*I.J. Modern Education and Computer Science*, **2024, 2, 58-71**
Published Online on April 8, 2024 by MECS Press (http://www.mecs-press.org/)
DOI: 10.5815/ijmecs.2024.02.05

# Factors Affecting the Fostering of Information and Communications Technology Application in Teaching for Teacher by the Blended Learning Model

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Received: 21 June, 2023; Revised: 19 August, 2023; Accepted: 10 October, 2023; Published: 08 April, 2024

**Abstract:** Through the Blended Learning model, this study explores the factors affecting fostering of information and communications technology **(**ICT) applications in teaching for teachers in the Northern midland and mountainous provinces of Vietnam. The survey is designed to be uploaded to the Learning Management System (LMS) system and requires learners to answer online after completing the course. Influential factors are considered, including 9 groups formed from 45 questions (independent variables). The independent variables are evaluated based on the 5-level Likert score bar. This study uses Cronbach's alpha to determine the reliability of the questions. The survey received responses from 1484 teachers who completed the course in the northern midland and mountainous provinces. After removing the answers with no statistical significance, the remaining samples included in the analysis through SPSS software were 558. The results of the EFA analysis retain 29 observed variables and indicate 7 factors affecting the fostering of ICT application in teaching for teachers. Next, using CFA (Confirmatory Factor Analysis), the study removed 02 more observed variables and pointed out 7 factors affecting the effectiveness of fostering information technology application in teaching for teachers, includes (i) Training methods; (ii) Organization of training courses; (iii) Online learning management system; (iv) Facilities for face-to-face learning; (v) Training content; (vi) Training objectives; (vii) Impact of training content. The results will help researchers and educational administrators find ways to improve the quality of professional development for teachers in high schools in this content and other similar contents.

**Index Terms:** Fostering, professional expertise, information and communications technology, teachers, blended learning.

## 1. Introduction

The rapid development and dissemination of information technology have created significant changes in all areas of social life, including education. The application of information technology in teaching has become a trend for teachers in high schools [1]. Although the application of information technology in teaching is not new, it is always attractive to researchers [2]. At the high school level, the issue of fostering and professional development in the application of information technology in teaching teachers has always been focused on and studied by many scholars. In

 

recent years, Blended Learning has become popular in the educational process; using the Blended Learning model in fostering teachers' professional competence has become an inevitable trend, and more and more research revolves around the teaching profession. This issue recently. However, according to this model, learning causes many difficulties for teachers [3]; typically, many teachers still need help fully operating the LMS in their learning process [4].

The Ministry of Education and Training developed and announced the General Education Program in Vietnam in 2018. The program is built in the direction of developing the quality and capacity of students – an approach. Approach to contribute to the whole and comprehensive renovation of Vietnamese education in the context of globalization and international integration. To implement the general education program well, one of the leading conditions is to foster the teaching staff's professional skills, including expertise in the application of information technology in teaching. Learn. This training has been carried out according to the Blended Learning teaching model, in which learning content and materials are uploaded to a learning management system (LMS). Learners have 7 days to self-study through the learning materials available in the LMS system, then learners focus on meeting face-to-face for 2 days for the reporter to exchange and share the learning content. Finally, learners have the next 7 days to complete the exercises and harvest at the end of the course.

This is the first time Vietnam has implemented professional competence training for teachers using the Blended Learning model. However, the implementation process encountered many difficulties, reflected in all stages of the training process. Therefore, the research to determine the factors affecting this activity is necessary today and is an essential practical basis for the classroom organizers to intervene in those factors to increase the effectiveness of the work. Fostering. This study was conducted to answer the following questions:

1. What factors affect the effectiveness of fostering the application of information technology in teaching for teachers? What are the specific observed variables of each factor?
2. How is the impact of each factor on the effectiveness of fostering information technology application in teaching for teachers?

## 2. Literature Review

### *2.1. Professional training for teachers*

Teachers are the single most crucial factor in the success of an education system. In other words, the professional quality of teachers plays a significant role in improving the quality of teaching and students' learning quality. Therefore, teacher professional development is an essential issue in any education system.

Professional development of teachers can be understood as all systematic activities (provided from outside or tied to teaching) that support the improvement and development of professional knowledge and skills. Subjects as other qualities and competencies of a teacher [5,6]. Professional development begins with training pedagogical students for the professional role of a teacher, and that activity will continue throughout each teacher's subsequent educational development. member [7].

There are many activities to support teachers' professional development. Still, they can be divided into two basic types: traditional types (including seminars and conferences) and non-traditional types (no. mentoring, coaching, peer observation, etc.) [8]. Coaching (coaching) is a regular or cyclical professional cooperation activity between a coach (usually a qualified professional) and a participating individual or group of teachers, aimed at specific standards of knowledge and skills within the most pre-determined time limit. By creating a learning-oriented environment, the coach regularly encourages, discusses, and gives feedback to the teacher on issues that need improvement and monitoring and can provide support based on appropriate tasks for professional development for teachers [9]. Mentoring is often seen as informal Professional Support activities between mentors – often fellow teachers with the right experience and teaching style. Mentors support teachers by sharing their experiences and providing advice, guidance, and emotional support to help them develop long-term goals [10].

The studies of Ell & Major (2019), Koponen et al. (2019), and McFadden & William (2020) [11,12,13] assert that professional development programs have a positive impact on teachers' professional knowledge, pedagogical skills, and professional attitudes [5]. However, many authors believe that, to maximize those values, professional development programs need a combination of certain elements, such as frequent repetition; supporting collaboration among many colleagues; based on the volunteer spirit of the teacher; content that combines general pedagogical knowledge and skills with subject specifics and focuses on certain strategies; have expert support; active learning, performance-oriented and authentic, and responsive and reflective [5,14]. Accordingly, non-traditional types of professional development respond better to these factors, thus more effectively influencing teachers' pedagogical competence [8,15]. Discussing this issue, they admit such quality assurance development programs require investment in money, people, and time, which becomes a recipe for professional development programs. Subjects in developing countries where resources for education are limited. However, the author believes this can be partly improved through low-cost solutions such as organizing training groups, using distance learning technology, or training in a stratified model (who practice becoming an intermediary coach for other teachers).

### *2.2. Professional training for teachers on the application of information and communication technology in teaching*

One of the basic and popular contents in current teacher training programs is applying information and communication technology (ICT) in teaching. This trend ensures adaptation in the special context of the current industrial revolution 4.0. Educational institutions and researchers affirm ICT competence as a core competency that all citizens (including students and teachers) need to master [16], in In the field of education, ICT has been applied more and more widely in teaching, no longer merely a means of teaching, but has become a critical infrastructure to help create an interactive teaching and learning environment. Connect. For teachers, ICT is a solution, an ally to support and overcome obstacles in the teaching process [17]. Redecker & Punie [18] affirms that, for ICT competence, teachers play a dual role; on the one hand, they have to develop their own ICT capacity to dominate and apply ICT in their professional work; on the other hand, taking it as a condition to help students develop ICT capacity.

The capacity to apply ICT in the teaching of teachers is the necessary knowledge, skills, and attitudes for teachers to take advantage and exploit ICT and use them effectively in teaching practice, and at the same time, support and guide students to learn in the digital age [19,20]. The determination of professional training content on the application of ICT in teaching is based on the views of the teacher's ICT capacity structure. Some typical models, such as ISTE's Standard Model of Technology Skills for Teachers [21] – 7 standards, are all conceptualized: in addition to the requirement of the ability to use ICT tools and support student learning. Through ICT, teachers also need to demonstrate this competence in many other social aspects, such as policy understanding, organization management, leadership, guidance, collaboration, encouragement, and inspiration. inspire learners to become digital citizens in the new era… Other models proposed by educational experts, such as the TPACK model of Koehler et al. [22], the model of Krumsvik [23], Gudmundstotirr & Ottested [24], Insterfjord & Munthe [25], or Blayone et al. [26] again emphasizes the problem of combining ICT-using skills with pedagogical competencies and other cognitive-metacognitive aspects that make up the structure of teachers' ICT application capacity to respond with the requirements of the teaching process.

However, many studies on professional development programs for teachers on the application of ICT in teaching still show some limitations in the approach to program content. Many programs still focus on training teachers in basic ICT skills – directing them to master technology, but they do not guarantee the ability to apply technology appropriately to activities. Teaching practice while ignoring the corresponding social-interaction skills when using technology in the classroom [27,28,29]. Many programs are still heavily theoretical, focusing on macro issues such as ICT infrastructure, policies, barriers, and enablers, rather than micro-tasks to enhance practice. Teaching using ICT for teachers [30]. That sometimes can hinder and reduce the effectiveness of education because if teachers cannot master the principles of applying ICT in teaching and use them competently, they may suffer from technology. Distraction and becoming distracted from teaching tasks [28] and can further lead to the design and implementation of learning activities that use technology but are not supportive. Learning and do not bring meaningful results for students, negatively affecting student learning quality [27].

### *2.3. Methods and forms of professional training for teachers on the application of information technology in teaching*

Researchers often aim to propose models of ICT capacity development that ensure some basic requirements in organizational form and mode. Firstly, the development of ICT application capacity for teachers should be based on training through practice, fostering according to the needs of teachers in a specific context, attaching importance to the element of experience and practice through authentication context [30,31]. Second, fostering ICT application capacity needs to occur in the direction of constructive and cooperative learning and organize teachers to participate in learning communities [32,33]. In addition, many researchers also believe that in the process of professional development in ICT application, it is necessary to create conditions for teachers to reflect, exchange, and consult with educational experts regularly. regularly, continuously. Concretizing from the above orientations, Tondeur et al. [34] proposed 6 practical strategies for training teachers in ICT, including 1) Using the teaching style of the lecturer as a model; 2) Discussing to reflect illustrative examples of the role ICT plays in the learning process; 3) Organize teachers to learn how to use ICT to design teaching materials and plans; 4) Creating a peer-to-peer collaborative environment in technology practice; 5) Bringing teachers to experience applying ICT knowledge and skills in authentic situations; 6) Continuous feedback during ICT professional development training for teachers.

An inevitable but also exciting thing is that when it comes to the issue of the form of ICT application capacity development for teachers, we cannot ignore the role of technology itself. One of the trends in using technology to train teachers' ICT capacity is the application of a blended-learning model. Thus, this learning method is organized under a close combination of face-to-face teaching methods (face-to-face lessons) with online teaching (via computers connected to the Internet) in a single process. Unified curriculum that promotes and supports learning [35,36]. Blended Learning can be divided into some different models [37] due to the incorporation of online elements (ICT) into face-to-face teaching at various levels ranging from low-level – just a supplement, in support of traditional classes, to a great extent – online courses [38].

The Blended Learning models ensure the above requirements on the method of organizing teachers' professional development activities. Blended Learning has a positive impact on learners' self-study (behavioral perspective) and, at the same time, improves learners' ability to self-regulate learning, dynamism, attitude, and positive motivation (psychological perspective) ) [39]. For teachers, Blended Learning also helps them optimize learning time, increase access to resources/materials, reduce learning costs, and give teachers opportunities for professional development

cooperation. In rural, remote - remote areas with characteristics of geographical distance [40]. Therefore, in this study, we chose to design and organize a professional training program for teachers on applying ICT in teaching with a blended learning approach to maximize the effectiveness of these activities. Training and mentoring activities for teachers' awareness and practice of ICT use.

## 3. Methodology

From December 2021 to May 2022, Vietnam organizes professional training for elementary, middle, and high school teachers on applying information technology in teaching. Teachers highly appreciated by their colleagues for their professional competence and experience in education will be sent to study in these classes. The class is organized according to the Blended Learning teaching model, in which the content and learning materials are already available in the learning management system (LMS). Learners have 7 days to self-study through the learning materials available in the LMS system, then learners focus on meeting face-to-face for 2 days for the reporter to exchange and share the learning content. Finally, learners have the next 7 days to complete the exercises and harvest at the end of the course. To assess the effectiveness and satisfaction of the course, the Ministry of Education and Training of Vietnam designed a survey. This form is uploaded to the LMS system and requires learners to answer the online form after completing the course. The survey form consists of two parts: Part I includes questions to collect demographic information of research subjects such as gender (Male/Female), working location (Difficulty/Not difficult); Ethnicity (whether you are from an ethnic minority); teachers working at school level (elementary, junior high and high school); Years of teaching in high schools. Part II is a group of questions built to get teachers' opinions after participating in training on factors affecting the quality of information technology application training in teaching for teachers. These factors belong to the following groups: "Training objectives," "Content of training," "Method of fostering," "Assessment of training results," "Retraining materials," "Training means," and “Organization of refresher courses,” “Impacts of training content,” “Online support after training.” Our study analyzes the training process of 1484 teachers in the northern midland and mountainous provinces (Vinh Phuc, Phu Tho, Tuyen Quang, Ha Giang, Yen Bai, Lao Cai, and Bac Giang).

This study uses the Exploratory Factor Analysis (EFA) method to identify groups of factors affecting the effectiveness of professional training in information technology applications. And the Confirmatory Factor Analysis (CFA) method to confirm the factors affecting the effectiveness of professional training activities on information technology applications and the influence of these factors.

The data obtained through the survey should be analyzed using percentages and frequencies to get confidence values. This study uses Cronbach's alpha to determine the reliability of the questions. The higher the validity and reliability, the more accurate data can be obtained to produce quality results. Reliability is a criterion for determining the consistency of the scores of each item. Therefore, the data obtained through the survey should be analyzed using percentages and frequencies to get a confidence value. In this study, we use Cronbach's alpha to determine the reliability value of the study. Cronbach's alpha measures the consistency of a research instrument's reliability. Typically, Cronbach's alpha values above 0.60 are said to be moderately reliable and can be used as an indicator to measure device reliability. On the other hand, a Cronbach alpha value lower than 0.60 indicates a low-reliability level and is unacceptable. Therefore, any variable with a value lower than 0.60 must be deleted or modified.

The study continues to use the exploratory factor analysis (EFA) method to identify groups of factors affecting the effectiveness of professional training in information technology applications. In multivariate statistics, EFA is a statistical method used to discover the underlying structure of a relatively large set of variables. EFA is a technique in factor analysis whose overarching goal is to determine the underlying relationships between the variables being measured. It is commonly used by researchers when developing a scale (a scale is a set of questions used to measure a particular research topic) and identifying a set of latent constructs below a series of measured variables. It should be used when the researcher has no a priori hypothesis about the factors or models of the variables being measured. Typically, researchers will have a large number of variables to be measured, which are assumed to be related to a smaller number of "unobserved" factors. Researchers must carefully consider the number of measured variables to include in the analysis. EFA procedures are more accurate when each factor is represented by more than one measure in the analysis. EFA is based on a common factor model. In this model, the variables are expressed as a function of common factors, unique factors, and measurement error. Each unique factor affects only one variable and does not explain the correlation between the variables. Common factors affect more than one variable and Factor Loading coefficients are measures of how much influence a common factor has on a variable. For the EFA process, we are more interested in determining the common factors and related expression variables.

EFA analysis is used to reduce data from a set of discrete observed variables gathered into a larger group of observed variables, called representative variables, to determine influencing factors. The bases for selecting evaluation criteria (factors) are based on the activities of the process of organizing professional training for teachers. Influential factors are considered, including 9 groups formed from 45 questions (independent variables). The independent variables are evaluated on a 5-point Likert bar: 1 = Totally disagree, 2 = Disagree, 3 = Confused, 4 = Agree, 5 = Strongly agree. Through the EFA analysis technique, the factors will be grouped and tested to determine the representative factors that affect the effectiveness of the professional development process for teachers and the degree of influence of each factor on the expected results. At the same time, EFA considers the relationship between variables in all different groups to

detect observed variables with multifactor loading or observed variables with factor differences from the beginning. The number of survey respondents included in the EFA analysis was 1484. After removing the answers that were not statistically significant, the remaining 558 samples were included in the analysis through SPSS software.

Next, confirmatory factor analysis (CFA) was studied. The purpose is to re-affirm the univariate, multivariable, convergent, and discriminant validity of the set of scales to evaluate the factors affecting the effectiveness of professional training in information technology applications. In statistics, confirmatory factor analysis (CFA) is a special form of factor analysis. It is used to test whether measures of a structure are consistent with the researcher's understanding of the nature of the structure (or factor). As such, the objective of the CFA is to check whether the data fits a hypothetical measurement model. This hypothetical model is based on previous theory and/or analytical research. In confirmatory factor analysis, researchers first develop a hypothesis about which factors they believe are underpinning the measures used and may impose constraints on the model based on these a priori hypotheses. By imposing these constraints, the researcher is forcing the model to fit their theory.

The study used multivariate regression analysis to answer the research question, "How important are these factors?". After having the results from exploratory factor analysis, the factors with eigenvalues were used as independent variables for multivariate regression analysis. This method aims to find the correlation between the main factors to the effectiveness of professional training in applying information technology in teaching. The multivariate regression model in this study is defined as follows:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_n X_n$

Which: Y is the dependent variable reflecting the effectiveness of professional training for teachers on the application of information technology in teaching; β is the normalized regression coefficient; X are the main factors to be retained.

Table 1. Study sample characteristics using EFA and CFA analysis(N=558)

| **Survey sample characteristics** | | **Quantity** | **Ratio %** |
|---|---|---|---|
| Sex | Male | 217 | 38.89% |
| | Female | 341 | 61.11% |
| School | Primary school | 256 | 45.88% |
| | Junior high school | 257 | 46.06% |
| | High school | 45 | 8.06% |

## 4. Data Analysis and Findings

### *4.1. The results of testing the reliability of the scale and the correlation indicators*

Table 2 shows the conversion coefficients of Cronbach's alpha in surveying the factors affecting the effectiveness of professional training for teachers on the application of information technology in teaching.

Table 2. Cronbach alpha values obtained in the pilot study

| No. | Variable | Cronbach alpha values |
|---|---|---|
| 1 | Training goals | 0.943 |
| 2 | Training content | 0.969 |
| 3 | Training method | 0.980 |
| 4 | Evaluation of training results | 0.965 |
| 5 | Training materials | 0.973 |
| 6 | Training means | 0,972 |
| 7 | Organization of training | 0,974 |
| 8 | Impact of training content | 0,978 |
| 9 | Online support after training | 0,977 |

The statistical analysis by SPSS found that the Corrected Item -Total Correlation indexes of the variables were greater than 0.3. The Cronbach Alpha indexes of factors affecting the effectiveness of professional training for teachers on applying information technology in teaching are all high (>0.9). Through this, the survey questionnaire has high and reliable validity and reliability. The survey shows that these factors must be impacted to improve the effectiveness of professional training for teachers on applying information technology in teaching.

### *4.2. The results of exploratory factor analysis EFA*

The first EFA exploratory factor analysis was performed on 45 questions with Varimax rotation. With a total of 558 research samples, the value is greater than 0.3 when selecting the load factor. The analysis results from SPSS

software allow the researcher to extract the characteristic value for each factor. The results in Table 3 show that the KMO coefficient reaches 0.953, which is sufficient for factor analysis, higher than Kaiser's proposal, which is 0.7.

Table 3. KMO and Bartlett's Test

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .953 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 14145.659 |
| | df | 990 |
| | Sig. | .000 |

Bartlett test results $\chi 2$ (990) = 14145,659, $\rho < 0.000$, indicating that the correlation between the question items is large enough to conduct exploratory factor analysis. The results in the Communalities table in the EFA analysis show that all observed variables have an Extraction greater than 0.5, so these observed variables are good and will be retained in the exploratory factor analysis. Next, the Total Variance Explained table shows the most relevant factors in the study. As a result, are 8 factors extracted based on the criterion of eigenvalue greater than 1, so these 8 factors summarize the information of 45 observed variables included in EFA best. In other words, these 8 factors contribute 62.589% of the importance of factors affecting the effectiveness of professional training for teachers on applying information technology in teaching; the remaining 37.411% are due to other factors. Other factor percentages are explained by each factor: factor 1 is 36,440%; Factor 2 is 6.710%; Factor 3 is 4,203%; Factor 4 is 3.960%; Factor 5 is 3.454%, factor 6 is 2.858%; Factor 7 is 2.651%; Factor 8 is 2.312%.

The results of the rotation matrix in the Rotated Component Matrix table in the first EFA analysis show that 45 observed variables are classified into 8 factors, and all observed variables have loading coefficients greater than 0.3. Some bad variables need to be eliminated because the load factor difference between the factors is less than 0.2. They are Q8, Q15, Q16, Q17, Q22, Q26, Q27, Q35, Q36, Q40, Q41. From 45 observed variables in the first EFA analysis, 11 variables were removed, and the remaining 34 observed variables were included in the second EFA analysis. When analyzing a bad variable appears, remove those variables and continue EFA analysis to the final result. Last time, the study removed 5 more variables, which are Q18, Q19, 120, Q21, and Q23. The final EFA analysis results for 29 observed variables are as follows:

Table 4. Key factors table in the 2nd EFA analysis

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 9.940 | 34.275 | 34.275 | 9.940 | 34.275 | 34.275 | 4.174 | 14.392 | 14.392 |
| 2 | 2.649 | 9.133 | 43.408 | 2.649 | 9.133 | 43.408 | 2.881 | 9.933 | 24.325 |
| 3 | 1.821 | 6.280 | 49.688 | 1.821 | 6.280 | 49.688 | 2.728 | 9.408 | 33.733 |
| 4 | 1.542 | 5.319 | 55.007 | 1.542 | 5.319 | 55.007 | 2.519 | 8.687 | 42.421 |
| 5 | 1.247 | 4.298 | 59.306 | 1.247 | 4.298 | 59.306 | 2.509 | 8.651 | 51.071 |
| 6 | 1.115 | 3.844 | 63.150 | 1.115 | 3.844 | 63.150 | 2.308 | 7.958 | 59.029 |
| 7 | 1.042 | 3.593 | 66.743 | 1.042 | 3.593 | 66.743 | 2.237 | 7.714 | 66.743 |
| 8 | .893 | 3.078 | 69.822 | | | | | | |
| 9 | .652 | 2.247 | 72.069 | | | | | | |
| 10 | .620 | 2.137 | 74.206 | | | | | | |
| 11 | .589 | 2.032 | 76.238 | | | | | | |
| 12 | .540 | 1.861 | 78.099 | | | | | | |
| 13 | .517 | 1.784 | 79.883 | | | | | | |
| 14 | .508 | 1.751 | 81.634 | | | | | | |
| 15 | .483 | 1.665 | 83.299 | | | | | | |
| 16 | .464 | 1.599 | 84.897 | | | | | | |
| 17 | .448 | 1.543 | 86.441 | | | | | | |
| 18 | .414 | 1.428 | 87.868 | | | | | | |
| 19 | .402 | 1.386 | 89.254 | | | | | | |
| 20 | .392 | 1.353 | 90.607 | | | | | | |
| 21 | .373 | 1.287 | 91.894 | | | | | | |
| 22 | .354 | 1.221 | 93.115 | | | | | | |
| 23 | .346 | 1.195 | 94.310 | | | | | | |
| 24 | .311 | 1.071 | 95.381 | | | | | | |
| 25 | .295 | 1.017 | 96.398 | | | | | | |
| 26 | .279 | .963 | 97.361 | | | | | | |
| 27 | .268 | .925 | 98.286 | | | | | | |
| 28 | .263 | .908 | 99.195 | | | | | | |
| 29 | .234 | .805 | 100.000 | | | | | | |

Extraction Method: Principal Component Analysis.

The results of Table 4 show that there are 7 factors extracted based on the criterion of eigenvalue greater than 1, so these 7 factors summarize the information of 29 observed variables included in EFA in the best way. In other words, these 7 factors contribute 64.743% of the importance of the factors affecting the effectiveness of professional training for teachers on applying information technology in teaching.

Table 5. Rotated Component Matrix in the 2nd EFA

| | Component | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Q12 | .790 | | | | | | |
| Q11 | .788 | | | | | | |
| Q13 | .762 | | | | | | |
| Q14 | .744 | | | | | | |
| Q9 | .734 | | | | | | |
| Q10 | .681 | | | | | | |
| Q28 | | .760 | | | | | |
| Q29 | | .700 | | | | | |
| Q30 | | .646 | | | | | |
| Q25 | | .635 | | | | | |
| Q24 | | .601 | | | | | .321 |
| Q43 | | | .763 | | | | |
| Q44 | | | .753 | | | | |
| Q45 | | | .734 | | | | |
| Q42 | | | .575 | | | | .382 |
| Q32 | | | | .751 | | | |
| Q33 | | | | .745 | | | |
| Q34 | | | | .731 | | | |
| Q31 | | | | .713 | | | |
| Q5 | | | | | .751 | | |
| Q4 | | | | | .742 | | |
| Q6 | .337 | | | | .656 | | |
| Q7 | .326 | | | | .631 | | |
| Q1 | | | | | | .853 | |
| Q2 | | | | | | .824 | |
| Q3 | | | | | | .746 | |
| Q38 | | | | | | | .775 |
| Q37 | | | | | | | .747 |
| Q39 | | | | | | | .677 |

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]
a. Rotation converged in 7 iterations.

The analysis results at EFA show that 29 observed variables converge and differentiate into 7 factors. The naming of factors is based on the loading coefficient of the observed variables in each factor; the observed variable with the larger load factor will serve as a basis for the author to name the group of factors. [41]

Table 6. Naming factors

| **Code** | **Observed variables** | **Load factor** |
|---|---|---|
| **Factor 1: Training method (PP) (Cronbach's Alpha = 0,891)** | | |
| PP 1 | Reporters/lecturers always support, encourage, inspire learners and motivate learners. | 0.790 |
| PP 2 | The language of the reporter/lecturer is clear and easy to understand | 0.744 |
| PP 3 | I receive timely answers to professional problems from pedagogical lecturers during face-to-face training | 0.762 |
| PP 4 | Pedagogical lecturers' professional answers/exchanges are appropriate and of high professional quality. | 0.751 |
| PP 5 | Reporters flexibly use many training methods | 0.776 |
| PP 6 | Fostering methods promote active learning and create conditions for learners to have the opportunity to apply and practice new skills | 0.765 |
| **Factor 2: Training organization (TC) (Cronbach's Alpha = 0,822)** | | |
| TC 1 | I received notifications and instructions for participating in the refresher module on time | 0.760 |

| | | |
|---|---|---|
| TC 2 | I was provided with an account to access online documents on time. | 0.700 |
| TC 3 | The refresher plan is provided in a timely, complete, and clear manner | 0.765 |
| TC 4 | Access to use easily, conveniently, anytime, anywhere | 0.760 |
| TC 5 | The transmission bandwidth meets the access needs of learners, preventing network congestion due to overload | 0.601 |
| **Factor 3: Online learning management system (LMS) (Cronbach's Alpha = 0,856)** | | |
| LMS 1 | I receive timely answers to professional problems from SP teachers after direct training (if there is a question to ask if there is no question, leave it blank, do not answer this question) | 0.775 |
| LMS 2 | My progress and results are fully updated online. | 0.784 |
| LMS 3 | I am satisfied with the professional support after face-to-face training. | 0.767 |
| LMS 4 | I often discuss with colleagues about professional issues after the seminar – face-to-face training. | 0.802 |
| **Factor 4: Facilities for face-to-face learning (CSVC) (Cronbach's Alpha = 0,764)** | | |
| CSVC 1 | The right time to organize face-to-face training | 0.772 |
| CSVC 2 | Classrooms and equipment to meet teaching and learning requirements | 0.807 |
| CSVC 3 | Well done on logistics and support | 0.796 |
| CSVC 4 | I am provided with timely and complete study materials (prints) | 0.796 |
| **Factor 5: Training content (ND) (Cronbach's Alpha = 0,828)** | | |
| ND 1 | The training content is suitable for the job requirements of the high school where I work. | 0.742 |
| ND 2 | The content of the training is in line with current trends in general education reform. | 0.734 |
| ND 3 | The content of the training is in line with the requirements set forth for the task of supporting colleagues in professional development regularly at high school. | 0.744 |
| ND 4 | The refresher course's content effectively contributes to improving student learning outcomes. | 0.761 |
| **Factor 6: Training goals (MT) (Cronbach's Alpha = 0,821)** | | |
| MT 1 | The objective of the refresher module is clearly communicated | 0.801 |
| MT 2 | Modular goals that fit my regular career development needs | 0.811 |
| MT 3 | I clearly understand the tasks/assignments required to complete the refresher module | 0.729 |
| **Factor 7: Impact of training content (TD) (Cronbach's Alpha = 0,803)** | | |
| TD 1 | I am confident that I can support my colleagues in implementing the learned content to improve student learning outcomes. | 0.795 |
| TD 2 | I am confident enough to regularly support my colleagues in their professional development at high school in the content related to the refresher module. | 0.777 |
| TD 3 | I am part of the learning community built by the refresher course. | 0.809 |

### *4.3. The results of confirmatory factor analysis CFA*

#### *4.3.1. 1st CFA analysis results*

Confirmatory factor analysis (CFA) is the next step of exploratory factor analysis (EFA) and includes the design to independently identify, test, and adjust measurement models. CFA aims to establish well-fit measurement models that can be used to test structural models. After having the EFA exploratory factor analysis results, we proceed to the next step, confirmatory factor analysis CFA. Using the research data, we analyzed it with SPSS software by the principal axis factoring method with Promax, and the obtained results took a rotation matrix of independent scales.

Researchers use some evaluation indicators such as Chi-square/df; GFI; AGFI; CFI; RMSEA to measure the Model's Fit with the survey data set. If a model receives a Chi-square/df value < 3; GFI, AGFI, CFI from 0.9 to 1:

RMSEA < 0.08 is considered a model that fits well with the survey dataset. The results of the Model Fit in the first CFA analysis show that the Model Fit indexes are all within the acceptable threshold: CMIN/DF = 2.174 < 3; GFI = 0.912 > 0.9; CFI = 0.947 > 0.9; TLI = 0.939 > 0.9; RMSEA = 0.046 < 0.08; PCLOSE = 0.936 > 0.05. Thus, the model has a good fit. Next, based on the analysis results of Regression Weights: (Group number 1 - Default model), all observed variables are significant in the model because the p-value is less than 0.05. (In AMOS, p-value = 0.000 will be denoted by 3 ***. Rows with Estimate = 1,000 and no values in the following columns because those are the default reference variables. These observed variables are always significant in the model). And the Standardized Regression Weights: (Group number 1 - Default model) results show that all the normalized weights (the Estimate column in the Standardized Regression Weights table) are greater than 0.5. Thus, all observed variables have a high degree of agreement.

Table 7. Evaluation of validity: Convergence and discriminability

| | CR | AVE | MSV | PP | TC | LMS | CSVC | ND | MT | TD |
|---|---|---|---|---|---|---|---|---|---|---|
| **PP** | 0.893 | 0.581 | 0.462 | **0.763** | | | | | | |
| **TC** | 0.825 | 0.489 | 0.465 | 0.573 | **0.699** | | | | | |
| **LMS** | 0.859 | 0.604 | 0.465 | 0.549 | 0.682 | **0.777** | | | | |
| **CSVC** | 0.778 | 0.474 | 0.343 | 0.306 | 0.586 | 0.466 | **0.689** | | | |
| **ND** | 0.828 | 0.547 | 0.462 | 0.680 | 0.599 | 0.595 | 0.426 | **0.740** | | |
| **MT** | 0.824 | 0.611 | 0.321 | 0.416 | 0.383 | 0.352 | 0.202 | 0.567 | **0.781** | |
| **TD** | 0.807 | 0.583 | 0.461 | 0.462 | 0.628 | 0.679 | 0.527 | 0.504 | 0.285 | **0.764** |

**Validity Concerns**

[1] Convergent Validity: the AVE for TC is less than 0.50. Try removing TC5 to improve AVE.

[1] Convergent Validity: the AVE for CSVC is less than 0.50. Try removing CSVC4 to improve AVE.

Through Table 7 it is found that the two scales TC and CSVC do not guarantee convergence because the AVE coefficient is less than 0.5. Therefore, the study implements the elimination of 2 observed variables TC5, CSVC4 to improve the AVE coefficient.

*4.3.2. Results of the 2nd CFA analysis*

After removing 2 variables TC5 and CSVC 4, the study continued to perform the second CFA analysis. The results of the Model Fit in the second CFA analysis showed that the Model Fit indexes were all within the second CFA analysis. acceptance threshold: CMIN/DF = 1.897 < 3; GFI = 0.931 > 0.9; CFI = 0.963 > 0.9; TLI = 0.957 > 0.9; RMSEA = 0.040 < 0.08; PCLOSE = 1,000 > 0.05. Thus, the model has a good fit. Next, based on the analysis results of Regression Weights: (Group number 1 - Default model), all observed variables are significant in the model because the p-value is less than 0.05. And the Standardized Regression Weights: (Group number 1 - Default model) results show that all the normalized weights (the Estimate column in the Standardized Regression Weights table) are greater than 0.5. Thus, the observed variables all have a high degree of agreement

Table 8. Evaluation of validity: Convergence and discriminability

| | CR | AVE | MSV | PP | TC | LMS | CSVC | ND | MT | TD |
|---|---|---|---|---|---|---|---|---|---|---|
| **PP** | 0.893 | 0.581 | 0.462 | **0.763** | | | | | | |
| **TC** | 0.820 | 0.537 | 0.447 | 0.568 | **0.733** | | | | | |
| **LMS** | 0.859 | 0.604 | 0.460 | 0.549 | 0.668 | **0.777** | | | | |
| **CSVC** | 0.775 | 0.539 | 0.316 | 0.320 | 0.562 | 0.486 | **0.734** | | | |
| **ND** | 0.828 | 0.547 | 0.462 | 0.679 | 0.584 | 0.595 | 0.440 | **0.740** | | |
| **MT** | 0.824 | 0.611 | 0.321 | 0.416 | 0.375 | 0.352 | 0.216 | 0.567 | **0.781** | |
| **TD** | 0.807 | 0.583 | 0.460 | 0.462 | 0.603 | 0.679 | 0.523 | 0.504 | 0.285 | **0.764** |

Table 8 shows that the Composite Reliability (CR) values are greater than 0.7, and the extracted mean-variance (AVE) is greater than 0.5, so the scales are all convergent. The square root of AVE (bold numbers) is larger than the correlations between latent variables (correlation coefficient is in the lower part of the bold diagonal), MSV is smaller than AVE, so it guaranteed distinctiveness (Fornell & Larcker (1981)

Thus, the results after analyzing CFA indicate 7 factors affecting the effectiveness of professional training activities on information technology applications, including (1) Training method; (2) Organization of training; (3) Online learning management system; (4) Facilities for face-to-face learning; (5) Training content; (6) Training objectives; (7) Impact of training content with a total of 27 observed variables. The components are interrelated with each other. The observed variables all achieve convergent and discriminant values and meet the value and reliability requirements.

### *4.4. Regression model test results*

After the results of CFA analysis, 7 factors affecting the effectiveness of professional training activities on information technology application were used for regression analysis. The results of the regression model testing between the factors affecting the training results are shown in Table 9:

Table 9. Model Summary

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
|---|---|---|---|---|---|
| 1 | 1.000[a] | 1.000 | 1.000 | .000000000000000 | 1.442 |

a. Predictors: (Constant), TD, MT, CSVC, PP, TC, ND, LMS
b. Dependent Variable: HQ

The results of the regression analysis in Table 9 show that: Adjusted R Square = 100%, that is, explaining 100% of the variation of the dependent variable is the effectiveness of professional training in information technology application. . Thus, the regression model satisfies the conditions for drawing the research results.

Table 10. Results Coefficients

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Tolerance | VIF |
| 1 | (Constant) | 6.106E-15 | .000 | | .000 | 1.000 | | |
| | PP | .222 | .000 | .313 | 1137211027.330 | .000 | .584 | 1.711 |
| | TC | .148 | .000 | .194 | 669597318.855 | .000 | .527 | 1.897 |
| | LMS | .148 | .000 | .201 | 682722842.608 | .000 | .507 | 1.972 |
| | CSVC | .111 | .000 | .155 | 626336896.060 | .000 | .718 | 1.392 |
| | ND | .148 | .000 | .202 | 693614009.988 | .000 | .518 | 1.929 |
| | MT | .111 | .000 | .182 | 749897771.729 | .000 | .750 | 1.334 |
| | TD | .111 | .000 | .147 | 538627565.500 | .000 | .594 | 1.684 |

a. Dependent Variable: HQ

All factor variables have sig = 0.000 < 0.05, so these variables are significant in the regression model, or in other words, this variable impacts the dependent variable "training performance efficiency." expertise in information technology applications." The normalized multivariate regression equation:

HQ = 0.313* PP + 0.194 *TC + 0.201 *LMS + 0.155 * CSVC + 0.202* ND +0.182 *MT+0.147 TD

## 5. Discussion

The purpose of the study is first to discover, then to confirm the factors affecting the effectiveness of training activities on information technology applications for high school teachers. Finally, the study provides a regression model showing the correlation between those factors and training activities' effectiveness. Regarding this, from the EFA and CFA, it is shown that the working process of the rapporteur in the refresher course plays an instrumental role. Specifically, the method of fostering and the content of the trainer's training plays a great role in the effectiveness of professional training activities of high school teachers. The training method factor has the greatest influence on the training results. This has been confirmed by Bárbara Oliván-Blázquez [42], who said that active learning methods, such as flipped classrooms, problem-based learning, and case studies, produce higher levels of human interaction. Students have reasonable satisfaction and high test scores. Next, the training content factor has the second greatest influence on the effectiveness of professional training for high school teachers. Janković, Aleksandar [43] also pointed out that it is necessary to enrich and renew the pedagogical content in teaching to encourage teachers and learners to establish relationships in interpersonal communication and communication with students. Different groups help increase learning efficiency.

On the other hand, the support of learners by organizing classes and operating on the LMS system also promotes the effectiveness of training in ICT applications. The LMS management system has the third greatest influence, and the training organization has the fourth greatest impact on the effectiveness of professional training for high school teachers.

Claude Müller [44] points out that when implementing blended learning courses, special attention should be paid to the following educational design principles: appropriate course structure and instruction for learners, activating learning tasks practice, encouraging teacher interaction and social presence, and providing timely feedback on learning progress and outcomes. Kholid Haryono, Almed Hamzah [45] said three activities are considered the most important: creating classes, topics, and course materials. These are noted and fully implemented by the organizers of the professional training course for high school teachers on information technology applications.

The study also shows that external factors, such as physical facilities for direct teaching, and internal factors, such as clearly defining training objectives and the impact of training content in teachers' work, affect the effectiveness of the professional development process for high school teachers. These factors are identified in the first round, when the experts give the survey, and are kept until the evaluation by the CFA model. However, among the factors, the impact factor of the training content has the least influence on the training results. This can be explained that: teachers consider fostering to improve their professional skills as an essential thing, and this helps teachers to have better professional competence, and teachers have not thought about supporting them. Their colleagues after the training process ended, so they needed to appreciate the influence of this factor. Besides, the following elements are facilities for face-to-face learning and training objectives. Vietnam's general education program is changing, in which the most significant change is the educational goal, and the program is built according to the output standards. Therefore, before high school teachers participate in professional training courses, they also need to understand the course's goals and whether it suits them. This helps to make the student's learning attitude more positive, directly affecting the training effectiveness. In addition, the thoughtful preparation of classrooms, equipment, and direct learning materials by the organizers also helps teachers learn more smoothly. The results of CFA clearly show the influence of seven factors on the effectiveness of fostering ICT application in teaching for high school teachers.

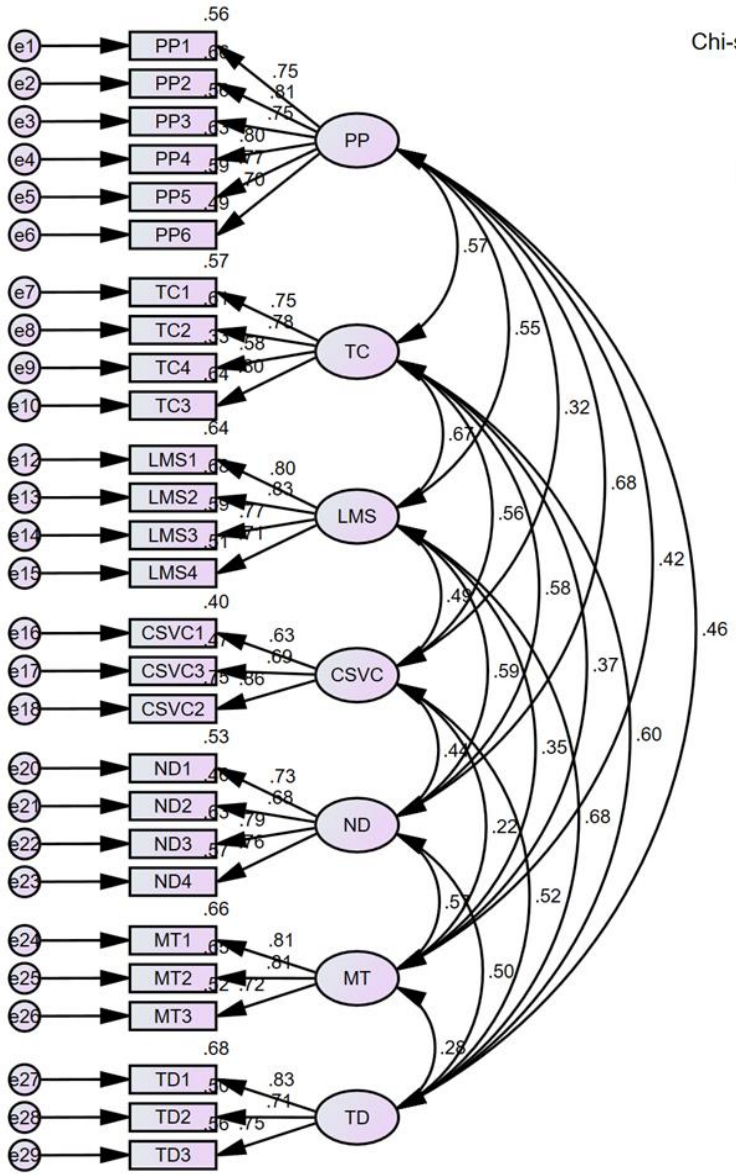


Fig. 1. Measurement model: factors affecting the effectiveness of fostering information technology application in teaching for high school teachers

## 6. Conclusion

In the context of educational innovation in Vietnam, professional training for high school teachers is necessary, especially in fostering the application of information technology in teaching. With the Integrated Learning model, learners have seven days of automatic learning through the LMS system, followed by two days of face-to-face learning and seven days of completing assignments and lessons of the course. The study identified seven factors affecting the effectiveness of compensating information technology applications in teaching for teachers, including (i) Compensating method; (ii) Organization of training courses; (iii) Online learning management system; (iv) Facilities for face-to-face learning; (v) Content offset; (vi) Compensation objectives; (vii) Impact of content enrichment. In which the most influential factor is the compensation method. The remaining factors, such as refresher content, online learning management system, training organization, training objectives, physical facilities for face-to-face learning, the impact of second training content, and the effects on the results of teacher training according to the level of influence from more to less. Based on the results of this study, the organizers of professional training courses for high school teachers can rely on the factors that promote the effectiveness of the training process.

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**How to cite this paper:** Nga Viet Thi Nguyen, Dung Van Ha, Vu Thuan Khuu, "Factors Affecting the Fostering of Information and Communications Technology Application in Teaching for Teacher by the Blended Learning Model", International Journal of Modern Education and Computer Science(IJMECS), Vol.16, No.2, pp. 58-71, 2024. DOI:10.5815/ijmecs.2024.02.05