

The Study of TPACK Ability Training for Student Teacher Specializing in English— A Case Study of Huainan Normal University

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ABSTRACT

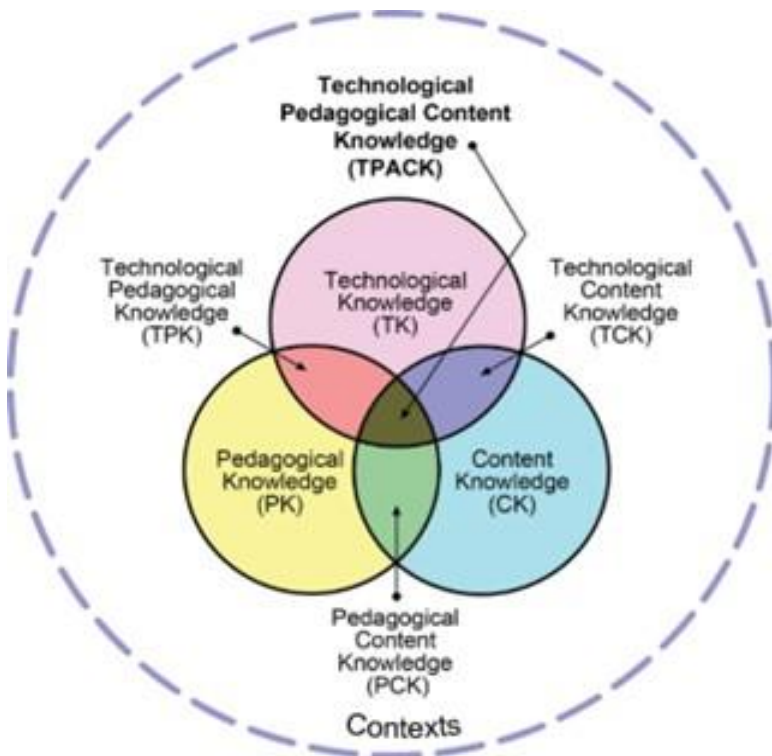
It is a necessary requirement to enhance the information literacy of university teachers and students in an all-round way to adapt to the development of information society. At the heart of the work is an understanding of the framework Matthew J. Koehler and Punya Mishra proposed, TPACK—Technological Pedagogical Content Knowledge. This study takes student teacher specializing in English of Huainan Normal University as an example and aims to understand the current situation of developing the TPACK ability of the student teachers specializing in English through a survey. To investigate the relevant factors affecting the development of English teacher trainees' TPACK ability, and to explore new ideas for revitalizing the TPACK ability of English teacher trainees to contribute to higher levels of teacher education accreditation and to cultivate higher quality student teachers specializing in English education.

Keywords: TPACK, student teacher specializing in English, teaching ability

INTRODUCTION

TPACK stands for Technological Pedagogical Content Knowledge. It was Punya Mishra and Matthew J. Koehler of Michigan State University who first proposed the TPACK concept in 2005, based on the PCK proposed by Shulman, L.S, in their five studies of teacher professional development program design, and in 2006, they provided a detailed discussion of the seven elements of the TPACK framework, clearly outlining the relationship between technological knowledge, content knowledge, and pedagogical knowledge (Zhan Yi, 2010: 78-87). The TPACK framework contains three core elements: CK (Content Knowledge), PK (Pedagogical Knowledge), TK (Technological Knowledge), and the four core elements intertwined to form composite elements: PCK (Pedagogical Content Knowledge), TCK (Technological Content Knowledge), TPK (Technological Pedagogical Knowledge) and TPACK (Technological Pedagogical Content Knowledge) and the elements of the contextual factors outside its framework. Contextual factors, also called situational factors, can be simply understood as the teacher's entire external environment in the teaching process. The features of balance, integration, complexity, and interaction among these elements could be presented in Figure 1 (Xu Peng, 2013: 112-116).

Figure 1. Schematic Diagram of TPACK Structure



(From TPACK Explained—TPACK.ORG matt-koehler.com)

The characteristics of TPACK, a new and already academically accepted teacher knowledge structure, have also been widely studied. TPACK is characterized by knowledge integration, situational dependence, dynamic development, intra-individual implicit, and practicality (Lu Qiang, 2011: 68-72).

The TPACK concept arose in the United States, and the period from 2005 to 2008 was the founding phase of TPACK, a period dominated by the theoretical review literature published by Koehler and Mishra. The period from 2009 to 2012 was a period of rapid development of TPACK. The relevant research literature increased significantly during this period and showed a trend of multiple research methods, research fields, and research contents. In addition, TPACK-related researchers are mainly from the United States, Singapore, and Europe. In terms of research methods, the most prominent research methods used for TPACK-related studies are qualitative research, quantitative research, and mixed research (qualitative and quantitative). Earlier (2005-2007) research literature methods were mainly qualitative, while from 2008 onwards, TPACK-related studies have been predominantly quantitative and mixed research. In terms of research content, the main focus is on five areas: TPACK ontology research, TPACK cultivation strategy research, TPACK measurement method research, TPACK framework-based teacher development research, and TPACK framework-based information technology and curriculum integration research (Xu Peng, 2013: 112-116).

Although the concept of TPACK was introduced late, research on TPACK has gradually started to receive the attention of researchers in China. By searching all the literature related to TPACK with the title “TPACK” on the CNKI, a total of 1025 Chinese papers were collected from 2009 to 2021. They were screened one by one, and 25 papers without direct correlation such as duplicate literature, news reports, and academic conferences were excluded. It retains 1000 valid documents, including 323 dissertations and 677 academic papers, with an annual average of 96.9 publications. The effective literature distribution statistics are shown in Figure 2, from which it can be seen that the relevant literature was still very small in the three years from 2009 to 2011, and has been increasing since then, accumulating more than 100 publications in

each of the six years from 2016 to 2021; According to the main research, content can be divided into five categories: basic research, application research, status research, development research, and evaluation research, among which the highest attention is paid to application research (accounting for 43.3% of the total number of publications), followed by the status research on TPACK, while the research activities with TPACK evaluation as the research content are relatively minimal.

Research on TPACK in China involves the following six areas: introduction of TPACK; research on the integration of information technology and curriculum based on TPACK; research on subject areas based on TPACK; research on teachers' TPACK competence development; research on teachers' professional development based on TPACK; and research on the TPACK level measurement scale for teachers of various subjects. Among them, the research on the professional development of teachers based on TPACK is currently in the core area of TPACK in China (Zhao Leilei, 2014: 32-37).

In 2008, Li Meifeng and Li Yi's (2008: 74-77) "TPCK: A New Framework for Integrating Technology in Teacher Expertise" is one of the earliest papers that appeared in China to introduce the introduction of TPACK. The research on the progress of TPACK research abroad is represented by the research results of Xu Peng (2013: 112-116) and other researchers.

In terms of the current progress of TPACK research in China, the introduction of pure TPACK theory has been very detailed and comprehensive. Among the subject area studies on TPACK, the English subject is still in the stage of the scarcity of research, and most research is about TPACK ability development of students of Mathematics teachers-making. For the research on teachers' TPACK ability development, the domestic research results have not yet escaped the shadow of foreign research in this area, and there are fewer innovations in methods. There are fewer national research results on measurement instruments and it is difficult to break through Schmidt's TPACK level measurement scale model for pre-service teachers (2009: 123-149).

Based on the comprehensive theoretical introduction of TPACK by Li Meifeng (2008: 74-77), Zhan Yi(2010: 78-87), Jiao Jianli(2010: 39-45), Yuan Zhiqiang (2013: 107-113), etc., this study is a breakthrough in the research field by studying the direction of TPACK ability development in the English discipline and designing a scale applicable to testing the TPACK ability of students of English teachers-making to more accurately know the true level of TPACK of students of English teachers-making with English discipline characteristics.

This study started by investigating the status of English teacher trainees' TPACK ability and settled on a study of strategies to improve the TPACK ability of student teachers specializing in English. The following questions will be explored in depth:

1. What is the state of technical knowledge of student teacher specializing in English in the era of information technology?
2. What are the reasons for the current state of TPACK ability of student teacher specializing in English.
3. How to improve the TPACK ability of student teacher specializing in English?

METHOD

This study is a survey and problem analysis of the current situation of the TPACK ability of student teachers specializing in English. A five-point Likert scale containing seven dimensions and 47 test questions designed by Schmidt's study (2009: 123-149) was used and modified according to the characteristics of the English discipline to form a questionnaire specifically designed to measure the TPACK ability. Based on the statistical analysis of the survey data, this study proposes feasible recommendations to teachers' training.

The questionnaire method was used in this study.

Design of the basic information section in the questionnaire

A series of 6 questions were designed for the basic information section.

Content Knowledge, Technological Knowledge, and Pedagogical Knowledge are the three core and essential elements of the TPACK knowledge framework for the student teachers specializing in English. In the current English teacher training program at Huainan Normal University, Content Knowledge is studied in the first two years of university. Pedagogical Knowledge is acquired through the arrangement of courses such as Pedagogy and Psychology, which are usually arranged in the third year of college. The learning of English teacher-training students' technological knowledge is realized through similar courses such as Modern Educational Technology. In addition, students have been exposed to various technologies in their daily study, especially the learning of software, and with the introduction of modern educational technology courses, student teachers specializing in English can get systematic learning of computer technology. Concerning the above conditions, students in their third and fourth year of college were selected for the test, so question 1 started with student's grade.

Question 2: A survey that addresses the gender of the survey respondents.

Question 3: Have you taken or are you currently taking the Modern Educational Technology course or a similar educational technology course? This question was designed to find out whether technology education is emphasized in the training. Since the survey respondents were selected as junior and senior students, all students at that stage have already received a technical education.

The next three questions were about the teaching practices of English teacher trainees' teaching skills. Three main types of teaching practices were investigated in this study, including teaching exercises, educational apprenticeship, and educational internship. Teaching exercises, educational apprenticeships, and educational internships are in a progressive relationship in the development of teacher training skills, so they are ranked in the order of topics 4, 5, and 6 respectively.

Question 4: whether the survey respondents had participated in teaching exercises, which are referred to teaching exercise activities conducted in classrooms or rooms for micro-lessons.

Question 5: have you ever had a middle school apprenticeship or are you currently on a middle school apprenticeship? An apprenticeship, in this case, is an activity where you listen to a class in a middle school classroom, but do not do actual classroom teaching. Educational apprenticeship is also an important part of teaching practice, the beginning of English teacher trainees' exposure to real classrooms, and is important for the development of English teacher trainees' teaching skills.

Question 6: have you ever had an internship in a middle school or are you doing an internship in a middle school? It is about educational internships. The internship is defined as an actual classroom teaching activity in a secondary school. The above basic information questions are mostly bivariate correlations, which facilitate subsequent correlation analysis based on descriptive statistics to explore the relationship between English teacher trainees' TPACK levels and basic information to ensure that the suggestions made are more relevant and reliable.

Design of TPACK level measurement scale in the questionnaire

Of the three core factors in the TPACK framework: technological knowledge, content knowledge, and pedagogical knowledge, the most flexible and most discussed in the academic community is technological

knowledge. Technology is a very broad concept, and different aspects of technology exist in different fields and disciplines, so what is the technological knowledge of English teacher training students, which is explained at the beginning of the scale, explains that technology in this questionnaire refers to modern educational technology, that is, the technology used in the teaching process, such as computers, interactive whiteboards, multimedia, office, flash and other kinds of software and hardware technologies that can serve teaching and learning. Content knowledge is also described in the instructions, with special emphasis on content knowledge, i.e., the English expertise of the survey respondents.

The scale was developed based on Schmidt's scale (2009: 123-149), concerning Singaporean scholars Chai and others (2010: 563-573), Archambault and Crippen's scales (2009: 71-88), and Zhan Yi's scale design (2011: 1-3). The Schmidt research design of the five-point Likert scale TPACK measure is the most widely used TPACK measure today. The 46-item five-point Likert scale designed by Singaporean scholar Chai and others and the 24-item five-point Likert scale designed and developed by Archambault and Crippen in 2009 were tested for good validity. The TPACK scale was adapted according to the actual situation of the student teachers specializing in English and the research content, referring to the TPACK scale in the article 'An experimental study on cultivating TPACK among teacher-training students in mathematics' designed by Zhan Yi in 2011.

The specific topics were set as follows:

- **Technological Knowledge**

This dimension consists of seven questions: Question 1, 'When I encounter technological problems, I can solve them on my own', which assesses the English teacher trainee's self-assessment and knowledge of the technology he or she has mastered; Question 2 is 'I can learn technology effortlessly', which examines the basic learning ability and attitude of the student teachers specializing in English to learn technology effortlessly; Question 3 is 'I can keep up with major new technologies' and Question 4 is 'I often fiddle with technology'. Questions 3 and 4 are about the sensitivity of student teachers specializing in English to new technologies and knowledge and their attitude toward learning, i.e., whether they have a sense of self-growth. Question 5, 'I know a lot of different technologies,' and question 6, 'I have the necessary skills for the technologies I use,' are similar to question 1 in that they consider the English teacher trainee's self-assessment of the level of technology he or she currently has. Question 7, 'I have ample opportunities to use different technologies in my studies and work,' measures English teacher trainees' perceptions of the usefulness of their technological knowledge. The seven questions in the technological knowledge dimension were derived from the seven questions in the TK section of the original translation of Schmidt's 2009 Survey of Preservice Teachers' Knowledge of Teaching and Technology questionnaire.

- **Content Knowledge**

The content knowledge dimension contains a total of 4 questions, i.e., questions 8-11. Question 8, 'I have sufficient knowledge of English', tests the professional knowledge of student teachers specializing in English; question 9, 'I can build English thinking', develops students' English thinking ability, which has become the center of English teaching under the new curriculum concept and is also a new challenge for English teachers in middle schools (Liu Weixing, 2008). As English teacher trainees, they should have the ability to think in English, and this question is about the English thinking ability of English teacher trainees. Question 10, 'I have many ways to develop my understanding of English,' considers how English teacher trainees acquire knowledge of English, which includes the habits of English teacher trainees. These three questions were based on Schmidt's questionnaire, replacing subjects of mathematics with English. The 11th question, 'I can think like an English expert', is based on the second question in the CK section of the J.H.L. Koh scale of Singaporean scholars.

• Pedagogical knowledge

The measurement of the pedagogy factor in the TPACK framework contains six questions in this scale, i.e., questions 12-17. Question 12, 'I know how to evaluate students' performance in class', is about the level of teaching evaluation in the pedagogy of English teacher trainees; Question 13 is 'I can adjust my teaching according to student's current knowledge and understanding', which reflects the concept of constructivism and tests whether English teacher educators can analyze learning in the teaching process; Question 14 is 'I can adjust my teaching style according to learners' differences', which is similar to the previous question and tests the adaptability of English teacher trainees. Question 15, 'I can use a variety of ways to evaluate students' learning process and what they have learned,' and question 11 both test English teacher-training students' ability to evaluate their teaching, because teachers must have the appropriate professionalism and evaluation skills to effectively use evaluation to improve teaching and thus promote students' learning and development (Zhao Xuejing, 2014). Therefore, it is necessary to measure the teaching evaluation ability of English teacher trainees. Question 16, 'I can use a variety of teaching methods in the teaching process,' is a test of English teacher trainees' mastery of teaching methods; question 17, 'I know how to organize and maintain classroom management,' is a test of their organizational and management skills.

The six questions in the pedagogical knowledge dimension are all original translations of the questions in the PK section of Schmidt's 2009 Survey of Pre-service Teachers' Knowledge of Teaching and Technology questionnaire, where the questions on misconceptions were adjusted to the PCK section concerning Zhan Yi's questionnaire.

• Pedagogical Content Knowledge

The subject pedagogy knowledge dimension measure for English teacher trainees consisted of four questions, i.e., questions 18-21 on the scale. Question 18, 'I know how to choose effective teaching methods to guide students' thinking and learning in English,' is based on Schmidt's 2009 questionnaire and replaces subjects of mathematics with English. Question 19, 'I know what different teaching methods are needed for different English language problems,' translates a question used by Schmidt and others in another study and replaces mathematics with English; the 20th question, 'I can help students notice the connections between concepts in English', is a translation of a question in the PCK section of Archambault and Crippen's questionnaire; the 21st question, 'I am familiar with students' common understanding and misconceptions of a specific English concept', is based on the 19th question in Zhan Yi's TPACK questionnaire for mathematics teacher trainees level questionnaire.

• Technological Content Knowledge

The subject knowledge dimension of integrating technology contained only one question, question 22 on the scale, which was 'I know about technologies that enable students to better understand and solve problems in English,' based on Schmidt's 2009 Survey of Pre-service Teachers' Knowledge of Teaching and Technology questionnaire, and replacing subjects of mathematics with English.

• Technological Pedagogical Knowledge

This dimension contains 5 questions, i.e., questions 23-27 on the scale. Question 23, 'I can choose a technology to enhance the effectiveness of my classroom approach'; Question 24, 'I can choose a technology to enhance student learning in the classroom'; Question 25, 'My education courses have guided me to think deeply about how technology affects the classroom approach I use'; Question 26, 'I can think critically about how I use technology in the classroom'; and Question 27, 'I can adapt the technology I have learned to apply it to different English language teaching activities'. All five questions are original

translations of the five questions in the TPK section of Schmidt's 2009 Survey of Preservice Teachers' Knowledge of Teaching and Technology.

• Technological Pedagogical Content Knowledge

This dimension contains 5 questions, i.e., questions 28-32 on the scale. Question 28 is 'I can appropriately integrate English, technology, and teaching methods into English classroom teaching', which refers to Schmidt's 2009 classic scale and replaces the subject of mathematics with English; Question 29 is 'I can choose a technology to optimize students' learning and my teaching process.' The word 'optimize' is translated from 'enhance', which is translated as 'growth' in Zhan Yi's scale, but I think it is better to translate 'growth' as 'optimize' to fit the context. Question 30 is 'I can use the strategies I have learned to integrate subject content, technology, and pedagogy'; Question 31 is 'I can play a guiding role in helping others, such as my classmates, to coordinate the use of subject content, technology, and pedagogy'; question 32 is 'I can select a technology for a lesson that can be used to optimize the content being taught', also translated from 'enhance'. The questions designed for both the basic information survey section and the scale section of the questionnaire have been described, and the complete questionnaire is available in the Appendix.

Questionnaire implementation

In terms of timing, the questionnaire was mainly distributed at the end of the first semester of the school year of 2022-2023 in late December. The timing is very suitable, since various teaching exercises, educational apprenticeships, and educational internships were winding down, and the largest number of students stayed in the school. However, there was an inevitable drawback to the questionnaire distribution at the end of the semester, that was, most of the juniors had started to prepare for their final exams, and most of the seniors were in the sprint phase of their postgraduate entrance exams. Some students did not have a very positive attitude toward the questionnaire, which slightly affected the effectiveness of the questionnaire.

In terms of methods and approaches, the questionnaires were distributed online. A total of 539 questionnaires were released in 14 classes of juniors and seniors, and the number of responses was 368, with a response rate of 68.3%. Among them, after the screening, the valid questionnaires were 230, and the effective rate was 62.5%.

RESULTS

Questionnaire analysis

Basic Information Statistics

1. Gender ratio of survey respondents

Because of the specificity of the unbalanced ratio of male to female students in teaching education, among the valid cases investigated, 44 male students, 19% of the total number, and 186 females to 80.8% of the total number.

2. Grade distribution

In terms of the grade division of the survey respondents, due to the time of the survey, most of the senior students are in the examinations, and cannot the serious completion of the answer sheet, the effective questionnaire rate is lower, so the junior students surveyed more, and the effective questionnaire rate is higher. Among them, there are 143 junior students, accounting for 62.2% of the total number of

respondents; 187 senior students, accounting for 37.8% of the total number of respondents.

3. Teaching exercise participation

The fourth question of the basic information in the questionnaire is ‘have you taken or are you taking Modern Educational Technology or similar educational technology courses?’ However, after the implementation of the questionnaire, it was found that the survey respondents were limited to juniors and seniors, and both of them had already taken the Modern Educational Technology course or similar educational technology courses. Therefore, this question was judged as an invalid question and was discarded from the analysis of the questionnaire.

A teaching exercise is a section of a middle school textbook that teachers will have students select to teach during the teacher training process, and some teachers arrange this session in the microteaching classroom. Of the total number of students surveyed, there were 128 students (55.6%) had participated in teaching exercises and 102 students (44.4%) had not participated in teaching exercises. The number of students who had participated in teaching exercises was also related to their grade level, with 52 students (36.4% of the total number of juniors) having participated in teaching exercises for juniors and 83 students (95.4% of the total number of seniors) having participated in teaching exercises for juniors. (Figure 2)

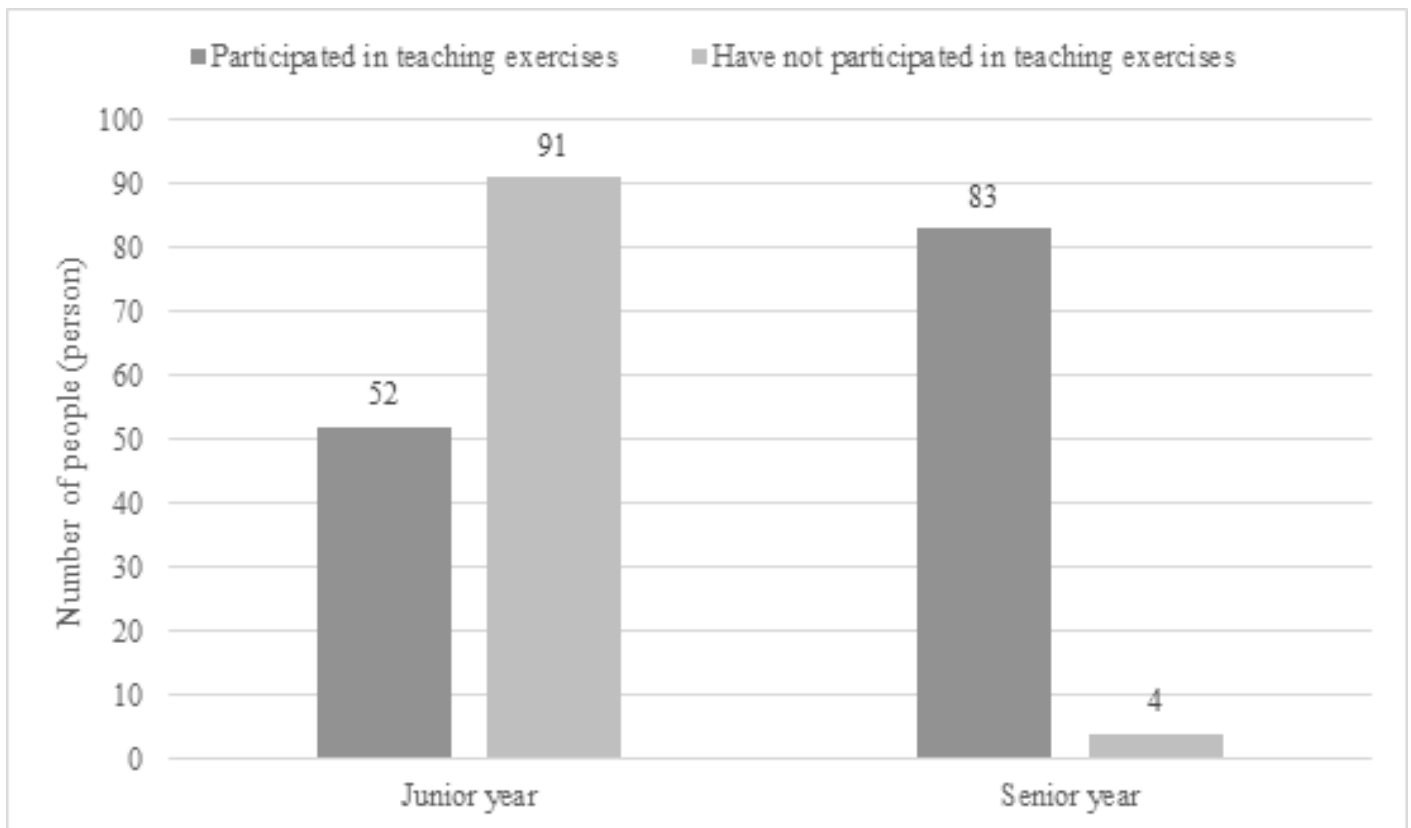


Figure 2. The Number of Participants in the Teaching Exercise by Grade Group

The 59% difference in the number of students who had participated in teaching exercises between the third and fourth year of university indicates that the development of English teacher trainees’ on-campus lecturing skills is only widely implemented in the fourth year. The number of male students who had participated in teaching exercises was 24, accounting for 10.4% of the total number; the number of female students who had participated in teaching exercises was 106, accounting for 46.1% of the total number (Table 1). The difference between the two is 35.7%, which shows that a larger percentage of female students have participated in teaching drills than male students have.

Table 1. Proportion of Participants in Teaching Exercises by Gender Grouping

Whether or not you have participated in teaching exercises by gender	Yes	No	Total
Male students	24	20	44
Percentage of total	10.4%	8.7%	19.1%
Female students	106	80	186
Percentage of total	46.1%	34.8%	80.9%

1. Participation in educational apprenticeship

The improvement of skills, in addition to their practice, but also the borrowing of other objects. Educational apprenticeship is an effective way to develop students' ability to adapt to nature and society, develop positive professional attitudes, and promote professional growth through practical activities that lead to new experiences and new understanding (Peng Liyun, 2007: 108-111), therefore, the development of English teacher training students' teaching skills requires apprenticeship activities in addition to in-school teaching practice activities. One of the questions in the questionnaire's basic information survey asked whether the students had had middle school apprenticeship experience or were in middle school apprenticeship.

Of these, 86 students (37%) had apprenticeship experience and 144 students (63%) had no apprenticeship experience. 6.5% of the male students and 30.9% of the female students participated in educational apprenticeships (Table 2. This means that a larger percentage of female students participate in educational apprenticeships than male students. The percentage of participants in educational apprenticeships has decreased significantly, and the result is quite different from the educational exercises. This has to do with the special features of educational apprenticeships, which are different from teaching exercises and require students to take the initiative to go out of the university to a secondary school, as well as to be strong in social contact skills, which explains the differences that appear above.

Table 2. Proportion of Participants in Educational Apprenticeship by Gender Group

Whether or not you have participated in an educational apprenticeship by gender	Yes	No	Total
Male students	15	29	44
Percentage of total	6.5%	12.6%	19.1%
Female students	171	115	186
Percentage of total	30.9%	50%	80.9%

2. Participation in the educational internship

The teaching profession is highly practical, and educational internships have always been an important part of the teacher education curriculum (Yang Yue, 2011: 63-67). However, there are various problems with educational internships in student teachers specializing in English. Therefore, in the basic information survey of the questionnaire, a special question was set for whether students had internship experience in middle schools. Analysis of the questionnaire revealed that only 7.8% of all students in their third year of university had a middle school internship experience. Most of the student teachers specializing in English in the Huainan Normal University surveyed had their internships in their last year, so 64.9% of the senior students had internship experience in middle schools. Of course, this is related to the training program of student teachers specializing in English each year, and what we know so far is that the educational internship of student teachers specializing in English in all classes is arranged in the first semester of the fourth year, except for the educational internship in the second semester of the fourth year of the university. Because the questionnaire was implemented in the first half of the academic year, there is a very large difference between the grades in terms of whether there is an internship experience or not.

Analysis of the scale

Overall TPACK levels and distribution

This scale uses a five-point Likert scale with five levels: strongly agree, agree, neither disagree nor agree, disagree, and strongly disagree. Different values were assigned to each option in the questionnaire, where 5 points were assigned to strongly agree, 4 points to agree, and so on, i.e., 3 points for neither agree nor disagree, 2 points for disagree, and 1 point for strongly disagree. There are 32 questions on the scale, and each question is a positive question with no negative questions, so it is easy to understand from the assignment that a higher score means a higher level of TPACK for the subject.

First, the overall TPACK levels of all respondents were analyzed, and the mean value of TPACK scores of 230 respondents was 3.52 from SPSS analysis. The TPACK values of individual cases were distributed by a normal distribution (Figure 3).

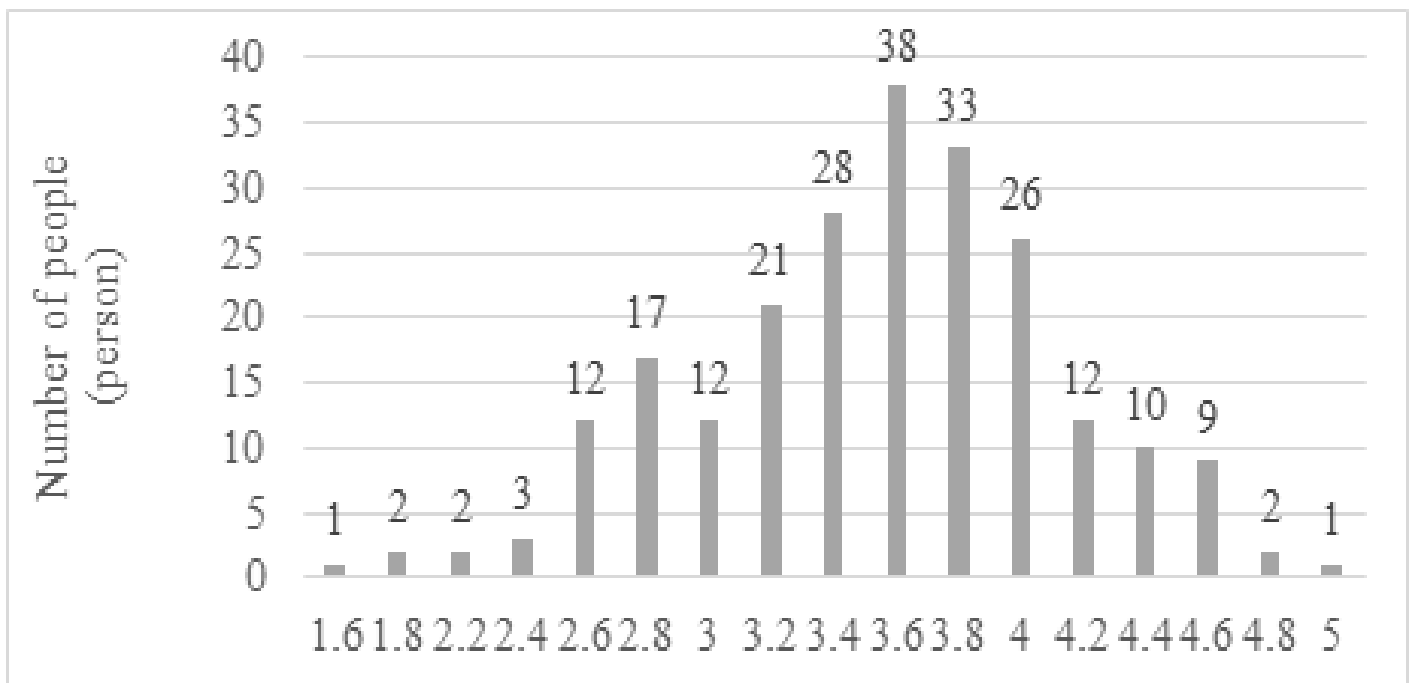


Figure 3. Histogram of the Frequency Distribution of TPACK Values of Respondents

The TPACK mean value, which is the mean value of each survey respondent's score on TPACK questions in the scale, represents, to some extent, the TPACK level of that respondent. Thus, we see from the overall distribution of the above figure that the mean scores of the survey respondents are normally distributed as a whole. According to the differences in the basic information of the survey respondents and how they differed in terms of gender, grade level, whether they had participated in teaching exercises, whether they had educational apprenticeship experiences, and whether they had participated in educational internships, the TPACK means were calculated for the survey data in groups in turn, in which female students were better than male students; students who had participated in teaching exercises had higher TPACK levels than those who had not participated in teaching exercises; students who had participated in educational apprenticeships had higher levels than those who had not participated in educational apprenticeships; and students who had educational internship experiences had higher TPACK levels than those who had not experienced educational internships (Figure 4). These not only give good ideas on how to improve the TPACK level of English teacher trainees but also provide a simple explanation of why there is a significant gap between the TPACK level of third-year students and fourth-year students.

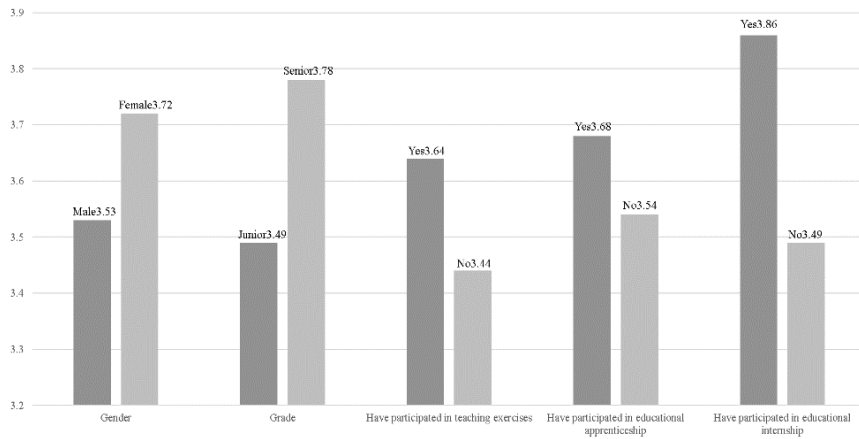


Figure 4. TPACK of Survey Respondents Grouped by Each Element

- Comparison of mean values of factors

According to the TPACK structural theory, the overall questionnaire consists of seven factors, TK, CK, PK, PCK, TCK, TPK, and TPACK of student teachers specializing in English.

Each factor in turn corresponds to a different number of questions, so we find the mean value of the overall data for each factor for comparative analysis, and TK is significantly different from the other factors (Table 3). TK is not only the most unstable factor in the TPACK framework, but this survey also shows that the technical knowledge factor is also the weakest in English teacher trainees' TPACK competencies.

Table 3. Mean Values of Factors of the Scale

	TK	CK	PK	PCK	TCK	TPK	TPACK
Mean value	3.07	3.34	3.53	3.48	3.29	3.58	3.59

Quality analysis of the questionnaire

Validity analysis

The 32 questions in the scale section were processed in SPSS software for factor analysis to test their validity, and their KMO and Bartlett's test coefficients were obtained (Table 4).

Table 4. KMO and Bartlett's Sphericity Test Results

Number of KMO sampling suitability		.930
Bartlett's sphericity test	The cardinality of the last read	4703.984
	Degree of freedom	496
	Significance	.000

The KMO test coefficient was 0.930 and Bartlett's sphericity test coefficient was 0.000 to reach a significant level, and the above data can indicate that the questionnaire validity of this study has a high level.

Reliability analysis

Reliability analysis was conducted using SPSS for each factor in the scale and the scale, where TCK

corresponded to only one question in the scale, and was ignored in the reliability analysis of the scale because reliability analysis could not be conducted for a single factor. Cronbach Alpha value greater than 0.9 indicates good reliability of the scale, and the overall reliability value of the scale reached 0.997 (Table 5), indicating that the reliability of the TPACK proficiency scale for this test of English teacher candidates is good.

Table 5. Reliability of the Scale and Each Factor

Dimension	TK	CK	PK	PCK	TPK	TPCK	ALL
Cronbach's Alpha	0.987	0.968	0.985	0.983	0.990	0.990	0.997
Items	7	4	6	4	5	5	32

Correlation Analysis

Correlation analysis is a statistical method to study the correlation between random variables by examining whether there is some kind of dependence between phenomena and exploring the direction of correlation and the degree of correlation for specific dependent phenomena. For variables that are not functionally related, correlation analysis is the best way to explain their relationship. This section focuses on the relationship between the factors within the TPACK level scale for English teacher trainees and the correlation between each factor and the overall TPACK level to capture the key factors to improve the overall TPACK level of students.

Correlation analysis of the factors in the scale with TPACK levels

(1) TK level and the level of TPACK

Before correlating the two variables, a scatter diagram of the two variables with TK values as the x-axis and TPACK values as the y-axis was made (Figure 5). We can determine whether the two variables are likely to be positively correlated, then whether the relationship between the two variables is correlated, and whether the correlation is significant. This study perform correlation analysis for the two variables in SPSS software by finding the Pearson correlation coefficient of the two variables. The results of the analysis showed that the Pearson correlation coefficient between English teacher trainees' technological knowledge and technological pedagogical content knowledge was 0.483, which was bilaterally significantly and positively correlated at the 0.01 confidence level.

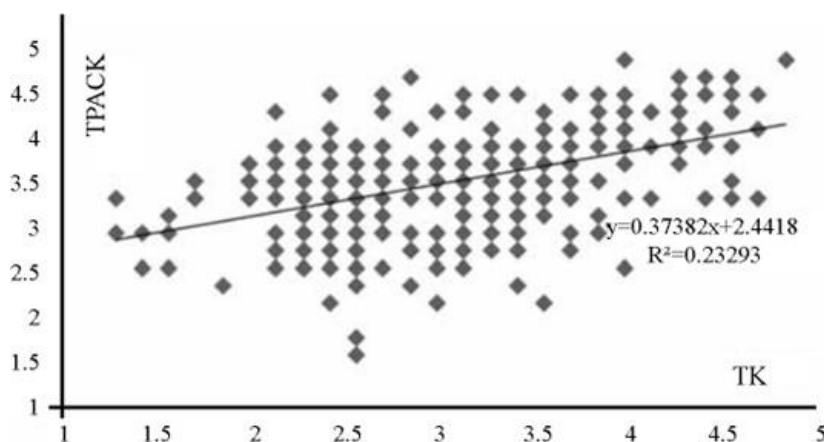


Figure 5. Scatter Diagram of the Correlation Between TK and TPACK

(2) CK level and the level of TPACK

The idea of analyzing the correlation between English teacher trainees' subject knowledge and subject knowledge of integrated technology is the same as the idea of analyzing the correlation between English teacher trainees' technical knowledge and subject pedagogical knowledge of integrated technology, this study still makes a scatter diagram of the two variables first to determine their correlation direction, where the X-axis is the value of CK and the Y-axis is the value of TPACK (Figure 6)

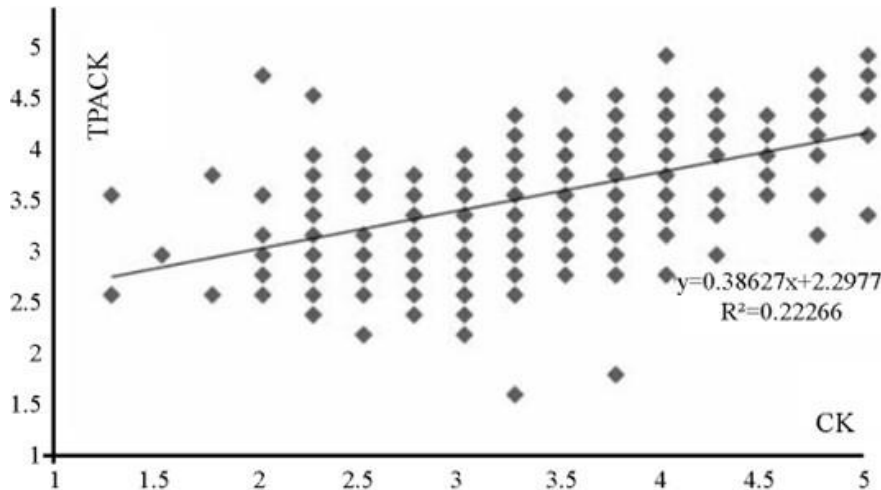


Figure 6. Scatter Diagram of the Correlation Between CK and TPACK

The same method was used to test the correlation coefficient of the two variables in SPSS. The results of the analysis showed that the subject matter knowledge of student teachers specializing in English and the subject matter pedagogical knowledge of integrated technology had a Pearson correlation coefficient of 0.472, which was significantly and positively correlated bilaterally at the 0.01 confidence level.

(3) Other technological knowledge related to pedagogical content knowledge

Through the correlation analysis of the above two variables (TK and CK) with TPACK, this study mastered the basic methodological steps of correlation analysis. We can find out the correlation between several other elements and TPACK.

The results of the analysis showed that the Pearson correlation coefficient between PK and TPACK for the student teachers specializing in English was 0.649, which was bilaterally significant and positive at the 0.01 confidence level. The Pearson correlation coefficient between PCK and TPACK for student teachers specializing in English was 0.579, which was bilaterally significant and positively correlated at the 0.01 confidence level. The Pearson correlation coefficient between TCK and TPACK for the student teachers specializing in English was 0.449, which was bilaterally significant and positive at the 0.01 confidence level. The Pearson correlation coefficient of TPK and TPACK for the student teachers specializing in English was 0.644, which was bilaterally significant and positive at the 0.01 confidence level.

The correlation size of each factor with the TPACK level can be judged from the correlation coefficient, and the closer the absolute value of the correlation coefficient is to 1, the higher the correlation is indicated. In the correlation analysis between each factor and TPACK, the PK of English teacher trainees had the largest correlation coefficient with TPACK (Figure 7).

This study concluded that the highest correlation coefficient among the factors with TPACK was PK for the student teachers specializing in English, followed by TPK for the student teachers specializing in English. The above findings give data support on how to improve the TPACK ability of English teacher trainees and

where to start to improve the TPACK ability of students in English teacher training.

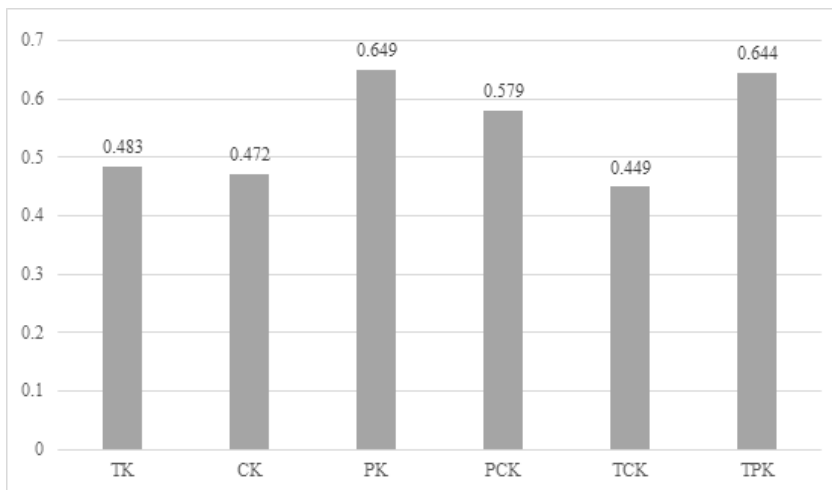


Figure 7. (ii) Correlation analysis between the factors in the scale

To explore which factor plays a particular role in the overall structure of TPACK, this study performed a correlation analysis between any two variables in the structure. This study have also analyzed the correlations among the factors before, but the above discussion of what elements are correlated with TPACK shows straightforwardly what aspects of strengthening the training can improve the TPACK of English teacher trainees. The next step is to analyze the correlation between any two variables in the TPACK framework to see which elements play the most fundamental and systemic role in the entire TPACK framework.

Therefore, this study performed correlation analysis in SPSS software by finding the Pearson correlation coefficient between two variables. This study yielded a two-sided significant positive correlation between any of the elements within the TPACK framework for English teacher educators at the 0.01 confidence level (Table 6). Not only does this show that the elements within the TPACK framework are integrated rather than simply overlapping relationships, but it also shows that the correlations between the PK of English teacher trainees and each of the other elements are all above 0.5, which is significantly higher than the correlation coefficients between the other elements. Thus, this study can see that PK is in a very basic position in the whole TPACK framework for English teacher trainees.

Table 6. The Matrix of Two by-Two Correlation Coefficients for Each Factor

	TK	CK	PK	PCK	TCK	TPK	TPACK
TK	1						
CK	0.578	1					
PK	0.571	0.595	1				
PCK	0.472	0.461	0.659	1			
TCK	0.420	0.403	0.443	0.476	1		
TPK	0.448	0.432	0.560	0.562	0.463	1	
TPACK	0.483	0.472	0.649	0.579	0.449	0.644	1

Regression analysis of TPACK levels

Previously, this study conducted a correlation analysis among the elements in the TPACK framework, and the analysis showed that there were significant positive correlations among all the elements of TPACK,

especially the six elements other than the TPACK element that were significantly and positively correlated with TPACK. Then how to predict the TPACK level of English teacher trainees this study used regression analysis. Considering the development of TPACK, regression analysis is now done for the factors within the framework of TPACK in the scale, with TPACK as the dependent variable and the other six elements: TK, CK, PK, PCK, TCK, and TPK as independent variables in SPSS (Table 7).

Table 7. Regression Analysis Coefficients

Models	Unstandardized coefficients		Standardization coefficient	t	Significance
	B	Standard error	Beta		
(Constants)	.624	.149		4.179	.000
TK	.052	.037	.067	1.377	.169
CK	.024	.040	.029	.604	.547
PK	.268	.051	.295	5.208	.000
PCK	.118	.050	.122	2.356	.019
TCK	.074	.029	.064	1.445	.149
TPK	.0343	.048	.338	7.106	.000

a. Dependent variable: TPACK

In the whole regression equation with TPACK as the dependent variable, the independent variable with the largest contribution value from the standardized coefficients is TPK, followed by PK, and the TPK and PK elements occupy an important position in the prediction of English teacher trainees' TPACK levels. Therefore, when we consider how to improve the TPACK level of student teachers specializing in English, the first thing we need to consider is how to improve the PK and TPK ability of student teachers specializing in English. Considering the regression analysis and the actual situation of student teachers specializing in English, and considering that TPK is a higher-level composite element, we can consider one of the two simpler elements as an entry point to develop English teacher-training students' TPACK ability. In addition, knowledge of pedagogy is relatively easy to acquire knowledge that can be acquired through careful study of Education, Psychology, and other related courses, which can achieve twice the effect with half the effort.

ANALYSIS OF THE REASONS

Limited opportunities for teaching exercises

The differences in English teacher trainees' TPACK competencies were related to their participation in teaching exercises, and from what was learned, English teacher trainees were less able to conduct teaching exercises. Of the total number of students surveyed, 128 (55.6%) had participated in teaching drills and 102 (44.4%) had not. The number of students who have participated in teaching drills also depends on their grade level. For juniors, 52 students (36.4% of juniors) participated in teaching drills, and for seniors, 83 students (95.4% of seniors) participated in teaching drills.

The opportunities to participate in teaching exercises fall into roughly three types, one of which is in the classroom of similar courses such as Theory of English Language Teaching. This is related to the nature of the courses in this category, which aim to provide student teachers specializing in English with basic English teaching theories and teaching methods, so students have the opportunity to practice teaching in their classes. However, due to class time constraints, not every student can improve greatly from this.

The second type of opportunity to participate in teaching practice is through various teaching skills competitions for teacher-training students. At present, there are three major competitions for English teacher-

training students in Anhui Province, namely ‘Anhui Higher Education Teaching Skills Competition for Teacher-Training Students’, ‘The Yangtze River Delta Basic Teaching Skills Competition for Teacher-Training Students’ and ‘The Tian Jiabing Cup National Teaching Skills Competition for Teacher Training Students in Teacher Training Colleges and Universities’. The number of students who can represent their college and major in the Teacher Training Skills Competition is usually 15-20. Due to the limitation of the quota, every English teacher training student can't have the opportunity to participate, and each participating college will conduct sufficient intra-college selection. There are not too many opportunities for such competitive teaching exercises, and all three of these competitions are annual, so English teacher trainees have only three opportunities per year to go to the selection process and improve their TPACK in this way.

The third type is classroom exercises in the on-campus internship phase of the educational internship. As far as we know, Huainan Normal University has various kinds of educational internships in all schools where teacher-training students are trained, and in general, educational internships are divided into two stages: on-campus internships and off-campus internships. The on-campus internship stage is mainly for the internship supervisor to give final guidance to each student's lecture. In reality, however, not all educational internship supervisors can do everything in detail.

Differences of educational internship schedules

Regarding the educational internship, in terms of organization, all the grades surveyed were arranged by the college. In terms of timing, among the two grades surveyed, only the educational internship of the class of the 2020 who upgrade from junior college student to university student was arranged in the second half of the fourth year of college, while the educational internship of the other classes was arranged in the first half of the fourth year of college. In terms of the way of contacting secondary schools, there are two kinds, one is the internship through the ‘National Training Program’ and the other is the direct contact between universities and internship secondary schools.

Of the total number of students surveyed, 86 students (37%) had educational apprenticeship experience and 144 students (63%) had no educational apprenticeship experience.

The analysis of the questionnaire showed that only 7.8% of all students in their third year of university had secondary school internship experience. Most of the English teacher trainees in Huainan Normal University surveyed had their internships in their fourth year, so 64.9% of all students in their fourth year of college had secondary school internship experience.

Since most of the educational internships are arranged in the first half of the fourth year of university, the time conflicts with students' postgraduate entrance examinations, so there are a lot of inactive factors. Of course, the implementation of educational internships for English teacher training students is also related to the training ideology of the college, which should actively mobilize students to participate in educational internships and educational internships, emphasize the significance and importance of internships and internships, and appropriately advance the time of internships and internships to avoid the time conflicts with students' postgraduate entrance examination and civil service examination. The data showed that students who had participated in the educational internship and educational practice were significantly more competent in TPACK than students who had not participated in the educational internship and educational practice.

Lack of a clear understanding of TPACK

From 2008 when the first article introducing TPACK appeared in China (Li Meifeng, 2008: 74-77) to today when TPACK research has developed, it has not come into the English teacher-training students although it has caused some influence in the academic world. The survey shows that 97% of the respondents have not

heard of the term TPACK, and it is difficult to build awareness of developing TPACK skills when English teacher educators themselves are not aware of TPACK.

Student teachers specializing in English do not recognize the importance of TPACK, nor do they realize the impact of TPACK ability improvement on technology literacy and teaching quality. Most English teacher-training students still maintain traditional thinking, do not understand the important role of technology in teaching, do not establish an awareness of integrating information technology and curriculum, and do not consider integrating technology as the mainstream learning style in the information age.

Most of the respondents indicated that they had not heard the teacher of the class introduce the subject teaching knowledge of TPACK integration technology during the class period, while a small number of respondents indicated that they had only heard the teacher of the class mention the subject teaching knowledge of TPACK integration technology, but did not introduce it in depth. Without proper teacher guidance and introduction, English teacher students would not have clear goals and plans when learning, and would easily deviate from the topic and waste time.

DISCUSSION

This study is influenced by the constructivist idea that the improvement of English teacher-training students' TPACK ability should be a process of active and active given construction by the teacher-training students themselves based on their existing knowledge and ability. Therefore, this study focuses on the self-growth perspective of English teacher trainees and, based on the existing findings, offers practical suggestions and recommendations for English teacher trainees to improve their TPACK levels.

In this study, the TPACK level values varied widely with or without having participated in an educational internship. The TPACK level of the group with educational internship experience was as high as 3.86, while the TPACK level of students who had not participated in an educational internship was only 3.49. From such a large difference between the two values, whether they have participated in educational internships has a large impact on English teacher trainees' TPACK ability. This study suggests that English teacher trainees should take a positive approach to their educational internship because it plays an important role in improving the TPACK of English teacher trainees.

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