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An Examination of Automatic Speech Recognition (ASR)-based Computer-assisted Pronunciation Training (CAPT) for Less-proficient EFL Students Using the Technology Acceptance Model

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Abstract

The implementation of computer-assisted pronunciation training (CAPT) has been proven to be successful in improving learners' pronunciation abilities. Automatic speech recognition (ASR) software was used to provide mediated support to 103 pre-intermediate level students (62 males and 41 females). After experiencing a two-semester of CAPT instruction in their Freshman English course, students completed a questionnaire to assess their perceptions of and attitudes towards technology. This paper reports on the findings that examine the structural relationships using the Technology Acceptance Model (TAM). The findings indicate that students, generally, were in favor of using ASR-based pronunciation training, and although no statistically significant gender difference was found, female students appeared to view its use more favorably than were their male counterparts. The perceived effectiveness of the system, and the attitudes of students towards using it, were shown to be significantly correlated, which encourages the ongoing use of ASR-based CAPT. Based on these responses, it was established that the ASR function enhanced students' awareness of their pronunciation errors. Furthermore, they willingly engaged in individual, repetitive pronunciation exercises, allowing them to build confidence in speaking practices without fearing embarrassment in front of their peers. Recommendations were provided for EFL educators interested in implementing CAPT in EFL settings.

Introduction

With the rapid development of information technologies, the landscape of language education has changed (Chang & Hsu, 2011). Learners can now easily access any input of the target language, and language teachers use technology to engage them meaningfully (Orsini & Evans, 2015). Evidently, Information and Communications Technology (ICT) has benefited EFL learning through creative pedagogy. Within the context of Computer Assisted Language Learning (CALL), it is crucial to recognize that technology in isolation cannot inherently enhance English language acquisition for EFL learners. Effective implementation necessitates a profound understanding of learners' attitudes and perspectives towards CALL by course designers and instructors (Albirini, 2006).

Therefore, because of this imperative, there has been a need for more empirical research within the CALL domain, particularly regarding investigations into the association between EFL learners' engagement with CALL and the individual factors. In the context of the escalating dependence on technology, it is crucial to understand those individual factors that affect users' acceptance and adoption of technological innovations (Mah & Er, 2009; Yi & Hwang, 2003), and that ultimately promote language learners' self-directed and active participation in their learning, which can lead students to become autonomous learners (Benaissi, 2015).

In order to assess the value of CALL as a means to improve learning generally, and pronunciation training in particular, it is essential for EFL instructors and course designers to fully understand learners' perceptions and attitudes towards the system (Albirini, 2006; Hsu, 2017; Mah & Er, 2009). Presently, there remains to be discovered the relationship between learners' use of information technology adaptation and their attitudes towards future computer use (Teo, 2010; Hsu, 2016). Also, there is limited research in the area of Automatic Speech Recognition technology in pronunciation training. This study, therefore, aims to examine the relationships between the variables in the acceptance of the technology model and the learner autonomy, which is the external variable.

Literature Review

ASR-based Computer-assisted Pronunciation Training

Pronunciation, which plays a pivotal role in developing linguistic competence, is the foundation of language acquisition, since clear and comprehensible pronunciation enhances learners' oral communication skills and contributes significantly to their speech fluency (Farhat & Dzakiria, 2017; Morley, 1991). However, despite its importance, pronunciation has frequently been overlooked in foreign language research and teaching (Derwing & Munro, 2015; Farhat & Dzakiria, 2017; Haghighi & Rahimy, 2017). Because learners, due to their limited knowledge of segmental and suprasegmental sounds, have difficulty in in pronunciation acquisition, they need assistance to identify the gap between their performances and the desired results (Bodnar, Cucchiarini, de Vries, Strik, & van Hout, 2017). Consequently, pronunciation training needs immediate and frequent personalized instruction; however, this also requires much effort and time.

Nowadays, the rapid development of technology has significantly changed the domain of language education in both feasibility and availability (Chang & Hsu, 2011). Language learners now benefit from seamless access to the authentic pronunciation models, facilitated by CAPT (Neri, Cucchiarini, & Strik, 2001; Zhao, 2003). The combination of various computer technologies has garnered widespread recognition because of its paramount role in the development of educational and instructional aids, thereby enhancing its influence in EFL teaching (Adair-Hauck, Willingham-McLain & Youngs, 2000).

The importance of using systematic and constant practices of acquired skills in class has been highly recommended in order to improve learners' English language performances (Thornton & Houser, 2005). However, opportunities for in-class, face-to-face interactions may be limited for all EFL learners due to contextual limitations, such as large class sizes and short class periods (Chang, Yan, & Tseng, 2012). Thus, the utilization of

CAPT based on ASR technology, emerges as a viable alternative by providing English language pronunciation teaching and learning possibilities. By offering speakers quality evaluation and timely corrective feedback, learners receive an immediate diagnosis of their pronunciation problems and correct them immediately, which can make up for the insufficiency of traditional pronunciation teaching (Katz & Assmann, 2019; Yuan & Liu, 2020). Also, learners can access ASR-based applications to practice their pronunciation independently whenever they possibly can, which also helps reduce their anxiety levels (Neri, Cucchiarini, Strik, 2001; Yuan & Liu, 2020). As indicated earlier, ASR-based CAPT systems have attracted great interest in the field of speech technology and language education due to their emphasis on assisting learners to attain clear and comprehensible pronunciation and to explore its feasibility and application in language education (Musa & Mohamad, 2017; Neri, Cucchiarini, & Strik, 2006).

Accordingly, it seems desirable to apply ASR-based CAPT within the context of EFL teaching and learning. However, to ensure the adequate utilization of technological tools effectively for instructional purposes and to optimize the effectiveness of ASR in CAPT, the effects resulting from learners' acceptance of it should also be considered.

Technology Acceptance Model

The TAM was developed to measure the cognitive and psychological factors shaping users' intentions regarding their further use of new technologies. Hence, it been widely tested as predictor of both further computer use and technology adoption (Figure 1) as it has been proved to be the most popular model due to its ability to make successful predictions and to offer explanations for users' acceptance of targeted technology (Ariyanti, Gustianing & Arifin, 2021; Chang, Yan & Tseng, 2012; Granić & Marangunić, 2019). Consequently, over the years, many researchers have used it as a predictive tool and their findings have been that it is a stable model, providing an appropriate theoretical framework for educational research (Al-Adwan, 2020; Al-Emran et al., 2018; Hasan & Ahmed, 2007).

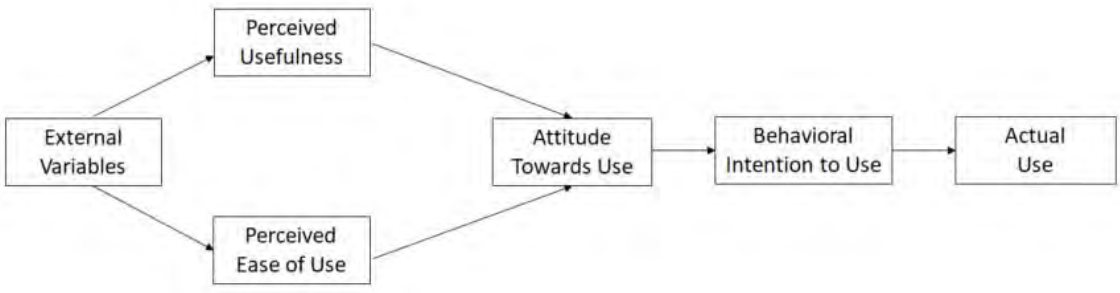

Figure 1. The Technology Acceptance Model (Adapted from Davis, 1989)

The two specific variables, namely, the perceptions of usefulness (PU) and perceived ease of use (PEU), were hypothesized in order to fundamentally affect an individual's acceptance of technology (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989; Teo, 2010). In addition, previous studies also reported that users' attitude is a crucial factor that affect the success of a system. Among the various proposed definitions of attitude, the relationship between an individual and an object has been the most considered by researchers (Woelfel, 1995). When users

perceive the technology to be useful and easy to use, they tend to formulate positive attitude towards both the technology and to technology-based learning (Khee, Wei, & Jamaluddin, 2014; Park, 2009; Wu & Wang, 2005). PU also reveals the extent to which the user perceives a specific technology that enhances their learning performance, while PEU signifies beliefs concerning the effort needed to utilize the technology. Recent studies confirmed that the PU of a system significantly affects users' attitudes to the system (Park, Baek, Ohm & Chang, 2014; Hsu, 2016). However, studies addressing the PEU do not directly involve users' attitudes (Al-Adwan et al., 2023; Lee, Cheung & Chen, 2005; Lu, Zhou & Wang, 2009).

Regarding CALL, during the past two decades, the TAM has been employed to observe language learners' behavioral intentions. For instance, in a study examining Malay students' acceptance of writing weblogs in the ESL classroom, Mah and Er (2009) found there to be positive and significant relationships between PU, PEU, and behavior intention among weblog users. More specifically, PU significantly affected users' attitudes towards weblog writing and their intention to use it more than PEU did. Lin (2014) discovered that both PU and PEU significantly affected EFL learners' intentions to use it in connection with mobile-assisted language learning (MALL). However, the complexity, together with the usefulness of the CALL system may also affect the learning process (Chang, Yan, & Tseng, 2012).

Another study done by Hsu (2016) examining 341 university EFL learners' acceptance of ASR-based CAPT in Taiwan discovered similar results. Hsu replaced behavioral intention with continuing use (CU) to examine learners' intentions to actually use the system. His results showed that PEU had a significant effect on PU, and PU significantly affected learners' attitudes towards ASR-based CAPT, leading to their continuing use of the system. In his later study of 796 vocational high school students, Hsu (2017) also discovered that PU significantly affected users' attitudes towards CALL, while learners' attitudes significantly affected their satisfaction with CALL.

Based on the above results, Mah and Er (2009) and Lin (2014) have suggested that PEU is associated with learners' behavioral intentions, while PU may be affected by PEU; however, Chang and Hsu (2011), Lee, Kozar and Larsen (2003) believed that such assumptions needed further evidence. In line with Hsu's earlier findings, this present study examines the relationships between four constructs when using ASR-based CAPT: PU, PEU, attitude towards use (ATU), and learners' intention to use it continuously (CU).

The external variables, according to Davis et al., (1989) have crucial effects on users' acceptance and their actual use of the system. Many studies have extended the basic TAM by including various external variables into the model, and by investigating the effects of different system features and users' behavioral intentions regarding the use of technologies (Fathali & Okada, 2018). Among the models that added external variables to the basic TAM, Abdullah and Ward (2016) found five variables— (i) self-efficacy, (ii) computer anxiety, (iii) computer use experience, (iv) subjective norm and (v) perceived enjoyment, have been frequently used. However, motivation appears to have been neglected, even though it is an important external variable, and only 'perceived enjoyment' as an intrinsic motivational feature, has been intensively examined (Rentler & Apple, 2020). However, there is much more to be explored regarding other motivational factors.

Learner Autonomy and TAM

Research has found strong correlations between motivation and autonomy, and fostering learners' motivation and autonomy. Autonomy is a highly desirable goal in foreign language learning. Autonomous learners understand the purpose of their learning and have the ability to take charge of it and how to act in learning situations (Benaissi, 2015; Liu, 2015). Furthermore, autonomy has been viewed as a prerequisite for success in language learning (García Botero, Questier & Zhu, 2019; Hermagustiana & Anggriyani, 2020).

Technology offers learners opportunities to experiment with a language more efficiently. In the past, experimenting with a language usually meant they were using the language for communication purposes, which often caused learners' worries and negative emotional reactions (MacIntyre, 2007). Such language anxiety can be a huge hindering factor regarding learning in the classroom (Horwitz, Horwitz, & Cope, 1986). In a study examining learners' willingness to communicate, MacIntyre (2007) suggested that anxiety is the key factor obstructing students' willingness to communicate in their target language.

Nowadays, accessing technologies, such as computers and mobile devices, allows students to practice in a non-threatening setting; also, recent studies investigating MALL have discovered that technologies play a crucial role in supporting learner-centered environments, which may lead to learner autonomy (Darsih & Asikin, 2020; Swatevacharkul & Boonma, 2020). With the help of ASR, individual learners can receive visible immediate feedback, which promotes both autonomy and pronunciation instruction (Kruk, 2012). Further, learner autonomy is often associated with learner attitudes; fir instance, more recent studies found that learners with positive attitudes towards integrating technology-assisted learning, together with mobile learning, fostered learner autonomy (Purwaningrum & Yusuf, 2019; Swatevacharkul & Boonma, 2020).

While some researchers have pointed out that technologies have the potential to foster autonomy, studies to confirm the actual role this plays are still rare, as are researchers into pronunciation training. However, in an empirical study, Kruk (2012) investigated the effect of technology use to foster learner autonomy in pronunciation training, and obtained positive results. In his study, students with computer-based work performed better than those in traditional classroom settings; also, they displayed more signs of acquiring autonomy.

As mentioned earlier, ASR shows great promise for pronunciation self-access by allowing learners to experience the target language in a private and safe setting. Interestingly, earlier studies in ASR focused mainly on assessing accuracy, rather than specifically measuring changes in autonomy. Also, most autonomy studies focused on language learning in general with little acknowledgment about pronunciation training. Thus, there is a great need for further research that explores ways to help learners become autonomous with their pronunciation training program.

This study expected that perceived autonomy would affect the perceived usefulness of the system. It was also predicted that attitudes towards using the system would be influenced by perceived autonomy. However, as Fathali and Okada (2018) pointed out, empirical support for the relationship between learners' perceived autonomy and

their perceived ease of use is still rare. Thus, this study excluded those hypotheses that examined the relationships affecting their perceived ease of use. Thus, it was expected that if the less proficient first-year university students felt certain levels of control over their actions when they used the ASR-based CAPT system, their perceptions of usefulness and autonomy would also be increased. Accordingly, in their study, two research questions were set:

1. What are the relationships between the TAM variables: PEU, PU, ATU, and CU?
2. How is EFL students' perceived autonomy associated with other variables in TAM?

Methodology

Research Hypotheses

According to the Literature Review, PEU and PU are the two key variables that affect users' acceptance of the system, attitudes towards using, and their intention to use the system continuously (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989; Teo, 2010; Park, et al., 2014; Hsu, 2016; 2017). Thus, within a technology-based pronunciation training environment, relationships between PEU, PU, ATU, and CU to use the ASR-based CAPT are hypothesized as follows:

H1: PEU positively affects PU of the system

H2: PEU positively affects ATU ASR-based CAPT system

H3: PU positively affects ATU ASR-based CAPT system

H4: PU positively affects CU ASR-based CAPT system

H5: PEU positively affects CU ASR-based CAPT system

H6: ATU positively affects CU ASR-based CAPT system

It was expected from this study that perceived autonomy would affect the perceived usefulness of the system. In addition, it was predicted that attitudes towards using the system would be influenced by perceived autonomy. However, as Fathali and Okada (2018) pointed out, empirical support for the relationship between learners' perceived autonomy and perceived ease of use is rare. Thus, this study excluded the hypotheses examining the relationships affecting perceived ease of use. Accordingly, this study hypothesizes that EFL learners' perceived autonomy will affect their PU and ATU of ASR-based CAPT, hence:

H7: Learners' PA positively affects PU of the system

H8: Learners' PA positively affects ATU of ASR-based CAPT system

Research Context

This study was carried out at a private university located in central Taiwan. One hundred and three first-year undergraduate students taking a two-semester General English course participated in it. The class was held twice a week and lasted for 18 weeks. The students were streamed based on the English score of their university entrance exam and they mostly had an A2 level of CEFR (Common European Framework of Reference for Language). In order to raise their awareness of correct pronunciation, LearnMode, an open courseware for students in Taiwan was adopted, to provide extra help with their pronunciation. A 15-week ASR-based CAPT activities was set on the LearnMode platform as extras for the two semesters from September 2022 to June 2023. The students

completed the survey in mid-June, 2023.

Participants

The participants were 103 first-year undergraduate students (62 males and 41 females) with various majors attending Freshman English classes at a private university of technology in central Taiwan. The students were informed of the purpose of this research, and their data were used merely for this study. In addition, they were free to be excluded from the study at any time, and their academic records would be unaffected.

All participants completed ASR-based CAPT assignments incorporated with their General English course over a two-semester course. They were asked to log into the platform and practice their pronunciation. Each assignment contained a 150-word text adapted from recent world news. Once they completed the assignment, they received immediate ASR feedback identifying their pronunciation errors and problems. Participants then repeated the pronunciation assignment until they were satisfied with the results. At the end of the course, they were asked to complete an end-of-term questionnaire that assessed their acceptance of ASR-based CAPT.

Instrument

The data was collected using an online questionnaire, in which the items were measured on a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). Questionnaire items were adopted from previous relevant studies to examine the participants' acceptance of the use of ASR-based CAPT (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989; Hsu, 2016), with wording modifications to fit the context of this study.

The first section of the questionnaire included participants' demographics details. The second part contained 16 items on the four constructs of the TAM: perceived usefulness (PU) (5 items), perceived ease of use (PEU) (4 items), attitudes (ATU) (4 items) towards using, and continuance intention to use (CU) (3 items) the system. The third section consisted of four items developed by the researcher in order to examine learner perceived autonomy (PA).

The questionnaire items were translated into the students' first language, Chinese, by the researcher, to facilitate their understanding, and the questionnaire was back-translated to ensure it accurately compared to the original English version. Finally, the Chinese version was piloted before its formal administration for data collection purposes. Based on the TAM measures, the definitions of the construct variables are shown in Table 1.

Table 1. Constructs Variables and Measured Items

Constructs	Operational Definitions	Items	
Perceived ease of use (PEU)	PEU refers to the degree to which a learner feels that using ASR-based CAPT will be easy and	PEU1	I find that the process of using the ASR-based CAPT was clear, understandable, and straightforward.
		PEU2	Navigating through the ASR-based CAPT was

Constructs	Operational Definitions	Items	
	free from effort.		easy for me.
		PEU3	I find ASR-based CAPT to be flexible to interact with.
		PEU4	It would be easy to become skillful at using the ASR-based CAPT.
Perceived usefulness (PU)	PU refers to the degree to which a learner feels that using ASR-based CAPT will improve their pronunciation performance.	PU1	Using ASR-based CAPT enables me to accomplish my learning more quickly.
		PU2	Using ASR-based CAPT improves my English pronunciation performance.
		PU3	Using ASR-based CAPT enhances my English speaking performance in fluency.
		PU4	Using ASR-based CAPT enhances my learning English effectiveness.
		PU5	Using ASR-based CAPT makes it easier to do my English speaking practice.
Attitude towards using (ATU)	ATU measures a learner feels positively towards ASR-based CAPT.	ATU1	Learning English pronunciation via ASR-based CAPT is a good idea.
		ATU2	Learning English pronunciation via ASR-based CAPT is a wise idea.
		ATU3	Learning English pronunciation via ASR-based CAPT is a pleasant idea
		ATU4	Learning English pronunciation via ASR-based CAPT is a positive idea.
Continuance intention to use (CU)	CU refers to a learner's willingness to continue to practice pronunciation using ASR-based CAPT afterwards.	CU1	In the future, I would like to learn English pronunciation via ASR-based CAPT
		CU2	I intend to show others this ASR-based CAPT.
		CU3	I will frequently use ASR-based CAPT.
Perceived Autonomy (PA)	PA refers to a learner's action of self-regulation and involvement when using the tool and reflection for their learning	PA1	Although there may be frustrated during the process of pronunciation practice at times, I kept doing it.
		PA2	During the practicing process, even when encountering the content that didn't interest me, I still made an effort to complete it.
		PA3	I completed all the pronunciation assignments in time.
		PA4	I believed I did a good job in all pronunciation assignments.

Procedure

The instructor set the pronunciation assignments at the beginning of each semester. As most students were new to ASR-based CAPT, the researcher provided an operational session at the beginning of the first semester explaining its procedure on the LearnMode platform. After the participants understood how the procedure worked, they started to practice pronunciation. They were then required to complete one assigned pronunciation text each week for 15 weeks (30 assignments for two semesters) and they could practice the assignment repeatedly until they were satisfied. After all the assignments were finished, they were required to complete the questionnaire.

Data Analysis

Data was analyzed using SPSS to obtain descriptive statistic results, including means and standard deviation for each item to examine participants' PEU, PU, ATU and CU and perceived autonomy in using the system for pronunciation training. As seen in most TAM research, Cronbach's alpha and Pearson correlation coefficient analyses were performed to identify and confirm the internal consistency and reliability of the survey measurement (Fathali & Okada, 2018). Accordingly, the internal consistency results of the 20-item survey were divided into five sub-category constructs, and each obtained a good reliability of Cronbach's α value (.93, .98, .97, .96 and .85 for PEU, PU, ATU, CU, and PA, respectively).

Such high internal consistency suggests that the questionnaire items utilized for this study were closely related. In addition, the administration of convergent reliability (AVR) and composite reliability were also carried out to ensure the reliability and validity of the measurements. The CR value for every TAM construct was above .85, and the AVE value was above .65, confirming the reliability and validity of the research measurements (see Table 2).

Results

From the results in Table 2, the participants displayed relatively high autonomous learning during the ASR-based CAPT implementation, with a mean score of 4.50, the highest of all constructs. Such results suggest that the concept of autonomy was generally accepted among them. ATU received the second-highest mean score (M= 4.43), while PU and PEU ranked third and fourth (M= 4.29 and 4.22, respectively). Participants showed a favorable intention to use the system continuously (M= 4.07). Regarding gender factors, although no significant difference was obtained, females generally displayed higher perceptions than males.

Table 2. Reliability and Validity Analysis and Statistics Results of Sub-Variables and Items (N=103)

Construct	Item	CR	AVE	Cronbach α	Mean		Mean	SD	Construct Mean	Construct SD
					M	F				
Perceived	PEU1				4.21	4.34	4.26	1.45		
Ease of Use	PEU2	.91	.71	.93	4.02	4.24	4.11	1.42	4.22	1.34
(PEU)	PEU3				4.26	4.32	4.28	1.45		

Construct	Item	CR	AVE	Cronbach α	Mean		Mean	SD	Construct Mean	Construct SD
					M	F				
	PEU4				4.11	4.39	4.22	1.49		
Perceived Usefulness (PU)	PU1	.96	.82	.98	4.19	4.24	4.21	1.43	4.29	1.37
	PU2				4.10	4.46	4.24	1.42		
	PU3				4.19	4.56	4.34	1.37		
	PU4				4.24	4.51	4.35	1.45		
	PU5				4.21	4.39	4.28	1.45		
Attitude Towards Using (ATU)	ATU1	.93	.77	.97	4.23	4.59	4.37	1.48	4.43	1.35
	ATU2				4.29	4.59	4.41	1.42		
	ATU3				4.27	4.63	4.42	1.43		
	ATU4				4.35	4.78	4.52	1.32		
Continuance Intention to Use (CU)	CU1	.88	.72	.96	4.15	4.29	4.20	1.49	4.07	1.45
	CU2				3.81	4.15	3.94	1.52		
	CU3				3.98	4.20	4.07	1.52		
Perceived Autonomy (PA)	PA1	.89	.68	.85	4.37	4.68	4.50	1.24	4.50	1.06
	PA2				4.50	4.95	4.68	1.13		
	PA3				4.45	4.41	4.44	1.33		
	PA4				4.47	4.32	4.41	1.22		

In order to examine the relationships between the TAM constructs, a Pearson correlation was performed. Table 3 shows the correlation matrix of the TAM variables of PEU, PU, ATU, CU, and LA. Identifying the correlation among the constructs answers the second research question of this study. According to the statistical results, the strongest correlation falls between PU and PEU (r= .933), showing that PEU is a strong indicator of PU, which echoes results from previous studies that PU strongly affects users' acceptance of technology and continuous intention to use the system (Lee et al., 2003; Rentler & Apple, 2022; Hsu, 2016). Moreover, the additional external construct that this study included, showed that PA, was a significant correlation to the four constructs, which indicates that users' reflection and involvement in the ASR-based CAPT during the implementation was highly correlated to their perceived ease of use (*r*= .556), perceived usefulness (*r*= .568), attitudes towards using (*r*= .583), and continued utilization of the system (*r*= .582).

Table 3. Pearson Correlation coefficient between constructs (N=103)

Constructs	PEU	PU	ATU	CU	AL
PEU					
PU	.933**				
ATU	.900**	.934**			
CU	.866**	.901**	.897**		
PA	.556**	.568**	.583**	.582**	

Note. **p< .01

The Structural Model Analysis

The structural model analysis was employed to examine path coefficients between the constructs in the research model. Figure 2 shows the results of path coefficients and provides insights into the relationships among the five major constructs. The estimate of each path between TAM constructs is shown in Table 4.

Table 4. Hypothesis Testing Results

Hypothesis	Path	Path Coefficient	Result
1	PEU → PU	.933***	Supported
2	PEU → ATU	.225	Not supported
3	PU → ATU	.725***	Supported
4	PU → CU	.413***	Supported
5	PEU → CU	.111	Not supported
6	ATU → CU	.411***	Supported
7	PA → PU	.568***	Supported
8	PA → ATU	.583***	Supported

Notes: ***p< 0.001

PEU – perceived ease of use; PU – perceived usefulness; ATU – attitude, CU –continuous; PA –perceived autonomy

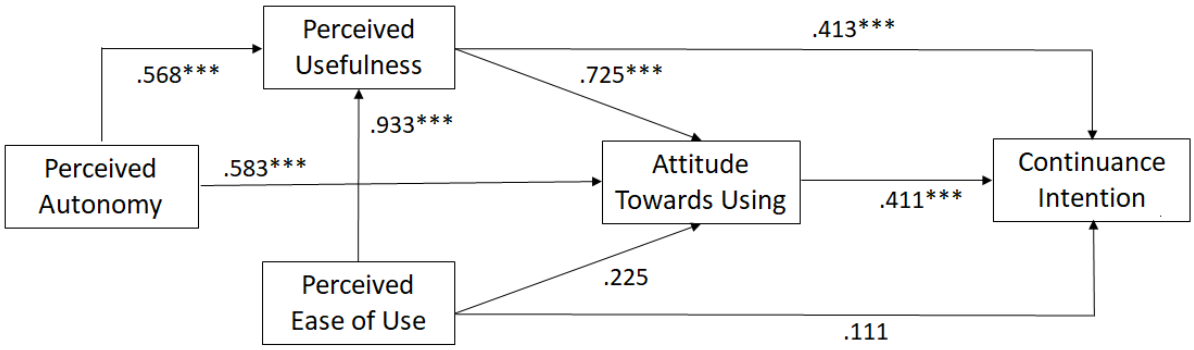

Figure 2. Path Coefficients of the Research Model

Six out of eight hypotheses were supported. It was found that participants' perceived autonomy had a positive significant effect on PU of ASR-based CAPT (β= .568, p< .001) and did ATU (β= .583, p< .001). In terms of TAM constructs, PEU had a significant effect on PU (β= .933, p< .001), and PU significantly affected participants' ATU towards using the system (β= .725, p< .001). In addition, both participants' PU and ATU obtained significant confirmation of their intention to use the system in the future (β= .411, p< .001). However, the paths between PU and ATU, as well as PU and CU, did not obtain significant results, showing that the participants' perceived ease of use of the system did not play a key role regarding their attitude towards using the system and their intention to use it continuously.

Discussion

Technology is making a growing impact on language learning. Computers and mobile devices that functionally provide multimodal input and enhance learners' motivation have been used widely to assist language learning and teaching (Hsu, 2016). However, the fundamental issue is that technology-based learning might not work well if learners hesitate to use them. Thus, it is necessary to understand the factors that may facilitate, or hinder, learners' acceptance of it and their willingness to use it continuously. The results of research into these issues may help uncover the role of language learners' technology acceptance to EFL course designers and instructors who wish to implement CALL or MALL in order to maximize their effectiveness in both learning and teaching (Finch & Rahim, 2011).

Concerning how PEU correlates with PU, the findings support previous studies by Hsu (2017) and Mah and Er (2009) which affirmed that PEU had a positive direct effect on PU. Regarding the effect of PEU and PU on learners' ATU of using the ASR-based CAPT in TAM, the findings showed that PU had a significant effect on ATU, whereas PEU did not directly affect ATU. The impact of PEU on ATU was not statistically significant, and this result is consistent with the findings of previous studies (Al-Adwan et al., 2023; Chang et al., 2012; Hsu, 2016; 2017; Lee et al., 2005; Lu et al., 2009). However, such results did not indicate that PEU can be ignored; as Khee et al. (2014) proposed, users' familiarity with the system should be the primary consideration in platform design regarding PEU. It is also suggested that future studies may include learners' familiarity with the system as an external factor in TAM in order to examine its relationships with other variables (Hsu, 2016). Moreover, this study obtained an encouraging result, echoing Hsu's finding (2016), that learners with positive attitudes towards ASR-based CAPT improved the probability of their continuing to use the system in future.

Overall, the participants' high levels of autonomy (Table 4) suggests that creative instruction using online resources helps to create more independent learners, and that learning through ASR-based CAPT provides a link between autonomy and pronunciation improvement, which echoes Kurk's (2012) findings that such an effect could be viewed as a direct positive outcome in that the participants were encouraged to work. Unlike the traditional teacher-student teaching approach, in this study the participants were given the opportunity to work independently when developing their pronunciation skills by using the system; by these means, they were able to allocate as much time as they needed to practice the sound and repeat the task as many times as they wished. However, autonomous learning doesn't mean learning in isolation; instead, since it was up to them to decide what to learn, it was only necessary to provide them with continuous assistance and critical direction as Benson (2011) also found.

As shown in the model, perceived autonomy is a positive predictor of the participants' intention to continue using the ASR-based CAPT to further developing their pronunciation skills. In addition, in line with the findings of Purwaningrum and Yusuf (2019), and Swatevacharkul and Boonma (2020), TAM and MALL were successfully integrated in an educational setting. As a consequence, this study proved that participants' perceived autonomy as being directly related to their attitudes towards using the system, which in turn strongly promotes their continued intentions to use the available technology. These results are consistent with the findings of a study by

Fathali and Okada (2018), whereby learners' autonomous requirements, as predicted by the TAM components, greatly affected their intention to use the ASR-based CAPT. Accordingly, the findings of this study are significant because they offer empirical evidence for the hypothesized relationship between perceived autonomy and technology acceptance traits among students.

Limitations

This study extended the TAM with external factors to explain the effects it had on higher education Taiwanese first-year university students' use of the ASR-based CAPT system. However, as with any study, this one is not free of limitations. Firstly, the participants were streamed as being 'less proficient' by the same university, therefore, it is not possible to generalize the results either to other educational institutions, or English proficiency levels, or students of different ages. However, future studies may aim to extend the scope of this study in order to target participants from a broader range of backgrounds to address this matter. Secondly, although this study employed an ASR-based CAPT system for two semesters, it was never intended to be a longitudinal research. As Chang et al. (2012) suggested, future research may include a 'time effect' to examine learners' long-run beliefs, experience and behavior so as to improve the understanding of causal relationships among TAM variables.

Although a gender effect was not included as a variable of TAM, this study did uncover some interesting insights into it. Previous studies have discovered that gender plays an important role in explaining user behavior in regard to using the system (Venkatesh, Thong, & Xu, 2012; Sun & Zhang, 2006). Therefore, understanding the variations between males and females in technology-based teaching helps language teachers to employ the most appropriate learning processes for all students (Ong & Lai, 2006). Goswami and Dutta (2016) found such an understanding also furthers technological improvements; consequently, the gender effect may be taken into account for future research.

This study employed self-reported data to measure students' acceptance of using technology in pronunciation training, which may potentially amplify the connection between variables and result in unrealistic conclusions, as was found by Teo (2010) and Hsu (2016). Hence, this study's qualitative research design provided valuable insights by adding the benefit of personal testimony in order to answer the research questions. Nevertheless, this study offers a foundation for further investigating EFL learners' autonomy and its influence on technology acceptance regarding the applicability of CALL and MALL.

Conclusions and Implications

As information technology has gained popularity in EFL learning and teaching, examining its efficiency devotes valuable contributions (Hsu, 2016). This study highlighted the role of learners' autonomy in students' acceptance of ASR-based CAPT. The findings of this study support that TAM was found to be a valid model for predicting students' intention to use the system. Six out of eight research hypotheses proposed for this study were significantly supported. The participants' perceived autonomy was significantly associated with their PEU and attitudes towards ASR-based-CAPT. Regarding TAM-related variables, the results revealed that PEU affected PU

significantly, and PU was directly linked with ATU. Although PEU did not significantly affect PU, it was indirectly associated with the mediation of PU. Furthermore, participants' attitudes towards using the system were found to be directly affected their continuance intention to use.

The results of this study may be considered to be of importance to researchers and language educators, since they showed that autonomy, as an external factor in an integrated model, to identify the relationships among the other TAM variables. Furthermore, the study obtained positive results, suggesting that pronunciation via ASR-based training might help learners take responsibility for their own learning, ultimately to become autonomous learners. Presently, for purposes of convenience, CALL and MALL can be used interchangeably, and language learners can approach the same learning functions, either by using their computers or smartphones. Thus, EFL teachers who wish to enhance their students' pronunciation through ASR-based CAPT, might appreciate having access to software that can operate either through computers or mobile devices.

To achieve the best outcome, it is suggested that teachers combine both digital and analog ways of teaching, which allow students to improve their English pronunciation skills and help them to develop autonomy; also, they should encourage them to assess their own progress by reflecting on both their pronunciation skills and to improve the quality of their EFL learning.

It is accepted that not all learners will be equally motivated to take responsibility for their own learning; however, it is necessary for educators to provide all their students with adequate technological learning resources in order for them to study independently if they wish. It is equally accepted that a pronunciation training program can help to develop learners' positive perceptions of the system generally, and to encourage them to acquire equally positive attitudes towards using the technological equipment for the remainder of their course.

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