Journal of Infrastructure, Policy and Development 2024, 8(13), 9213.
https://doi.org/10.24294/jipd.v8i13.9213

Article

From the tam model to the acceptance of using the flipped classroom in teaching at primary schools: A case study in Vietnam

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CITATION

Hung VT, Quyen NK, Tram NTB, et al. (2024). From the tam model to the acceptance of using the flipped classroom in teaching at primary schools: A case study in Vietnam. Journal of Infrastructure, Policy and Development. 8(13): 9213. https://doi.org/10.24294/jipd.v8i13.9213

ARTICLE INFO

Received: 19 September 2024
Accepted: 31 October 2024
Available online: 6 November 2024

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Abstract: The flipped classroom (FC) model has long brought significant benefits to higher education, secondary, and elementary education, particularly in improving the quality and effectiveness of learning. However, the implementation of FC model to support elementary students in developing self-learning skills (autonomous learning, independent study, self-directed learning) through technology still faces numerous challenges in Vietnam due to various influencing factors. Data for the study were collected through direct questionnaires and online surveys from 517 teachers at elementary schools in Da Nang, Vietnam. Based on SEM analysis, the study identified factors such as perceived usefulness, accessibility, desire, teaching style, and facilitating conditions. The research findings indicate that factors like the perceived effectiveness of the model, teaching style, and facilitating conditions have a positive correlation with the decision to adopt the FC model. Therefore, to encourage the use of the FC model in teaching, it is essential to raise awareness of the model's effectiveness, improve teaching styles, and create favorable conditions for implementation.

Keywords: the flipped classroom model; influence of factors; elementary education; intention to use

1. Introduction

The Fourth Industrial Revolution has transformed Information Technology, prompting innovations in teaching methods. These innovations shift from traditional, one-way instruction to active learning. The aim is to foster qualities like independence, critical thinking, creativity, self-learning, teamwork, and a passion for learning among students. There are many reference materials supporting this approach. In the book 'Active Learning Techniques for 21st Century Teaching and Learning' by Tarik (2023) various active teaching methods and the FC model are provided. Research from the 'Journal of Educational Technology and Society' by Zhang and Zhao (2022) affirms the value of integrating the FC with virtual interactive educational tools.

Based on the prominent advantages of the FC model, international researchers have focused on analyzing its impact on learners' quality and performance, as well as their engagement. To effectively organize FC, factors influencing the implementation of the model have also been of interest to researchers, including studies by Abeysekera (2015), Ateş (2023), Bakheet (2020), Cheng (2018) and Fidan (2021). Additionally, Liu et al. (2016), investigated the influence of seven factors on the effective organization of FC in education, covering general design, information design, technology use, active learning, learning motivation, specific guidance, and guided self-learning; they also applied the proposed model to teaching experiential activities. The challenges and barriers for teachers were analyzed by Wang (2017), including external factors such as equipment, training, support, and internal factors like resistance to change, confidence, and belief in teaching methods. Accordingly, certain conditions regarding equipment and basic IT skills for teachers and students are necessary to organize the FC model. Hung (2022) conducted an experimental study on the feasibility of the FC model in teaching, using online materials for teaching and learning before class through the web. The results showed that the application of FC helped improve learning performance and created a positive learning environment (Xue and Jing, 2024). Lin et al. (2021) analyzed factors affecting satisfaction and learning perception in flipped courses. Their study explored the relationship between quality factors (replacing quality factors in the ISSM with flipped learning foundation quality, video content quality, and teaching quality) and three types of interactions (student-content, student-teacher, and student-student).

Many studies highlight key factors necessary for utilizing the FC model such as: Technology access skills are essential (Bakheet et al., 2020); school infrastructure and students' home technology access must effectively support digital learning platforms (Ogundari, 2023). Teacher readiness is also an important factor (Alenezi, 2022). Teachers need not only be proficient in technology but also excel in creating engaging, student-focused learning experiences (Geinnotta and Haley, 2022). This often requires professional development and a shift in teaching philosophy. Additionally, parental involvement is crucial in the FC model (Tambunan, Silitonga and Sinaga, 2023). Parents need to be informed and supported, as they play a more active role in their children's education by facilitating the home learning phase. Moreover, the suitability of content for younger students in the flipped format must be carefully considered (Ölmefors and Scheffel, 2023). The material must be engaging and age-appropriate, ensuring that students can interact with the content independently or with minimal guidance. Furthermore, support from school administrators is necessary to provide essential resources and create an environment that encourages innovative teaching methods (Villalba et al., 2018). Schools must be prepared to invest in the necessary tools and training for the successful implementation of the FC model.

Research Questions:

(1) What are the main factors that influence the adoption of the FC model by elementary school teachers in Da Nang city in their teaching practices?

(2) What is the extent of the impact of each factor on the use of the FC model?

2. Theoretical framework

2.1. Model TAM

The Technology Acceptance Model (TAM) is a significant theoretical framework in the study of technology acceptance, developed by Fred Davis and further researched by Fred Davis and Richard Bagozzi in the 1980s. The primary goal of TAM is to explain and predict information technology (IT) usage behavior based on psychological and social factors. According to the TAM, Perceived Usefulness and Perceived Ease of Use are the two most important factors. Davis (1989) defined Perceived Usefulness as "the degree to which a user believes that using a specific technology will enhance their work performance or meet their personal goals" (Alalwan et al., 2020). Meanwhile, Perceived Ease of Use is "the degree to which a user believes that using a specific technology will be effortless and free of difficulty" (Lee et al., 2020). Subsequent studies have expanded and adjusted the TAM model (Bakheet, 2020). Venkatesh and Davis (2000) proposed TAM2, which expands the original model by adding Antecedent Knowledge to explain technology acceptance without prior user experience (Walczuch, 2007). Bagozzi (2007) proposed several improvements and a new approach to the TAM model, also suggesting a significant shift in approach and theory (Soomro et al., 2020).

Choosing the Technology Acceptance Model (TAM) as the theoretical framework for our research is justified as it has been proven effective in studying technology acceptance across various fields, including education (Munir et al., 2021). As the FC model increasingly gains attention as a popular teaching method, applying the TAM helps to better understand teachers' perceptions and behaviors towards new educational technologies. In this study, assessing teachers' perceived effectiveness (PE) regarding their ability to enhance pedagogical quality through the FC model is crucial. For the aspect of perceived ease of use (PEOU), analyzing the factors of the information technology infrastructure that supports teachers in using and organizing FC is essential. Literature such as "Teachers' Perceptions and Behaviors towards the Use of Information Technology in Teaching" (Baş, 2016; Betihavas, 2021) can provide detailed insights into these factors and their impact on the FC teaching process. Meanwhile, teachers' willingness to use and organize FC also plays an important role, as it can offer information about teachers' purposes and expectations in incorporating information technology into teaching (Sun, 2023).

2.2. Proposed model

Applying research related to the factors and benefits of the FC model helps us better understand the perceptions, desires, and approaches of teachers towards using and organizing FC, thus providing directions for improving and optimizing the teaching process. Based on the Technology Acceptance Model (TAM), the paper proposes a research model as shown in **Figure 1**.

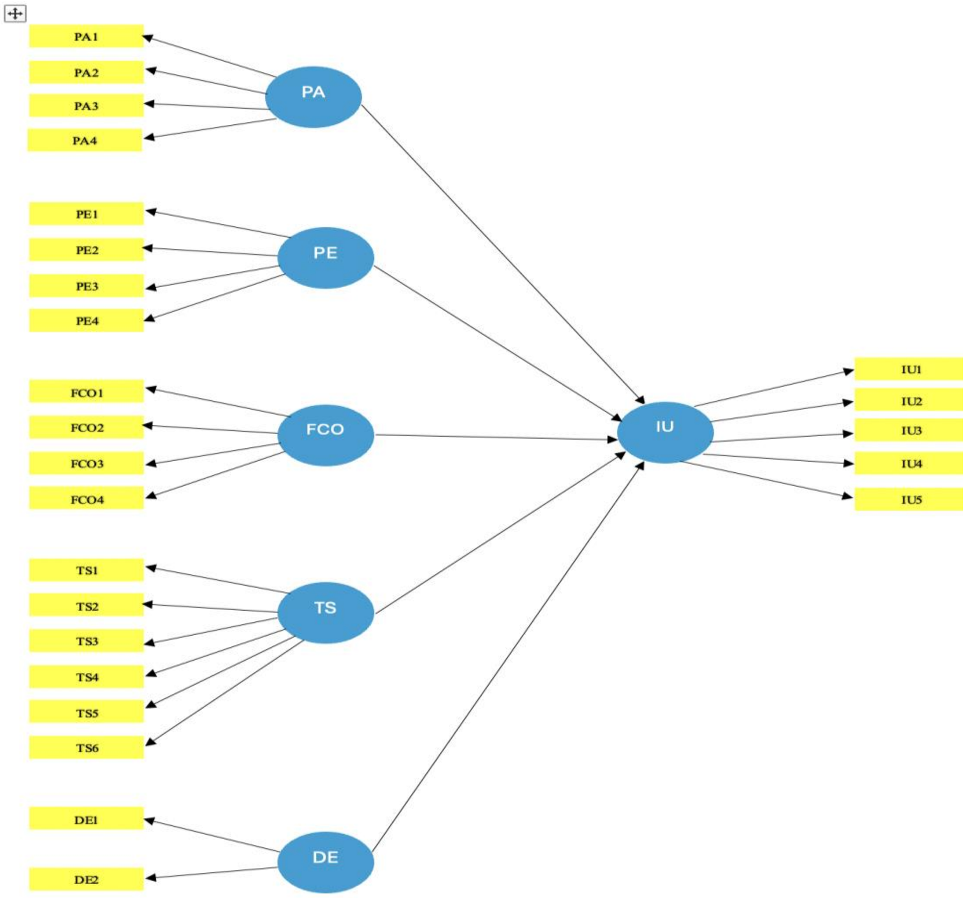

Figure 1. Proposed model.

3. Review of literature and hypothesis development

3.1. Perceived effectiveness (PE)

Perceived Effectiveness (PE) in this study is understood as teachers' perceptions of their ability to enhance pedagogical quality when organizing instruction activities using the FC model. This requires teachers to not only understand the benefits and conveniences of the FC model but also know how to evaluate and measure its effectiveness. In the study by Samaila et al. (2021), the authors explored the relationship between perceptions of effectiveness and intentions to use the FC model. The results of this study provide an overview of how perceptions of effectiveness can influence intentions to use the FC model in various countries, offering important insights into trends and practices in international education. Teachers adapt to the FC from the perspective of Activity Theory (Melliti et al., 2023). From these analyses, we propose four observed variables to analyze the factor of perceived effectiveness (PE). First, learning effectiveness (PE1) focuses on examining how this model affects student learning outcomes and whether it achieves the desired results. Strayer (2012) provided analyses on the impact of quality in the intention to use FC. Second, self-learning and autonomy (PE2) relate to students' abilities to learn independently and self-manage during the learning process, assessing the extent to which the FC model encourages student autonomy and self-learning. According to Bishop and Verleger

(2013), the ability to develop capacities for self-motivation and interest in learning is a motivation for teachers to change and update teaching methods. Third, knowledge responsiveness (PE3) focuses on assessing the ability of the FC model to meet knowledge needs, achieving set learning objectives, and deepening understanding of content. Finally, student skills assessment (PE4) refers to how the FC model supports teachers in evaluating student capabilities. Therefore, we hypothesize that:

H1: Perceptions of the effectiveness of the FC model have a direct impact on the intention to use FC in elementary teaching

3.2. Perceived accessibility (PA)

Accessibility encompasses the availability of technological infrastructure, such as digital tools and platforms necessary for implementing the FC model. When teachers perceive that these resources are readily accessible and easy to use, their confidence in adopting the model increases. For instance, schools that provide comprehensive training and reliable technological support enable teachers to feel competent and prepared to incorporate the FC model into their lessons. Ensuring that teachers have access to both the tools and the knowledge necessary to use them effectively is crucial for fostering positive attitudes towards the FC model. According to Hodges et al. (2020), there is a distinction between emergency remote teaching and online learning. The authors suggest that deploying the FC model could be a useful means of transitioning from traditional teaching models to online formats. Perceived accessibility can be strengthened by providing online resources, utilizing online learning platforms, and ensuring that teachers are fully trained and supported to use technology effectively (Atta and Bonyah, 2023). The factor of perceived accessibility (PA) is observed through four variables (PA1, PA2, PA3, PA4). The first observed variable is ease of access (PA1), understood as the ease with which teachers can access technologies and resources related to FC. According to O'Connor and Andrews (2018), providing easy-to-use tools and platforms can increase teachers' confidence in adopting the FC model. The second variable, infrastructure development (PA2), relates to building IT infrastructures robust enough to support the deployment of FC. The next variable, diversity of learning materials (PA3), aims to assess the resources available to support teachers in implementing this model. O'Connor (2018) highlighted that diversity in learning materials enhances the appeal of a FC model session. Finally, data management (PA4) focuses on managing learning data and information related to the FC model. Using effective data management tools and methods can help teachers organize and monitor the learning process more accurately and smoothly.

H2: Perceived accessibility has a direct impact on the intention to use the Flipped Classroom in elementary teaching.

3.3. Desire (DE)

The desire to improve teaching practices and student outcomes motivates teachers to adopt innovative methods such as the FC model. Teachers who express a strong desire for professional growth and development often seek opportunities to implement new strategies that can enhance their effectiveness. This intrinsic motivation is vital as it drives teachers to engage with the FC model, experiment with its application, and overcome challenges associated with its use. Therefore, nurturing teachers' professional aspirations and providing opportunities for professional development can significantly influence their decision to use the FC model. Teachers' desire (DE) to use and organize the FC model is a crucial factor for employing FC in teaching processes. Understanding these desires can offer deeper insights into teachers' motivations and goals when adopting FC. Specifically, the DE factor is represented in two observed variables: Enhancing professional capacity (DE1) focuses on the desire to improve pedagogical skills and teaching abilities. According to Bates and Sangrà (2011), promoting teachers' professional development through FC is an essential goal to enhance the quality of teaching and learning. Effective use of information technology in teaching (DE2) is the observed variable related to teachers' needs to use technology effectively to create a positive and engaging learning environment. Wijnen (2023) provides detailed insights into teachers' desires when implementing FC and how information technology can be appropriately integrated into education to improve teaching and learning quality. At present, integrating flexible and systematic tools and software to create innovative and engaging lessons has become imperative.

H3: The desire to teach has a direct impact on the intention to use the FC model in elementary teaching.

3.4. Teaching style (TS)

Teaching style plays a significant role in adopting the FC model, as it reflects the flexibility and adaptability of educators in integrating new instructional methods. Teachers who prefer student-centered approaches and are open to shifting from traditional lecture-based methods to interactive, technology-enhanced learning environments are more likely to embrace the FC model. This shift in teaching style allows teachers to act as facilitators, guiding students through interactive activities and discussions. Therefore, teachers who adapt their styles to cover more collaborative and digital elements find the FC model beneficial and are motivated to adopt it. Teaching style (TS) is an indispensable part of pedagogical activities, representing how teachers apply and implement methods, techniques, and means to convey knowledge and develop students' skills. In this study, the teaching style using the FC model is observed through six variables such as the frequency of using the FC model (TS1). According to the research, the frequency of teachers using the FC model can vary depending on several factors including learning objectives, students' learning needs, and individual teaching styles. The study also focuses on the frequency of teachers' speech during lessons (TS2). The frequency of lecturing by teachers is significantly reduced compared to the traditional classroom model. In FC, teachers create opportunities and conditions for students to access and consume knowledge before class through pre-class materials. Teachers create a diverse and rich learning environment where students can interact and learn from each other. The observed variable about lesson introduction (TS3) states that introducing lessons in the FC model is a crucial step to study the habit of starting a lesson by teachers. This helps students prepare psychologically and have a preliminary understanding of the topic before coming to class. According to research by Gustian (2023), introducing lessons in FC model is not only about conveying information but also an opportunity to create interaction and stimulate students' curiosity before they begin the self-learning process. The observed variable about organizational form (TS4) is designed to focus on creating a flexible and interactive learning environment between teachers and students. Currently, the organizational form of FC is applied very diversely, from creating practical activities and applying knowledge to real-life knowledge to using integrated technology in the classroom. Research by Bishop et al. (2013), evaluated students' learning activities (TS5). Accordingly, teachers will encourage students to reason and analyze by encouraging them to present arguments and defend their views. Teachers may also present a real-life situation or problem and ask students to work in groups to come up with solutions and specific scenarios. Then, teachers have the toolset (TS6), creating conditions for implementing teaching ideas and assessing pedagogical effectiveness. Additionally, teachers can apply tools to make lessons interesting, captivating, and engaging.

H4: Teaching style has a direct impact on the intention to use the FC model in elementary teaching.

3.5. Favorable conditions (FCO)

Favorable conditions, including administrative support, training opportunities, and technological infrastructure, are essential for the successful adoption of the FC model. When teachers receive institutional backing, such as access to training programs and the necessary technological resources, they are more likely to feel confident and supported in their efforts to implement the FC model. Schools that foster a supportive environment for innovation and provide teachers with ongoing professional development encourage greater engagement with and adoption of new teaching methods like the FC model. Favorable Conditions (FCO) in this study focus on researching variables to provide an overview of the current situation. This factor includes four observations such as: Professional teams (FCO1), according to the research, professional teams still play an important role as in other traditional models. However, the role of professional teams may have some differences and customization to suit the flipped learning model. Professional teams can answer questions, provide feedback, and create support activities to help teachers understand and apply knowledge. Infrastructure (FCO2) also plays an important role in supporting and facilitating the learning process. A stable internet connection is essential for students to access online learning resources. Teachers and students need electronic devices such as computers or tablets to watch videos, access documents, and participate in online activities. Organizing, participating in activities (FCO3), and announcements and participation in training (FCO4) are also important factors in creating favorable conditions. Training sessions will support teachers in accessing and using the FC model. Participation in activities and training not only helps teachers develop skills and knowledge but also creates an environment for exchanging and sharing experiences about organizing FC. At the same time, it is also an opportunity to create relationships, exchanges, and share experiences among members of the educational community.

H5: Favorable conditions have a direct impact on the intention to use the FC model in elementary teaching.

4. Methodology

4.1. Data collection and participants

The study on the intention to use the FC model among elementary school teachers in Da Nang city focuses on surveying 170 elementary school teachers about their adoption of FC model. This research also aims to gain a deeper understanding of the Technology Acceptance Model (TAM) and its empirical application in the educational context of Da Nang. Although the implementation of FC model in elementary education is still in its early stages in Vietnam in general and Da Nang in particular, previous studies on FC model in education have provided important information about the benefits of using the FC model in teaching elementary students. However, the development and application of FC model in education also present challenges (Alahmadi, 2022; Wasriep et al., 2020).

The participants in this study are 555 teachers currently teaching at elementary schools in Da Nang city, selected based on their experience and understanding of teaching. Data were collected over two months, from 26 January 2024, to 26 March 2024, through surveys and questionnaires both online and in person in the form of multiple-choice tests at four elementary schools in Da Nang city.

4.2. Method

We selected elementary school teachers in Da Nang City, focusing on those experienced in technology-integrated methods. Teachers with prior exposure to FC model methodologies were included, while those with less than one year of technology use experience were excluded.

Reliability and Validity of the Questionnaire:

Information about the demographics of the teachers was requested to be collected in the first part of the questionnaire, where details such as age, gender, educational level, and teaching experience were recorded. The second part of the questionnaire consisted of a total of 25 observed variables designed to measure teachers' intention to use the FC model. Participants were chosen from elementary school teachers in Da Nang City, focusing on those with experience in technology-integrated teaching methods. The inclusion criteria involved teachers currently teaching in elementary schools who had prior knowledge or exposure to FC model methodologies. Exclusion criteria included teachers with less than one year of experience in technology use in classrooms. Reliability and Validity of the Questionnaire: The questionnaire items were adapted from validated scales used in similar studies, ensuring their reliability. These variables were drawn from previously published literature and were adjusted to reflect the specific context of the study. The questions in the questionnaire are designed on a Likert scale with a range from 1 to 5, where 1 represents the lowest level and 5 represents the highest level. A pilot study was conducted to refine the questions, and Cronbach's Alpha values exceeded 0.7, confirming the internal consistency and reliability of the scales. Furthermore, expert reviews and confirmatory factor analysis

(CFA) were utilized to validate the constructs. This indicates the consistency and reliability of the measurement items used in this study.

4.3. Data analysis

We conducted data analysis using the SPSS (Statistical Package for the Social Sciences) application to examine the data, following the method outlined by Anderson and Gerbing (1988). The first step of the analysis involved evaluating the measurement model, where we assessed the reliability of the factor groups on the proposed scale. Next, we performed exploratory factor analysis (EFA) and applied multivariate regression equations. To illustrate the research model based on the theory of the TAM model, we utilized SmartPLS 4/SPSS software (Wong, 2013). This tool provides structural equation modeling methods and is capable of handling complex data within a linear structural model. The results of the analysis process will provide detailed information and specific figures for each question, supporting the main purpose of the study. This will help us gain a deeper understanding of the intention to use the FC model by elementary school teachers and the impact of various factors on their decisions.

5. Research results

5.1. Sample description

The study was conducted through direct surveys and online surveys on Google Forms with 555 teachers. A total of 385 teachers participated in the survey through direct forms and 170 teachers took part in the online survey. The surveyed teachers all held positions at primary schools located in Cam Le district, Hoa Vang district, and Ngu Hanh Son district. After processing the data, 517 out of 555 (93.15%) survey sheets were valid from primary schools in Da Nang City. According to the results from these 517 teachers with valid sheets, females constituted the majority with a percentage of 98.68%, 58.55% of the surveyed teachers had 10–25 years of experience, while 22.37% had more than 25 years of experience.

5.2. Reliability of the scale

To assess the reliability of the scale, the authors applied two indices: Cronbach's Alpha (CA) and Corrected Item-Total correlation (CITC). According to Hair et al. (2009), a scale is considered reliable when CA reaches a level of 0.7 or higher. Similarly, according to Cristobal et al. (2007), a scale is deemed good when the Corrected Item-Total correlation (CITC) of observed variables (OVs) is 0.3 or higher. This value reflects the correlation of each OV with other variables within the same group. The reliability increases as CITC increases, indicating a positive correlation between OV and other variables. The results of data analysis using IBM SPSS Statistics 26 software indicate that all OVs of the measurement scale have CITC surpassing the threshold of 0.3. The factors of the measurement scale have CA ranging from 0.727 to 0.934, meeting the reliability requirements. **Table 1** below shows the *CA* values for each factor of the measurement scale:

Table 1. Reliability of the scale.

Factor	Cronbach's Alpha
Perceived Effectiveness	0.859
Perceived Accessibility	0.891
Desire	0.727
Teaching Style	0.934
Favorable Conditions	0.916

5.3. Exploratory factor analysis (EFA) results

To assess the validity of the scale, the authors employed Exploratory Factor Analysis (EFA) to examine the relationships between the observed variables (OVs) across all factors, aiming to identify OVs that load onto multiple factors or OVs that are misallocated from the initial factors. The criteria used in the EFA analysis included: Kaiser-Meyer-Olkin (KMO) measure; Bartlett's test of sphericity; Eigenvalue; Total Variance Explained; and Factor Loading.

Table 2 shows that the KMO measure is 0.902, which is greater than 0.5, indicating that the factor analysis is appropriate. Bartlett's test with *Sig* = 0.000 < 0.05 demonstrates that the OVs are correlated with each other overall. Therefore, the exploratory factor analysis (EFA) is deemed appropriate.

Table 2. KMO measure and bartlett's test.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.902
Bartlett's Test of Sphericity	Approx. Chi-Square	10899.11
	df	300
	Sig.	0.000

Eigenvalue is used to determine the number of factors in EFA. From the obtained results, 6 factors were extracted based on the criterion that Eigenvalue is greater than 1. Therefore, these 6 factors best summarize the information of the 26 observed variables entered into EFA. These six factors are retained for analysis. The Total Variance Explained is 77.739%, which is greater than 50%, indicating that the 6 extracted factors explain 77.739% of the variation in the data of the 26 OVs included in EFA.

Table 3. Factor rotation matrix.

Rotated Component Matrix[a]						
	Component					
	1	2	3	4	5	6
TS3	0.892					
TS5	0.886					
TS4	0.881					
TS2	0.830					
TS1	0.815					
TS6	0.804					

Table 3. (*Continued*).

Rotated Component Matrix[a]						
	Component					
	1	**2**	**3**	**4**	**5**	**6**
IU1		0.862				
IU2		0.862				
IU3		0.832				
IU5		0.761				
IU4		0.740				
FCO2			0.888			
FCO3			0.856			
FCO4			0.831			
FCO1			0.730			
PA4				0.857		
PA3				0.848		
PA1				0.796		
PA2				0.791		
PE3					0.750	
PE2					0.750	
PE1					0.716	
PE4					0.705	
DE1						0.881
DE2						0.733

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
[a] Rotation converged in 6 iterations.

The author utilized Varimax rotation with a factor loading threshold of 0.5 to examine the correlation relationships between OVs and factors. **Table 3** demonstrates that OVs with similar characteristics converge in the same column, indicating that these variables converge towards the same factor. Additionally, when represented in the rotation matrix, groups of variables are separated into distinct columns, showing that these variables converge towards this factor and are distinguished from variables converging towards other factors.

After conducting EFA, the Observational Variables (OVs) within each measurement scale did not exhibit mixing among components. Therefore, the author retained the original factor names with the scale comprising 5 independent variables: PE (Perceived Efficiency), PA (Perceived Accessibility), DE (Desire), TS (Teaching Style), FCO (Facilitative Conditions), and 1 dependent variable: IU (Intention to Use).

5.4. Results of multivariate linear regression analysis

Following the EFA, the independent and dependent variables were utilized to conduct multivariate regression analysis. To assess the suitability of the model, the authors used the *F*-test to test the hypothesis H0: $R^2 = 0$. The results of the test obtained from **Table 4** indicate that Sig = 0.000 < 0.05, thus rejecting the null hypothesis H0, implying that R^2 is statistically significant. Therefore, the regression model is deemed appropriate.

Table 4. ANOVA table on model fit.

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	***F***	**Sig.**
	Regression	105.527	5	21.105	98.290	0.000[b]
1	Residual	109.725	511	0.215		
	Total	215.252	516			

[a] Dependent Variable: IU; [b] Predictors: (Constant), FCO, TS, PA, DE, PE.

Table 5 shows that all five independent variables in the regression analysis have a positive relationship with the intention to use. **Table 5** demonstrates a correlation coefficient (*R*) of 0.700, which is relatively high. The adjusted coefficient of determination is 0.485, meaning that 48.5% of the variation in Intention to Use is explained by the linear relationship between the study concepts.

This table also provides the Durbin–Watson statistic to assess first-order autocorrelation. The DW value of 1.969 falls within the range of 1.5 to 2.5, indicating that the results do not violate the assumption of first-order autocorrelation.

Table 5. Results of multivariate linear regression.

Model Summary[b]					
Model	***R***	***R* Square**	**Adjusted *R* Square**	**Std. Error of the Estimate**	**Durbin-Watson**
1	0.700[a]	0.490	0.485	0.46339	1.969

[a] Predictors: (Constant), FCO, TS, PA, DE, PE; [b] Dependent Variable: IU.

To assess the regression coefficients of each independent variable's significance within the model, the author relied on the t-test with the hypothesis H0: The regression coefficient of the independent variable Xi equals 0. In the t-test, according to the results obtained in **Table 6**, there are 4 independent variables: PE, PA, TS, and FCO, with *Sig* < 0.05, indicating that the coefficients of these variables are statistically significant, implying a direct impact on the dependent variable IU. Additionally, the remaining independent variable, DE, with *Sig* = 0.146 > 0.05, suggests that this variable does not have a significant impact on the dependent variable IU and only plays a supportive role for the other variables in the scale.

Table 6 reveals that among the 4 independent variables, PE, PA, TS, and FCO have positive regression coefficients (Beta), meaning these independent variables have a positive impact on the dependent variable. Specifically, Intention to Use is most strongly influenced by Perceived Efficiency ($\beta 1 = 0.403$), followed by Facilitative Conditions ($\beta 5 = 0.230$), Teaching Style ($\beta 4 = 0.140$), and Perceived Accessibility ($\beta 2 = 0.124$).

The Variance Inflation Factor (VIF) is an index used to assess multicollinearity in regression models. According to Hair et al. (2010), (where VIF above 10 indicates severe multicollinearity), **Table 6** shows that the VIF for each variable Xi is below 2, indicating no violation of the multicollinearity assumption.

Table 6. Regression coefficients of independent variables.

Coefficients[a]								
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	***t***	***Sig.***	**Collinearity Statistics**	
		B	**Std. Error**	**Beta**			**Tolerance**	**VIF**
1	(Constant)	0.028	0.206		0.136	0.892		
	PE	0.465	0.047	0.403	90.889	0.000	0.601	1.664
	PA	0.127	0.038	0.124	30.377	0.001	0.736	1.358
	DE	0.059	0.041	0.053	10.456	0.146	0.744	1.344
	TS	0.090	0.023	0.140	30.942	0.000	0.791	1.264
	FCO	0.270	0.046	0.230	50.912	0.000	0.659	1.517

[a] Dependent Variable: IU.

From the regression coefficients Beta, the author constructed the standardized regression equation as follows:

$$IU = 0.403PE + 0.230FCO + 0.140TS + 0.124PA + \varepsilon$$

5.5. Confirmatory factor analysis (CFA) results

After conducting Exploratory Factor Analysis (EFA) to serve CFA (**Figure 2)**, the initial assumption of CFA was that the observed variables were assigned to the identified factors. To assess the measurement model's adequacy, the author evaluated the internal consistency of factor structure and the relationships between factor structures.

The obtained results show that basic evaluation indices such as Chi-square/df= 3.836 ≤ 5, indicating acceptability; CFI = 0.932 ≥ 0.9, indicating good results; GFI = 0.857 ≥ 0.8, considered acceptable according to the studies by Baumgartner and Homburg (1995) and Doll, Xia, and Torkzadeh (1994); TLI = 0.921 ≥ 0.9, indicating good fit; RMSEA = 0.074 ≤ 0.08, considered acceptable. This demonstrates that the model is congruent with the initially declared factor structures.

After examining the overall fit of the CFA model, the author will proceed to evaluate the quality of observed variables (measurement model evaluation) to determine which observed variables are suitable and which ones are not and need to be removed. From the results of the two tables, Regression Weights and Standardized Regression Weights, the quality of observed variables in CFA can be evaluated.

Table 7. Regression weights: (Group number 1—default model).

			Estimate	**S.E.**	**C.R.**	***P***
TS3	←	TS	1.000			
TS5	←	TS	1.005	0.036	27.914	***
TS4	←	TS	0.957	0.034	28.369	***
TS2	←	TS	0.806	0.034	23.710	***
TS1	←	TS	0.887	0.037	24.202	***
TS6	←	TS	0.885	0.040	22.356	***
IU1	←	IU	1,000			
IU2	←	IU	1.011	0.016	62.836	***

Table 7. (*Continued*).

			Estimate	S.E.	C.R.	P
IU3	←	IU	0.815	0.021	39.433	***
IU5	←	IU	0.694	0.030	22.839	***
IU4	←	IU	0.770	0.033	23.435	***
FCO2	←	FCO	1.000			
FCO3	←	FCO	1.003	0.026	38.756	***
FCO4	←	FCO	0.887	0.030	29.815	***
FCO1	←	FCO	0.801	0.038	21.163	***
PA4	←	PA	1.000			
PA3	←	PA	0.971	0.035	27.564	***
PA1	←	PA	0.860	0.037	23.477	***
PA2	←	PA	0.856	0.043	19.819	***
PE3	←	PE	1.000			
PE2	←	PE	1.134	0.064	17.764	***
PE1	←	PE	1.028	0.060	17.024	***
PE4	←	PE	1.017	0.061	16.567	***
DE1	←	DE	1.000			
DE2	←	DE	1.738	0.171	10.183	***

Examining the *p*-values, according to the results from **Table 7**, all observed variables have a *p*-value of 0.000, which is less than 0.05. Thus, all observed variables are significant in the model.

Continuing to evaluate the Standardized Regression Weights to assess the explanatory power of the observed variables on the latent factor, the results in **Table 8** show that all observed variables have standardized regression weights in the "Estimate" column greater than 0.5, and even greater than 0.7. Therefore, the observed variables have a significant explanatory power for the latent factor.

Table 8. Standardized regression weights: (Group number 1—default model).

			Estimate
TS3	←	TS	0.879
TS5	←	TS	0.876
TS4	←	TS	0.883
TS2	←	TS	0.804
TS1	←	TS	0.813
TS6	←	TS	0.777
IU1	←	IU	0.973
IU2	←	IU	0.972
IU3	←	IU	0.890
IU5	←	IU	0.725
IU4	←	IU	0.734
FCO2	←	FCO	0.938

Table 8. (*Continued*).

			Estimate
FCO3	←	FCO	0.936
FCO4	←	FCO	0.849
FCO1	←	FCO	0.719
PA4	←	PA	0.922
PA3	←	PA	0.863
PA1	←	PA	0.790
PA2	←	PA	0.715
PE3	←	PE	0.734
PE2	←	PE	0.824
PE1	←	PE	0.787
PE4	←	PE	0.765
DE1	←	DE	0.642
DE2	←	DE	0.908

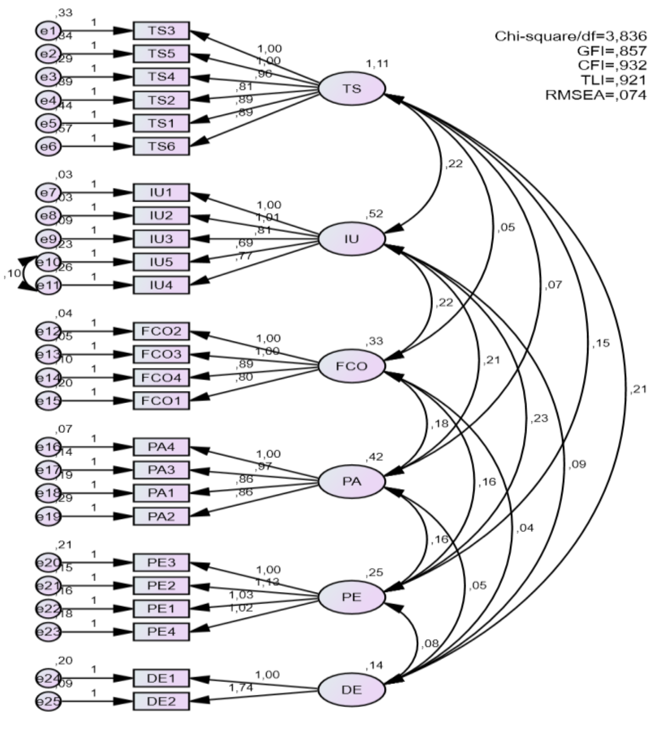

Figure 2. Confirmatory factor analysis CFA.

Next is the assessment of the reliability, convergent validity, and discriminant validity of the scale. Before considering the proposed hypotheses, the reliability and validity of the measurement items (indicators) and the scale (structure) were tested (Hair et al., 2010).

Firstly, the factor loading of each indicator was evaluated. Loadings ≥ 0.708 indicate acceptable item loadings. **Table 9** shows that the loadings of each item exceed the proposed value, indicating that all items have adequate reliability.

Secondly, two measures are used to assess internal consistency: Cronbach's Alpha (α) and Composite Reliability (CR). The minimum acceptable values of α and CR are recommended to be 0.7 and not ≥ 0.95 (Henseler and Sarstedt, 2013). This condition is met by all structures (see **Table 9**), indicating that internal consistency is present in all structures.

Thirdly, according to Hair et al. (2016), we use the AVE, MSV indices, and the Fornell and Larcker table to evaluate convergent validity and discriminant validity of the scale. Convergence is determined by testing the "extracted average variance—AVE" with a minimum acceptable AVE value of 0.5. As seen in **Table 9**, the AVE values of each structure generally exceed 0.5, demonstrating that convergence exists in all structures. The final test in this stage is to check discriminant validity. According to the results in **Table 9**, all factors have MSV values smaller than AVE, thus ensuring discriminant validity. Moving on to examine the square root of AVE for each variable (bold values at the beginning of each column along the arrows in the Fornell and Larcker table). Fornell and Larcker (1981) recommend that discriminant validity is ensured when the square root of AVE for each latent variable is higher than all correlations between latent variables. As presented in **Table 9**, this condition is met, concluding that discriminant validity is established.

Table 9. AVE, MSV indices and fornell and larcker criterion.

	CR	AVE	MSV	MaxR(H)	TS	IU	FCO	PA	PE	DE
TS	0.935	0.705	0.279	0.940	0.840					
IU	0.936	0.750	0.428	0.976	0.289	0.866				
FCO	0.922	0.748	0.317	0.947	0.083	0.526	0.865			
PA	0.895	0.683	0.249	0.919	0.103	0.456	0.484	0.826		
PE	0.860	0.606	0.428	0.863	0.285	0.654	0.563	0.499	0.778	
DE	0.759	0.618	0.279	0.844	0.528	0.331	0.185	0.190	0.404	0.786

5.6. Structural equation model (SEM) testing results

Commenting on the significance levels (*p*-values or sig) and Estimates. Using a 95% confidence level standard, according to **Table 10** and **Figure 3**, the sig value of DE's impact on IU is 0.478 > 0.05, indicating that the variable DE does not have a significant impact on IU. The remaining variables all have *sig* < 0.05, indicating that these relationships are significant. Therefore, there are 4 variables influencing IU: TS, FCO, PA, PE. Among the 5 hypotheses, we reject hypothesis H3, while the remaining hypotheses are accepted. In the Estimates column, positive values indicate that the variables TS, FCO, PA, PE have a positive impact on IU.

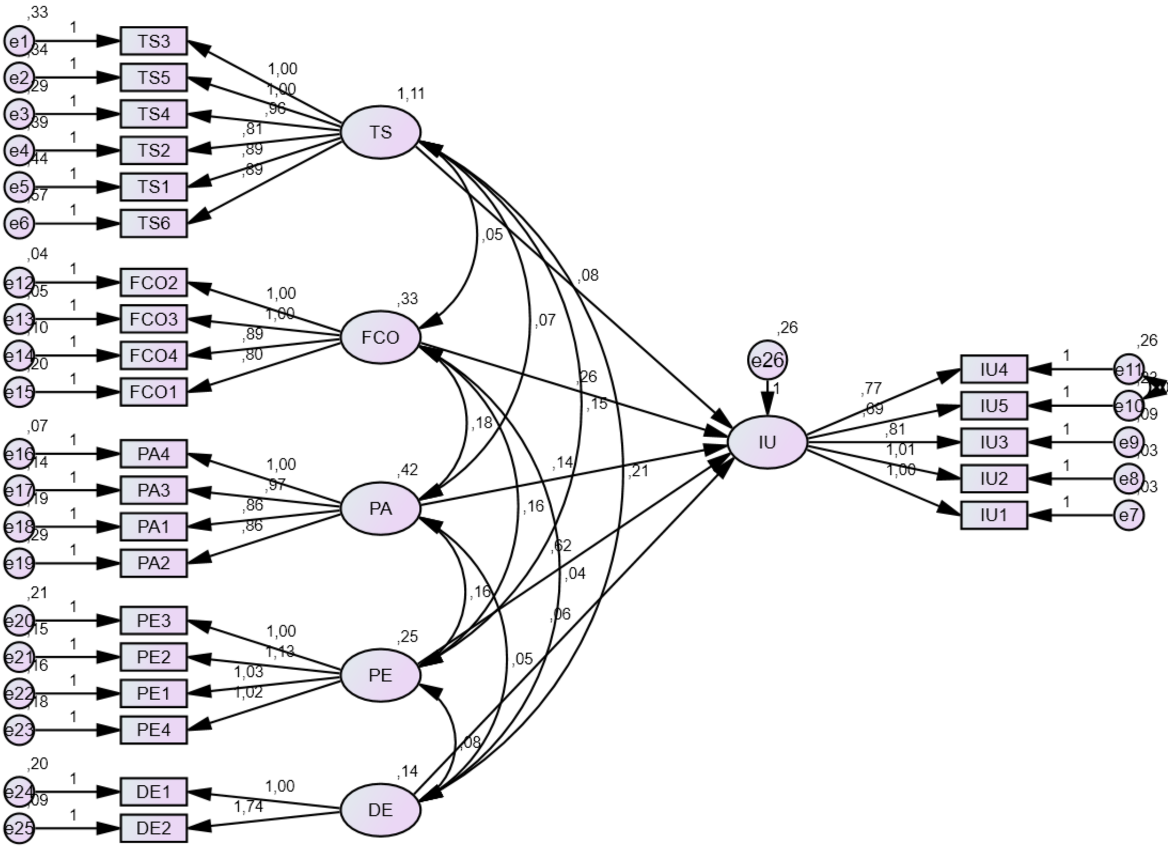

Figure 3. Linear structural SEM model.

Table 10. Regression weights: (Group number 1—default model).

			Estimate	S.E.	C.R.	*P*
IU	←	TS	0.082	0.029	2.817	0.005
IU	←	FCO	0.264	0.057	4.640	***
IU	←	PA	0.137	0.048	2.851	0.004
IU	←	PE	0.619	0.081	7.634	***
IU	←	DE	0.064	0.091	0.709	0.478
TS3	←	TS	1.000			
TS5	←	TS	1.005	0.036	27.914	***
TS4	←	TS	0.957	0.034	28.369	***
TS2	←	TS	0.806	0.034	23.710	***
TS1	←	TS	0.887	0.037	24.202	***
TS6	←	TS	0.885	0.040	22.356	***
IU1	←	IU	1.000			
IU2	←	IU	1.011	0.016	62.836	***
IU3	←	IU	0.815	0.021	39.433	***
IU5	←	IU	0.694	0.030	22.839	***
IU4	←	IU	0.770	0.033	23.435	***
FCO2	←	FCO	1.000			
FCO3	←	FCO	1.003	0.026	38.756	***
FCO4	←	FCO	0.887	0.030	29.815	***

Table 10. (*Continued*).

			Estimate	S.E.	C.R.	P
FCO1	←	FCO	0.801	0.038	21.163	***
PA4	←	PA	1,000			
PA3	←	PA	0.971	0.035	27.564	***
PA1	←	PA	0.860	0.037	23.477	***
PA2	←	PA	0.856	0.043	19.819	***
PE3	←	PE	1.000			
PE2	←	PE	1,134	0.064	17.764	***
PE1	←	PE	1.028	0.060	17.024	***
PE4	←	PE	1.017	0.061	16.567	***
DE1	←	DE	1.000			
DE2	←	DE	1.738	0.171	10.183	***

Continuing with the examination of the Standardized Regression Weights table, which presents the standardized regression coefficients, we will rely on the regression coefficient Estimate in this table to evaluate the extent of the impact of independent variables on the dependent variable. According to **Table 11**, among the 4 variables influencing IU, the order of decreasing impact of these variables is as follows: TS, FCO, PA, PE.

Table 11. Standardized Regression Weights: (Group number 1—Default model).

			Estimate
IU	←	TS	0.120
IU	←	FCO	0.210
IU	←	PA	0.123
IU	←	PE	0.427
IU	←	DE	0.034
TS3	←	TS	0.879
TS5	←	TS	0.876
TS4	←	TS	0.883
TS2	←	TS	0.804
TS1	←	TS	0.813
TS6	←	TS	0.777
IU1	←	IU	0.973
IU2	←	IU	0.972
IU3	←	IU	0.890
IU5	←	IU	0.725
IU4	←	IU	0.734
FCO2	←	FCO	0.938
FCO3	←	FCO	0.936
FCO4	←	FCO	0.849
FCO1	←	FCO	0.719

Table 11. (*Continued*).

			Estimate
PA4	←	PA	0.922
PA3	←	PA	0.863
PA1	←	PA	0.790
PA2	←	PA	0.715
PE3	←	PE	0.734
PE2	←	PE	0.824
PE1	←	PE	0.787
PE4	←	PE	0.765
DE1	←	DE	0.642
DE2	←	DE	0.908

Finally, we consider the Squared Multiple Correlations table. This table represents the squared value of *R*, indicating the proportion of variance in the dependent variable explained by the independent variables. According to **Table 12**, the squared multiple correlation (R^2) of IU is 0.491, which equals 49.1%. This means that the independent variables collectively explain 49.1% of the variance in IU.

Table 12. Squared multiple correlations: (Group number 1—default model).

	Estimate
IU	0.491
DE2	0.824
DE1	0.412
PE4	0.586
PE1	0.620
PE2	0.679
PE3	0.539
PA2	0.511
PA1	0.624
PA3	0.744
PA4	0.850
FCO1	0.517
FCO4	0.721
FCO3	0.876
FCO2	0.880
IU4	0.539
IU5	0.525
IU3	0.792
IU2	0.946
IU1	0.948
TS6	0.604
TS1	0.662

Table 12. (*Continued*)

	Estimate
TS2	0.647
TS4	0.780
TS5	0.768
TS3	0.772

6. Discussion

The findings demonstrate that PE significantly and positively influences PE1, PE2, PE3, and PE4, providing corresponding support for H1. Previous studies such as (Cheng, 2018; Hu and Kuo, 2020; Lei, 2021) have also found that PE is a key determinant related to PE1, PE2, PE3, and PE4. This indicates that the present study focuses on analyzing effective factors that may concentrate on specific aspects. This is the perception of educators about the extent to which applying the FC model contributes to effectiveness in the teaching and learning process. To analyze PE, the study used methods such as interviews, surveys, or direct observation in the classroom. In interviews, teachers may be asked about their perceptions of whether the FC model helps improve students' learning performance and what they think about applying this model in their daily teaching work. Surveys may require educators to assess their level of agreement with statements such as "The FC model adequately meets knowledge requirements" or "FC model is valuable in enhancing teaching quality".

The results show that PA significantly impacts IU, confirming hypothesis H2. Additionally, Chen et al.'s (2019) study provided an adjusted model of UTAUT, which evaluates the influence of TS on technological IU. The consistency and uniformity of these results from various studies enhance support for the notion that PA plays a crucial role in promoting the application and success of the FC model in modern education.

The study has shown that the positive influence of DE on IU is considered insignificant, indicating that proposed hypothesis H3 is not supported. Why so? can be explained as follows: (H3—desire's impact on the intention to use the FC model) This outcome may reflect the stability of the teaching environment and institutional constraints, where desire alone is insufficient without adequate resources and infrastructure. This has practical implications for educational practice; interventions should focus not only on increasing teacher desire but also on providing necessary support and infrastructure. Integrating technology into the classroom (McGrath, 2017) suggests that the intention to use technology often depends not so much on desire but on other factors such as skills, comfort, and support. These documents provide clear evidence that DE is not a decisive factor in the use of educational technology, including the FC model. DE may not greatly affect the IU of the FC model due to the stability of the work environment, limitations in technology infrastructure, or the lack of direction and support from the school. Although DE is not a significant factor, it helps to create motivation for educators to engage in the learning process and develop competence in educational technology, defining goals and directions in applying the FC model in their teaching.

According to the results, TS directly influences IU of the FC model and satisfies H4. Previous studies have also reached the same conclusion. The teaching TS of educators can be flexible, transitioning from transmitting information to guiding and interacting with students, fostering positive interactions, autonomy, and exploration in students. Additionally, educators serve as guides and supports for students to excel in their learning process. The teaching TS also reflects educators' willingness to support students, not only by answering questions but also by actively guiding students in accessing materials and information (Fung, 2024; Li, 2023; Moghadam, 2022; Munir, 2021). Teaching TS also demonstrates educators' willingness to support students. When educators not only answer questions but also actively guide students in accessing materials and information, they help students develop independent research and analysis skills. Therefore, TS not only affects the effectiveness of the FC model but also is a crucial determinant of students' learning experiences in the classroom. To promote the effective application of this model, supporting and encouraging educators to apply flexible teaching TSs and create conditions for positive student interactions are essential.

Finally, FCO not only positively influences IU of the FC model but also fully meets hypothesis H5. Other studies have also demonstrated the same, affirming the significant role of FCO in implementing the FC model (Liu and Bao, 2016; Liu, Liu and Nan, 2024). This study provides specific evidence of the importance of FCO in deploying the FC model. Some studies (Moore, 2020; Sointu, 2023; Sulaimon, 2024; Utami, 2023) have demonstrated that FCO is a critical factor in the success of the FC model. In summary, FCO is not only an essential factor but also a significant support in the YDSD of the FC model. To enhance the effectiveness of the FC model, creating a favorable and supportive learning environment is necessary, as evidenced and demonstrated by studies (Lei, 2021; Sharom, 2022; Zhang, 2024; Zou, 2021).

7. Conclusion

The survey results demonstrate that teachers' awareness of the usefulness of the Flipped Classroom (FC) model, along with their perceptions of its effectiveness, accessibility, teaching style, and conducive conditions, significantly influence their intention to adopt the FC model. Each of these factors positively correlates with the decision to implement FC.

According to Hypothesis H1, the "Perception of Effectiveness" directly impacts teachers' intentions to use FC. Therefore, it is essential to raise awareness among teachers about how the FC model can increase self-study time, promote collaborative group activities, and provide opportunities to apply and extend knowledge. Additionally, teachers should recognize how the FC model can be used to evaluate student skills and manage their learning processes effectively.

Hypothesis H2 highlights the impact of "Perception of Accessibility" on the adoption of FC. To support this, designing the FC digital learning system should prioritize a simple, user-friendly interface, ensure easy access across various devices (e.g., computers, tablets, and smartphones), and offer diverse lecture formats. Integrating educational games and materials that engage students, along with features for tracking and analyzing student learning data, is also critical for helping teachers monitor and enhance the learning process.

Hypothesis H4 relates to the role of "Teaching Style" in using the FC model. It is important for teachers to build and deliver online lectures, facilitate online assessments, and encourage interactive online activities. By effectively using digital educational materials, teachers can create a dynamic and engaging learning environment that supports FC implementation.

Hypothesis H5 emphasizes the importance of "Favorable Conditions" in organizing FC. Ensuring adequate infrastructure, providing teachers with training in information technology and instructional methodologies, supplying detailed instructional materials, and offering support from school leadership are crucial steps in motivating teachers to adopt and sustain the FC model.

Overall, the successful implementation of the FC model in primary schools depends on a holistic approach that includes raising teacher awareness, improving accessibility, and providing adequate support. Schools should focus on creating favorable conditions such as professional development opportunities, robust infrastructure, and continuous support to help teachers confidently integrate the FC model into their teaching practices. By taking these practical steps, schools can significantly enhance teacher motivation and capacity, leading to more effective use of the FC model and improved educational outcomes for students.

Author contributions: Conceptualization, TVH and NKQ; methodology, NTBT; software, TVH and NTHT; validation, TVH, DTPT and NKQ; formal analysis, NKQ and TVH; investigation, NTBT; resources, NTHT; data curation, NKQ; writing—original draft preparation, TVH; writing—review and editing, NTBT; visualization, TVH; supervision, TVH; project administration, NTHT; funding acquisition, NKQ. All authors have read and agreed to the published version of the manuscript.

Conflict of interest: The authors declare no conflict of interest.

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