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The Practice of Technological Pedagogical Content Knowledge of Teacher Educators in Education Colleges in Myanmar

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Abstract

The purpose of this study was to investigate the practice of technological pedagogical content knowledge (TPACK) of teacher educators (N=108) in three Education Colleges in Myanmar. A quantitative survey research design focusing on a set of questionnaires was used. The results showed that there were no significant differences in the TPACK-based practices of teacher educators in terms of their Education College, experience, degree, rank, department and gender. However, significant differences were unearthed in their practices of technological knowledge according to their experience and degree. Besides, by their ranks, significant differences were found in the practice of technological and content knowledge.

Keywords: teacher educators, technological pedagogical content knowledge, education colleges

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Introduction

In the nineteenth century, the predominant notion was that strong subject matter knowledge was enough for teachers to be able to teach new content. However, this notion shift with the awareness of the importance of pedagogical knowledge and knowledge of the content when it came to the early twentieth century. Towards the end of the twentieth century, perceptions about the knowledge of teacher was recognized as the combination of content and pedagogy, as well as the pedagogical content knowledge (PCK) described by the intersection of content and pedagogy (Angeli & Valanides, 2015). However, in the twenty-first century, teaching requires considerably more than delivering subject matter knowledge to students, and student learning is considerably more than absorbing information for later retrieval. Therefore, knowledge of technology becomes an important aspect of overall teacher knowledge in this globalization age as one of the strengths of technology is to support student learning rather than as a tool to deliver the content. As a consequence, teachers not only need to know how to use information and communication technologies (ICT), but also have an awareness of the strategies to incorporate them into teaching a particular subject's content to enhance student learning.

Importance of the study

As a result of the speedy development in information and communication technology, and the demand to achieve the 21st century skills in this globalization age, global trends in higher education are moving towards using digital pedagogies (Goradia, 2018). In other words, technology has already been using in teaching to improve students' engagement and achievement in learning. Therefore, knowledge related to technology of education plays an important role in all aspects of teacher' knowledge.

As mentioned, technology has become an essential proficiency required in teaching at the higher education level, but many professional development programs mostly emphasize on the learning specific applications, rarely on how to approach the content by using technology. To remove this barrier, technological pedagogical content knowledge (TPACK) framework provides a way to integrate pedagogical, content, and technological knowledge in order to produce effective teaching with technology (Koehler & Mishra, 2009).

Therefore, many research studies related to technological pedagogical content knowledge have been done during this decade. However, studies based on the TPACK theoretical framework have been mostly carried out with pre-service teachers, but research conducted with the teacher educators is still limited till now, especially in higher education (Keser, Yılmaz, & Yılmaz, 2015; Karaca, 2015; Can, Erokten, & Bahtiyar, 2017; Özdemir, 2006; & Kou, 2015). Moreover, many studies that focused on the development of instruments related to TPACK confirmed TPACK framework and also the seven subscales of it (Nordin & Ariffin, 2016; Sahin, 2011; & Kiray, 2016). Furthermore, there were studies that tried to determine which factors affect teachers' TPACK levels. The results of many studies uncovered that gender and professional experience of teachers influence their TPACK levels (Ozudogru & Ozudogru, 2019; Akturk & Ozturk, 2019; Alqurashi, Gokbel, & Carbonara, 2016; & Jang & Chang, 2016).

Many studies related to teachers' pedagogical content knowledge have been done in Myanmar. However, very few studies related to teachers' technological pedagogical content knowledge was carried out, especially in Education Colleges. Thus, this study was carried out to investigate the practice of teacher educators' technological pedagogical content knowledge in their profession.

Review of related literature

As technologies have gradually been integrated in teaching learning process, new technology integration models have been developed by many scholars. Among them, the framework that becomes popular after 2006 is technological pedagogical content knowledge (TPACK) of Mishra & Koehler (2006). They declared that the three main components of teachers'

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knowledge: content, pedagogy, and technology are at the heart of TPACK as this framework was developed based on pedagogical content knowledge (PCK) of Shulman (1986). Shulman (1987) asserted that among the seven categories of teacher's knowledge: content knowledge, general pedagogical knowledge, curriculum knowledge, pedagogical content knowledge, knowledge of learners and their characteristics, knowledge of educational contexts, and knowledge of educational ends, purposes, and values, and their philosophical and historical grounds, pedagogical content knowledge is of special interest as it represents the unique bodies of knowledge for teaching that distinguishes teachers from content specialists. Therefore, pedagogical content knowledge was defined as:

“... the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction. It is the category most likely to distinguish the understanding of the content specialist from that of the pedagogue” (Shulman, 1987).

The definition of pedagogical content knowledge (PCK) by Loughran, Berry, & Mulhall (2012) was that it is the knowledge about how to teach particular content in particular ways with the aim of strengthening student understanding that teachers gradually develop by means of experience. They also mentioned that PCK of teachers may be different from each other depending on the teaching context, content, and their experience but it is, nevertheless, a corner stone of teachers' professional knowledge and expertise.

Angeli & Valanides (2015) stated that TPACK framework characterizes the knowledge that teachers focus on, when designing and implementing curriculum and instruction, while guiding the way of thinking and learning of their students with digital technologies in various content areas. Therefore, TPACK model of Koehler & Mishra (2009) describes teacher's knowledge as a result of combination of seven knowledge dimensions: technological knowledge (TK), pedagogical knowledge (PK), content knowledge (CK), pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPCK) that are equally important in this model.

Technological knowledge (TK) is knowledge about technologies ranging from standard to digital technologies, and involves the skills required to operate particular technologies (Mishra & Koehler, 2006).

Pedagogical knowledge (PK) includes the knowledge of strategies and principles of teaching, classroom management and organization in education (Shulman, 1987).

Content knowledge (CK) is the amount of the actual knowledge and organization in the mind of the teacher (Shulman, 1986). It is the depth and breadth of knowledge in a specific content area (Doering, Veletsianos, Scharber, & Miller, 2009).

Pedagogical content knowledge (PCK) is the combination of the rich knowledge of pedagogy and content together, each shaping and interacting with the other so that what is taught, and how it is constructed are purposefully created to ensure that the content is better understood by students in a given context because of the way the teaching has been organized, planned, analyzed and presented (Loughran et al., 2012).

Technological content knowledge (TCK) is the knowledge of various technologies and their uses in teaching depending on the nature of the content and to change the way learners understand the concepts (Padmavathi, 2017).

Technological pedagogical knowledge (TPK) is the knowledge of using pedagogical strategies appropriate to technological tools and the knowledge of how teaching might change as a result of using particular technologies (Mishra & Koehler, 2006).

Technological pedagogical content knowledge (TPCK) is the knowledge teachers rely on

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while guiding their students' thinking and learning of specific content areas with particular technologies efficiently (Mishra & Koehler, 2006).

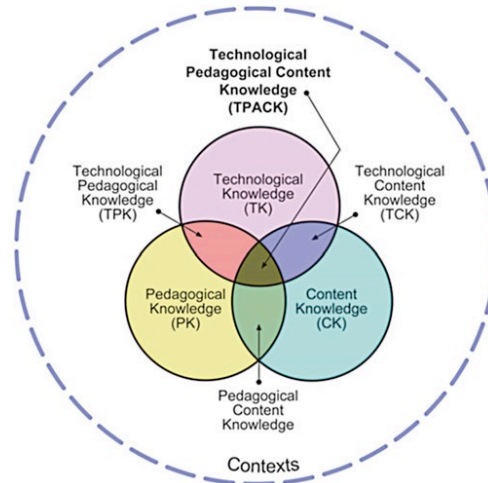


Figure 1. The TPACK framework and its knowledge components (Koehler & Mishra, 2009)

According to Mishra & Koehler, (2006), TPACK framework contributes an analytic framework and categorization schemes for the analysis of teacher knowledge and its evolution. What is more, it imparts how to design pedagogical strategies and an analytic ways to examine the changes in educators' knowledge about successful teaching with technology. Additionally, it allows not only to understand about the effective teaching with technology but also to make predictions and assumptions about contexts under which such good teaching will occur. Moreover, it offers the ways of analysis and development of a complex phenomenon of technology integration and offers considerable options for further researches in teacher education, teacher professional development, and teachers' use of technology (Koehler & Mishra, 2009).

Purposes

The main purpose of this study was to investigate the practice of technological pedagogical content knowledge of teacher educators in Education Colleges in Myanmar.

The specific purposes are:

1. To investigate the practice of teacher educators' technological pedagogical content knowledge in Education Colleges in Myanmar.
2. To give suggestions on the practice of technological pedagogical content knowledge of teacher educators to the teacher education programmes.

Research hypotheses

The research hypotheses adopted in this study are as follows.

There are significant differences in applying technological pedagogical content knowledge among teacher educators with respect to their: (1) Education College (2) teaching experience (3) degree (4) rank (5) department, and (6) gender.

Research Method

Research design

The research design applied in this study is a descriptive survey in which the quantitative data were collected by a set of predetermined questionnaires.

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Scope of the study

The following points indicate the scope of the study.

- This study was carried out in three education colleges in Yangon Region, Myanmar.
- The participants in this study were teacher educators from three education colleges in Yangon Region, Myanmar.

Sample of the study

The sample of the study was comprised of all teacher educators from three education colleges - Thingangyun (TEC), Yankin (YEC), Hlegu (HEC) in Yangon Region, Myanmar, except those who were engaged in their class schedules during the survey. The sample can be organized as follows.

Table 1. Demographic data of participants or teacher educators

Category	Subcategories	Number	Total
Education College	Thingangyun (TEC)	35	108
	Yankin (YEC)	41	
	Hlegu (HEC)	32	
Gender	Male	12	108
	Female	96	
Teaching Service	1-10 years	35	108
	11-20 years	38	
	21-30 years	9	
	Above 31 years	26	
Degree	Master of Arts/ Science (MA, MSc)	46	108
	Bachelor of Education (BEd)	38	
	Master of Education (MEd)	20	
	Doctor of Philosophy (PhD)	4	
Rank	Tutor	33	108
	Assistant Lecturer	18	
	Lecturer	57	
Department	Academic	53	108
	Education	55	

Instruments

The instruments used in this study were a predetermined questionnaire. The questionnaire was composed of 45 items constructed by Ismail Sahin (2011) based on Mishra and Koehler (2006) model: 14 items were related to technological knowledge, 6 items to pedagogy knowledge, 6 items to content knowledge, 4 items to technological pedagogical knowledge, 7 items to pedagogical content knowledge, 3 items to technological content knowledge and 5 items were related to technological pedagogical content knowledge. The rating scale for the response was set in 5-point Likert as “never”, “rarely”, “sometimes”, “often” and “always”.

Procedure

First, the relevant literature was reviewed. Then, the instrument questionnaire constructed by Ismail Sahin (2011) based on Mishra and Koehler (2006) model was modified and translated into Myanmar language. Three teacher educators (a retired professor of education, an associate professor of education from the Methodology Department, Sagaing University of Education, and an assistant lecturer from the Methodology Department, Yankin Education College) were requested for expert review for the validation of the questionnaire. After that, the study was piloted with 20 teacher educators in Thingangyun Education College. The items were modified and the data obtained from the pilot study were calculated by the Cronbach's alpha coefficient. The internal consistency for the questionnaire was (0.785). The main survey was completed in three Education Colleges in Yangon Region, Myanmar in March, 2019.

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Analysis of the data

The data were analyzed by calculating the means of each dimension in order to determine the practice of technological pedagogical content knowledge of teacher educators from the selected education colleges. Moreover, descriptive statistics, one-way ANOVA, Post Hoc Multiple Comparison Test and Mann-Whitney U tests were used to analyze whether there is a significant difference in the practice of technological pedagogical content knowledge among teacher educators in terms of their Education College, teaching service, degree, rank, department and gender.

Research Findings

Findings of the practice of teacher educators' TPACK in the selected education colleges

To determine the practice of teacher educators' TPACK, descriptive data (mean and standard deviation) of the TPACK survey scores were calculated. The results of the analysis were given in table 2.

Table 2. Means and standard deviations of the practice of each dimension of teacher educators' TPACK

Dimension	N	\bar{X}	SD
Technological Knowledge (TK)	108	2.58	.878
Pedagogical Knowledge (PK)	108	3.82	.745
Content Knowledge (CK)	108	3.67	.641
Technological Pedagogical Knowledge (TPK)	108	3.32	.722
Pedagogical Content Knowledge (PCK)	108	3.96	.675
Technological Content Knowledge (TCK)	108	3.43	.957
Technological Pedagogical Content Knowledge (TPCK)	108	3.11	.726

The comparison of means of each dimension of teacher educators' TPACK indicated that the means of technology related dimensions (TK, TPK, TCK and TPCK) were lower than other dimensions (see Table 2). Among them, the mean of technology knowledge dimension (\bar{X} = 2.58) was the lowest whilst that of pedagogical content knowledge dimension (\bar{X} = 3.96) was the highest compared to others. Moreover, the means of pedagogical knowledge dimension and technological pedagogical content knowledge dimension stood at the second highest and lowest positions (\bar{X} = 3.82 and \bar{X} = 3.11) respectively whereas content knowledge, technological content knowledge and technological pedagogical knowledge followed subsequently. It means that teacher educators rarely applied technological knowledge in their teaching and other dimensions of TPACK were utilized on some occasions as the value of the means resulted around 3.0.

4.2. Findings of the practice of TPACK among the teacher educators according to their education colleges

In order to compare the selected education colleges on the practice of teacher educators' TPACK, descriptive data (mean and standard deviation) of the TPACK survey scores were calculated. The participants were divided into three groups according to their education colleges (group 1; Thingangyun Education College, group 2; Yankin Education College and group 3; Hlegu Education College). The results of the analysis were given in table 3.

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Table 3. Means and standard deviations of three education colleges

EC	N	TK (\bar{X} , SD)	PK (\bar{X} , SD)	CK (\bar{X} , SD)	TPK (\bar{X} , SD)	PCK (\bar{X} , SD)	TCK (\bar{X} , SD)	TPCK (\bar{X} , SD)	TPACK (\bar{X} , SD)
TEC	35	2.71, .928	3.78, .806	3.69, .638	3.26, .838	3.95, .592	3.34, 1.021	3.05, .758	3.40, .577
YEC	41	2.67, .879	4.00, .706	3.74, .635	3.50, .597	4.08, .613	3.51, .907	3.21, .705	3.53, .451
HEC	32	2.32, .788	3.63, .691	3.56, .659	3.15, .701	3.82, .813	3.41, .968	3.04, .723	3.27, .542
Total	108	2.58, .878	3.82, .745	3.67, .641	3.32, .722	3.96, .675	3.43, .957	3.11, .726	3.41, .528

In the dimensions of PK, CK, TPK, PCK, TCK and TPCK, the means of YEC were the highest among the selected education colleges while the mean of TEC was the highest in the dimension of TK (see Table 3). Furthermore, the means of TEC stayed on the second highest status in other dimensions except the dimension of TCK. The point is that the mean of HEC stood third as its means were at the lowest in other dimensions. To sum up, the total mean (TPACK) of YEC (\bar{X} =3.53) outperformed those of TEC and HEC (\bar{X} =3.40 and \bar{X} = 3.27) respectively. Therefore, it can be interpreted that teacher educators from Yankin Education College applied their TPACK in their profession more than those of Thingangyun and Helgu Education Colleges. Moreover, they rarely applied technological knowledge in their teaching as the means of three education colleges resulted below 3.0.

One way ANOVA was used to explore the significant level of the utilization of Teacher Educators' TPACK among the selected Education Colleges.

Table 4. ANOVA results comparing the selected education colleges on applying teacher educators' TPACK

		Sum of Squares	df	Mean Square	F	Sig.
TK	Between Groups	3.100	2	1.550	2.050	.134
	Within Groups	79.397	105	.756		
	Total	82.497	107			
PK	Between Groups	2.609	2	1.034	2.410	.095
	Within Groups	56.843	105	.541		
	Total	59.451	107			
CK	Between Groups	.591	2	.296	.715	.491
	Within Groups	43.409	105	.413		
	Total	44.000	107			
TPK	Between Groups	2.379	2	1.189	2.341	.101
	Within Groups	53.350	105	.508		
	Total	55.729	107			
PCK	Between Groups	1.249	2	.625	1.383	.255
	Within Groups	47.438	105	.452		
	Total	48.687	107			
TCK	Between Groups	.559	2	.280	.301	.740
	Within Groups	97.404	105	.928		
	Total	97.963	107			
TPCK	Between Groups	.734	2	.367	.693	.502
	Within Groups	55.617	105	.530		
	Total	56.351	107			
TPACK	Between Groups	1.192	2	.596	2.189	.117
	Within Groups	28.588	105	.272		
	Total	29.780	107			

Table 4 showed that there was no significant difference among the selected Education Colleges in the practice of teacher educators' TPACK, $F(2, 105) = 2.189, p=.117$. Moreover, no

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statistically significant difference was found among these three Education Colleges in all the dimensions of TPACK. Therefore, it can be concluded that the application levels of TPACK among the teacher educators of the selected Education Colleges were almost the same.

Findings of the practice of teacher educators' TPACK in terms of teaching service

In order to make a comparison on the application levels of TPACK among the teacher educators in terms of their teaching experience, descriptive data was calculated. The participants were divided into four groups according to their teaching experience (group 1; 1-10 years, group 2; 11-20 years, group 3; 21-30 years and group 4; above 31). The results were shown in Table 5.

Table 5. Means and standard deviations of the teacher educators in terms of their teaching service

Teaching Service	N	TK (\bar{X} , SD)	PK (\bar{X} , SD)	CK (\bar{X} , SD)	TPK (\bar{X} , SD)	PCK (\bar{X} , SD)	TCK (\bar{X} , SD)	TPCK (\bar{X} , SD)	TPACK (\bar{X} , SD)
1-10 Yrs	35	2.99,.718	3.92,.574	3.66,.506	3.28,.742	3.78,.547	3.26,.987	2.90,.727	3.40,.519
11-20 Yrs	38	2.74,.859	3.78,.884	3.72,.715	3.39,.764	3.99,.649	3.56,.949	3.17,.698	3.48,.576
21-30 Yrs	9	1.87,.606	3.80,.655	3.85,.704	3.50,.625	4.08,.866	3.63,.889	3.51,.736	3.46,.500
Above 31 Yrs	26	2.04,.796	3.76,.785	3.53,.680	3.20,.675	4.13,.770	3.38,.960	3.16,.716	3.31,.485
Total	108	2.58,.878	3.82,.745	3.67,.641	3.32,.722	3.96,.675	3.43,.957	3.11,.726	3.41,.528

The results of Table 5 revealed that the means of teacher educators whose teaching service falls between 1 and 20 years were found to be at the top in the dimensions of TK and PK though their means were at the lowest in the dimensions of TCK, PCK and TPCK. Interestingly, for those whose had between 11 and 20 years of teaching service, their means never stayed at the highest and lowest but the means of TK, PK and TPK dimensions were at the second highest and the others at the second lowest. Moreover, while the means of those whose teaching service was between 21 and 30 years showed the highest in the dimensions of CK, TPK, TCK and TPCK, the means of those who had at least 31 years of teaching experience had the highest PCK compared to others. However, their means in the dimension of CK, PK and TPK were the lowest. One interesting point is that the means of PCK dimension increased according to the increment in their teaching experience.

Thus, in general, it can be interpreted that young teacher educators though they had the less teaching experience than others utilized the TPACK more than others. However, it was revealed that PCK increased gradually with respect to the year of teaching experience and the young teacher educators had much more TK than others.

In order to investigate the statistically significant level in comparing teacher educators by means of teaching service on applying TPACK, one way ANOVA and Post Hoc Multiple Comparison Tests were used.

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Table 6. ANOVA results comparing teacher educators in terms of teaching service on the exploitation of TPACK

		Sum of Squares	df	Mean Square	F	Sig.
Mean TK	Between Groups	18.896	3	6.299	10.299	.000***
	Within Groups	63.601	104	.612		
	Total	82.497	107			
Mean PK	Between Groups	.526	3	.175	.309	.818
	Within Groups	58.925	104	.567		
	Total	59.451	107			
Mean CK	Between Groups	.886	3	.295	.712	.547
	Within Groups	43.114	104	.415		
	Total	44.000	107			
Mean TPK	Between Groups	.926	3	.309	.586	.626
	Within Groups	54.803	104	.527		
	Total	55.729	107			
Mean PCK	Between Groups	2.071	3	.690	1.540	.209
	Within Groups	46.617	104	.448		
	Total	48.687	107			
Mean TCK	Between Groups	2.112	3	.704	.764	.517
	Within Groups	95.851	104	.922		
	Total	97.963	107			
Mean TPCK	Between Groups	3.257	3	1.086	2.127	.101
	Within Groups	53.094	104	.511		
	Total	56.351	107			
Total Mean TPACK	Between Groups	.450	3	.150	.532	.661
	Within Groups	29.330	104	.282		
	Total	29.780	107			

Note. *** $p < .001$

The results highlighted that there was no statistically significant difference among the teacher educators by their teaching service in the application of TPACK, $F(3, 104) = .532, p = .661$. However, statistically significant difference was found among those in only one dimension of technological knowledge (TK), $F(3, 104) = 10.299, p = .000$ (see Table 6). Post hoc Tukey HSD tests also indicated that significant differences were found among the groups in TK ($p < .05$) except between the groups of 1-10 years and 11-20 years. It means that the practice of teacher educators' TPACK did not differ according to their teaching experience even though they had different practice of technological knowledge in their teaching.

Findings of the practice of teacher educators' TPACK in terms of their degree

In order to compare the teacher educators' application level of TPACK according to their different degrees at the university, the analysis of descriptive data was made where the participants were divided into four groups according to their respective degrees: group 1; MA/MSc degree holders, group 2; BEd degree holders, group 3; MEd degree holders and group 4; PhD degree holders. The result can be seen in Table 7.

Table 7. Means and standard deviations of teacher educators by means of their degree

Degree	N	TK (\bar{X} , SD)	PK (\bar{X} , SD)	CK (\bar{X} , SD)	TPK (\bar{X} , SD)	PCK (\bar{X} , SD)	TCK (\bar{X} , SD)	TPCK (\bar{X} , SD)	TPACK (\bar{X} , SD)
MA/MSc	46	2.77, .717	3.87, .746	3.64, .626	3.29, .713	3.86, .586	3.51, 1.063	2.93, .701	3.41, .534
BEd	38	2.21, .812	3.70, .752	3.55, .737	3.22, .757	3.91, .848	3.32, .958	3.19, .747	3.30, .541
MEd	20	2.80, 1.088	3.89, .742	3.83, .433	3.46, .	4.29, .433	3.47, .721	3.34, .726	3.58, .46

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					685				8
PhD	4	2.79,1.211	4.04,,821	4.25,,289	3.88,,479	3.89,,317	3.25,,877	3.20,,542	3.61,,486
Total	108	2.58,,878	3.82,,745	3.67,,641	3.32,,722	3.96,,675	3.43,,957	3.11,,726	3.41,,528

According to table 7, the means of teacher educators holding PhD degree were the highest in the dimensions of PK, CK and TPK whilst the means of those BEd degree holders were at the lowest in those dimensions in addition to TK. Moreover, in the dimensions of TK, PCK and TPCK, the means of MEd degree holders stood at the peak and remained at the second highest in other dimensions except TCK where the means of those (MA/ MSc degree holders) were the highest and PhD degree holders' means were at the bottom. In short, the total mean (TPACK) of PhD degree holders (\bar{X} = 3.61) exceed others which was followed by the means of MEd, MA/MSc and BEd degree holders successively (\bar{X} = 3.58, \bar{X} = 3.41 and \bar{X} = 3.30) respectively. Therefore, it can be assumed that teacher educators who attained the higher educational level applied TPACK more than those of lower level attainment.

To find out the statistically significant difference in the practice of TPACK among the teacher educators in terms of their respective major, one way ANOVA and Post Hoc Multiple Comparison Tests were computed.

Table 8. ANOVA table comparing teacher educators' TPACK with respect to their degree

		Sum of Squares	df	Mean Square	F	Sig.
Mean TK	Between Groups	8.035	3	2.678	3.741	.013*
	Within Groups	74.462	104	.716		
	Total	82.497	107			
Mean PK	Between Groups	.984	3	.328	.583	.627
	Within Groups	58.468	104	.562		
	Total	59.451	107			
Mean CK	Between Groups	2.479	3	.826	2.070	.109
	Within Groups	41.521	104	.399		
	Total	44.000	107			
Mean TPK	Between Groups	2.038	3	.679	1.316	.273
	Within Groups	53.691	104	.516		
	Total	55.729	107			
Mean PCK	Between Groups	2.759	3	.920	2.083	.107
	Within Groups	45.928	104	.442		
	Total	48.687	107			
Mean TCK	Between Groups	.979	3	.326	.350	.789
	Within Groups	96.984	104	.933		
	Total	97.963	107			
Mean TPCK	Between Groups	2.743	3	.914	1.774	.157
	Within Groups	53.608	104	.515		
	Total	56.351	107			
Total Mean TPACK	Between Groups	1.237	3	.412	1.503	.218
	Within Groups	28.543	104	.274		
	Total	29.780	107			

Note. * $p < .05$

Table 8 uncovered no statistically significant difference among teacher educators' application of TPACK in terms of their respective degrees, $F(3, 104) = 1.503, p = .218$. Nevertheless, there was statistically significant difference among those in the dimension of technological knowledge, $F(3, 104) = 3.741, p = .013$, but none was found in other dimensions. Moreover, as a result of Post hoc Tukey HSD tests, significant differences were found between the groups of BEd degree holders and MA/MSc degree holders in TK ($p < .05$), but not in other groups. Thus, it can be assumed that teacher educators had no difference in applying TPACK according to their different degrees but they had different background knowledge and application levels

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concerning with technological knowledge.

Findings of the practice of teacher educators' TPACK in terms of rank

Descriptive data analysis was carried out to compare the practice of TPACK of teacher educators in terms of their position. The participants were divided into three groups according to their ranks: group 1; tutors, group 2; assistant lecturers and group 3; lecturers. A tutor is in the lowest position or rank in teaching profession at the higher education level. An assistant lecturer is higher in the position than a tutor and a lecturer is higher than an assistant lecturer. The result was displayed in table 9.

Table 9. Means and standard deviations of teacher educators by means of their rank

Rank	N	TK (\bar{X} , SD)	PK (\bar{X} , SD)	CK (\bar{X} , SD)	TPK (\bar{X} , SD)	PCK (\bar{X} , SD)	TCK (\bar{X} , SD)	TPCK (\bar{X} , SD)	TPACK (\bar{X} , SD)
Tutor	33	2.92,.743	3.88,.599	3.58,.514	3.27,.711	3.77,.554	3.22,.953	2.93,.798	3.37,.505
Assistant-Lecturer	18	2.62,.866	3.90,.741	4.01,.665	3.63,.729	4.21,.546	3.59,.890	3.31,.652	3.61,.471
Lecturer	57	2.37,.904	3.76,.826	3.61,.674	3.25,.713	3.99,.749	3.49,.976	3.15,.693	3.37,.551
Total	108	2.58,.878	3.82,.745	3.67,.641	3.32,.722	3.96,.675	3.43,.957	3.11,.726	3.41,.528

The results of the analysis disclosed that the mean of tutors overtook that of assistant lecturer and lecturer in TK dimension. Likewise, the mean of assistant lecturer outdid that of tutors and lecturers in all the dimensions except TK whereas the mean of tutors was at the bottommost in the dimensions of CK, PCK, TCK and TPCK, and the means of lecturers were also at the lowest level in the dimensions of TK, PK and TPK. All things considered, the mean of assistant lecturer (\bar{X} = 3.61) outperformed others who had the same mean (\bar{X} = 3.37). Hence, it can be interpreted that assistant lecturers used their TPACK in their profession more than others while the applications of TPACK of tutors and lecturers were at the same level.

One-way ANOVA and Post hoc Multiple Comparison Test were used with the aim of exploring the statistically significant difference among the application of TPACK in terms of their ranks in Education Degree Colleges.

Table 10. ANOVA table comparing the practice of teacher educators' TPACK in terms of their rank

		Sum of Squares	df	Mean Square	F	Sig.
Mean TK	Between Groups	6.289	2	3.144	4.333	.016*
	Within Groups	76.208	105	.726		
	Total	82.497	107			
Mean PK	Between Groups	.468	2	.234	.417	.660
	Within Groups	58.983	105	.562		
	Total	59.451	107			
Mean CK	Between Groups	2.551	2	1.275	3.231	.043*
	Within Groups	41.449	105	.395		
	Total	44.000	107			
Mean TPK	Between Groups	2.027	2	1.014	1.982	.143
	Within Groups	53.702	105	.511		
	Total	55.729	107			
Mean PCK	Between Groups	2.401	2	1.201	2.724	.070
	Within Groups	46.286	105	.441		
	Total	48.687	107			
Mean TCK	Between Groups	2.112	2	1.056	1.157	.318
	Within Groups	95.851	105	.913		
	Total	97.963	107			
Mean TPCK	Between Groups	1.838	2	.919	1.770	.175

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	Within Groups	54.513	105	.519		
	Total	56.351	107			
Total Mean	Between Groups	.840	2	.420	1.524	.223
TPACK	Within Groups	28.940	105	.276		
	Total	29.780	107			

The results of the analysis revealed that there was no statistically significant difference among the teacher educators' application level of TPACK with respect to their rank, $F(2, 105) = 1.524$, $p = .223$. But, statistically significant differences among those were found in the dimensions of technological knowledge and content knowledge, $F(2, 105) = 4.333$, $p = .016$ and $F(2, 105) = 3.231$, $p = .043$ respectively (see Table 10). Additionally, the result of Post hoc Tukey HSD tests showed that there were significant differences only between the groups of tutors and lecturers in TK ($p < .05$). Therefore, it can be interpreted that the application level of TPACK among teacher educators did not differ in terms of their rank but their technological knowledge and content knowledge were put differently into practice.

Findings of the practice of teacher educators' TPACK in terms of department

Mann-Whitney U tests to make a comparison between the two departments, academic and education, based on the application level of teacher educators' TPACK because the dependent variables were ordinal and the variances were unequal (Morgan, Leech, Gloeckner, & Barrett, 2011). In fact, there are three main departments in Education Colleges; Education, Academic and Co-curriculum. However, the participants from the Co-curriculum department were very few compared to the other two departments. For that reason, the participants of that department were excluded from the study. Then, the participants were divided into two groups (group 1; Academic, and group 2; Education). The results were shown in table 11 and 12.

Table 11. Mean ranks and sum of ranks of teacher educators with respect to their department

	Department	N	Mean Rank	Sum of Ranks
Mean TK	1 Academic	53	60.92	3228.50
	2 Education	55	48.32	2657.50
	Total	108		
Mean PK	1 Academic	53	56.06	2971.00
	2 Education	55	53.00	2915.00
	Total	108		
Mean CK	1 Academic	53	54.08	2866.50
	2 Education	55	54.90	3019.50
	Total	108		
Mean TPK	1 Academic	53	54.69	2898.50
	2 Education	55	54.32	2987.50
	Total	108		
Mean PCK	1 Academic	53	48.78	2585.50
	2 Education	55	60.01	3300.50
	Total	108		
Mean TCK	1 Academic	53	56.89	3015.00
	2 Education	55	52.20	2871.00
	Total	108		
Mean TPACK	1 Academic	53	47.88	2537.50
	2 Education	55	60.88	3348.50
	Total	108		
Total Mean TPACK	1 Academic	53	54.87	2908.00
	2 Education	55	54.15	2978.00
	Total	108		

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Table 12. Mann-Whitney U tests table comparing the department on the practice of teacher educators' TPACK

	Mean TK	Mean PK	Mean CK	Mean TPK	Mean PCK	Mean TCK	Mean TPCK	Total Mean TPACK
Mann-Whitney U	1117.500	1375.000	1435.500	1447.500	1154.500	1331.000	1106.500	1438.000
Wilcoxon W	2657.500	2915.000	2866.500	2987.500	2585.500	2871.000	2537.500	2978.000
Z	-2.091	-.510	-.136	-.062	-1.870	-.785	-2.168	-.120
Asymp. Sig. (2-tailed)	.037	.610	.892	.951	.061	.432	.030	.905

The average of 53 teacher educators from the academic department had significant higher mean (60.92) than that of 55 teacher educators from the education department (48.32) in the dimension of TK, $U = 1117.5$, $p = .037$, $r = -.20$, which, according to Cohen (1988), is a small to medium effect size. Likewise, there was a significant difference in the mean ranks of teacher educators between the two departments. The mean of education department (60.88) was higher than that of the academic department (47.88) in the dimension of TPCK, $U = 1106.5$, $p = .03$, $r = -.21$, which is considered a small to medium effect size as well. However, they did not differ on the other dimensions and also on the total TPACK. Mean ranks of TPACK were 54.87 and 54.15, respectively, $U = 1438$, $p = .905$, $r = .01$ (see Tables 11, 12). As a consequence, it can be interpreted that the practice of teacher educators' TPACK in their profession did not relate to which department they belong to.

Findings of the practice of teacher educators' TPACK in terms of gender

To compare the gender on the practice of teacher educators' TPACK, Mann-Whitney U tests was used.

Table 13. Mean ranks and sum of ranks of teacher educators according to gender

	Gender	N	Mean Rank	Sum of Ranks
Mean TK	1 Male	12	58.29	699.50
	2 Female	96	54.03	5186.50
	Total	108		
Mean PK	1 Male	12	64.33	772.00
	2 Female	96	53.27	5114.00
	Total	108		
Mean CK	1 Male	12	49.88	598.50
	2 Female	96	55.08	5287.50
	Total	108		
Mean TPK	1 Male	12	66.50	798.00
	2 Female	96	53.00	5088.00
	Total	108		
Mean PCK	1 Male	12	57.13	685.50
	2 Female	96	54.17	5200.50
	Total	108		
Mean TCK	1 Male	12	51.75	621.00
	2 Female	96	54.84	5265.00
	Total	108		
Mean TPCK	1 Male	12	50.63	607.50
	2 Female	96	54.98	5278.50
	Total	108		
Total Mean TPACK	1 Male	12	58.33	700.00
	2 Female	96	54.02	5186.00
	Total	108		

Table 14. Mann-Whitney U tests table comparing gender on the practice of teacher educators' TPACK

	Mean TK	Mean PK	Mean CK	Mean TPK	Mean PCK	Mean TCK	Mean TPCK	Total Mean TPACK
Mann-Whitney U	530.500	458.000	520.500	432.000	544.500	543.000	529.500	530.000
Wilcoxon W	5186.500	5114.000	598.500	5088.000	5200.500	621.000	607.500	5186.000
Z	-.445	-1.160	-.545	-1.418	-.309	-.326	-.457	-.450
Asymp. Sig. (2-tailed)	.656	.246	.586	.156	.757	.744	.648	.653

The results showed that there was no significant difference in TPACK between the groups divided by gender and even in any dimension of TPACK as well. Mean ranks of TPACK were 58.33 and 54.02, respectively, $U = 530$, $p = .653$, $r = .04$ (see Tables 13, 14). According to these results, it can be interpreted that the difference in the application level of teacher educators' TPACK in their profession did not relate to gender.

Discussion

One of the findings of this study uncovered that the application level of teacher educators' technological pedagogical content knowledge (TPACK) had no significant difference among the selected Education Colleges.

Moreover, the results revealed that different years of teaching service and different degrees of teacher educators could not make any difference in applying overall TPACK in their teaching, but made a different level in using technological knowledge. These results were consistent with the findings of Jang & Chang (2016) which showed that there was no significant difference in overall TPACK of physics instructors according to academic degrees but not in line with one of his findings that indicated the statistical significance in overall TPACK according to their teaching experience. Moreover, the result of Ozudogru & Ozudogru (2019) which showed no significant effect on TPACK by the year of teaching experience and significant difference on technological knowledge subscale was consistent with the finding of this study. On the contrary, Akturk & Ozturk (2019) found that professional experience of teachers made a significant difference in their TPACK levels.

Likewise, one of the results highlighted that although various levels of teacher educators' rank could not make any contrast on utilizing overall TPACK, they brought about a different applying level of technological knowledge and content knowledge. Besides, working in different departments gave rise to various application levels of technological knowledge and technological pedagogical content knowledge (TPCK) subscales but not in all subscales of TPACK. The last finding which is concerned with the gender of the participants showed that there was no significant difference in using overall TPACK of teacher educators. This finding was in line with many findings which reported that there was no significant difference in the overall TPACK of instructors/teachers in terms of gender (Jang & Chang, 2016; Akturk & Ozturk, 2019). In contrast, the result of Ozudogru & Ozudogru (2019) which showed significant differences between gender was not consistent with the result of this study.

Furthermore, in comparing the means of teacher educators' TPACK, it was found that the teacher educators' application levels of CK, PK and PCK were higher than TK, TCK, TPK and TPCK levels. This result was not deviated from the findings of Akturk & Ozturk (2019) which indicated that CK and PCK levels of teachers were at good levels and the levels of TK, PK, TPK, TCK and TPACK were moderate. Likewise, Alqurashi et al. (2016) mentioned in their paper that pedagogy and pedagogical content knowledge were the highest mean scores and technology and technological pedagogy knowledge were the lowest mean scores of all the domains in studying teachers in USA and Saudi Arabia. This was in line with the result of this study.

In addition, those groups of teacher educators who had the lowest and highest years of teaching

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service applied their TPACK lower than the other two groups. In addition, it was found that teacher educators who had higher educational level applied TPACK more than those who had lower educational attainment. What is more, the result mentioned that pedagogical content knowledge of teacher educators increased gradually with respect to their teaching experience and the young teacher educators applied much more technological knowledge than the elders. This is consistent with the result of Akturk & Ozturk (2019) that showed teachers who have low teaching experience has higher TK than teachers who have been working for 21 years or more.

The reason why teacher educators have lower TPACK level (as means showed that they sometimes used their TPACK in their teaching) may be that there is still lack of infrastructure in both public schools and universities, especially access to technology. Another point is that the teachers from both basic and higher education did not have much opportunity to be familiar with technology. The next problem is that most teachers from Myanmar have many obstacles to use learner centered approach till now. The reason may be because of the large class size, lack of materials, insufficient teachers.

Dysart & Weckerle (2015) stated in his paper that new teachers entered into teaching profession as experts in their discipline at the university or college level, but did not always have experience with pedagogical techniques or technological tools. The same situation takes place in Myanmar as well. It is undeniable that most teachers lack experience in both except those who graduated from the Universities of Education. But, even they still have insufficient technological knowledge. Thus, it is obvious that insufficient pedagogical and technological knowledge in teachers before their profession is one of the main reasons.

Conclusion

This study was carried out to investigate the TPACK-based practice of teacher educators from the Education Colleges. The findings revealed that the teacher educators applied their knowledge related to technological subscales lower than pedagogical content knowledge subscales in their teaching. However, there was no significant difference in the practice of Technological Pedagogical Content Knowledge among the teacher educators in terms of their Education College, experience, academic degree, rank, department and gender. Nevertheless, different practice of technological knowledge was found among those teacher educators. Plus, pedagogical content knowledge of teacher educators became higher with the increase of their experience. The findings of this study highlighted the need to upgrade the TPACK level of teacher educators in Education Colleges in Myanmar to be effective in their profession.

Recommendations

It is assured that the integration of technology in teaching provides a considerable support to the learning and teaching processes. Teacher educators who train prospective teachers should integrate pedagogical approaches and technology in their teaching which will assist student teachers to have a better understanding of the content and educational practices. It means that teacher educators' TPACK-based practices can encourage teacher candidates to apply these practices in their profession later. Thus, professional development programs related to technology and pedagogy trainings should be conducted as a mandatory for teacher educators in education colleges. Moreover, to be able to apply TPACK-based practices during teaching, the courses which emphasize TPACK should be specific in the curricula of teacher education and learning environments which provide more opportunity for the pre-service teachers to practice.

Limitations

Although this study focused on the TPACK practice of teacher educators from three Education Colleges, Yangon Region in Myanmar, further research should be carried out in other Education Colleges and Academic Universities and in Basic Education Schools as well. Furthermore, as this research was a quantitative study, a qualitative study related to teachers' TPACK should be carried out to have a deeper understanding on that issue.

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