Factors Affecting Students' Flow Experience of E-Learning System in Higher Vocational Education Using UTAUT and Structural Equation Modeling Approaches

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Abstract. Higher vocational education has adopted the e-learning system, and scholars have achieved a lot of results in e-learning. Query ID=`Q1' Text=`This is to inform you that corresponding author has been identified as per the information available in the Copyright form.' However, how to introduce flow ex-perience theory, extract the behavioral intention characteristics of higher vocational students, and how to integrate job requirements and skill certificates into e-learning Design and application need to be discussed in depth. We propose a UTAUT model that combines flow experience, exploring the use of behavior intention as a mediator and flow experience as the target variable. More than 7000 students from City College of Huizhou participated in the questionnaire. The Structural Equation Modeling (SEM) SmartPLS3 software was used to investigate their flow experience to use the e-learning system. The results show that perceived usefulness and facilitating conditions have an important influence on their flow experience and behavioral intentions, both have a partial mediating effect on flow experience through behavioral intention. The e-learning system of higher vocational education should promote the flow experience level of students, and strengthen the elements of employment positions and skills certificates. Suggestion: The e-learning system of higher vocational education should promote the flow experience level of students, and strengthen the elements of employment positions and skills certificates. The model of intention to use e-learning systems for senior students is innovative and effective in practice.

Keywords: UTAUT · Flow experience · Higher vocational students · E-learning · Behavioral intention

1 Introduction

With the widespread use of AI technology and big data technology in e-learning, it has a deepening impact on higher vocational education. Using artificial intelligence technology and big data technology, it becomes a smart education platform (Holmes et al. 2019; Shuguang Liu et al. 2020).

For example, through the e-learning system, Huizhou City College, has a total of 11,329 classes, 700 direct teachers, 20,780 students, and 3,372 courses. The resources deployed in the e-learning system include videos, courses, pictures, documents,

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graphics and text pages, and web links. Among them, 36.41% are videos, 14.83% are pictures, 29.48% are documents, and 11.57% are web links, which are the four most important types of resources. Learners can interact with teachers and students through the e-learning system, and can view real-time experience values, access to videos, document resources and web links, submit assignments, and check the status of assignments submitted and graded. e-learning system can give teachers alerts based on students' learning status. However, there are still more than 420 courses with abnormal class attendance, with absenteeism rates ranging from 10% to 47.25%. This semester, 2,416 courses have been deployed in the e-learning platform, but the number of active courses ranges from 1,147 to 1,726.

Students have different abilities, personalities, and motivations. How to implement education according to the different characteristics of students is a key topic of current education. If the student's characteristics are not understood and applied, the technology of wisdom education cannot be used well (Wandasari et al. 2019; Abbas et al. 2019; Huda, 2020). Flow experience comes from work and entertainment activities with people. It is usable and versatile. Therefore, it can better explain the psychological state of people's personal behavior. The process was defined as the state of the best experience, in this state, people would get a sense of pleasure by focusing on a certain task, regardless of external rewards (Csikszentmihalyi, 1990). Flow is very important for active learning. When people are immersed in tasks or activities, at this moment, people will feel happy and enjoy the moment (Chin-Lung Hsu et al. 2003; Shin et al. 2006; Müller and Wulf 2020; Wan et al. 2020). Someone in flow state only has goals and activities, forget all the others (Csikszentmihalyi 1997; Lee 2005; Skadberg et al. 2004).

The UTAUT model has been widely adopted by many countries to study the acacceptance of e-learning (Williams 2015; Mohammed 2019; Tarhini 2016; Isaac 2019; Yakubu 2019).

Therefore, this research integrates flow experience and UTAUT model to explore the behavior intentions of higher vocational students using e-learning systems, also try to find the key factors that affect their flow experience and behavior intentions (See Fig. 1). The specific research is as follows:

(i) Explore the UTAUT model and flow experience theory, and propose a flow experience model of vocational students use the e-learning system

(ii) Investigate the key factors influencing the use of e-learning by students in higher vocational schools and the possible intermediary effects.

(iii) In particular, when higher vocational schools link the content of the platform with job requirements and skills certificate requirements, explore the impact of the perceived usefulness on the behavioral intention and higher vocational students' flow experience.

This research plan is to extract the important factors that may exist in the flow experience of vocational students using e-learning. In this study, the UTAUT model will be added to the flow experience, and it will be used as the target variable. In addition, according to the importance of job requirements and skill certificates in higher vocational education, it is planned to add corresponding content to the usefulness index of perceived content. Explore the explanatory power of the newly constructed model for flow experience. At the same time, combined with the research results of previous scholars to explore the influence of behavioral intentions on the target variables of flow

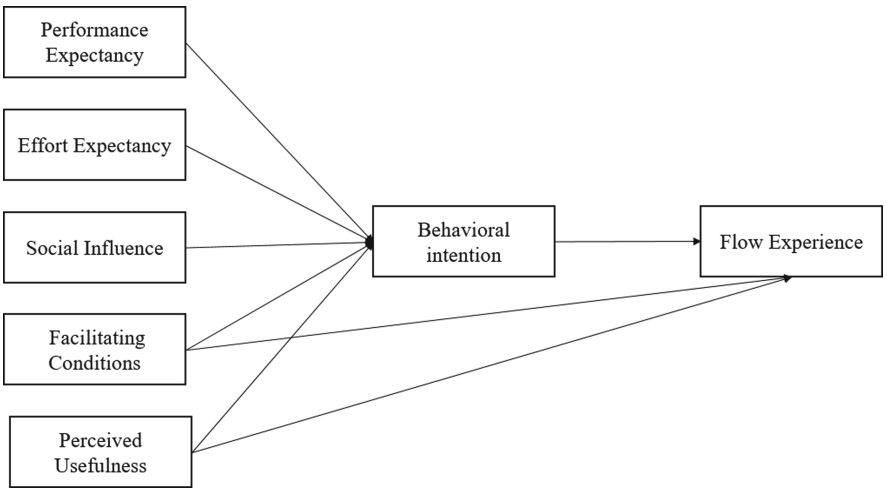

Fig. 1. Research model

experience, and explore the possible mediating effects, methods such as PLS, Bootstrapping, and IPMA will be used, and the key indicators in the model will be used, Taking the students of higher vocational schools as the research objects, explore the possible key indicators of their use of e-learning systems.

2 Literature Review

The UTAUT model has been widely adopted by many countries to study the acceptance of e-learning. It is used to investigate the influencing factors of e-learning websites (Tan 2013; Lin 2020; Alkhuwaylidee 2019). Using the structural equation method, ex-plain the UTAUT model of the e-learning system for students receiving higher education and seek out the influencing factors (Salloum 2018; Gitau 2016). Some scholars had revised the dimensions of UTAUT (Gunasinghe 2019). Under similar circum-stances, some scholars had extended this model and added other dimensions (Khechine 2019). In the early stage, some scholars added the function of this model to teacher characteristics and curriculum characteristics (Almaiah 2019), In Korea, UAE, Those researches have also been effectively carried out (Kang 2015; Salloum 2018), Similarly, Saudi Arabia promotes such research (Alshehri et al. 2019). Of course, the comprehensive measurement level of the model is also very important (Al-Fraihat 2018). Some scholars had proposed the behavioral intention model of students in developing countries in this field (Maldonado 2011; Valencia-Arias 2019). Also in Pakistan's (Kanwal 2017). There are also scholars focusing on investigating the intention of e-learning behavior in mathematics courses (Tarmuji 2019). The UTAUT model is often used to explain the behavioral intentions of the vocational education industry (Nur 2017; Thomas 2013).

The flow experience theory has been adopted by more and more scholars and used flow experience as an important aspect to explain behavioral intentions. (Fraihat 2020; Park, 2020; Ha, 2020; Gao, 2020; Hassan, 2019; Hong, 2019).

Behavioral intention (BE): It is the main goal of the UTAUT model (Venkatesh et al. 2003). It mainly refers to the degree to which someone will perform a certain action in the future. In this study, BE is defined as the degree to which vocational students will adopt e-learning systems in the future.

The PE has a Significant influence impact on BE in the UTAUT model (Venkatesh et al. 2003). PE has been consistently proven to be the most robust and the strongest predictor of BE (Daud et al. 2019). This is supported (Gunasinghe 2019; Alkhuwaylidee et al. 2019; Chao 2019; Garone and Pynoo 2019; Susanto 2019; Handoko 2019).

In this research, EE is defined as the degree to which professional students perceive the e-learning system to help them learn. In past studies, EE has also been shown to be an important predictor of BE (Venkatesh et al. 2003; Yakubu and Dasuki 2019; Rahman and Rosman et al. 2019; Odegbesan and Ayo et al. 2019).

This study SI is defined as the degree to which the vocational students perceive that important people in their lives think they should use one e-learning system. The previous studies have noted the positive influence of SI towards BE (Venkatesh et al. 2003; Olasina 2018; Zhang and Cao 2020; Saragih and Setyowati 2018).

As for PU, it is defined as the degree of improvement in the perceived learning effect of students in vocational schools when using e-learning systems. Previous studies have noted the positive impact of PU on BE (Davis et al. 2003; Al-Fraihat and Joy et al. 2018; Rafiee and Abbasian-Naghneh 2019; Farhan and Razmak et al. 2019).

Facilitating conditions (FC) are perceived enablers or barriers in the environment that influence a student's perception of ease or difficulty of performing a task when using the e-learning system. The previous studies have noted the positive influence of FC towards BE (Davis et al. 2003; Khechine and Raymond 2019; Camilleri and Affiliations 2019; Chopra and Madan 2019).

In this study, flow experience was taken as the target variable, and the BE was regarded as one of the important latent variables, but not as the target variable. This study defined flow experience as the degree to which the vocational student might have flow and focused on the e-learning scene.

Considering this objective, the following hypotheses were framed in this study:

H1: BE significantly FE.
H2: EE significantly BE.
H3: FC significantly BE.
H4: FC significantly FE.
H5: PE significantly BE.
H6: PU significantly BE.
H7: PU significantly FE.
H8: SI significantly BE.
H9: FC has an indirect effect on FE via BE.
H10: PU has an indirect effect on FE via BE.

3 Methodology

3.1 Measuring Instrument

After 5 professional groups of higher vocational schools talked, the questionnaire included 38 questions. This quantitative study used a set of questionnaires containing 38 e-learning questions. According to the 5-point Like force scale, the scores of the questionnaire items increased from completely non-compliant (1) to completely consistent with 5 points. According to the characteristics of higher vocational students, two indicators are added to the latent variable PU, include "the content is closely related to the competence requirements of advertised jobs.", "the content is closely related to the requirements stated in professional certificates."

3.2 Partial Least Square Structural Equation Modeling (PLS-SEM)

Measurement evaluation was analyzed by Least Squares (PLS) with SmartPLS3.0 software. Measurement model indicators are designed to evaluate potential or constructed measurement effects (Ingenhoff and Buhmann 2016). The evaluation of reflectivity measurement models includes convergence validity and discrimination Validity analysis. Convergence validity includes the following: CR, and AVE. The discriminant validity consisted of the following: Cross-loading, Fornell&Larker's criteria. The indicator reliability loadings of Higher than 0.70 means that the structure explains more than 50% of the indicator difference. Internal consistency reliability with a higher value has higher reliability. Convergence effectiveness measures the degree of convergence of the structure on its indicators by explaining the variance of the project through the extracted average variance (AVE). On the other hand, the validity of the discrimination determines the degree of empirical difference between the structure and other structures in the path model in terms of the degree of relevance between the path model and other structures and the difference in the way indicators in a single structure are expressed. (Sarstedt et al. 2014). Fornell&Larcker's criteria were used to determine discriminant validity for the reflective measurement model through cross-loading. This study aimed to analyze the measurement model consisting of seven constructs using SmartPLS 3.0 software.

3.3 Items Validity and Reliability

By selecting 10% of randomly selected students for a small sample test, the purpose is to test the reliability and validity of the questionnaire. It will be launched on July 19, 2020, and the questionnaire will be returned on July 20, 2020. We found that CR > 0.7, Cronbach's Alpha > 0.7, AVE > 0.5 for all indicators, but the observation of the cross-loading table found that the SI indicators were low, and in the differential validity table, the SI variable was not acceptable in Fornell&Larcker, so the judgment was inflated For the question of factors, by observing the VIF value, the three indicators of EE1, EE3, and EE5 with VIF > 5 are deleted from the questionnaire, and the FC7 indicator with VIF < 2 is deleted from the questionnaire. Remove the indicators of SI variables from the questionnaire. Then the items were examined for item redundancy or

possible multi-collinearity through item pairs. The results of the pilot test revealed 5 items were discarded and the total of 34 items is accepted with the Cronbach Alpha value is >0.90.

3.4 Population and Sample

The official questionnaire comes from two grade students who have successfully implemented the e-learning system in the year 2019 and 2020. The electronic questionnaire will be launched on July 21, 2020, and the questionnaire will be returned on July 23, 2020. The questionnaire after the test was distributed to 7810 students in the same school. Among the recovered documents, there are 165 unfinished answer sheets. There are 7645 complete answers, so the questionnaire response rate is 97.8%. The sample meets the requirements of the result equation model SmartPLS3. Therefore, it can be used to test hypotheses that we might make.

A totol of 7645 students from City College of Huizhou participated in this research. The respondents were both male (N = 4072, 53.3%) and female (N = 3573, 46.7%). Respondents came from 2 grades, the first year of higher vocational education (N = 3289, 43.0%) and the second year of higher vocational education (N = 4536, 57.0%). Respondents were distributed in 8 different types of majors, including art majors (N = 662, 8.7%), business majors (N = 1752, 22.9%), education majors (N = 541, 7.1%), mechanical and electrical majors (N = 1593, 20.8%), finance majors (N = 836, 10.9%), international docking majors (N = 419, 5.5%), electronic information majors (N = 1287, 16.8%), people's livelihood services majors (N = 555, 7.3%).

4 Findings and Discussion

4.1 Measurement Model Assessment

CR (BE = 0.964, EE = 0.953, FC = 0.959, FE = 0.939, PE = 0.937, PU = 0.955) all meet the recommended index > 0.7, and all of the Cronbach's alpha (BE = 0.959, EE = 0.938, FC = 0.948, FE = 0.902, PE = 0.910, PU = 0.937) all meet the recommended index > 0.7(See Table 1). Table 1 show that construct reliability was accepted (Hair Jr et al. 2016; Gefen et al. 2000; Kannan and Tan 2005).

Table 1. Measurement model result and item

Constructs	Items	Factor loading	AVE	Composite reliability	Cronbach alpha
BE	BE1	0.860	0.751	0.964	0.959
	BE2	0.875			
	BE3	0.869			
	BE4	0.867			
	BE5	0.834			
	BE6	0.873			
	BE7	0.880			
	BE8	0.859			
	BE9	0.883			

(*continued*)

Table 1. (*continued*)

Constructs	Items	Factor loading	AVE	Composite reliability	Cronbach alpha
EE	EE2	0.889	0.801	0.953	0.938
	EE4	0.903			
	EE6	0.895			
	EE7	0.895			
	EE8	0.893			
FC	FC1	0.849	0.796	0.959	0.948
	FC2	0.917			
	FC3	0.912			
	FC4	0.910			
	FC5	0.898			
	FC6	0.864			
FE	FE1	0.921	0.836	0.939	0.902
	FE2	0.889			
	FE3	0.933			
PE	PE1	0.883	0.788	0.937	0.910
	PE2	0.898			
	PE3	0.906			
	PE4	0.865			
PU	PU1	0.885	0.842	0.955	0.937
	PU2	0.926			
	PU3	0.930			
	PU4	0.929			

Table 2. The results of Fornell&Larcker

	BE	EE	FC	FE	PE	PU
BE	**0.867**					
EE	0.835	**0.895**				
FC	0.867	0.853	**0.892**			
FE	0.806	0.870	0.811	**0.915**		
PE	0.781	0.830	0.808	0.760	**0.888**	
PU	0.867	0.844	0.892	0.813	0.770	**0.917**

Table 3. The results of cross–loadings

	BE	EE	FC	FE	PE	PU
BE1	**0.860**	0.752	0.778	0.726	0.702	0.798
BE2	**0.875**	0.759	0.766	0.736	0.696	0.792
BE3	**0.869**	0.759	0.763	0.737	0.695	0.789
BE4	**0.867**	0.703	0.760	0.668	0.672	0.735
BE5	**0.834**	0.664	0.747	0.628	0.653	0.696
BE6	**0.873**	0.712	0.749	0.690	0.673	0.726
BE7	**0.880**	0.726	0.736	0.717	0.663	0.746
BE8	**0.859**	0.699	0.716	0.674	0.647	0.722
BE9	**0.883**	0.727	0.749	0.704	0.684	0.746
EE2	0.725	**0.889**	0.743	0.734	0.736	0.739
EE4	0.734	**0.903**	0.736	0.794	0.722	0.753
EE6	0.726	**0.895**	0.733	0.772	0.749	0.738
EE7	0.766	**0.895**	0.784	0.793	0.742	0.761
EE8	0.780	**0.893**	0.813	0.797	0.761	0.780
FC1	0.736	0.747	**0.849**	0.737	0.682	0.756
FC2	0.791	0.791	**0.917**	0.745	0.746	0.802
FC3	0.782	0.768	**0.912**	0.724	0.738	0.799
FC4	0.784	0.779	**0.910**	0.739	0.737	0.813
FC5	0.796	0.772	**0.898**	0.731	0.722	0.839
FC6	0.751	0.703	**0.864**	0.660	0.699	0.763
FE1	0.750	0.841	0.753	**0.921**	0.722	0.765
FE2	0.714	0.740	0.726	**0.889**	0.663	0.709
FE3	0.748	0.804	0.746	**0.933**	0.697	0.755
PE1	0.660	0.688	0.686	0.632	**0.883**	0.643
PE2	0.703	0.746	0.731	0.677	**0.898**	0.700
PE3	0.689	0.740	0.703	0.688	**0.906**	0.676
PE4	0.718	0.768	0.747	0.697	**0.865**	0.712
PU1	0.789	0.784	0.869	0.745	0.730	**0.885**
PU2	0.809	0.776	0.812	0.747	0.707	**0.926**
PU3	0.791	0.764	0.783	0.742	0.684	**0.930**
PU4	0.791	0.772	0.809	0.748	0.704	**0.929**

AVE (BE = 0.751, EE = 0.801, FC = 0.796, FE = 0.836, PE = 0.788, PU = 0.842) all meet the recommended index >0.5 (See Table 1). The smallest value of each AVE is 0.751, and the largest is 0.842, which exceeds the recommended value >50. Table 1 show that construct validity was accepted (Hair Jr et al. 2016).

See Table 1, all factor loads in the model exceed 0.7. The discriminative validity is measured using Fornell&Larker and evaluated by dividing the load (Hair Jr et al. 2016). See Table 3, according to the results displayed by the Fornell&Larker method, the square root mean of all AVEs in the table is greater than its correlation with other

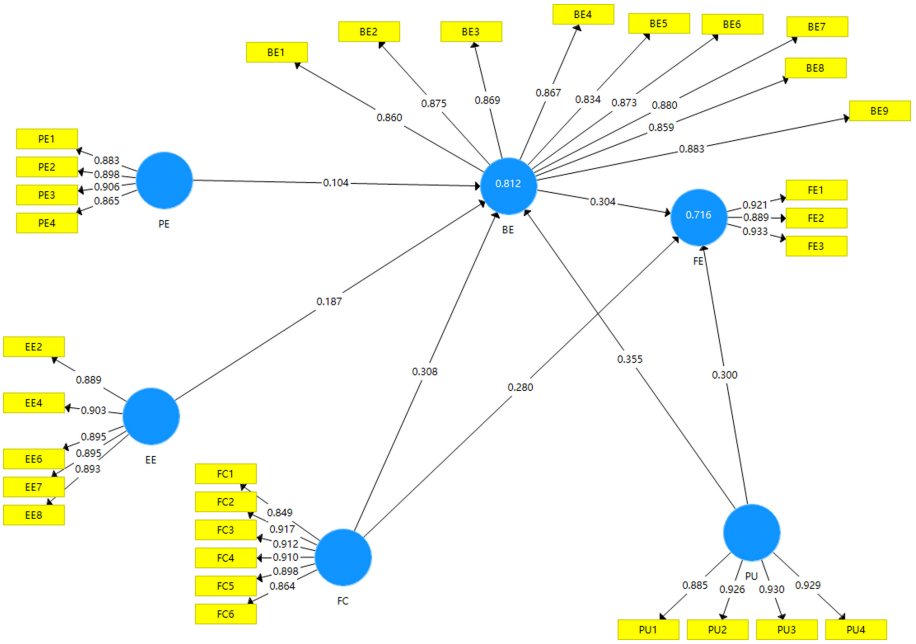

Fig. 2. PLS algorithm results

structures (Fornell&Larcker 1981). See Table 2, the index load on each structure in Table 2 is higher than that of its corresponding structure. Therefore, the discriminative validity of the modified model meets the requirements.

4.2 Structural Model Assessment

In the SmartPLS3.0 software, select the bootstrapping module, select 5000 bootstrap samples, the user can obtain the path coefficient, T value, P value and other indicators of parameters such as R2. Users can directly obtain indicators such as direct effects, indirect effects, and total indirect effects (Hair et al. 2016). See Table 4, Therefore, H1 (BE significantly FE) is received given that ($\beta = 0.304$, $t = 13.529$, $p < 0.001$). H2(EE significantly BE) is received with ($\beta = 0.187$, $t = 11.194$, $p < 0.001$). H3(FC significantly BE) is received with ($\beta = 0.308$, $t = 15.539$, $p < 0.001$). H4(FC significantly FE) is received with ($\beta = 0.280$, $t = 12.891$, $p < 0.001$). H5(PE significantly BE) is received with ($\beta = 0.104$, $t = 7.398$, $p < 0.001$). H6(PU significantly BE) is received with ($\beta = 0.355$, $t = 18.586$, $p < 0.001$). H7(PU significantly FE) is received with ($\beta = 0.300$, $t = 13.873$, $p < 0.001$) (See Table 4, Fig. 3).

In this study, all tests that have an indirect influence on the target variable need to use the method proposed by Preacher and Hayes (2004) and the method of Preacher and Hayes (2008) according to the indirect influence of the guideline.

As shown in Table 5, the indirect influence of FC- > BE- > FE with ($\beta = 0.093$, $t = 11.411$, $p < 0.001$, $LL = 0.078$, $UL = 0.110$). It was therefore determined that BE

has a meaningful mediating effect between FC and FE, Therefore H9(FC has an indirect effect on FE via BE) is confirmed.

Table 4. Structural assessment result

Hypothesis	Relationship	Std Beta	t-value	p-value	LL	UL	Decision
H1	BE - > FE	0.304	13.529	0.000	0.258	0.347	Supported
H4	FC - > FE	0.280	12.891	0.000	0.237	0.322	Supported
H7	PU - > FE	0.300	13.837	0.000	0.258	0.343	Supported
H2	EE - > BE	0.187	11.194	0.000	0.154	0.220	Supported
H3	FC - > BE	0.308	15.539	0.000	0.267	0.346	Supported
H5	PE - > BE	0.104	7.398	0.000	0.077	0.131	Supported
H6	PU - > BE	0.355	18.586	0.000	0.317	0.392	Supported
H9	FC-BE-FE	0.093	11.411	0.000	0.078	0.110	Supported
H10	PU-BE-FE	0.108	11.777	0.000	0.090	0.125	Supported

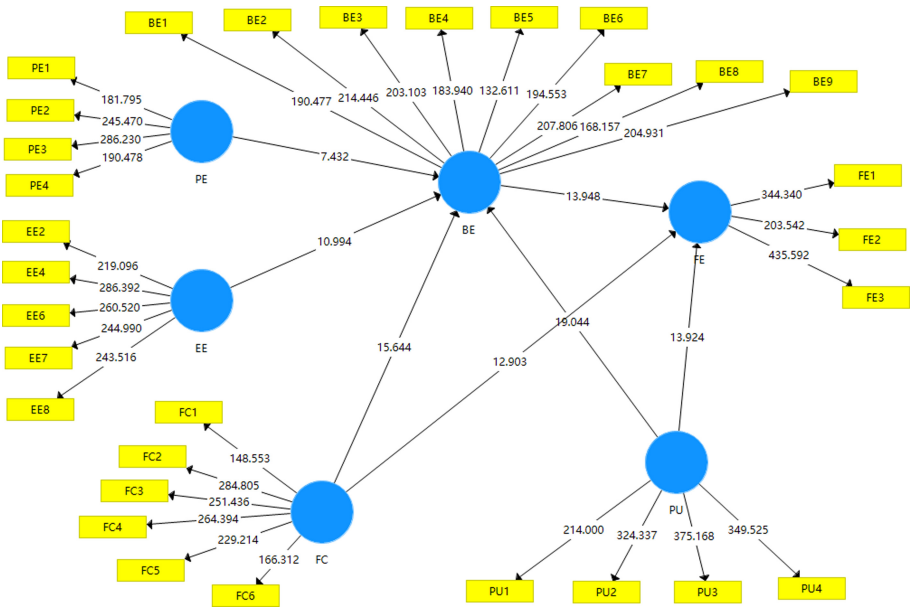

Fig. 3. Bootsrapping results

Table 5. Specific indirect effect

Path coefficient	β	t-value	p-value	2.50%	97.50%
FC - > BE - > FE	0.093	11.411	0	0.078	0.11
PU - > BE - > FE	0.108	11.777	0	0.09	0.125

As shown in Table 5, the indirect influence of PU- > BE- > FE with (β = 0.108, t = 11.777, p < 0.001, LL = 0.090, UL = 0.125). It was therefore determined that BE has a meaningful mediating effect between PU and FE, Therefore H10(PU has an indirect effect on FE via BE) is also confirmed.

Williams and MacKinnon (2008) put forward the view of mediation effect. The mediating effect was judged by the VAF score. The intermediate effects of FC and PU are respectively the total effects of FC and PU, and their VAF scores are obtained respectively. When the VAF score is >20% but less than 80%, the latent variable is considered to have a partial mediating effect (Iacobucci, Saldanha, and Deng 2007). From Table 4 and Table 5, The VAF value indicates the result, the VAF of FC- > BE- > FE = 0.249; the VAF of PU- > BE- > FE = 0.264. Therefore, H9(FC has an indirect effect on FE via BE), and therefore H10 (PU has an indirect effect on FE via BE) is also confirmed) have a partial mediating effect.

In Fig. 2, the results revealed that behavioral intention, facilitating conditions, and perceived usefulness had explained 71.6% of the variance in effort expectancy. EE, FC, PE, and PU explained the 81.2% variance of behavioral intention to use e-learning. According to Chin (1998), the R2 of this model is acceptable.

4.3 Importance-Performance Map Analysis (IPMA)

According to Table 6, PU (0.408, 68.038), FC (0.372, 70.569) have high importance and high performance to the flow experience. However, EE (0.057,66.547) and PE (0.032,69.075) are not important but perform well. They are still worth noting. PU and FC have high importance and high performance for behavioral intentions, while EE and PE have low importance but high performance, which cannot be ignored. Based on the results of IPMA, in e-learning, PU and FC can enable vocational students to experience important indicators of flow and play an important role. For vocational students, PU and FC are the most important key indicators of BE.

Table 6. Results of IPMA

Latent constructs	Importance for FE	Performance for FE	Importance for BE	Performance for BE
BE	0.304	69.017		
EE	0.057	66.547		
FC	0.373	70.569		
PE	0.032	69.075		
PU	0.408	68.038		
EE			0.187	66.547
FC			0.308	70.569
PE			0.104	69.075
PU			0.355	68.038

This research mainly extracts the main influencing factors of higher vocational education students' flow experience using e-learning. Based on the UTAUT model, it is proposed that the flow experience theory should be combined, and the behavioral intentions should be aimed at students' ability to produce better flow experience. Therefore, in the basic model, the flow experience structure is added. Also, according to the actual situation of employment competitiveness and skill certificates, which are the focus of higher vocational education, "The content is closely related to the competence requirements of advertised jobs." and "The content is closely related to The requirements stated in professional certificates.", extended the UTAUT model, and proposed a behavioral intention model for higher vocational students using e-learning. The model was analyzed using SmartPLS3.0, The results show the model achieve explain 71.6% of the variance of FE, and 81.2% the variance of BE. Finally, through IPMA analysis, PU has the greatest Performance impact total effect on BE and EE. This data comes from students who have used the e-learning system from City College of Huizhou in the two years. This research result has certain reference value for regional higher vocational education. How to design one e-learning system suitable for higher vocational students? How to promote the flow experience of students? How to best use artificial intelligence technology and big data technology in the smart education platform? How to design and implement courses based on the behavior characteristics of vocational students? This research has practical reference value.

5 Conclusion and Future Works

5.1 Study Contributions and Discussion

The purpose of this study was to extract the factors that influence the intention to use e-learning from the viewpoint of senior vocational students. The results of the data analysis are considered; the relevance of the proposed research model is illustrated and the behavioral intentions of vocational students using e-learning are analyzed under the hypothesis. A structural equation model (PLS-SEM) was used to analyze the research hypothesis. The UTAUT model was modified and the factors of process experience were added. Discriminant validity was analyzed at the prediction phase. It was discovered that the cross-loading of the SI surface and the Fornell&Larker did not satisfy the requirements of the structural equation (PLS-SEM). Therefore, the research model of vocational students' behavioral intentions for e-learning was revised and the association between vocational students' interest in future positions and skill certificates was added in terms of perceived PU. As regards the content usefulness, the eight hypotheses were tested using the PLS technique. It was noted that behavioral intention BE, facilitation FC and perceived content usefulness PU accounted for 71.6% of the variance in flow experience. And it was found that perceived content usefulness PU and facilitation con-dition FC partially mediated the flow experience FE through behavioral intent BE. All eight hypotheses were supported. The study showed that the positive factors influenc-ing the behavioral intentions of vocational students to use e-learning were PU and FC, and the facilitators were EE and PU. For senior students, the positive factors for using e-learning to experience flow experience were BE, PU, and FC. And PU was the most important factor in IPMA analysis.

5.2 Limitations and Future Directions

The study is limited by under-representation as other regions and their findings were not considered. The sample may introduce bias. However, the valid sample covers almost all students in both grades of the school, which could represent the views of students in a particular vocational school. Therefore, the results may not be generalizable to students in other schools, but the views of students in the same type of advanced vocational schools are still informative. The research is aimed at students in regional vocational schools and is exploratory in some nature. The research scope will be expanded in the future.

The results of this study show that practical research on specific factors will continue in the future and provide several opinions as references. First, the future research direc-tion should confirm what are the important factors of vocational school students that have not been detected or verified? Such as behavior habits, hedonic motivation, etc. The second is to study this to further understand whether the samples truly reflect their thoughts during the survey process. If you want to extract the actual behavior of stu-dents in e-learning and include them in the research model? Third, expand the scope of research and understand the generality of this model. Finally, it should be possible to find out that the sample response will be the most efficient at different stages by exper-imental research. For example, different majors, different learning stages, different courses, etc.

References

Holmes, W., Bialik, M., Fadel, C.: Artificial Intelligence in Education. Center for Curriculum Redesign, Bos-ton (2019)

Shuguang, L., Zheng, L., Lin, B.: Impact of artificial intelligence 2.0 on teaching and learning. In: Proceedings of the 2020 9th International Conference on Educational and Information Technology, pp. 128–133 (2020)

Wandasari, Y., Kristiawan, M., Arafat, Y.: Policy evaluation of school's literacy movement on improving discipline of state high school students. Int. J. Sci. Technol. Res. **8**(4), 190–198 (2019)

Abbas, J., Aman, J., Nurunnabi, M., Bano, S.: The impact of social media on learning behavior for sustainable education: evidence of students from selected universities in Pakistan. Sustainability **11**(6), 1683 (2019)

Huda, M.: Empowering application strategy in the technology adoption. J. Sci. Technol. Policy Manage. (2019)

Csikszentmihalyi, M.: Flow and education. NAMTA J. **22**(2), 2–35 (1997a)

Hsu, C.-L., Hsi-Peng, L.: Why do people play online games? an extended tam with social influences and flow experience. Inf. Manage. **41**(7), 853–868 (2004)

Shin, N.: Online learner's 'Flow'experience: an empirical study. Br. J. Educ. Technol. **37**(5), 705–720 (2006)

Müller, F.A., Wulf, T.: Flow experience in blended learning: behind the inconsistent effects of flexibility and interaction. In: Paper presented at the Academy of Management Proceedings (2020)

Wan, Q., Liu, M., Gao, B., Chang, T., Huang, R.: The relationship between self-regulation and flow experience in online learning: a case study of global competition on design for future education. In: Paper presented at the 2020 IEEE 20th International Conference on Advanced Learning Technologies (ICALT), pp. 365–367 (2020)

Csikszentmihalyi, M.: Flow and education. NAMTA J. **22**(2), 2–35 (1997b)

Lee, E.: The relationship of motivation and flow experience to academic procrastination in university students. J. Genet. Psychol. **166**(1), 5–15 (2005)

Skadberg, Y.X., Kimmel, J.R.: Visitors' flow experience while browsing a web site: its measurement, contributing factors and consequences. Comput. Hum. Behav. **20**(3), 403–422 (2004)

Williams, M.D., Rana, N.P., Dwivedi, Y.K.: The unified theory of acceptance and use of technology (Utaut): a literature review. J. Enterp. inf. Manage. (2015)

Almaiah, M.A., Alyoussef, I.Y.: Analysis of the effect of course design, course content support, course assessment and instructor characteristics on the actual use of e-learning system. IEEE Access **7**, 171907–171922 (2019)

Tarhini, A., El-Masri, M., Ali, M., Serrano, A.: Extending the utaut model to understand the customers' acceptance and use of internet banking in Lebanon. Inf. Technol. People (2016)

Isaac, O., Abdullah, Z., Aldholay, A.H., Ameen, A.A.: Antecedents and outcomes of internet usage within organisations in Yemen: an extension of the Unified Theory of Acceptance and Use of Technology (UTAUT) model. Asia Pac. Manage. Rev. **24**(4), 335–354 (2019)

Yakubu, M.N., Dasuki, S.I.: Factors affecting the adoption of e-learning technologies among higher education students in Nigeria: a structural equation modelling approach. Inf. Dev. **35**(3), 492–502 (2019)

Tan, P.J.B.: Applying the UTAUT to understand factors affecting the use of English e-learning websites in Taiwan. Sage Open **3**(4), 2158244013503837 (2013)

Lin, H.-M., Lee, M.-H., Liang, J.-C., Chang, H.-Y., Huang, P., Tsai, C.-C.: A review of using partial least square structural equation modeling in e-learning research. Br. J. Educ. Technol. **51**(4), 1354–1372 (2020)

Alkhuwaylidee, A.R.: Extended Unified Theory Acceptance and Use Technology (UTAUT) for e-learning. J. Comput. Theoret. Nanosci. **16**(3), 845–852 (2019)

Salloum, S.A., Shaalan, K.: Factors affecting students' acceptance of e-learning system in higher education using UTAUT and structural equation modeling approaches. In: Hassanien, A.E., Tolba, M.F., Shaalan, K., Azar, A.T. (eds.) AISI 2018. AISC, vol. 845, pp. 469–480. Springer, Cham (2019). https://doi.org/10.1007/978-3-319-99010-1_43

Gitau, M.W.: Application of the UTAUT model to understand the factors influencing the use of web 2.0 tools in e-learning in Kenyan public universities. University of Nai-robi (2016)

Gunasinghe, A., Abd Hamid, J., Khatibi, A., Azam, S.F.: The Ad-equacy of Utaut-3 in interpreting academician's adoption to e-learning in higher education environments. Interact. Technol. Smart Educ. (2019)

Khechine, H., Augier, M.: Adoption of a social learning platform in higher education: an extended UTAUT model implementation. In: Paper presented at the Proceedings of the 52nd Hawaii International Conference on System Sciences (2019)

Kang, M., Liew, B.Y.T., Lim, H., Jang, J., Lee, S.: Investigating the determinants of mobile learning acceptance in Korea using UTAUT2. In: Chen, G., Kumar, V., Kinshuk, {.}., Huang, R., Kong, S.C. (eds.) Emerging Issues in Smart Learning. LNET, pp. 209–216. Springer, Heidelberg (2015). https://doi.org/10.1007/978-3-662-44188-6_29

Salloum, S.A.S., Shaalan, K.: Investigating students' acceptance of e-learning system in higher educational environments in the Uae: applying the extended technology acceptance model (Tam). The British University in Dubai (2018)

Alshehri, A., Rutter, M.J., Smith, S.: An implementation of the Utaut model for understanding students' perceptions of learning management systems: a study within tertiary institutions in Saudi Arabia. Int. J. Distance Educ. Technol. (IJDET) **17**(3), 1–24 (2019)

Al-Fraihat, D., Joy, M., Sinclair, J.: A comprehensive model for evaluating e-learning systems success. Distance Learn. **15**(3), 57–88 (2018)

Maldonado, U.P.T., Khan, G.F., Moon, J., Rho, J.J.: E-Learning motivation and educational portal acceptance in developing countries. Online Information Review (2011)

Valencia-Arias, A., Chalela-Naffah, S., Bermúdez-Hernández, J.: A proposed model of e-learning tools acceptance among university students in developing countries. Educ. Inf. Technol. **24**(2), 1057–1071 (2019)

Kanwal, F., Rehman, M.: Factors affecting e-learning adoption in developing countries-empirical evidence from Pakistan's higher education sector. IEEE Access **5**, 10968–10978 (2017)

Tarmuji, N.H., Ahmad, S., Abdullah, N.H.M., Nassir, A.A., Idris, A.S.: Perceived resources and technology acceptance model (PRATAM): students' acceptance of e-Learning in mathematics. In: Mohamad Noor, M.Y., Ahmad, B.E., Ismail, M.R., Hashim, H., Abdullah Baharum, M.A. (eds.) Proceedings of the Regional Conference on Science, Technology and Social Sciences (RCSTSS 2016), pp. 135–144. Springer, Singapore (2019). https://doi.org/10.1007/978-981-13-0203-9_13

Nur, M.N.A., Faslih, A., Nur, M.N.A.: Analysis of behaviour of e-learning users by unified theory of acceptance and use of technology (Utaut) model a case study of vocational education in Halu oleo University. Jurnal Vokasi Indonesia **5**(2) (2017)

Thomas, T., Singh, L., Gaffar, K.: The utility of the Utaut model in explaining mobile learning adoption in higher education in Guyana. International Journal of Education and Development using ICT **9**(3) (2013)

Venkatesh, V., Morris, M.G., Davis, G.B., Davis, F.D.: User acceptance of information technology: toward a unified view. MIS quarterly, pp. 425–478 (2003)

Daud, S.M., et al.: A comparison of long-term fouling performance by zirconia ceramic filter and cation exchange in microbial fuel cells. Int. Biodeterior. Biodegradation **136**, 63–70 (2019)

Chao, D., Zhou, W., Ye, C., Zhang, Q., Chen, Y., Lin, G., Davey, K., Qiao, S.-Z.: An electrolytic Zn–Mno2 battery for high-voltage and scalable energy storage. Angew. Chem. Int. Ed. **58** (23), 7823–7828 (2019)

Garone, Anja., et al.: Clustering university teaching staff through Utaut: implications for the acceptance of a new learning management system. Br. J. Educ. Technol. **50**(5), 2466–2483 (2019)

Meiryani, M., Susanto, A., Warganegara, D.L.: The issues influencing of environmental accounting information systems: an empirical investigation of Smes in Indonesia. Int. J. Energy Econ. Policy **9**(1), p. 282 (2019)

Handoko, W., Pahlevani, F., Sahajwalla, V.: Effect of austenitisation temperature on corrosion resistance properties of dual-phase high-carbon steel. J. Mater. Sci. **54**(21), 13775–13786 (2019)

Odegbesan, O.A., Ayo, C., Oni, A.A., Tomilayo, F.A., Gift, O.C., Nnaemeka, E.U.: The prospects of adopting e-learning in the Nigerian education system: a case study of covenant university. In: Paper presented at the Journal of Physics: Conference Series (2019)

Olasina, G.: Factors of best practices of e-learning among undergraduate students. Knowl. Manage. E-Learn. Int. J. **10**(3), 265–289 (2018)

Saragih, A.H., Setyowati, M.S., Hendrawan, A., Lutfi, A.: Student perception of student centered e-learning environment (Scele) as media to support teaching and learning activities at the university of Indonesia. In: Paper presented at the IOP Conference Series: Earth and Environmental Science (2019)

Rafiee, M., Abbasian-Naghneh, S.: E-learning: development of a model to assess the acceptance and readiness of technology among language learners. Comput. Assist. Lang. Learn. pp. 1–21 (2019)

Farhan, W., Razmak, J., Demers, S., Laflamme, S.: E-learning systems versus instructional communication tools: developing and testing a new e-learning user interface from the perspectives of teachers and students. Technol. Soc. **59**, 101192 (2019)

Ingenhoff, D., Buhmann, A.: Advancing Pr measurement and evaluation: demonstrating the properties and assessment of variance-based structural equation models using an example study on corporate reputation. Public Relat. Rev. **42**(3), 418–431 (2016)

Sarstedt, M., Ringle, C.M., Smith, D., Reams, R., Hair Jr., J.F.: Partial least squares structural equation modeling (Pls-Sem): a useful tool for family business researchers. J. Fam. Bus. Strategy **5**(1), 105–115 (2014)

Hair Jr, J.F., Sarstedt, M., Matthews, L.M., Ringle, C.M.: Identifying and treating unobserved heterogeneity with fimix-Pls: part I–method. European Business Review (2016)

Fornell, C., Larcker, D.F.: Structural equation models with unobservable variables and measurement error: algebra and statistics. Sage Publications Sage CA: Los Angeles, CA (1981)

Preacher, K.J., Hayes, A.F.: SPSS and SAS procedures for estimating indirect effects in simple mediation models. Behav. Res. Methods, Instrum. Comput. **36**(4), 717–713 (2004)

Preacher, K.J., Hayes, A.F.: Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behav. Res. Methods **40**(3), 879–891 (2008)

Williams, J., David, P.M.: Resampling and distribution of the product methods for testing indirect effects in complex models. Struct. Eqn. Model. Multi. J. **15**(1), 23–51 (2008)

Iacobucci, D., Saldanha, N., Deng, X.: A meditation on mediation: evidence that structural equations models perform better than regressions. J. Consum. Psychol. **17**(2), 139–53 (2007)