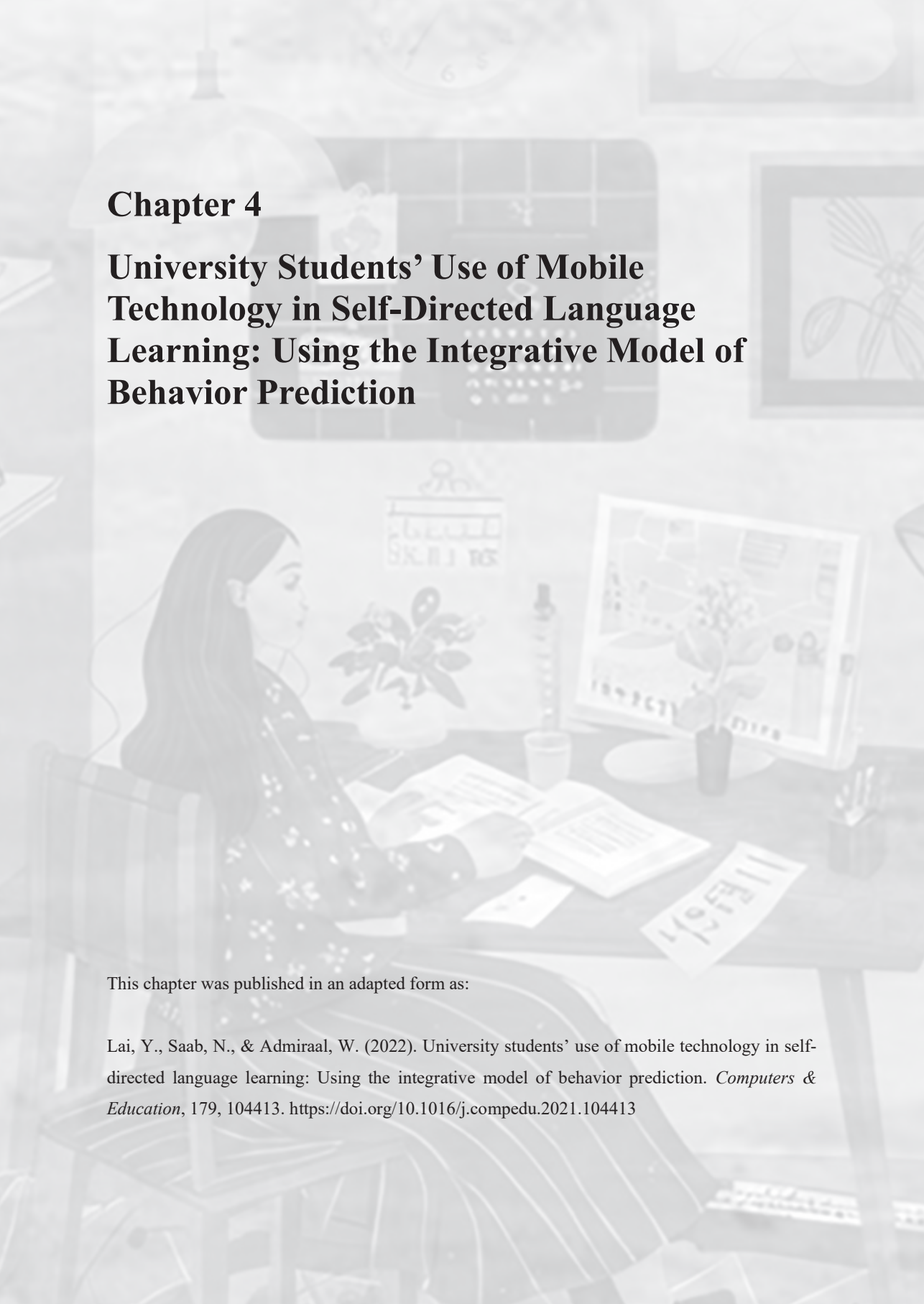
Chapter 4

University Students' Use of Mobile Technology in Self-Directed Language Learning: Using the Integrative Model of Behavior Prediction



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Abstract

Mobile technology offers great potential for university students' language learning. Numerous studies have been conducted on utilizing mobile technology in language learning classroom. However, using it in self-initiated and self-directed learning outside class remains to be explored. The present study employed the Integrative Model of Behavior Prediction to investigate the relationships between attitude, subjective norm, self-efficacy and behavioral intention, as well as the association between intention, facilitating conditions, self-regulation skills and actual use of mobile technology in self-directed language learning. This study also examined whether self-regulation skills moderated intention and actual use. Survey data from 676 language learners in different disciplines from Chinese universities were collected and analyzed using Structural Equation Modeling approach. The results showed that 37.1 percent of respondents indicated that they never used mobile technology for self-directed language learning. Of the other 425 respondents who did indicate that they used mobile technology for this purpose, the majority of them seemed to be extrinsically motivated. Learning activities regarding vocabulary acquisition and translation were far more reported than those in terms of listening, speaking, reading and writing. In addition, attitude and subjective norm significantly explained students' intention to use mobile technology, but self-efficacy did not have a direct effect on students' intention. Moreover, students' self-regulation skills and intention significantly predicted students' actual use of mobile technology. Through moderation analysis, the results indicated that the relationship between intention and actual behavior would be stronger with any increase in self-regulation skills. These findings are discussed and implications are formulated.

Keywords: Self-directed learning; Mobile technology; IMBP; Higher education

4.1 Introduction

It is widely acknowledged that learning a foreign language is often a difficult and time-consuming journey (Wang, Grant, & Grist, 2021). In higher education, however, there is not much space to learn foreign languages as part of the subject curriculum in a discipline, and in some countries students do not receive enough in-class language exposure to ensure their learning success (Liu, 2020; Richards, 2015; Trinder, 2017; Tsou et al., 2006). Thus, for the sake of increasing the opportunities for exposure to foreign languages, it is of great significance for students to devote their time on out-of-class and self-directed language learning as well. At the heart of out-of-class and self-directed language learning is the notion that learners take control of their own learning process by taking responsibility for and deciding what and how language knowledge is learned (Merriam & Bierema, 2013). Currently, many students have attempted to use mobile technology to learn foreign languages outside the curriculum, in a self-directed way, so as to improve their foreign language competencies. Students utilize mobile-accessible apps such as YouTube, Duolingo, Facebook, etc. to create their own learning environment. In this process, students may receive support (i.e., useful mobile apps or learning materials) from facilitators like teachers or maybe not, since the whole process is student-initiated.

Mobile technology has been widely used in language learning. It enables learners to access information anytime and anywhere (Hsu, & Lin, 2021), share their experiences and understanding, and collaborate with other learners or native speakers (Kukulska-Hulme, & Viberg, 2018), so as to improve their learning performance and interest. In higher education, this mobile assisted language learning is widespread. In Australia, for example, a virtual world, Chinese Island (CI), was introduced to effectively engage Chinese language learning students, facilitate their authentic language use, and enhance their learning experience (Wang, Grant, & Grist, 2021). In China, WeChat, a multi-purpose mobile app, was used to help students to develop their pronunciation learning by receiving feedback from automatic speech recognition (ASR) and/or peers (Dai, & Wu, 2021). Also, in Japan, video streaming services were employed in order to promote reading, vocabulary and listening comprehension in the foreign language learning (Dizon, 2021). All these applications are suited for mobile technology.

However, university students vary considerably in their out-of-class use of mobile technology (Lai & Gu, 2011; Nguyen, & Takashi, 2021; Stockwell, 2010; Zhang & Pérez-Paredes, 2019; Luo, 2019). Stockwell (2010), for example, examined 175 Japanese learners of English over a three-

year period and found that their usage of mobile phones for English vocabulary learning remained quite low when given the alternative of using desktop computers. Yet Lai and Gu (2011) revealed that Hong Kong students showed different levels of engagement with technology. Students not only employed a variety of technologies for language learning, but also used these technologies for different purposes, such as seeking opportunities for authentic language use, assessing their current level of language proficiency, motivating themselves to commit to the learning goals, obtaining cultural information, and broadening their social connections. In addition, Luo (2019) reported that Chinese students used different mobile apps, and 70% of the students used mobile technology for language learning less than 20 minutes. In the same country, Zhang and Pérez-Paredes (2019) showed that students were not regularly and actively involved in mobile English learning resources. Also, Nguyen and Takashi (2021) indicated that Vietnamese and Japanese learners rarely used mobile devices to study English outside the classroom, even though they would like to use mobile devices more often. Furthermore, as documented in the literature, a number of obstacles make students hesitate to engage in self-directed learning with mobile technology. For example, students are not always confident about their proficiency levels during online interactions, lack overlap between their social networking friends and language learning partners (Lai & Gu, 2011; Lai, Hu, & Lyu, 2018; Lai & Zheng, 2018), and are afraid of getting incorrect feedback (Lai & Gu, 2011). Due to the variety and hesitation in mobile technology use, an essential question emerges as to which factors drive or hinder university students' use of mobile technology for self-directed language learning outside the classroom. With the answer, the potential measures could be taken to enable students to utilize online resources on mobile technology to sharpen their language skills.

4.1.1 Mobile-assisted language learning

Previous empirical research has been carried out to examine students' acceptance and use of mobile-assisted language learning (MALL) and related factors. Kim and Lee (2016) examined how Korean students used MALL and investigated related factors that potentially affected MALL usage. Their findings revealed that content reliability, perceived enjoyment, perceived usefulness and perceived ease of use had significant effects on students' acceptance of MALL. García Botero, Questier, Cincinnato, He, and Zhu (2018) applied the modified version of the Unified Theory of Acceptance and Use of Technology to examine the factors affecting behavioral intentions and actual use of MALL. Results showed that performance expectancy, social influence, and

facilitating conditions influenced students' attitudes towards using MALL, and behavioral intention had an effect on actual MALL use. In 2020, Hoi (2020) used the same model to understand the acceptance and use of MALL by higher education learners in Vietnam. Results indicated that attitude and performance expectancy predicted learners' behavioral intention and their usage of MALL, and facilitating conditions had no direct effect on learners' MALL usage. In the same year, Sun and Gao (2020) investigated the relationships among intrinsic motivation, critical variables related to technology adoption, and students' behavioral intention in MALL. The authors reported that although intrinsic motivation did not have a direct influence on students' behavioral intention in MALL, it had a positive influence on students' behavioral intention through the two intervening variables, perceived usefulness and task technology fit. Despite these studies used various models to identify the determinants that affected MALL use, most of them did not differentiate specific educational contexts, such as teacher-initiated or student-initiated learning, and in-class or out-of-class learning.

Not all educational settings show similar results in mobile learning integration. A recent meta-analysis study on mobile learning in general found that mobile learning had a higher effect size in informal settings than in formal settings (Sung, Chang, & Liu, 2016). Moreover, Hsu (2013) stated that the teacher-centered educational approach was one of the factors that negatively affected students' attitude toward MALL. Given the effectiveness of informal out-of-class learning and the negative influence of teacher-centered approach, it is important to conduct research specifically on student-initiated self-directed learning outside class. In addition, the research samples in most studies are foreign language-majored learners, which makes conclusions difficultly generalize as - compared to other learners - these learners generally are better at language learning. Consequently, the current study includes students from humanities, social science, natural science and engineering and therefore describes a more general picture of self-directed language learning.

Considering this "less explored territory to date" (An, Wang, Li, Gan, & Li, 2021; Nguyen, & Takashi, 2021; Kukulska-Hulme, 2016: 138), insights into student-initiated and out-of-class MALL use will support students' practice of their self-directed MALL as well as help school managers and teachers to see to what degree students reach their goal and provide potential directions to further cultivate students with self-directed learning ability. In addition, several studies have investigated how different self-regulation skills related to learning behavior in an e-learning environment. Wang (2011), for example, showed that in an e-Learning environment with

Normal Web-based Test (N-WBT), students with a high level of self-regulated learning (SRL) had significantly better learning outcomes, whereas in an e-Learning environment with Peer-Driven Assessment Module of the Web-based Assessment and Test Analysis system (PDA-WATA) no significant difference was found between students with a low level and a high level of SRL in terms of learning effectiveness. In a study on computer-supported collaborative learning (CSCL), Lin, Huang, and Chuang (2015) reported that self-regulation positively influenced learning behavior, along with network centrality (i.e., social network position) in a CSCL environment. Lin, Szu, and Lai (2016) also found that students' learning behavior in different CSCL systems depended on their self-regulation levels. In a study on user-acceptance of computer-based assessment, Lin and Lai (2019) showed that students' behavioral intention significantly predicted their actual behavior for students with high self-regulation skills but not for students with low self-regulation skills. In a study on Massive Open Online Courses (MOOCs), additionally, Jansen, van Leeuwen, Janssen, Conijn & Kester (2020) revealed that the learners who complied with the SRL intervention were more engaged in SRL activities than the learners in the control group who did not receive any intervention. Moreover, self-directed learning with mobile technology is voluntary and therefore it requires students' self-discipline and self-regulation. Hence, in the present study, self-regulation skills are assumed to moderate the relationship between behavioral intention and actual use of using mobile technology in the self-directed learning process.

4.2 Theoretical Background

In order to explain university students' intention towards and use of mobile technology in self-directed language learning, we employed the Integrative Model of Behavior Prediction (IMBP; Fishbein & Ajzen, 2010) as the theoretical model in this study. IMBP evolved from the Theory of Reasoned Action (TRA; Fishbein & Ajzen, 1975) and Theory of Planned Behavior (TPB; Ajzen, 1991). It could be used to investigate the factors that determine a given behavior in any given population in a parsimonious way (Admiraal et al., 2013). IMBP is user-oriented and takes individual psychological processes into account. In this study, the actual behavior, using mobile technology in the self-directed learning process, is up to learners' own choices, which is well suited for this model. The IMBP posits that attitude, perceived norm, and self-efficacy predict intention to engage in particular behavior; intention as well as knowledge and skills and facilitating conditions predicts the actual behavior.

Some researchers have validated IMBP in the educational research (Admiraal et al., 2013; Kreijns, Van Acker, Vermeulen, & van Buuren, 2013; Vermeulen, Kreijns, Van Buuren, & Van Acker, 2017; Wang et al., 2019). However, all of them were conducted in teacher-directed learning. In the current study, IMBP is applied to identify the determinants of university students' use of mobile technology in their self-directed learning process. The proposed research model is indicated in Figure 4.1.

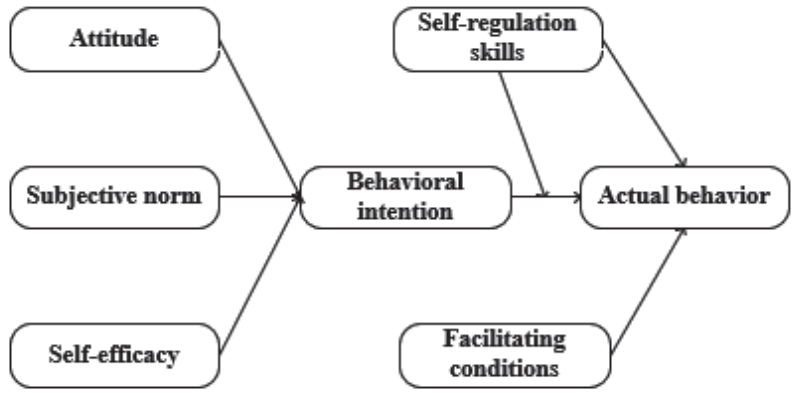

Fig. 4.1. The proposed research model of this study.

4.2.1 Attitude, subjective norm and self-efficacy

Attitude is defined as individuals' feelings about conducting a particular behavior (Ajzen, 1991). It was theorized and empirically proved to have a significant and positive effect on behavioral intention in general domains (Ajzen, 1991; Fred, 1989) and technology-based learning (Chen & Wu, 2020; Chu & Chen, 2016). In the present study, accordingly, it concerns university students' positive or negative perceptions towards using mobile technology when they learn English language in an out-of-class, self-directed way.

Subjective norm is viewed as an individual's perceptions of performing a specific behavior influenced by important persons (Fishbein & Ajzen, 2010). Previous empirical evidence has shown that subjective norm could explain students' intention to use mobile technology (Al-Adwan, Al-Madadha, & Zvirzdinaite, 2018; Cheon, Lee, Crooks, & Song, 2012). However, the study

conducted by Khechine, Raymond, and Augier (2020) indicated that social influence was not significantly related to behavioral intention in the context of social learning system use. Moreover, some researchers stated that the influence of social influence on technology adoption was complex and varied across contexts (Venkatesh, Morris, Davis, & Davis, 2003).

Self-efficacy denotes an individual's confidence in his or her capability to perform a behavior (Ajzen, 1991). Individuals who think that they are proficient in a certain action are inclined to have greater intention towards performing it. According to the studies carried out by Raza, Umer, Qazi, and Makhdoom (2018) and Mohammadi (2015), self-efficacy was found to have a direct effect on behavioral intention in mobile learning.

4.2.2 Behavioral intention, facilitating conditions, self-regulation skills and actual behavior

Behavioral intention refers to the strength of an individual's willingness to perform a particular behavior (Ajzen, 1991). In this study, it represents the degree to which university students are willing to adopt mobile technology to learn languages in an out-of-class, self-directed way. With regard to the relationship between intention to use and actual behavior, studies have shown mixed findings. Many studies reported a positive correlation between behavioral intention and actual behavior (e.g., García Botero et al., 2018; Hoi, 2020), whereas Chu and Chen (2016) revealed that intention only enhanced the time for using e-learning technology and not the frequency.

Facilitating conditions describe the perceived belief that using a new technology could get support from the environment (Taylor & Todd, 1995). This is understood in the mobile technology environment as organizational and technical assistance for students' use of mobile technology for self-directed learning, such as technical support and necessary resources and knowledge. Facilitating conditions have been found to significantly link with actual behavior (Salloum & Shaalan, 2018; Tarhini, Hone, & Liu, 2015).

Self-regulation skills are defined as the ability of individuals to actively regulate their own learning tasks or behaviors from metacognitive, motivational, and behavioral perspective (Zimmerman, 1989; Zimmerman & Schunk, 2001). Self-regulation is important for learners in online learning given its possibilities for self-directed learning (Leejoeiwara, 2013; Stephen, Rockinson-Szapkiw, & Dubay, 2020). Furthermore, as mentioned above, in e-learning environments, self-regulation influenced students' learning behaviors, and students with high self-

regulation skills were more likely to perform learning behaviors compared to those with low self-regulation skills (Lin et al., 2015; Lin & Lai, 2019; Lin et al., 2016).

Actual behavior refers to the actual adoption of mobile technology in self-directed language learning.

4.2.3 This study

As discussed above, the aim of this research is to investigate the factors that influence university students' intention towards and actual use of mobile technology in self-directed language learning outside class. The findings may support self-directed learners and teacher educators to enhance students' technology use for autonomous language learning.

More specifically, we address the following research questions:

(1) To what extent do attitude, subjective norm and self-efficacy relate to university students' behavioral intention toward using mobile technology in self-directed learning?
(2) To what extent do behavioral intention, facilitating conditions and self-regulation skills relate to university students' actual use of mobile technology in self-directed learning?
(3) To what extent do self-regulation skills moderate the relationship between behavioral intention and actual use of mobile technology in self-directed learning?

4.3 Method

4.3.1 Participants

Participants in this study were students from various disciplines in Chinese universities who learned English in a self-directed way. We selected the eligible students by the first item of the questionnaire ("Have you ever learned English language by yourself on your own choice?"). The study adopted a convenient sampling method to collect data with an online survey. In order to encourage participants to respond openly and honestly, the online survey used an anonymous link from Qualtrics. To recruit participants, a hyperlink was distributed via social media tools such as WeChat and QQ to students among many universities from the network of the first author. The hyperlink was also sent to university teachers educators to be included in their WeChat groups and QQ groups with university students. Completing the questionnaire took about 8-10 minutes. Students were informed about the aim of questionnaire and how their data would be used, and gave

their consent at the end of the questionnaire. Research clearance was obtained from the ethics committee of ICLON Research Ethics Committee.

The data collection period lasted from December 3rd to December 30th, 2020. A total of 676 returned the completed questionnaires. Among the 676 completed questionnaires, 425 (62.9%) indicated that they had the experience of self-studying English of their own volition, 5–20 times the number of parameters (i.e., variables and hypothesized relationships) to be estimated (Kline, 2005). The demographic data of the participants are shown in Table 4.1.

Table 4.1 Demographic statistics of participants (N=425).

Measures	Items	Frequency	Percentage (%)
Gender	Male	76	17.88
	Female	349	82.12
Age	<18	5	1.18
	18-25	374	88.00
	>25	46	10.82
Educational level	Undergraduate	215	50.59
	Postgraduate	210	49.41
Discipline	Social science and humanities	374	88.00
	Natural science	51	12.00
Location of university	Eastern China	167	39.29
	Middle China	149	35.06
	Western China	109	25.65
Level of university	Project 985	40	9.41
	Project 211	177	41.65
	Ordinary universities	208	48.94

Note. "Project 985" refers to the first-class universities in China. "Project 211" refers to the second-class universities in China. Ordinary universities refer to the universities which do not belong to "Project 985" or "Project 211".

4.3.2 Instruments

The questionnaire was divided into three parts. In Part 1, we collected demographic information (i.e., gender, age, current university location, educational level, and discipline), and asked a screening question whether students ever learned English language by themselves (as explained earlier in section 3.1) and, if they had done so, a multiple-selection question about the reasons why they chose to learn English by themselves. Part 2 involved the subscale related to self-regulation skills. Part 3 began with a multiple-selection question regarding the activities that students had participated in when using mobile technology to self-study English language in order to help them recall relevant learning experiences. This was followed by subscales pertaining to attitude, subjective norm, self-efficacy, facilitating conditions, behavioral intention and actual behavior (Table 4.2). All items had the statement "When self-studying English language" as the stem. All the items were scored on a 5-point Likert scale, ranging from strongly disagree to strongly agree, or never to always.

All the subscales were from previous related studies. The draft questionnaire was pilot tested with thirteen university students in China to collect feedback on the instrument. Based on their feedback, some items were modified, as demonstrated in Appendix E.

Table 4.2 Descriptions and sources of variables.

Variables	Abbr.	Descriptions	Items	Source
Actual behavior	AB	The dependent variable, frequency of mobile technology use for self-directed learning.	9	Lai, Wang, and Lei (2012)
Behavioral intention	BI	The degree to which language learners intend to continue using mobile technology in self-directed learning.	3	Moon and Kim (2001)
Attitude	ATT	Language learners' feelings about using mobile technology in self-directed learning.	4	Taylor and Todd (1995)
Self-efficacy	SE	Language learners' perceptions of their abilities to use mobile technology to support their self-directed learning.	3	Cheon et al. (2012)
Self-regulation skills	SRL	Language learners' perceived self-regulation skills to support using mobile technology in self-directed learning.	4	Lai and Gu (2011)
Facilitating conditions	FC	Students' perceived availability of support from the learning environment that facilitates technology adoption.	4	Nikou and Economides (2017)
Subjective norm	SN	The degree to which an individual perceives whether teachers and classmates believe he or she should use mobile technology in self-directed learning.	3	Cheon et al. (2012)

4.3.3 Data analysis

Structural equation modeling (SEM) with Mplus 8.3 (Muthén & Muthén, 2017) was employed in this study to analyze the data.

Firstly, the measurement model (also known as confirmatory factor analysis model) was estimated to describe how well the observed indicators measured the latent constructs. In this step, we obtained factor loadings, Cronbach's alpha, Composite Reliability (CR), Average Variance Extracted (AVE) (Fornell & Larcker, 1981), and inter-construct correlations to describe the reliability and validity of each construct.

Secondly, the structure model was performed to validate the strength of the relationships among the latent variables. The model fit was assessed by several key goodness-of-fit indices suggested (Hair, Black, Babin, Anderson, & Tatham, 2006; Kline, 2016). If the ratio of Chi-Square (χ^2) to its Degree of Freedom (χ^2/df) is smaller than 3, this is regarded as an acceptable fit (Schumacker & Lomax, 2012). The values of Tucker-Lewis Index (TLI) and Comparative Fit Index (CFI) greater than 0.90 exhibit a good fit for the structural model (Kline, 2005). Moreover, the values of Standardized Root Mean Square Residual (SRMR) and Root Mean Square Error of Approximation (RMSEA) less than 0.08 represent an acceptable model fit (Steiger, 2007).

Finally, the construct of self-regulation skills was tested as a moderator. Using the method of Baron and Kenny (1986), the moderating effect of self-regulation skills was tested in the relationships between behavioral intention and actual behavior.

4.4 Results

4.4.1 Descriptive statistics

Regarding the reasons why they learn English autonomously (see Table 4.3), over 50% of participants learned English in a self-directed way for passing language tests and getting better work or study opportunities in the future. In addition, in the option of "Others", two participants indicated that they conducted self-directed English learning because they wanted to improve their poor basic language ability.

Table 4.3 Reasons that students learned English language and the percentages.

Reasons	Frequency	Percentage
English language is my major, so I have to.	184	43.20
Passing English Language tests (IELTS, TOEFL, CET, TEM and so on).	309	72.70
Being good for getting better working or studying opportunities in the future.	233	54.80
Being interested in English language and culture.	207	48.70
Others	12	2.80

Regarding the activities that they participated in (see Table 4.4), most participants used mobile technology to learn vocabulary and translate, compared to practicing listening, speaking, reading, writing and other activities.

Table 4.3 Activities that students participated in.

Activities	Frequency	Percentage
Learn vocabulary (Like Baicizhan, Shanbei, etc.).	386	90.80
Translate (Like Youdao Dictionary, Baidu dictionary, etc.).	352	82.80
Practice listening (Like Shanbei Listening, Zhimi Listening, etc.).	287	67.50
Practice speaking (Like English Qupeiyin, English Liulishuo, etc.).	238	56.00
Practice reading (Like 21 Century News, etc.).	214	50.40
Practice writing (Grammarly, iwrite, etc.).	149	35.10
Other activities (Like TED, Wangyiyun, etc.).	241	56.70

4.4.2 Measurement model

The measurement model, which included six latent constructs, was validated by confirmatory factor analysis (CFA). All the constructs were evaluated by examining the reliabilities, convergent and discriminant validities.

Table 4.5 showed the results of the measurement model. All the item factor loadings ranged from 0.653 to 0.894. Facilitating conditions were deleted because only two item factor loadings were greater than 0.6, and it was not followed the three-indicator rule in SEM. The recommended cut-off levels for AVE, CR and Cronbach's alpha were 0.50, 0.70 and 0.70, respectively (Fornell & Larcker, 1981; Hair et al., 2006). In this study, the composite reliability (CR) of all constructs was larger than 0.70, indicating good reliabilities. All the Cronbach's values were larger than 0.70, indicating all constructs had appropriate internal consistency. Moreover, the average variance extracted (AVE) values were above 0.50, except for one construct (self-regulation skills). However, according to Fornell and Larcker (1981), the convergent validity of a construct is still adequate if AVE is less than 0.50, but composite reliability is higher than 0.60. Thus, the convergent validity of self-regulation skills was acceptable because the composite reliability was 0.763, although its AVE was 0.447.

Discriminant validity was found when the square root of the AVE of each construct was higher than its correlation coefficients with other constructs (Fornell & Larcker, 1981). In this study, as shown in Table 4.6, the square roots of the AVEs exceeded its correlation coefficients with other constructs, justifying discriminant validity.

Table 4.5 Reliability and convergent validity.

Construct	Items	Parameters of significant test				Item reliability	Composite reliability (CR)	Convergence validity (AVE)	Cronbach's alpha
		Estimate	S.E.	Est./S.E.	P-Value				
ATT	ATT1	0.765	0.027	28.752	***	0.585	0.872	0.632	0.874
	ATT2	0.846	0.017	48.737	***	0.716			
	ATT3	0.815	0.023	35.701	***	0.664			
	ATT4	0.749	0.027	28.235	***	0.561			
SE	SE1	0.827	0.024	34.064	***	0.684	0.849	0.654	0.844
	SE2	0.719	0.031	22.998	***	0.517			
	SE3	0.872	0.021	41.699	***	0.760			
SN	SN1	0.802	0.021	38.804	***	0.643	0.802	0.576	0.793
	SN2	0.681	0.037	18.531	***	0.464			
	SN3	0.788	0.024	32.217	***	0.621			
SRL	SRL1	0.661	0.042	15.672	***	0.437	0.763	0.447	0.760
	SRL2	0.653	0.041	15.812	***	0.426			
	SRL3	0.683	0.033	20.486	***	0.466			
	SRL4	0.676	0.035	19.245	***	0.457			
BI	BI1	0.832	0.024	34.488	***	0.692	0.881	0.712	0.874
	BI2	0.894	0.016	54.617	***	0.799			
	BI3	0.803	0.024	34.027	***	0.645			
AB	AB1	0.679	0.035	19.600	***	0.461	0.912	0.535	0.910
	AB2	0.790	0.022	35.465	***	0.624			
	AB3	0.756	0.025	30.324	***	0.572			
	AB4	0.682	0.034	20.205	***	0.465			
	AB5	0.734	0.025	28.997	***	0.539			
	AB6	0.654	0.032	20.680	***	0.428			
	AB7	0.788	0.023	33.784	***	0.621			
	AB8	0.717	0.026	27.942	***	0.514			
	AB9	0.769	0.026	30.091	***	0.591			

Note. ***$p < 0.001$.

Table 4.6 Discriminant validity.

Construct	AB	BI	ATT	SE	SN	SRL
AB	0.730					
BI	0.581	0.840				
ATT	0.496	0.748	0.795			
SE	0.394	0.486	0.571	0.808		
SN	0.446	0.683	0.741	0.580	0.759	
SRL	0.417	0.332	0.433	0.345	0.343	0.669

Note. Diagonal elements are the square root of the average variance extracted.

4.4.3 Structural model

All the constructs except facilitating conditions were further used in the structural model to examine their relationships. The fit indices of this model indicated good fit to the data, shown in Table 4.7.

The results, shown in Table 4.8 and Figure 4.2, demonstrated that the model explained 75.3% of the variance in behavioral intention and 54.2% of the variance in actual use of mobile technology. Table 8 also showed that attitude (β=0.731, $p < 0.001$) and subjective norm (β=0.217, $p < 0.05$) were positively related to behavioral intention. In addition, behavioral intention (β=0.562, $p < 0.001$) and self-regulation skills (β=0.282, $p < 0.001$) positively and significantly predicted actual behavior. No significant relationship was found between self-efficacy and behavioral intention.

Table 4.7 Model fit.

Index	Criteria	Research Model	Yes or No
MLχ^2	Smaller is better	846.778	-
df	Larger is better	288	-
χ^2/df	$1< \chi^2/df<3$	2.940	YES
CFI	>0.9	0.914	YES
TLI	>0.9	0.903	YES
RMSEA	<0.08	0.068	YES
SRMR	<0.08	0.047	YES

Note. ML=Maximum Likelihood.

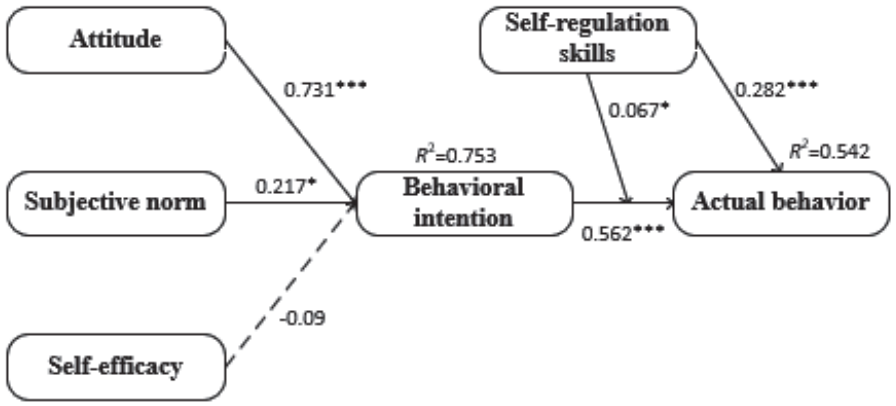

Fig. 4.2. Results of structural equation modeling.

4.4.4 Moderation analysis

The results in Table 4.8 showed that the interaction term (behavioral intention × self-regulation skills) ($\beta = 0.067$, $p < 0.05$) had a significant effect on usage behavior of mobile technology. Self-regulation skills significantly and positively moderated the relationship between behavioral intention and actual use of mobile technology in the self-directed learning process. This means the higher the students' self-regulation skills were, the stronger the relationship between students' intention and actual use of mobile technology.

Table 4.8 Path coefficients.

Path	Estimate	S.E.	Est./S.E.	P-Value
ATT→BI	0.731	0.129	5.667	***
SN→BI	0.217	0.126	1.715	*
SE→BI	-0.090	0.060	-1.513	-
BI→AB	0.562	0.054	10.436	***
SRL→AB	0.282	0.065	4.361	***
SRLBI→AB	0.067	0.032	-2.035	*

Note. ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

4.5 Discussion

4.5.1 Learners' use and motivation

Of all respondents of the questionnaire, 37.1 percent indicated that they never used mobile technology for self-directed language learning. The reasons can be clustered into two types. First, regarding mobile technology, they do not perceive it as an effective tool to support them in out-of-class learning because they are distracted by the prompts of social media applications (Kacetl & Klímová, 2019; Wilmer, Sherman, & Chein, 2017). Second, they do not conduct self-directed learning because they probably do not see the value of this kind of learning or lack self-directed abilities to guide themselves for effective learning. Further research needs to examine students' motivation for self-directed language learning with mobile technology.

Although many university students had engaged in out-of-class self-directed language learning, the majority of them seemed to be extrinsically motivated. This is similar to the finding of Zhang and Pérez-Paredes (2019), indicating that passing exams and improving exam scores were the main reasons for using mobile resources, even for postgraduates. Cheng and Lee (2018) revealed that extrinsic motives were conducive to initiating students' interest in language learning, but detrimental to sustaining their interest. More importantly, external motivation for engaging in a behavior would possibly decrease their intrinsic motivation for this behavior (Deci, 1971; Harackiewicz, 1979). In other words, if students perceive that external incentives are the main cause of their actions, they may feel controlled and thus the intrinsic motivation may be undermined (Li, Sheldon, & Liu, 2015). Furthermore, considering the result of Cheng and Lee (2018) that self-directed learners often suffer from losing motivation and give up, extrinsically motivated self-directed learners are more likely to quit in the course of learning. On the contrary, if students perceive that their behavior is caused by their personal desires and interests, then they may tend to enjoy this behavior (See also Li, Sheldon, & Liu, 2015), and they are more persistent (Hart, 2012; Parker, 2003). Additionally, language learning is critically gradual and developmental, which means it is not learnt in day or two, but in years, and demands long-time persistence for competence acquisition (Fryer, 2019). Thus, in order to enable students to persist in self-directed learning and acquire language development successfully, it is critically important that their intrinsic motivation be cultivated.

In addition, learning activities regarding vocabulary acquisition and translation were far more reported than those targeting listening, speaking, reading and writing. This is in line with the

findings of Zhang and Pérez-Paredes (2019) and Steel (2012), who reported that Chinese and Australian language learners were heavily engaged in vocabulary acquisition. A possible explanation could be that Chinese learners believe that a large amount of vocabulary is the basis for effective speaking, listening, reading and writing (Zhang & Pérez-Paredes, 2019). Another possibility may be that in terms of targeted language areas of MALL applications, vocabulary teaching and learning have been the mainstay (Burston, 2014).

4.5.2 Factors related to behavioral intention

The primary purpose of this research is to understand the factors that affect university students' intention towards and actual use of mobile technology in their self-directed language learning process. Attitude towards mobile technology had the most predictive power on students' behavioral intention. This coincides with previous research conducted in Vietnam, showing that attitude toward mobile-assisted language learning was found to be the most powerful predictor of learners' behavioral intention (Hoi, 2020). Self-directed learning is learner-controlled and usually occurs out of class. Learners are responsible for selecting the appropriate learning tools (e.g., mobile technology) and learning materials to learn (Garrison, 1997). It makes sense that attitudes and beliefs greatly contribute to students' intention towards using mobile technology in self-directed learning process.

The relationship between subjective norm and behavioral intention was positive and significant as well, which aligns with the results of Unal and Uzun (2021) and Chang, Hajiyev, and Su (2017). However, Hartwick and Barki (1994) reported that the opinions of others played no significant role in voluntary settings, only in mandatory ones. Except for the moderating effect of contexts on the relationship between subjective norm and behavioral intention (Venkatesh et al., 2003), Srite (2006) proposed that different cultures also influenced the relationship between them. In individualistic cultures, for example, subjective norm had a weak effect on behavioral intention, whereas in collective cultures, like China, interaction between social members is an essential way of information transmission and people care more about their interpersonal relationships (Srite, 2006; Zhao, Wang, Li, Zhou, & Li, 2021). Although how to conduct self-directed learning completely depends on learners' own choices, in this collective environment they are still affected by teachers and peers in that they want to maintain good rapport with and receive support from them. If so, in

the subsequent learning process, self-directed learners will likely get help from teachers when necessary and study with their peers to motivate each other.

Unexpectedly, self-efficacy was not significantly related to behavioral intention, which contradicts previous studies that suggested a significant effect of self-efficacy on behavioral intention (Buabeng-Andoh, 2021; Park, 2009; Venkatesh & Davis, 1996). Cigdem and Ozturk (2016) asserted that as a result of widespread Internet access and technology across the educational settings, today' s learners are digital natives and they enter universities with abundant knowledge and experiences of mobile technology. This means that variance in self-efficacy might be limited, which may explain why self-efficacy did not predict behavioral intention to use mobile technology.

4.5.3 Factors related to actual use

The relationship between behavioral intention and actual behavior in using mobile technology was positive and significant. This outcome is also confirmed in previous studies (Hoi, 2020; Nie et al., 2020), which revealed that behavioral intention was significantly correlated with actual behavior. Self-regulation skills also predicted actual behavior, which accords with the finding of a previous study by Wang et al. (2019), who determined that rural teachers' professional knowledge and skills were significantly related to their behaviors of using the digital educational resources.

4.5.4 Moderation analysis of self-regulation skills

A significant finding lies in the significant and positive moderation effect of self-regulation skills on the relationship between intention and behavior. This signifies that the effect of behavioral intention on actual behavior would increase with an increase in self-regulation skills. In other words, students with higher self-regulation skills are more likely to transform their behavioral intention into actual behavior than those with lower self-regulation skills. Similarly, Lin and Lai (2019) revealed that behavioral intention significantly predicted computer-based assessment use behavior for high-self-regulation students but not for low-self-regulation students. Apparently, students with higher self-regulation skills have better abilities to regulate their behavior, cognition and motivation, all of which are conducive to engaging and persisting in learning (Nicol & Macfarlane-Dick, 2006).

4.6 Limitations and future research

This research has some limitations, although it has provided valuable contributions to the determinants that affect technology use in self-directed language learning outside class. Firstly, the data collection of this study was completed in a short period of time. Students' attitudes and behaviors are changing over time, along with the accumulation of new knowledge and experience. Longitudinal research may be designed to exploit these changing factors at different points and see whether other variables such as foreign language competence, prior experience and satisfaction with language learning using mobile technology affect students' continuance use of mobile technology. Secondly, previous studies have indicated differences between self-reported usage scales and technology-recorded scales (Straub, Limayem, & Karahanna-Evaristo, 1995). This study used self-perceived usage scales to obtain students' actual behavior, which might lead to bias due to subjectivity. Future research is encouraged to use technology-recorded data to analyze students' actual usage. Thirdly, all the participants were native Chinese-speaking English language learners. Future studies could also be conducted in other cultural contexts to examine the self-directed language learning with mobile technology and investigate the effect of foreign language proficiency and other environmental variables on self-directed technology use as well.

Furthermore, various categories of mobile apps for educational purposes have been put into use. Future research should focus on specific technology (e.g., social media) to determine how students utilize them in their self-directed learning outside class. Finally, future research can also examine how teachers can assist students in their self-directed language learning process.

4.7 Conclusion and implications

The main objective of this research was to explore the relationships between attitude, subjective norm, self-efficacy and intention, as well as the association between intention, facilitating conditions, self-regulation skills and actual use of mobile technology in self-directed language learning among university students. Additionally, it also aimed to answer the question whether self-regulation skills moderated intention and actual use of mobile technology. Attitude and subjective norm significantly explained students' intention to use mobile technology, but self-efficacy was not related to students' intention. Moreover, self-regulation skills and intention had positive relationships with students' actual use of mobile technology. Finally, self-regulation skills significantly moderated the relationship between behavioral intention and actual behavior.

The findings of this study make several contributions to this field. First of all, this study investigated the technology use of students from various disciplines in the self-directed informal context, a setting that has not been sufficiently studied so far (An, Wang, Li, Gan, & Li, 2021; Nguyen, & Takashi, 2021; Kukulska-Hulme, 2016, p.138). Secondly, the findings supported the use of IMBP model as an appropriate framework for examining the acceptance and use of mobile technology, which has not been extensively adopted in research on student learning. Although the relationship between self-efficacy and intention was not significant, a good explanatory effect of IMBP was suggested in the context of technology adoption. Thirdly, a nonsignificant relationship between self-efficacy and intention also further confirmed the results of Cigdem and Ozturk (2016), revealing the insignificant role of self-efficacy on students' behavioral intention in collective cultures. More empirical evidence is needed on this variable in technology adoption.

This research also provides practical implications to promote university students' use of mobile technology in self-directed language learning. Based on the positive effect of subjective norm, it is suggested that teachers discuss with students the role and importance of self-directed learning facilitated by mobile technologies. Software developers could emphasize the function of learning community to increase students' learning intention, further maintaining their learning interest. Additionally, based on the result of moderation analysis, students could improve their self-regulation skills before starting self-directed learning to foster their use of mobile technology in self-directed language learning out of class. Educational institutions also need to pay more attention on cultivating students' self-regulation skills to facilitate their self-directed, lifelong learning.