Understanding factors influencing EFL students' technology-based self-directed learning

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Abstract

Based on the theories of self-directed learning, technology acceptance model (TAM) and the theory of planned behavior (TPB), this study constructed a model of predictors of English as a Foreign Language (EFL) students' technology-based self-directed learning. Through a questionnaire survey of 386 EFL students from a Chinese university and structural equation model analysis, this study intended to identify the factors that influence the students' use of technology for language learning and the relationship between these factors. The results revealed that attitude towards technology use, perceived usefulness and technological facilitating conditions are the dominant predictors of technology-based self-directed learning, whereas technological complexity had no direct impact on technology-based self-directed learning, but played an intermediary role through attitude towards technology use. Subjective norms had less predicative power on technology-based self-directed learning. The findings suggest improving students' perception of the usefulness of technology in learning, enhancing students' attitude towards technology use and constructing convenient technological facilitating conditions.

Keywords: *self-directed learning; technology acceptance; influencing factors; empirical research*

1. Introduction

With the development of network technology, diverse learning approaches, such as online learning, e-learning and other informal learning, expand students' learning time and space (Reinders & White, 2011). Those new ways of learning usually do not rely on the classroom, characterized with relatively flexible learning structures and learners' self-directed learning according to their own interests and needs. Benson & Reinders (2011) believed that the individual learning space constructed by modern technology focuses on the connection of learner-centered professional knowledge with learning environments. Through the association of learning networks in different learning situations, and the effective integration from bottom to top by learners, the free scheduling of learners can be realized and self-directed learning activities can be achieved in the distributed learning environments. As a new research direction, technology-based learning space is constructed on the basis of technology development in order to realize learners' autonomous, flexible and committed learning (Reinders & Darasawang, 2012). However, the existing research mainly discusses on how to use technology to share resources, construct learning situations, and interact socially (Jones, 2011). There are few studies on the impact of technology on English as a Foreign Language (EFL) students' self-directed learning and its mechanism. Relevant studies have pointed out that EFL learning supported by technology highlights the key role of self-directed learning (Peng & Woodrow, 2010). Therefore, this study aimed to explore the influencing factors of technology-based self-directed learning.

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2. Literature review

2.1. Self-directed learning

In the 1980s, Henry Holec put forward the term "autonomy" and introduced it into the study of foreign language learning. According to Holec (1981), autonomy was regarded as "the ability to take charge of one's learning" and as "an ability or a capacity that needs to be acquired", rather than a process (p.3). The initial research on autonomous learning mainly focused on learners' self-control ability, autonomous learning behavior and self-directed learning process (Dickinson, 1995). In the educational landscape, autonomous learning was quite often labeled and described as self-directed learning. Garrison (1997) described self-directed learning as "an approach where learners are motivated to assume personal responsibility and collaborative control of the cognitive (self-monitoring) and contextual (self-management) processes in constructing and confirming meaningful and worthwhile learning outcomes" (p. 18). Later, some scholars (such as Ryan & Deci, 2000; Reeve & Jang, 2006; Niemiec & Ryan, 2009; Reeve, 2013) introduced educational psychology, cognitive psychology, motivation theory and so on into the study of self-directed learning, thus the research on self-directed foreign language learning has entered a stage of vigorous development.

Based on the current situation of foreign language learning in China, Shu & Zhuang (2008) put forward three major elements of self-directed foreign language learning: 1) attitude, that is, learners are responsible for their own learning and actively participate in learning; 2) competence, which means that learners have the ability and learning strategies to independently complete learning tasks; and 3) environment, which means that learners should be given a lot of opportunities to conduct empirical practice and be responsible for their own learning process, and meanwhile the external environment is the guarantee of cultivating learners' autonomous learning attitude and ability. The external environment is changing with the social development. For example, with the development of computer network technology, computer-aided technology has been widely used in the process of self-directed foreign language learning (Ayan, 2015). The research on self-directed foreign language learning by using information technology and the Internet (such as MOOC and micro class) has also received great attention (Hubackova, Semradova, & Klimova, 2011; Giesbers et al., 2014). The objective factor of intelligent learning space was considered as a dominant predictor of technology-based self-directed learning. The influence of intelligent educational environment on EFL students' self-directed learning was explored (Lai, 2013), but few researches were conducted from the perspective of learners' acceptance of technology. Therefore, it is necessary to analyze the influencing factors of students' self-directed foreign language learning, and formulate corresponding strategies for cultivating students' self-directed learning ability around these factors.

2.2. TAM and TPB

Based on the theory of reasoned action (TRA) first proposed by Fishbein and Ajzen in 1975, Davis (1989) advanced technology acceptance model (TAM). According to TAM, people's beliefs and attitudes are connected with their intention to perform a behavior. Perceived usefulness and perceived ease of use constitute the primary predictors of users' attitude toward technology usage. Attitude toward use is posited to influence intention to use, which in turn influences actual usage behavior (Teo & Van Schaik, 2012). Venkatesh, Morris, Davis & Davis (2003) extended the original technology acceptance model with empirical research by adding such factors as social influence, cognitive structure, and experience, and the factor of subjective norm that had not been adopted in the original TAM. Grounded on this theory and analysis method, some studies were

conducted to verify the intention of students' technology use (Teo, 2011), and interpret the students' independent use of technology for language learning (Lai, 2013), etc. These studies are the concrete applications of TAM in empirical research.

For many years, Fishbein and Ajzen's theory of reasoned action (TRA) has been conceived as one of the intentional behavior models for the study of human behavior related to information technology. In TRA, the two driving antecedents are attitude towards the behavior and subjective norms. Furthermore, Ajzen expanded the explanatory power of TRA in 1991, by adding a new construct of perceived behavioral control, which developed into the theory of planned behavior (TPB). TPB contains five factors: attitude, subjective norm, perceived behavioral control, behavioral intention and behavior. In the context of technology-based behavior, several meta-analyses have found a good correlation between individual's perceived behavioral control and the usefulness of specific technology, which is considered as the major predictor of the intention of using the technology (Teo, 2009; Teo & Van Schaik, 2012).

Based on the above theoretical foundations, this study hypothesized five factors that influence technology-based self-directed learning: Perceived Usefulness, Attitude towards Technology Use, Technological Facilitating Conditions, Technological Complexity, Subjective Norms, and thus an empirical research was conducted.

3. Methods

3.1. Questionnaire

In this study, questionnaire was employed to collect data, and Amos 21.0 was adopted for data analysis.

3.1.1. Test of reliability and validity

A survey questionnaire was developed using items that were validated from previous studies (e.g., Lai, Wang, & Lei, 2012; Teo, 2009) with some items partly adjusted in relation to the real educational settings. In the questionnaire, participants provided their demographic information and responded to 22 items (see Table 1) on the six constructs in this study. These items include Perceived Usefulness (5 items), Attitude towards Technology Use (3 items), Technological Facilitating Conditions (3 items), Technological complexity (3 items), Subjective Norms (3 items), Technology-based Self-directed Learning (5 items). A 6-point Likert scale was used for the questionnaire items, ranging from 1 (strongly disagree) to 6 (strongly agree). Table 1 demonstrated that the standardized factor loadings of the 22 items range from 0.806 to 0.933, and the Cronbach's alpha values of 6 measures range from 0.825 to 0.896. In addition, the Cronbach's alpha value of the overall questionnaire is 0.937, and the KMO value for validity is 0.918, indicating that the questionnaire had a good reliability and validity.

3.1.2 Data collection

The hard-copy questionnaire was used to randomly choose EFL students in the authors' school for survey. At intervals before class, the questionnaire was distributed, answered in the classroom and recycled immediately. A total of 405 questionnaires were distributed. After discarding 19 incompleted questionnaires, 386 valid questionnaires were collected, with an effective rate of 95.31%. In order to eliminate respondents' misgiving and ensure the credibility of the research data collection, the questionnaire was conducted anonymously.

3.2 Method of data analysis

In this study, structural equation modeling (SEM) was adopted by using Amos 21.0 with a variance-covariance matrix as input and maximum likelihood as the method for estimation, and a two-stage approach to data analysis was adopted (Anderson & Gerbing, 1988). Firstly, the measurement model was tested to ensure its quality and validity. Secondly, the structural model was analyzed to specifically examine the relationship among constructs.

4. Results

4.1 Test of the measurement model

Confirmatory factor analysis (CFA) was used to assess the quality of the measurement model. Firstly, to assess the convergent validities, the reliability of each item was tested through its factor loading, construct reliability was examined by the Cronbach's alpha, and average variance extracted (AVE), t-value (C.R.>2) and S.E. value (>0) of parameter estimation were calculated. Teo & van Schaik (2012) suggested that the standardized factor loadings should exceed 0.7, and average variance extracted (AVE) by each construct should exceed 0.50. Table 1 indicated that this measurement model established the convergent validity. Secondly, to assess the discriminant validity, the square root of AVE for each construct was tested. "If the square root of the AVE of a construct was greater than the off-diagonal elements in the corresponding rows and columns, this suggests that a construct is more strongly correlated with its indicators than with the other constructs in the model thus suggesting the presence of discriminant validity" (Teo, 2011, p. 2436). Table 2 demonstrated that this measurement model established the discriminant validity, as the square root of AVE (shown in parentheses along the diagonal) of each construct is higher (0.831 to 0.900) than corresponding correlation values for that variable in all cases. In addition, CFA was conducted to test the fitness of the measurement model, finding a good fit (χ^2/df=2.996; TLI=0.916; CFI=0.930; RMSEA=0.072; SRMR=0.053).

4.2 The test and modification of the hypothesis model

This study adopted Amos 21.0 to test the hypothesis model about factors influencing Chinese EFL students' technology-based self-directed learning, and modify the hypothesis model according to preliminary test results. The verification results showed that the unrevised hypothesis model, which contained the path of technological complexity→technology-based self-directed learning, involved χ^2/df =4.191, SRMR=0.017, RMSEA=0.098 ($>$0.08), TLI=0.992, CIF=0.987 and the standardized path coefficient=0.030, SE=0.034, CR=0.700 ($<$2), *P*=0.484 ($>$0.05), indicating that technological complexity has no significant impact on technology-based self-directed learning, so this path was deleted and the modified model was tested again.

Table 3 demonstrated that the modified structural equation model (Figure 1) has a better fit, with the standardized path coefficient$<$1, S.E. value$>$0, and the C.R. critical value$>$2. Except for the paths of technological complexity→perceived usefulness and subjective norm→technology-based self-directed learning, the *P*-value is significant at the level of 0.001, indicating parameters of the structural model are significant. Specifically, technological facilitating conditions have a significant positive impact on perceived usefulness, attitude towards technology use and technology-based self-directed learning (*P*<0.001); technological complexity has a significant positive impact on attitude towards technology use (*P*<0.001); perceived usefulness has a significant positive impact on attitude towards technology use and technology-based self-directed learning (*P*<0.001); attitude towards technology use has a significant positive impact on

technology-based self-directed learning; there was no significant positive effect of technological complexity on perceived usefulness (P=0.051>0.05); there was no significant positive effect of subjective norms on technology-based self-directed learning (P=0.079 > 0.05).

Table 1. Measures of convergent and discriminant validities of the measurement model

Item	UFL	SFL	SE	CR	R²	AVE	α
Perceived Usefulness						0.695	0.887
PU1	1.000	0.848	---	---	0.653		
PU2	1.031	0.864	0.056	18.287	0.697		
PU3	1.103	0.795	0.072	15.288	0.527		
PU4	1.036	0.858	0.058	17.816	0.669		
PU5	0.959	0.802	0.060	15.904	0.561		
Attitude towards technology use						0.690	0.874
ATU1	1.000	0.799	---	---	0.446		
ATU2	1.289	0.849	0.105	12.295	0.539		
ATU3	1.296	0.843	0.100	13.027	0.627		
Technological facilitating conditions						0.795	0.868
TFC1	1.000	0.821	---	---	0.487		
TFC2	1.235	0.921	0.075	16.560	0.821		
TFC3	1.233	0.929	0.074	16.602	0.828		
Technological complexity						0.810	0.877
TC1	1.000	0.897	---	---	0.731		
TC2	1.068	0.935	0.048	22.049	0.856		
TC3	1.035	0.867	0.059	17.680	0.587		
Subjective norm						0.747	0.825
SN1	1.000	0.863	---	---	0.616		
SN2	1.071	0.886	0.067	15.945	0.717		
SN3	1.124	0.844	0.079	14.216	0.540		
Technology-based self-directed learning						0.707	0.896
TSL1	1.000	0.821	---	---	0.612		
TSL2	1.048	0.851	0.060	17.399	0.676		
TSL3	1.101	0.851	0.064	17.119	0.658		
TSL4	1.048	0.841	0.064	16.289	0.607		
TSL5	1.021	0.839	0.062	16.381	0.613		

Note. Parameter fixed at 1.0 in the original solution. UFL= unstandardized factor loading; SFL= standardized factor loading; CR= critical ratio; AVE= average variance extracted= $(\sum \lambda 2)/n$.

Table 2. Results for the test of discriminant validity

	PU	ATU	TFC	TC	SN	TSL
PU	(0.833)					
ATU	0.566	(0.831)				
TFC	0.503	0.623	(0.892)			
TC	0.311	0.521	0.450	(0.900)		
SN	0.371	0.447	0.579	0.457	(0.864)	
TSL	0.600	0.689	0.626	0.447	0.454	(0.841)

Note. All correlation coefficients significant at p<.01. Diagonal in parentheses: square root of average variance extracted from observed variables (items). Off-diagonal values: Pearson's correlation between constructs. PU= Perceived Usefulness; ATU= Attitude towards Technology Use; TFC= Technological Facilitating Conditions; TC= Technological Complexity; SN= Subjective Norm; TSL= Technology-based Self-directed Learning.
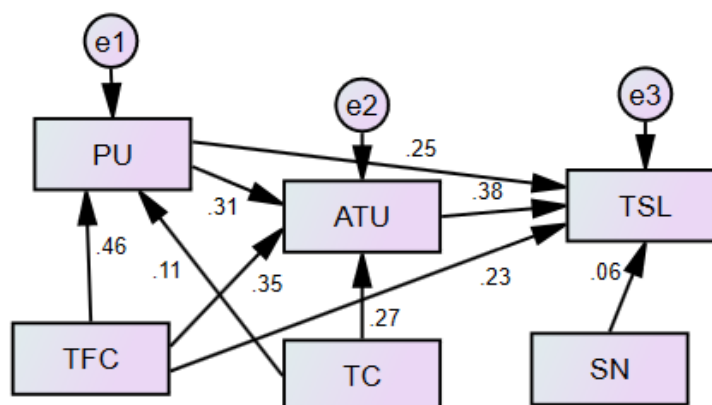
Figure 1. The Structural Equation Model of technology-based self-directed learning

Table 3. Testing results of the modified hypothesis model

Path	Path Coefficient	S.E.	C.R.	P
TFC→PU	0.455	0.043	9.282	***
TC→PU	0.106	0.039	2.167	0.051
PU→ATU	0.308	0.042	7.579	***
TC→ATU	0.269	0.032	6.850	***
TFC→ATU	0.347	0.039	8.037	***
PU→TSL	0.250	0.040	5.993	***
ATU→TSL	0.383	0.044	8.229	***
SN→TSL	0.061	0.029	1.759	0.079
TFC→TSL	0.234	0.037	5.324	***

Note：*** < 0.001; Path Coefficient= Standardized path coefficient. PU= Perceived Usefulness; ATU= Attitude towards Technology Use; TFC= Technological Facilitating Conditions; TC= Technological Complexity; SN= Subjective Norm; TSL= Technology-based Self-directed Learning.

In addition, this study used chi square freedom ratio (χ^2/df), root mean square residual (SRMR), approximate error root mean square (RMSEA), comparative fit index (CFI) and Tucker Lewis index (TLI) to observe the modified hypothesis model. Hair et al. (2010) suggested that a good fit of the model was reflected by values of 0.90 or more for the CFI and TLI, and values of 0.08 or less for RMSEA and SRMR. The testing results of the modified hypothesis model showed a good fit ((χ^2/df=2.959; SRMR=0.029, RMSEA= 0.072, CFI= 0.983, TLI= 0.964).

4.3. Impact analysis

The direct effect value among all factors is the standard regression coefficient. Table 4 indicated that attitude towards technology use, perceived usefulness and technological facilitating conditions have direct positive effects on technology-based self-directed learning, and the standard direct effect values are 0.308, 0.250 and 0.235respectively. The indirect effect is calculated by the product of the direct effect values of multi-path. Table 4 indicated that the technological complexity has no direct impact on technology-based self-directed learning, but it has an indirect impact on technology-based self-directed learning through the intermediary effect of attitude towards technology use. The standard indirect effect value is 0.170. In addition, perceived usefulness and technological facilitating conditions have both direct and indirect positive effects on technology-based self-directed learning. Technological facilitating conditions have a direct positive effect on perceived usefulness and attitude towards technology use. The standard direct effect values are 0.455 and 0.347. Perceived usefulness has a direct positive effect on attitude towards

technology use. The standard direct effect value is 0.308. The total effect value is the sum of direct effect value and indirect effect value. Table 4 showed that the total effect of each construct on technology-based self-directed learning from strong to weak is technological facilitating conditions, attitude towards technology use, perceived usefulness, technological complexity and subjective norms. The standard total effect values are 0.612, 0.383, 0.368, 0.170 and 0.061 respectively.

Table 4. Effect value of structural equation model

	Constructs	SN	TFC	TC	PU	ATU
Standardized direct effects	PU		0.455	0.106		
	ATU		0.347	0.269	0.308	
	TSL	0.061	0.235		0.250	0.383
Standardized indirect effects	PU		0.048			
	ATU		0.276	0.033		
	TSL		0.377	0.170	0.118	
Standardized total effects	PU		0.503	0.106		
	ATU		0.623	0.302	0.308	
	TSL	0.061	0.612	0.170	0.368	0.383

Note: PU= Perceived Usefulness; ATU= Attitude towards Technology Use; TFC= Technological Facilitating Conditions; TC= Technological Complexity; SN= Subjective Norm; TSL= Technology-based Self-directed Learning.

5. Discussion

Based on the TAM and TBP theory, this study proposed a hypothesis model of technology-based self-directed learning. Through a questionnaire survey and structural equation model analysis, this paper tested and modified the technology-based self-directed learning model, and constructed a structural equation analysis. Through the analysis of relevant data, the following empirical conclusions are drawn and teaching suggestions are advanced.

Firstly, attitude towards technology use has a direct positive and the largest impact on technology-based self-directed learning. This highlights the key role of attitude in the decision-making of students' technology acceptance, and points out the importance of the development and cultivation of attitude for the development of technology-based self-directed learning.

Secondly, perceived usefulness and technological facilitating conditions have both direct and indirect positive effects on technology-based self-directed learning, and both have direct positive effects on attitude. In addition, technological facilitating conditions have a positive effect on perceived usefulness. The discovery has three implications. First of all, students tend to focus on practicality in technology acceptance decision-making and pay more attention to the usefulness of technology. For example, students will use (or accept) technologies that are considered useful for their learning in the process of self-directed learning beyond class. Second, perceived usefulness is an important determinant of attitude, showing its ability to influence the formation of attitude. This finding is consistent with the results of previous studies, which examined the effect of perceived usefulness on attitude (Teo, 2009). Third, when students perceive the technological facilitating conditions as an external environment, they will be more inclined to use technology to conduct self-directed learning. For example, 85.5% of the students surveyed in this study use mobile phones to carry out foreign language self-directed learning, whereas only 30.9% use their own network resources. Therefore, it is suggested to improve the development and utilization of

school-based network resources, and create a favorable external environment for students to smoothly develop technology-based self-directed learning.

Thirdly, technological complexity has no direct impact on technology-based self-directed learning, but it has indirect impact on technology-based self-directed learning through the intermediary effect of attitude. The undergraduate students in this study already have equipped with a certain degree of computer skills and knowledge, which means that technological complexity will not be an obstacle to their technology-based self-directed learning and that their attitude towards use of technology constitutes a dominant factor.

Fourthly, subjective norms have less predicative power on technology-based self-directed learning. This finding is consistent with current research (e.g., Teo, 2011). The possible reason is that undergraduate students' views on the use of technology may have depended on their past experience or personal interest of interaction with technology, rather than rely on institutional mandate (subjective norms). Under the guidance of the traditional classroom-based way of learning, using technology to conduct self-directed learning is only an option for students, and whether they use technology for self-directed learning will not be under too much pressure from the outside world.

6. Conclusion

Aligning with the development of technology, more and more researches began to concentrate on this technology-related field for educational development, especially the significant impact of the technology development on students' learning experience. In this context, this study explored the influencing factors of technology-based self-directed learning through empirical research, and the conclusions can help optimize technology-enhanced curriculum design for educators, and bring inspirations for taking more advantages of modern technologies in students' self-directed language learning. The results of this study indicated a good fit of the hypothesized model. However, all models should be subject to further validations to strengthen its predictive ability and explanatory powers in order to be valid and useful under different contexts thus increasing its usefulness to researchers (Teo, 2011). Additionally, some limitations are found in this study. First of all, the questionnaire survey is not large-scaled and thus a possibility of potential bias is likely to arise. Secondly, the participants of the study are EFL students, and the findings should be applied cautiously in other subjects. Finally, although this study explored the influencing factors of technology-based self-directed learning, future research may need to further explore other influencing factors or intermediary effects, especially the combination of qualitative research methods to explore technology-based learning experience and learning engagement.

Disclosure statement

No potential conflict of interest was reported by the authors.

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