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TPACK of Faculty in Higher Education: Current Status and Future Directions

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The purpose of this study was to investigate teaching competence of faculty members based on TPACK which should be examined to ensure high quality in higher education. This study was conducted with a focus on TPACK, which integrate technology knowledge (TK), content knowledge (CK), and pedagogy knowledge (PK). Except insincere responses data from a total of 85 participants were used for data analysis in this study. K-mean cluster analysis method was used to examine how faculty members could be distinguished depending on TPACK type. Study results showed that there were three different types of faculty groups (well-balanced competence type, development required competence type, and lack of technology competence type). First, faculty members defined as well balanced competence type were more than the average level in TPACK. Second, faculty members belonged to development required competence type reported below the average level in TPACK. Thus, faculty members in this type were required to increase teaching competence. Finally, faculty members in lack of technology competence type were needed to enhance competence related to technology because their overall TK level was relatively low. This study examined what distinctive characteristics exited in each type depending on gender, teaching career, nationality, and age. Results from this study offered a basis for better understanding TPACK for enhancing teaching competence at the university level.

Keywords: TPACK, Faculty, Higher Education, Teaching Competence, K-mean Cluster Analysis

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Introduction

Results from Program for International Students Assessment (PISA), which was conducted with 15-year old students across 72 countries showed that Korean student achieved higher performance in reading, math, and science than students in other countries (OECD, 2015). Even though Korean students showed high achievement level in PISA which was conducted every three years, their human capital after completing secondary education just ranked in 26th place among 72countries. Especially, World Economic Forum (WEF, 2016) mentions that quality of higher education in Korea is needed to be reformed because of the relatively lower rank in that index comparing to other indices such as accessibility of Internet or enrollment ratio in higher education.

Higher education in Korea has shown tremendous qualitative growth as educational opportunities have been expanded. Almost 70% of high school students enter university after they graduate from high school in Korea. This rate is relatively high compared to Japan and United States, which is known as 37% and 21% respectively. However, universities need to more emphasize qualitative growth instead of quantitative growth because new era of the fourth industrial revolution requires unlimited competition among each university as the number of students is reduced. Therefore, universities have been interested in how to enhance the quality of education as a way of survival in unlimited competition. Teaching competence is one of the most important factors related to the quality of higher education (Duong, Nguyen, Nguyen, 2016). Teaching competence of faculty member is defined as a behavior combining knowledge, technology, attitude, and value required to perform teaching role successfully (Yang & Jeong, 2010).

Recently, Korean government has focused on enhancing the quality of higher education through distribution of educational finance such as Advancement of College Education (ACE) project or University for Creative Korea project. Even

though it is the first thing to examine teaching competence of faculty members to discuss the quality of university education, there are few research works which investigate the current situation in teaching competence of faculty member in Korea. Previously teaching competence mainly focused on expertise in content knowledge and teaching skill. However, recent researches have got interested in teachers' competence in using technology as one way to measure teachers' expertise because teachers' technology use is a very usual thing in current teaching and learning situations (Ertmer & Ottenbreit-Leftwich, 2010).

Mishra and Koehler (2006) have developed the concept of TPACK by adding knowledge related to technology to Pedagogical Content Knowledge (PCK) emphasized by Shulman (1986). According to them, TPACK means instructors' combined knowledge about technology, pedagogy, and content for the better learning and instruction. Especially, most of faculty members have relatively less knowledge in learning and instruction or less experience in teaching compared to elementary or secondary school teachers. Even though they can be recognized as experts in their major fields, most of them are not experts in learning and instruction. Therefore, it is necessary to confirm teaching competence of faculty members and offer educational programs to improve their teaching competence.

Therefore, the purpose of this study is to analyze the current status in teaching competence of faculty member and then to get some important implication in enhancing teaching competence as a way to improving the quality of university education. In order to examine teaching competence, this study is conducted based on the Technology, Pedagogy, And Content Knowledge (TPACK). Primary research questions in this study are as follow. 1) Is teaching competence of faculty member categorized by cluster depending on TPACK? 2) How does gender, teaching career, nationality, and age affect TPACK of faculty member?

Theoretical Background

TPACK

The concept of TPACK was invented based on PCK suggested by Shulman (1986). TPACK was defined as Technological Pedagogical Content Knowledge (TPCK) at first. TPACK means intersection portion among content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK) (See Table1 & Fig.1).

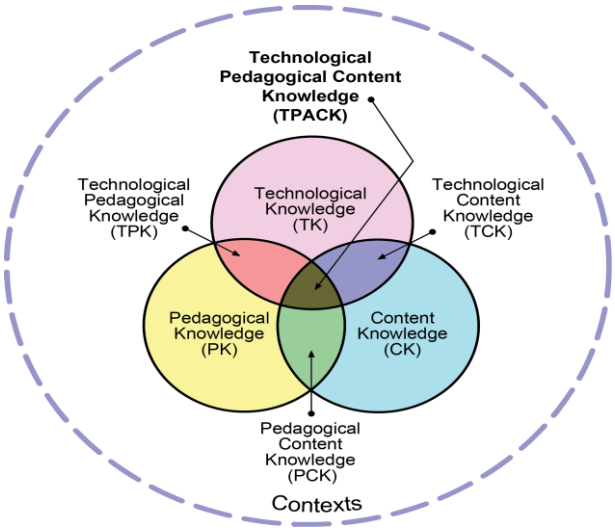

Figure 1. The TPACK model (www.tpack.org.)

Instructors are required to know how each individual knowledge related to teaching and instruction can be combined and applied to educational settings beyond acquiring knowledge about content, teaching method, and technology separately. TAPCK emphasizes the connected relationship among each separate knowledge. People assumed technology would lead big change in educational settings in the late 20th century. However, technology failed to cause big change in educational settings because there were few consideration about how to teach using

technology (Mishra & Koehler, 2006).

In fact, there were much discussion about instructors' competence to utilize technology before the research work conducted by Mishra and Koehler (2006) (Schmidt, Baran, Thompson, Mishra, Koehler, & Shin, 2009). Angeli and Valanides (2005) used the concept of ICT related PCK to explain technological knowledge required instructors. In addition, Slough and Connell (2006) used Technological Content Knowledge (TCK) and Franklin (2004) mentioned e-PCK in order to explain how instructors can develop their technological competence in education settings. TPACK is regarded as theoretical foundation for knowledge factors required to teachers. This study is conducted to measure various aspects of teaching competence using TPACK.

Table 1. TPACK definition

Variables	Definition
Technological Knowledge (TK)	▫ Knowledge about certain ways of thinking about, and working with technology, tools and resources
Pedagogical Knowledge (PK)	▫ Knowledge about the processes and practices or methods of teaching and learning
Content Knowledge (CK)	▫ Knowledge about the subject matter to be learned or taught
Technological Pedagogical Knowledge (TPK)	▫ Knowing the pedagogical affordances and constraints of a range of technological tools as they relate to disciplinarily and developmentally appropriate pedagogical designs and strategies
Technological Content Knowledge (TCK)	▫ An understanding of the manner in which technology and content influence and constrain one another
Pedagogical Content Knowledge (PCK)	▫ Knowledge of pedagogy that is applicable to the teaching of specific content
Technological Pedagogical Content Knowledge (TPACK)	▫ Underlying truly meaningful and deeply skilled teaching with technology

Previous studies using TPACK

A study by Shin, Han, and Eom (2012) examined correlation between subscales in TPACK and conceptual changes in TPACK before and after participants received a training about technology use. The study was conducted with 142 pre-service teachers and results reported TPK was positively correlated with TCK and TPACK respectively. In addition, the study showed that the training program could enhance participants' knowledge about technology use. Another study conducted by Latham and Carr (2012) in Australia with pre-service math teachers supported their perception of TPACK could be improved after they learn how to use technology in everyday life. Graham et al. (2009) reported the positive effect of technology use in science subject on TPACK.

Results from previous studies showed that teachers had relatively low level of technological knowledge compared to pedagogical and content knowledge. However, technological knowledge can be improved by various intervention program in educational settings. However, most of studies in terms of TPACK were conducted with secondary school teacher or pre-service teachers. Therefore, this study plans to conduct with faculty members to examine how difference in gender, age, teaching career, and nationality has implication in understanding TPACK.

TPACK research with faculty members

Most of researches in terms of TPACK have been conducted with preservice teachers (Choe & Lee, 2015; Eom, Shin, & Han, 2011; Mouza, Karchmer-Klein, Nandakumar, Ozden, & Hu, 2014) or elementary and secondary teachers (Cho & Jung, 2016; Harris, Mishra, & Koehler, 2009; Harris, & Hofer, 2011; Park & Kang, 2014). However, there were few researches with faculty members at the university level because teaching competence of faculty members more emphasized expertise

in their majors than elementary and secondary teachers.

Benson and Ward (2013) investigated a relationship between each subscale in TPACK with three faculty members working at Cyber University in order to measure their teaching competence. The research results suggested which competence was required to faculty members as shown TK, PK, and CK were equally distributed. Kopcha, Rieber, and Walker (2016) conducted a research to examine awareness of faculty member regrading Innovation in teaching and technology(ITT). They used Q method which categorizes group based on similarity in thoughts, attitudes, and values toward a specific object or phenomenon. Twenty faculty members participated in this study. Results showed that there were four different types of perception of ITT. First type is deeper understanders who recognize the large effect of ITT on students' achievement and actively apply it to teaching. Second type is called as big picture reflectors who acknowledge the big change and then try to apply it to teaching. Third type is deeper-purpose seekers who know the necessity of ITT, but hesitate to apply it to teaching. Fourth type is teaching/technology schismists who doubt the necessity of ITT in teaching. Even though Kopcha, Rieber, and Walker (2016) classified type of ITT, they emphasized that all of faculty members tried to seek various strategies besides technology for better educational performance.

There was only one research which investigated teaching competence of faculty member based on TPACK in Korea (Eom, Shin, & Han, 2011). The study was conducted with 55 faculty members using importance and implementation matrix method. The results showed that CK, PK, and PCK was high in both importance and implementation but TK and TPK was low in both importance and implementation. In addition, TCK was low in importance and high in implementation. Finally TAPCK was recognized as knowledge needed more concentration because it was high in importance and low in implementation.

There were few researches which investigated teaching competence based on TPACK in terms of quality of higher education. However, it is necessary to

examined TPACK as teaching competence because the fourth industrial revolution emphasizes both technology and education. Therefore, the goal of this study was to find characteristic of TPACK with faculty members and utilize it as basis for enhancing teaching competence.

Method

Participants

For this research, surveys were administered with at 105 faculty members at large private university located in Incheon Korea. Only 85 participants were involved in this study because 20 participants did not response to the survey sincerely (See Table 2). Among the participants, 38 were female and 47 were male. In terms of teaching career, 22.4% of participants belong to less than 5 years, 23.5% belong to between 5 and 10 years, and 32.9% belong to between 10 and 20 years. 66 of participants were Korean and 19 were foreign faculty members. 17.6% of participants were thirties, 42.4% of participants were forties, and 35.3% were fifties.

Data collection

Technological Pedagogical And Content Knowledge (TPACK): The concept of TPACK (Shulman, 1986) have been developed by Koehler and the TPACK used in this study consist of 6 subscales. The six-item Technological Knowledge (TK) subscale assessed teachers' competence to use technology and coefficient alpha for the TK subscale was .90. To measure Pedagogical Knowledge (PK), 7 items related to teachers' knowledge about teaching method were used. The coefficient alpha for the PK subscale was .89. The 3-item Content Knowledge (CK) subscale measured teacher's knowledge level about the subject matter they taught. The coefficient alpha for the CK subscale was .68.

Table 2. Demographic characteristics of the participants

Characteristics		N	%
Gender	Male	47	55.3
	Female	38	44.7
Teaching career	1-5 years	19	22.4
	6-10 years	20	23.5
	11-20 year	28	32.9
	21-30 years	16	18.8
	31 or more years	2	2.4
Nationality	Korean faculty	66	77.6
	Foreign faculty	19	22.4
Ages	30s	15	17.6
	40s	36	42.4
	50s	30	35.3
	60s	4	4.7
Total		85	100.0

In addition, intersecting areas between each knowledge was measured using 3 subscales, which were Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Pedagogical Content Knowledge (PCK). Finally, TPACK which represented the overlapped area across all three knowledge. 5 items were used to measure TPACK in this study.

Data Analysis

First, coefficient alpha value for each subscale was measured to verify reliability. Second, we calculated mean, standard deviation, kurtosis, and skewedness of each measurement variable through statistical analyses. Third, K-mean cluster analysis method was used for classification depending on type. K-mean cluster analysis was

conducted after setting up the number of cluster from 2 to 5 in TPACK. The characteristics of cluster was the most clearly distinguished when the number of cluster was 3. When the standardized score in each area as a result of cluster analysis was interpreted as low and very low group when the standardized score was below – 0.5 and -1.0 respectively. In the same manner, it was interpreted as high and very high group when standardized score in each area was above 0.5 and 1.0 respectively. Finally, difference between gender, teaching experience, nationality, and age was examined to understand characteristics of each type. One-was ANOVA was used. All data analysis was conducted using SPSS software.

Results

Descriptive statistics of measurement variables

We checked the mean, standard deviation, skewness, and kurtosis of each item parcel to confirm the multivariate normal distribution (See Table 3). The means ranged from 3.28 to 4.01, with the standard deviations of .57 to .76. In addition, the normal distribution condition was satisfied because the absolute values of skewness variables were less than 3, and the absolute value of kurtosis was less than 10 (Kline, 2015).

Table 3. Descriptive statistics for all variables

	TK	PK	CK	TPK	TCK	PCK	TPACK
M	3.28	3.90	4.01	3.52	3.57	3.81	3.42
SD	.74	.60	.57	.70	.76	.71	.76
Skewness	.00	.30	.06	-.18	-.27	-.37	-.27
Kurtosis	-.31	-.38	-.37	-.02	-.21	-.07	-.03

K-mean cluster analysis

Results from K-mean cluster analysis showed that faculty members consisted of 3 clusters depending on TPACK. <Cluster 1> was 34.12%, <Cluster 2> was 58.82% and <Cluster 3> was 7.06%. The largest number of cases belonged to <Cluster 2> and this cluster was named well-balanced competence type because all 7 subscale scores were distributed around mean scores. The second largest number of case belonged to <Cluster 1>. In Cluster 1, all subscale scores expect TK were distributed at low level. This cluster was named development required competence type. Cluster 3 has the lowest number of cases. In cluster 3, PK and OCK were high. However, TK, TPK, and TPACK was low and TKC was middle. Because of this reason, cluster 3 was named lack of technology competence type.

Table 4. Mean by clusters

Variable	Cluster1	Cluster2	Cluster3
TK	-.40(M)	.46(M)	-1.90(VL)
PK	-.88(L)	.36(M)	1.26(VH)
CK	-.55(L)	.32(M)	-.03(M)
TPK	-.82(L)	.63(M)	-1.31(VL)
TCK	-.89(L)	.62(M)	-.10(M)
PCK	-.99(L)	.49(M)	.76(VH)
TPACK	-.76(L)	.61(M)	-1.43(VL)
N(%)	29(34.12)	50(58.82)	6(7.06)

Characteristics of cluster

Table 5 showed that teaching career, nationality, and age of faculty member were significantly different among three clusters. However, there was no significant difference in gender.

It was also examined that how 3 different types of clusters were distinct

Table 5. Mean of cluster

Characteristics		Cluster 1		Cluster 2		Cluster 3		Total		*F*
Gender	Male	15	31.91	30	63.83	2	4.26	47	100.00	.00
	Female	14	6.84	20	52.63	4	10.53	38	100.00	
Teaching Career	1-5years	9	47.37	9	47.37	1	5.26	19	100.00	3.09*
	5-10years	6	30.00	13	65.00	1	5.00	20	100.00	
	10-20years	10	35.71	17	60.71	1	3.57	28	100.00	
	20-30years	4	25.00	11	68.75	1	6.25	16	100.00	
	Over 30 years	0	0.00	0	0.00	2	100.00	2	100.00	
Nationality	Korean faculty	26	39.39	38	57.58	2	3.03	66	100.00	8.09*
	Foreign faculty	3	15.79	12	63.16	4	21.05	19	100.00	
Age	30s	5	33.33	9	60.00	1	6.67	15	100.00	3.09*
	40s	14	38.89	22	61.11	0	0.00	36	100.00	
	50s	10	33.33	17	56.67	3	10.00	30	100.00	
	60s	0	0.00	2	50.00	2	50.00	4	100.00	
Total		29	34.12	50	58.82	6	7.06	85	100.00	

* $p < .05$

depending on gender, teaching career, nationality and age.47.37% of faculty members whose teaching career was less than 5 years belonged to cluster 1. In addition, 39.39% of Korean faculty member and 33.33% of faculty members between 30s and 50s belonged to cluster 1. 68.75% of faculty members in cluster 2 have taught for 20 to 30 years. In addition, 63.16% of foreign faculty members and 60% of faculty members between 30s and 60s belonged to cluster 2. 100% of faculty members whose teaching career was over 30 years belonged to cluster 3. 21.05% of foreign faculty members and 50% of 60-year-old faculty members belonged to cluster 3. However, there was no faculty member who was in his 40s in cluster 3.

Figure 2 showed that cluster 1 and 2 had the largest number of faculty members whose teaching career were10 to 20 years and cluster 3 had the largest number of faculty members whose teaching career were over 30 years. Most of faculty members belonged to cluster 2 had taught for less than 30 years but all faculty

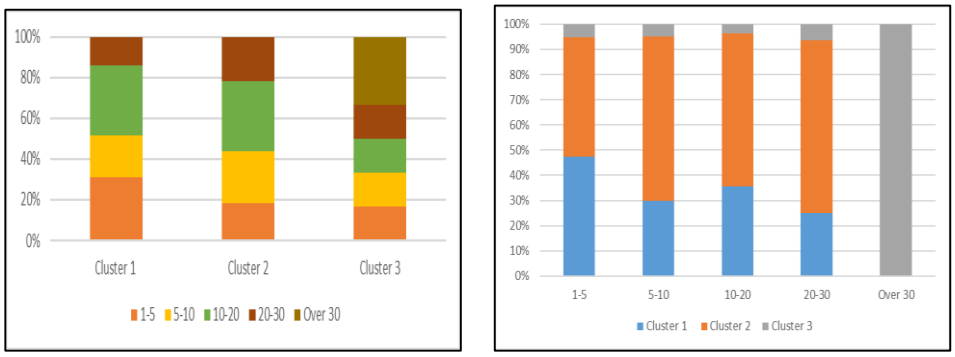

Figure 2. Clusters' characteristics according to teaching career

members who had taught for over 30 years belonged to cluster 3.

Figure 3 showed that there were more Korean faculty members than foreign faculty members in cluster 1 and 2, but there were more foreign faculty members in cluster 3. Most of Korean and foreign faculty members belonged to cluster 2.

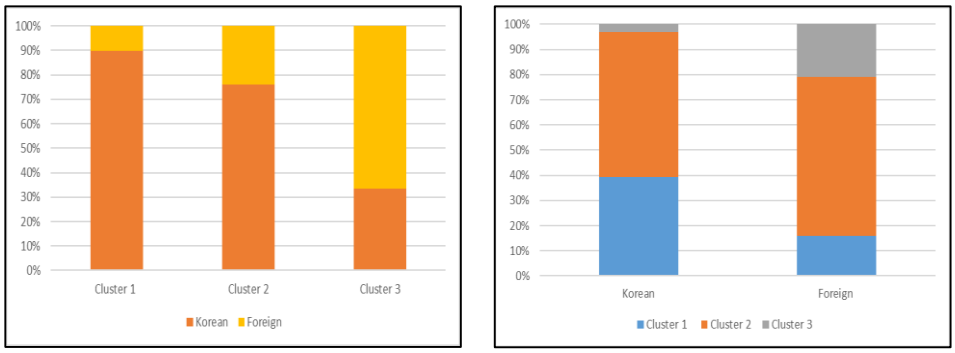

Figure 3. Clusters' characteristics according to nationality

Figure 4 showed that the largest number of faculty members in cluster 1 and 2 were their 40s respectively. The largest number of faculty members in cluster 3 were their 50s and 60s. Most of 30- to 50- year-old faculty members belonged to cluster 2. However, most of 60-year-old faculty members were in cluster 2 and 3.

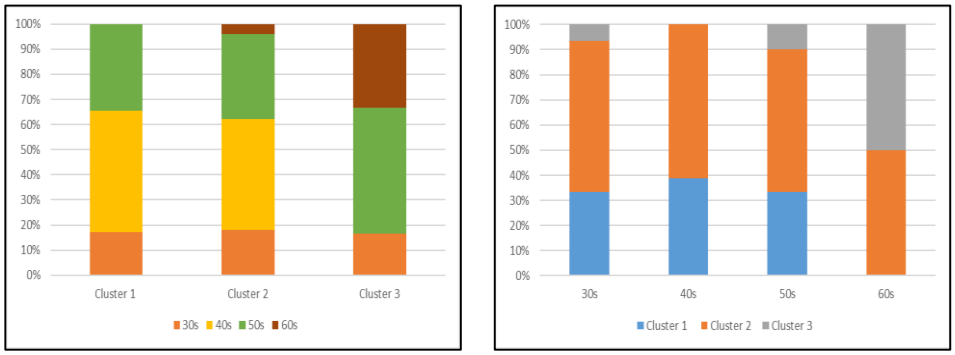

Figure 4. Clusters' characteristics according to age

Discussion and Conclusion

The goal of this study was to investigate categorized characteristics of teaching competence based on TPACK. Results showed that teaching competence fell into three types, which were well-balanced competence type, development required competence type, and lack of technology competence type. The way to enhance to teaching competence was discussed based on these results.

First, 58.2% of faculty members belong to well-balanced competence type. Faculty members in this type show middle level of competence in all area. Even though they have basic competence as a higher education teacher, level of each competence is not really high. Therefore, Ward and Benson (2010) suggested several ways to enhance level of TPACK in online educational setting. First, it is necessary for faculty member to read books and participate in discussion in order to increase understanding of TPACK. Second, faculty member need to be a learner in their colleague's class. Third, instructional design with teaching method and expertise as the center need be first and then application of technology should be followed when the faculty member was convinced the positive results in student's learning. Finally, the faculty members should consider how to apply technology strategies in order to support self-regulated learning of online learners. These

suggestions can be applied into offline educational setting as well as online settings for increasing overall level of teaching competence. Therefore, faculty members are required to develop understanding of TPACK and improve technology based on their expertise and instructional methods because these are good for increasing teaching competence.

Second, 38.1% of faculty members are recognized as development required competence type. Most of them are between 30s and 40s whose teaching experience are relatively short. Even though their TK and CK are intermediate-level, PK related with teaching competence and other competence which can combine TK, PK, and CK are insufficient. This study suggests that special learning program is necessary for faculty members who belong to development required competence type because their knowledge and experience in teaching are not enough to teach college students. Unlike American teaching support program which offer different teaching programs depending on teaching experience, most of teaching support programs run by center for teaching and learning in Korea offer a same program to all faculty members regardless their teaching experience (Jeon, 2006). White book for Korean higher education development published in 2011 also emphasizes the necessity of special teaching program for newly-appointed faculty members. Therefore, it is necessary appropriate teaching program depending on teaching experience from the very first state of teaching career at university level to guarantee quality of higher education through reinforcing teaching compete of faculty members.

Third, special teaching program is needed for lack of technology competence type. Faculty members in their 60s whose teaching experience are over 30 years report high competence in PK and CK. However, their competence in TA are relatively low. Most of learners in university are 20s. 43.7% of them have used internet service for between 10 and 15 years and 33.3% of them have used internet service over 15years (Ju, Chae, Bae, & Kim, 2016). Learners in higher education have various learning experience using internet service from elementary school to

high school and they do not have any difficulty in using information technology skills in everyday life. In fact, 60.4% of 20s used internet service for their learning. 99.8% of them used mobile service such as instant messenger and 91.5% of them also used SNS. Therefore, faculty members who belong to lack of technology competence type are needed for enhancing their teaching competence related to TK. In order to achieve this goal, their teaching competence should be strengthened based on concrete awareness investigation about whether they experience difficulty in utilization of technology or they are not sure about effect of technology use in educational settings.

Youth unemployment rate in august 2017 was 9.4%, the highest point since 1999 and youth sentiment unemployment rate was 22.5, which means difficult situation in youth employment. In this state, higher education should focus on improving competitiveness of college students through offering high quality education. Satisfaction of higher education is low compared to other countries. Especially, satisfaction of class and faculty member's competence is the worst (Ministry of Education & Korea Research Institute for Vocational Education & Training.). Therefore, faculty members should use various ways in their teaching in order for their students to develop competence required by new era. For this, faculty members need to acquire various teaching methods related to technology use. However, there are few research works regarding perception of faculty members about technology use. In addition, most of center for teaching and learning offer limited teaching programs (Min, 2012). Therefore, this study has educational implication in terms of offering baseline data for developing teaching support program considering TPACK of faculty members in order to improve the quality of higher education.

Even though results from this study showed several strengths, it was not enough to generalize what found in this study as overall characteristics of faculty members in Korea because participants in this study were recruited from only one university in Incheon. Especially, the goal or direction of teaching can be differentiated

depending on school size or school level between college and university. Therefore, future research needs to investigate teaching competence based on TPACK with various participants form different types of higher educational institution. In addition, this study only focused on finding various characteristics of TAPCK, instead of suggesting a way of increasing and enhancing faculty member's TPACK. Thus, future research also needs to find what factors can affect TPACK at university level. If future study can find how to increase TPACK of faculty members, that will offer a good opportunity to offer high quality of education to college students. Finally, longitudinal research with new faculty members who belong to lack of technology competence type is needed to investigate how TPACK can be changed through their career lives.

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