ASSESSING THE COMPETENCE OF TECHNOLOGY INTEGRATION IN TEACHING OF THE TEACHERS OF THE PROVINCES IN THE CENTRAL COASTAL REGION AND CENTRAL HIGHLANDS OF VIETNAM, BASED ON THE TPACK FRAMEWORK

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ABSTRACT

Based on the TPACK scale in [2], [3], this study was conducted based on the survey method with semi-structured questionnaires and interviews, with more than 210 participants. They are teachers at schools in the central coastal region and central highland provinces of Vietnam. The article will present some research results about evaluating the competence of integrating technology in teaching (ITT), based on TPACK framework. Besides, some discussions through the interview results on the status of technology application in teaching of teachers will also be mentioned.

Keyword: *TPACK, Competence of Integrating technology in teaching, Pedagogy, Teaching content, Teaching method, Technology*

1. INTRODUCTION

Application of information and communication technology (ICT) in teaching has been an indispensable trend of education. Technology is applied in teaching, not only as a teaching medium, but also to create a learning environment, interactive environment, and connection in teaching and learning. From the perspective of integrated teaching, technology is also the content of teaching. It can be said that, technology is increasingly integrated at a high level in teaching, to promote the full applicability of technology in teaching. Therefore, the competence of technology integration in teaching is one of the essential competencies of teachers in the current period ([1], [4], [6]). However, for Vietnamese education, integrating technology in teaching and learning are still a challenging task for teachers for a number of reasons such as student's lack of computers; teachers have little training on technology integration; teachers lack confidence in ITT competence; lack of technical support and access to technology resources.

In the process of educational renovation of the country, teachers have been making efforts to apply technology to promote the effectiveness of teaching and learning. In recent years, there have been many research results in the application of information and communication technology in teaching ([2], [3], [8], [9]).

In assessing teachers' professional competence, the relationship between pedagogy knowledge (Pedagogy Knowledge) and knowledge of teaching content (Content Knowledge) are considered in a harmonious manner. In recent years, the relationship between three areas of knowledge: pedagogy, teaching content and technology applications in teaching have also been concerned.

The TPACK model (Technological, Pedagogical and Content Knowledge) initiated by Mishra, P., & Koehler, MJ, is a combination of three essential knowledge components of teachers in the current period, including knowledge about content of teaching-learning (CK - Content Knowledge), knowledge of Pedagogy (PK - Pedagogical Knowledge) and knowledge of technology (TK - Technological Knowledge) ([7], [10]). TPACK can be considered a basis for analyzing essential knowledge and competencies of teachers, from which there are solutions in training pedagogical students to meet the teaching and learning requirements of the 21st century. Besides that, TPACK can be considered a theoretical framework to evaluate the teacher's integrated teaching competence. The level of achievement of component competencies in the TPACK framework contributes to the success of teachers in integrating technology in teaching. The TPACK framework also helps determine how teachers innovate and effectively use technology in their teaching and learning processes ([7], [10]).

It can be seen that ITT competence and TPACK framework, which are fully in line with teacher evaluation criteria set by the Ministry of Education and Training ([8], [9]). According to Ministry of Education and Training ([8]), teachers will be assessed against professional standards including 5 standards with 15 criteria: Standard 1 - Teacher quality; Standard 2 - Professional development; Standard 3 - Building educational environment; Standard 4 - Developing the relationship between the school, family and society; Standard 5 - Use of foreign languages or ethnic languages, application of information technology, exploitation and use of technological equipment in teaching and education. The evaluation criteria of the above standards also indicate the interest of the Ministry of Education and Training to the ITT competence of teachers in the current period of educational innovation. According to Circular 03/2018 /TT-BLĐTBXH, of the Ministry of Labor - Invalids - Social Affairs, the evaluation criteria for vocational teachers also include the above 5 criteria, with different criteria.

However, the above-mentioned evaluation criteria are a just limited to the application of technology in teaching and career development. To meet the needs of education in the 21st century, the process of applying technology in teaching needs to be developed more advanced to reach the level of integration in teaching. Technological competencies of teachers need a harmonious combination with other basic professional competencies, namely pedagogical competence and knowledge of professional content. A framework for evaluating teachers' ITT competencies, as well as assessing the current state of awareness of teachers and students, the environment, conditions, as well as the advantages and difficulties in integrating technology in teaching are deserve research interest in Vietnam today.

In [2], we reviewed the research issues related to the TPACK framework and laid out the scientific basis for building a TPACK survey framework suitable for the educational context of Vietnam. Besides, a process to build this survey frame, a measurement frame consisting of 7 items, including 41 criteria of TPACK survey framework was also sketched by us. In [3], we also gave the results of evaluating the necessity and feasibility of the criteria in the TPACK scale, proposed in [2].
This paper will present some initial research results about evaluating the teachers' ITT competencies, based on the TPACK framework.

2. PURPOSE OF THE RESEARCH

This study was conducted to evaluate ITT competence of teachers, who are teaching in high schools of the central coastal region and central highland provinces of Vietnam, based on TPACK framework.

Specifically, the study aimed as follows:

(a) Quantitative evaluation of TPACK scale was proposed in [2], [3];

(b) Some initial assessments of teachers' ITT competencies in technology integration in teaching based on TPACK framework;

(c) Some innovative practices, advantages and difficulties of teachers in integrating technology in teaching.

3. RESEARCH CONTENT

3.1 Subjects participating in the study

With the number of observed variables is 41, the number of surveyed teachers are 250. After collecting and cleaning data, eliminate unreliable data cases. The number of surveyed subjects collected and processed data is 210. This sample size was consistent with the results of Hair et al. ([5]).

Among them, 210 surveyed teachers, they are information technology (IT) teachers of 10 central coastal provinces and some provinces in the Central Highland, Vietnam. All of them have university degrees, some of which are masters, they have over 10 years of teaching experience.

3.2 Measurement and measuring tools

The TPACK framework in [2], [3] will be used to evaluate ITT competence. Combined with the practical assessment through semi-structured interviews with some teachers, to conduct research, analyze the data obtained from the practice.

The TPACK framework on ITT competency includes 7 components: (1) technology knowledge (TK); (2) pedagogical knowledge (PK); (3) content knowledge (CK); (4) technology pedagogy knowledge (TPK); (5) technology content knowledge (TCK); (6) pedagogical content knowledge (PCK) and (7) TPACK.

The frame is measured with 4-level Likert scale, which is assigned score for the items, as follows: 1: Very bad; 2: Not good; 3: Good; 4: Very good.

Level 1 – Very bad: The expression of the criteria has not yet been formed: There are only brief understandings, but no signs of the behavior of the criteria have been formed.

Level 2 – Not good: Low level of competency: There is expression but not often and not actively (stereotyping, little criticism or creativity of their own).

Level 3 – Good: Moderate level of competency: Has quite a regular and positive expression (with own judgment, criticism and creativity).

Level 4 – Very good. Competence at a high level: Have regular and positive expression (with own judgment, criticism and creativity). Can guide and share with others.

In each component of TPACK framework, there are certain criteria, the evaluation result of each component is the average of the points achieved by the elements in the component. By assigning point value as above, the competency score will receive values from 1.0 to 4.0.

3.3 Research process

This study is conducted from June to Decembre 2019, with the following basic steps:

+ Step 1: Introduce research purpose and the criteria in TPACK frame to the survey participants.

+ Step 2: Conduct assessment through the questionnaire.

+ Step 3: Collect and process data.

+ Step 4: Evaluate, analyze data and draw scientific conclusions.

After removing unreliable surveys, the collected data will be processed by MS Excel and SPSS software.

4. RESEARCH RESULTS AND DISCUSSION

4.1 Some evaluation results on TPACK frame

Processing survey data, some evaluation results about TPACK frames in [2], [3] will be shown through the following statistics tables.

Table – 1: Assessment of Cronbach's Alpha coefficient of the scale

Reliability Statistics	
Cronbach's Alpha	**N of Items**
,975	7

Table – 2: Assessment of EFA index (KMO - Bartlett and rotation matrix of components) of the scale

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,873
Bartlett's Test of Sphericity	Approx. Chi-Square	3498,946
	Df	21
	Sig.	,000

According to the results in Table 2, the factors of the scale are quite closely related, shown by the KMO - Bartlett index.

Each component competence also achieves high reliability and exploratory factor, Cronbach's Alpha coefficient was greater than 0.8.

For example, with TK component competence of TPACK frame:

Table – 3: Assessment of Cronbach's Alpha coefficient of the TK scale

Case Processing Summary			
		N	**%**
Cases	Valid	210	100,0
	Excluded[a]	0	,0
	Total	210	100,0
a. Listwise deletion based on all variables in the procedure.			

Reliability Statistics	
Cronbach's Alpha	**N of Items**
,847	4

Item-Total Statistics				
	Scale Mean if Item Deleted	**Scale Variance if Item Deleted**	**Corrected Item-Total Correlation**	**Cronbach's Alpha if Item Deleted**
TK1	7,5714	3,193	,421	,897
TK2	7,8381	2,481	,861	,750
TK3	7,5762	1,470	,844	,789
TK4	7,8714	2,505	,852	,755

Table – 4: Assessment of EFA index (KMO - Bartlett and rotation matrix of components) of the TK scale

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,754
Bartlett's Test of Sphericity	Approx. Chi-Square	724,672
	Df	6
	Sig.	,000

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,947	73,682	73,682	2,947	73,682	73,682
2	,790	19,749	93,432			
3	,197	4,930	98,362			
4	,066	1,638	100,000			
Extraction Method: Principal Component Analysis.						

4.2 Some assessments of teachers' ITT competencies based on the TPACK frame

Through the surveys, teachers' ITT competency assessment results based on TPACK frame will be shown in the following tables:

Table – 5: Assessment of Pedagogical Knowledge (PK)

	PK	PK1	PK2	PK3	PK4	PK5	PK6	PK7	PK8	PK9
AV	**3,03**	3,05	2,97	2,80	3,57	2,91	2,80	3,56	2,80	2,80
SD	**0,45**	0,68	0,38	0,40	0,81	0,28	0,40	0,82	0,40	0,40

(AV: Mean; SD: Standard derivation)

Table – 6: Assessment of Technology Knowledge (TK)

	TK	TK1	TK2	TK3	TK4
AV	**2,57**	2,71	2,45	2,71	2,41
SD	**0,51**	0,45	0,50	0,89	0,49

Table – 7: Assessment of the content knowledge (CK)

	CK	CK1	CK2	CK3	CK4
AV	**2,81**	2,83	2,66	3,14	2,63
SD	**0,45**	0,46	0,52	0,96	0,59

Table – 8: Assessment of Pedagogy Content Knowledge (PCK)

	PCK	PCK1	PCK2	PCK3	PCK4	PCK5	PCK6	PCK7
AV	**2,85**	2,80	2,84	2,60	3,13	2,84	2,60	3,13
SD	**0,57**	0,76	0,36	0,49	0,99	0,36	0,49	0,99

Table - 9: Assessment of the Technology Pedagogy Knowledge (TPK)

	TPK	**TPK 1**	**TPK 2**	**TPK 3**	**TPK 4**	**TPK 5**	**TPK 6**
AV	**2,44**	2,53	2,43	2,27	2,43	2,58	2,38
SD	**0,49**	0,50	0,82	0,45	0,82	0,50	0,49

Table – 10: Assessment of Content Technology Knowledge (TCK)

	TCK	**TCK 1**	**TCK 2**	**TCK 3**	**TCK 4**
AV	**2,56**	2,70	2,41	2,68	2,46
SD	**0,53**	0,46	0,49	0,90	0,59

Table – 11: Assessment of Technology Pedagogy and Content Knowledge (TPACK)

	TPACK	**TPACK 1**	**TPACK 2**	**TPACK 3**	**TPACK 4**	**TPACK 5**	**TPACK 6**	**TPACK 7**
AV	**2,47**	2,32	2,60	2,30	2,55	2,60	2,41	2,55
SD	**0,52**	0,53	0,49	0,46	0,89	0,49	0,49	0,89

Table - 12: Pearson correlation coefficient between component competencies of ITT competence

Correlations								
		PK	**CK**	**TK**	**PCK**	**TCK**	**TPK**	**TPACK**
PK	Pearson Correlation	1	,227**	,346**	,332**	,342**	,213**	,254**
	Sig. (2-tailed)		,001	,000	,000	,000	,002	,000
	N	210	210	210	210	210	210	210
CK	Pearson Correlation	,227**	1	,623**	,643**	,635**	,408**	,478**
	Sig. (2-tailed)	,001		,000	,000	,000	,000	,000
	N	210	210	210	210	210	210	210
TK	Pearson Correlation	,346**	,623**	1	,575**	,968**	,651**	,735**
	Sig. (2-tailed)	,000	,000		,000	,000	,000	,000
	N	210	210	210	210	210	210	210
PCK	Pearson Correlation	,332**	,643**	,575**	1	,580**	,358**	,433**
	Sig. (2-tailed)	,000	,000	,000		,000	,000	,000
	N	210	210	210	210	210	210	210
TCK	Pearson Correlation	,342**	,635**	,968**	,580**	1	,662**	,759**
	Sig. (2-tailed)	,000	,000	,000	,000		,000	,000
	N	210	210	210	210	210	210	210
TPK	Pearson Correlation	,213**	,408**	,651**	,358**	,662**	1	,865**
	Sig. (2-tailed)	,002	,000	,000	,000	,000		,000
	N	210	210	210	210	210	210	210
TPACK	Pearson Correlation	,254**	,478**	,735**	,433**	,759**	,865**	1
	Sig. (2-tailed)	,000	,000	,000	,000	,000	,000	
	N	210	210	210	210	210	210	210
**. Correlation is significant at the 0.01 level (2-tailed).								

Through the above tables, it can be seen that: the knowledge components of Content, Pedagogy and Technology of teachers are all relatively good, with mean (AV) is above 2.57. The integrated knowledge of this knowledge such as TPCK, TCK, PCK are quite good (2.4 <AV <2.85). Accordingly, it can be seen that the Pedagogy - Content knowledge of teachers is high with mean is 2.85, most of the teachers are well-trained in Pedagogical schools or have studied through training courses, advanced training on knowledge as well as pedagogical skills. Teachers have also improved pedagogical skills themselves through the actual teaching process in class, thereby making adjustments to suit each teaching environment, contributing to improving learning efficiency.

The data in Table 6 shows that, the majority of the teachers have good knowledge of Technology, with mean is 2.57. The teachers can easily operate computers (expressed through TK1 criteria with AV is 2.71). However, to solve problems directly related to new techniques or technologies, the many teachers are not proficient (2.41 <AV<2.45).

From the data in Table 7, it can be seen that the knowledge of specialized content of teachers (content knowledge) is high, the AV is 2.81. The statistics at CK2 and CK4 criteria show that some teachers are still not active, not interested in new knowledge ... This also affects students' learning results, especially in the Industry 4.0 era today.

The data in Table 8 shows that the integrated knowledge of the Teachers' Content and Pedagogy are quite good with the mean is 2.85. However, if teachers only know about the knowledge of content and pedagogy alone, it is not enough, they need to know how to integrate and apply, select pedagogical methods that are suitable for the teaching content.

Data in Table 9 indicated that the integrated knowledge between Technology knowledge and Pedagogy knowledge of teachers only reached the average level with AV is 2.44. From there, it can be seen that teachers are still limited in integrating technology with teaching methods. These needs to be overcome by exchange with peers and attending advanced training courses.

The integrated knowledge between Content knowledge and Technology knowledge of the teachers also only reached the average level with mean is 2.56 (Table 10). It can be seen that the interaction between specialized knowledge and technological knowledge of teachers is not good, because the teachers mostly focus on Content knowledge. This may be due to a number of reasons such as general schools only focus on teaching knowledge to learners, so they have not focused on technology integration in teaching activities. In part, due to the lack of infrastructure in the schools so that teachers can integrate technology with teaching content. In addition, teachers also do not have proper awareness about the role and importance of technology in teaching activities.

The results in Table 12 show that the correlation between the component competencies of ITT competence is quite high. This shows that the pedagogical schools as well as the teachers have an awareness of the relationship between the element's Pedagogy, Content and Technology of ITT competence, in order to improve the effectiveness in teaching.

4.3. Some discussed through interview results on technology integration in teaching of teachers

Combining the evaluation survey with the questionnaire, the semi-structured interviews were conducted with experienced teachers and some young teachers, on technology integration in teaching. Some discussion through the interview results on technology integration in teaching of teachers is presented below.

In general, teachers have applied technology in three important stages of the teaching process: lesson preparation; teaching practice; collaborative teaching.

In teaching, teachers have applied technology in supporting learning resources to learners, as well as tools to help learners interact with learning content, working with many information channels to create the knowledge. Technology applications in teachers' teaching do not stop at showing lectures with Powerpoint software, but also uses many other tools to enhance learning materials, simulate illustrations, and interact with the content of the lesson… In collaborative activities, some teachers said that they used social networks, email, chat ... as an interactive environment for learning between teachers - learners and learners - learners. This proves that teachers are not only proficient in technology but also initially apply the perspective of collaborative teaching in teaching. Through interviews, we found that teachers have also initially used some new teaching methods such as webquest, flipped classroom ... to teach from a problem-solving point of view, project teaching. Thus, the teachers had a good combination between professional knowledge and pedagogical knowledge, this is also a testament to the figures in the tables 5, 7 and 8 of the PK, CK and PCK components.

Some examples of technology application in teaching can be considered.

An IT teacher shared his experience about the importance of using ICT in teaching lessons about algorithm simulation. The teacher emphasized that it would be difficult to teach the process of algorithm to sort on an array, without the help of videos to simulate algorithms.

Learning resources will facilitate learners' learning, enabling learners to visualize things that cannot be seen with the naked eye, such as electromagnetic currents in wires, the movement of electrons, a technology teacher said.

Moreover, ICT provides teachers with the opportunity to personalize in teaching, to suit different types of learners and to serve individual differences, especially in learning styles. Some learners are visual learners, while others are auditory learners. The problem of personalize learners can be solved with the application of multimedia tools in the teaching process, content technology, teaching with the help of artificial intelligence (AI) or analysis behavior of learners through the technology of big data.

A remarkable pedagogical activity is the use of technology tools, such as email, chat, social networks, etc., especially the information portals, websites of the schools in collaboration activities with colleagues to develop careers. As such, teachers had a good awareness of improving professional skills through the process of continuing learning, using ICT to create teaching resources, teaching models and their professional development. These are also these practical illustrations for Table 9 and Table 11.

Some suggested that teachers need to create an appropriate model for teaching processes with ICT applications, for some specific specialized modules. Teachers need to use more technology to collect information about learners 'learning process with various methods to better assess learners' learning results. In addition, in order to apply technology in teaching better, teachers need to create conditions for learners to use technology and ensure fair access to learning resources for all learners.

Through surveys, interviews, we also recognize some challenges in technology integration in teaching are outlined below. The first difficulty mentioning is the limitation of infrastructure in some schools, as well as technological tools of learners, especially the internet and connection lines ...

The second difficulty is the lack of technical support from the school's technology department. Teachers need help from colleagues, specialized departments, people with better ICT skills, when they encounter technical problems.

Many teachers said that they have to spend a lot of time and even money to plan and prepare lessons using ICT, while there is not a reasonable financial support policy. Some teachers also have a negative attitude towards the application of new technologies for teaching, for reasons such as lack of motivation, lack of knowledge and skills in ICT, lack of confidence. Some teachers are probably because of their age and "traditional" ways of teaching (reading, chalking and speaking).

Another difficulty faced by teachers is the lack of effective ICT training courses that further enhances their ITT competencies, in using ICT in the teaching and learning process. There are many reasons for the inefficiencies in technology fostering for teachers, which will be covered in another article.

5. CONCLUSION

Combined with the data collection to assess quantitatively for ITT competence scale based on the TPACK framework, which was given in [2] and [3], the article has obtained two main results:

- Some preliminary results about the evaluation of ITT competencies of teachers based on TPACK framework.

- Some assess the situation of technology integration in teaching of teachers through interview results.

By assessing the data collected on a number of typical cases of general teachers in schools in the central coastal and Central Highlands provinces of Vietnam, some conclusions can be drawn: (1) Teacher's ITT competency are quite good. The teachers achieved quite good levels both in the field of Pedagogy and Teaching Content; (2) Teachers believe that integrating technology in teaching not only stops in lesson preparation and lesson execution, but also enhances cooperation, interaction in teaching, and supporting their career development; (3) Integrating technology in teaching, helping learners improve their understanding, increasing their motivation for learning, stimulating interest in scientific ideas, and also facilitating the teaching and learning process, provide innovative teaching opportunities. Besides, some discussions, based on the interview results were also mentioned, giving us an overview of the current situation of technology application in teachers' teaching.

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