TPACK Integration Technology Used in Improving Classroom Teaching Ability of College English under the Artificial Intelligence Environment

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Abstract

The study aims to evaluate the classroom teaching of college English, expand the application of the integrated technology pedagogical and content knowledge (TPACK) in the improvement of teaching ability, and promote the development of artificial intelligence (AI) technology in classroom teaching. Based on the seven dimensions of TPACK, first, the method of depth interview combined with questionnaire survey was used, and the correlation between different sub-dimensions and the impact of each dimension on TPACK was analyzed. Second, the first- and second-year undergraduate English students were selected to analyze the difference of TPACK level in the corresponding grades. Third, based on semantic analysis technology, AI was combined with TPACK to carry out intelligent evaluation of college English classroom teaching. The results showed that all dimensions of TPACK, such as content knowledge (CK), pedagogical knowledge (PK), technological knowledge (TK), had significant positive correlation, and all dimensions affected the overall TPACK level while influencing each other. There were significant differences in the cognition of TPACK level between the freshmen and sophomores, and TK and integrated-technology pedagogical knowledge (TPK) was the most significant. The intelligent assessment technology for TPACK level could effectively predict and evaluate the effect of TPACK integration, and effectively improve the classroom teaching ability of college English through scientific analysis. To sum up, the combination of intelligent assessment and TPACK integration technology has great potential for improving the classroom teaching ability.

Keywords: TPACK integration; dimension correlation; English classroom teaching; intelligent assessment;

1. Introduction

In the 21st century, with the rapid development of artificial intelligence (AI) technology, many machine learning methods have been applied to English classes. Currently, the common application includes distance online education, AI interactive teaching, and deep learning-based English pronunciation recognition and correction [1]. Combining AI and English education has accelerated foreign language teaching informatization. Currently,

some colleges and universities have opened the AI double-capability teaching mode, using virtual classrooms and AI English teachers to provide a one-to-one oral English practice environment for students. The AI English teacher is similar to a teaching assistant. Under the arrangement of school teachers, AI English teacher guides students in their study and reports students' grades and the frequently asked questions to the teacher actively, so that the teacher can have a more targeted approach for the next teaching [2, 3]. In an AI environment, how to make the college English class efficient and interesting using the information and technical means has become a hot research topic [4]. Through the advantages of AI technology, the working efficiency of teachers in the workplace will be greatly improved, and the difficulty of work will also be reduced, so teachers can spend more time and energy in knowledge teaching and methods innovation to further improve their teaching ability and professional knowledge attainment, and cultivate high-quality talents for society [5, 6]. Technology pedagogical and content knowledge (TPACK) integration originates from the development of science and technology which has far-reaching influence on English teaching informationization and teachers' knowledge structure change. The concept of TPACK is derived from pedagogical content knowledge (PCK). PCK mainly studies the relationship between content knowledge and pedagogical development, while TPACK is the integration of information technology and curriculum, which investigates teachers' practical application ability of AI technology in education [7-9]. Research on the concept and theory of TPACK also promote the transformation of English pedagogy from the traditional type to that of the modernized nonexam-oriented, and truly return the class to students, instead of teaching students to recognize things only through boring squeezing learning and

repeating memory [10]. The TPACK framework theory in the AI environment is to put the educatee at the core of teaching design, train students' independent learning ability and innovation ability, enable teachers to achieve personal growth in their careers, and finally, realize the sustainable development of the educators and the educatees in society [11].

Based on education informatization, the positive influence of TPACK on college English class under the AI environment is studied. The theoretical framework of TPACK, questionnaire survey, and interview are used to investigate the freshmen and sophomore normal university students and their English teachers, and the TPACK scale is developed according to the survey results. The scale analyzes their study and application of TPACK and the level difference of varied grades from seven dimensions. The problems in the process are identified and feasible suggestions are put forward to provide references for TPACK's practical activities in improving college English class efficiency.

2. Method 2. 2.1 TPACK framework concept

TPACK was proposed by American scholars Koehler and Mishra in 2005 based on the PCK proposed by Shulman [12]. Since 2005, scholars in many countries have carried out a large amount of theoretical and practical studies on TPACK, proving that the application of TPACK is beneficial to improving teachers' ability to master and apply information technology [13]. On the one hand, TPACK ability is necessary for college English teachers in future class and is significant to the education of normal university students and the professional development of college teachers; on the other hand, TPACK describes the degree of integration of technology and teaching through knowledge of technology, teaching method, and teaching content. When using TPACK for

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instructional design, the teacher or instructional designer needs to consider his or her knowledge level from the above three aspects comprehensively, and then integrate them into the same teaching activity [14-16].

TPACK framework contains three core elements, namely, content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). The three core elements form four compound elements: PCK, integrated technological content knowledge (TCK), integrated technological pedagogical knowledge (TPK), and TPACK (Figure 1).
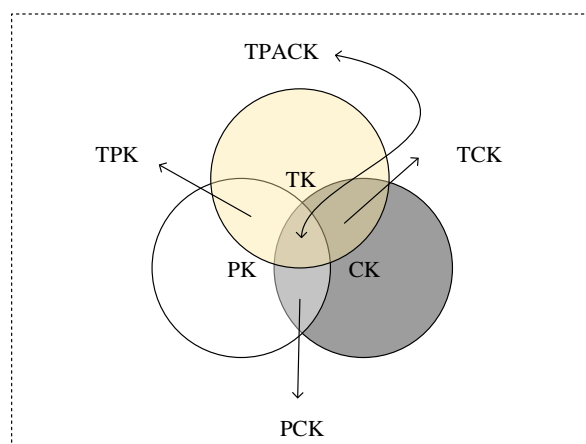
Figure 1 Element relationship

2.2 Questionnaire survey

The questionnaire is the main research method here. Based on the classic measurement scale of TPACK developed by Schmidt et al., the questionnaire on the status quo of TPACK in college English class was prepared in combination with the scales of other scholars and the characteristics of English subjects. Students in their first and second years of undergraduate education from four normal universities and their English teachers were selected, 170 in total, including 34 teachers, 73 freshmen, and 63 sophomores. The data were collected by paper questionnaire (Table 1), which was used to analyze how TPACK technology could be better integrated into the teaching process and promote the teaching reform, and provide case reference for the teaching application of TPACK under the AI environment in the future.

Table 1 Survey design of each dimension

CK	a. Basic knowledge of English b. English classroom teaching strategies c. Ability to cultivate English knowledge contest d. The latest English teaching and research topics
TPK	a. Whether the application of information technology teaching methods is appropriate b. Whether the information technology teaching method used is suitable for students c. Whether the information technology teaching method used is suitable for this course teaching
PCK	a. Basic knowledge of English b. English classroom teaching strategies c. Ability to cultivate English knowledge contest
TCK	a. The integration of English curriculum goals and information technology b. The integration of English course teaching plan and information technology c. Ability to cultivate English knowledge contest
TPACK	Teachers use TPACK's integration ability

Dimension	Research content
TK	a. Basic information technology mastery b. Ability to solve computer software and hardware problems c. Knowledge of the latest technology of artificial intelligence
PK	a. Classroom management ability b. Student evaluation c. Choose a teaching method

in colleges and universities and 17 interviewees were selected randomly from four universities for their understanding of TK, PK, CK, and TPACK. The quantitative method and qualitative method are integrated to have a deeper and more thorough understanding of the current application status of TPACK in college English class, find out the deficiencies of the method in the application level, and further propose corresponding solutions, thereby enlightening the professional development of English teachers.

3. Results and discussion

3.1 An Overall Analysis of the TPACK Application by College English teachers

According to the preparation of the questionnaire in Section 2.2, the scale selected is the Likert scoring method with 5 levels, from "very inconsistent" to "very consistent", scored from "1" to "5" points respectively. Through descriptive statistics, the score of each dimension of TPACK is obtained (Figure 5).

2.3 Interviewing

The aim is to understand the attitudes of teachers and students on the problems related to English teaching TPACK, and further analyze the main factors affecting TPACK's contribution to the development of English classes in colleges and universities. The interview method is adopted to provide support for the determination of influencing factors on TPACK and the proposal of corresponding strategies. Based on the previous investigation of 80 teachers and students, an interview outline was compiled for English teachers
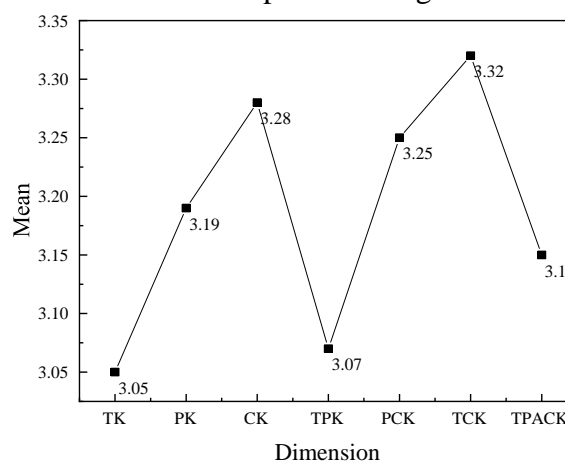
Figure 2 Score of each dimension of TPACK

Among the three core elements, the dimension with the lowest score is TK of 3.05, showing that some English teachers have insufficient TK in computer vision, speech recognition, natural language processing, machine learning, big data, and other artificial intelligence (AI) fields. The essence is that most of the teachers surveyed may master basic information technology skills well, but they do not think deeply about the importance that information technology ability should be cultivated continuously with the development of educational technology in society. The score of PK is higher, which is 3.19, indicating that English teachers have a good command of teaching skills and are confident to apply teaching knowledge in English class. However, their individual teaching experience is insufficient,

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which needs to be improved in the future. The highest score is that of CK, reflecting that most teachers have a strong command of English subject knowledge and always maintain good subject quality and professional knowledge in teaching.

The score of the four compound factors is similar to the score of the three core factors. (1) The lowest score is TPK (3.07), indicating that English teachers are not good at integrating English content knowledge with educational technology when they do not have a solid grasp of TPK. (2) TPACK scores 3.15, suggesting that teachers are unconfident in their ability in PK, CK, and TK integration. (3) PCK scores 3.25, indicating that teachers can solve most problems during the teaching process by using their teaching knowledge. (4) TCK score is the highest, which also indicates that teachers with rich professional knowledge have relatively high ability in TCK.

In conclusion, the seven dimensions contained in TPACK, including the three core elements and the four compound elements, show a significant positive correlation. These dimensions interact with each other, ultimately affecting the overall TPACK level. The overall TPACK score of English teachers is relatively lower and unbalanced, with great differences among dimensions, and especially, the master of TK and TPK is the lowest. As a result, narrowing the gap in all dimensions, improving overall English teaching quality, and strengthening the application and cognition ability of information technology is imperative.

3.2 Variation Analysis of the TPACK level of normal college students from different grades

The independent sample T-test is adopted to analyze the variation of the TPACK levels between students of different grades to evaluate the influence of college English courses on the improvement of the TPACK level of freshman and sophomore in the normal universities. According to the sample data used in the questionnaire in Section 2.2, 73 freshmen and 63 sophomores majoring in English are selected. The freshmen received no systematic training since their admission in September 2019, and the sophomores have no internship experience. Figure 3 illustrates the results.
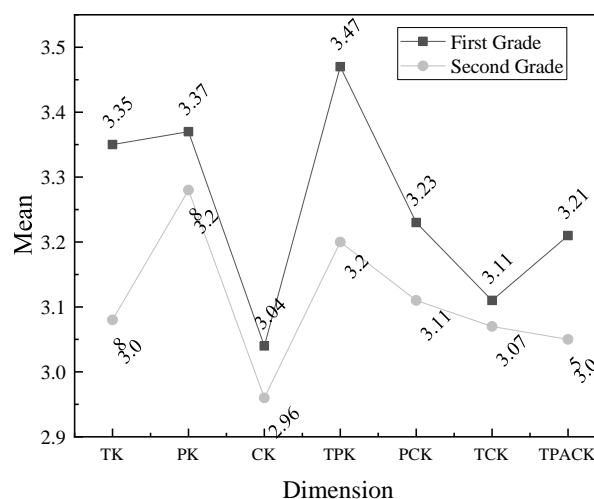
Figure 3 TPACK level variations of freshmen and sophomores

Compared with those of the freshmen, the selfcognition degrees of TPACK of sophomores decrease in all dimensions, with TK and TPK the sharpest, 3.35 to 3.08, and 3.47 to 3.2 respectively. It implies a negative correlation, that is, the higher the grade, the lower the self-cognition of TPACK level. It is because most of the sophomores experienced curriculum and ability tests, offcampus internships and various educational activities, recognizing that their current TPACK level is unmatched with the requirement of curriculum and practical activities, and they lack the ability in education and integration technology integration. Table 2 illustrates the Sig (2-sided) value:

Table 2 2-sided Sig value of TPACK level variation of different grades

Dimension	TK	PK	CK	TPK	PCK	TCK	TPACK
sig	0.02	0.35	0.41	0.03	0.17	0.59	0.11

In core elements, 0.01< Sig(TK) <0.05 after the two grades of students received subject knowledge education, indicating their differences in the TK level. The Sig value of CK and PK exceeds 0.05, manifesting unobvious variation between the two grades after they receive the subject knowledge curriculum. In compound elements, TPK Sig<0.05, and it indicates that there are significant differences between the freshmen and the sophomores at the TPK level. The Sig of all the other three dimensions exceeds 0.05, indicating no significant variations between the two grades.

3.3 Intelligent assessment of the effect of TPACK on pedagogical ability improvement in AI environment

The key technologies of intelligent assessment mainly include semantic analysis, speech recognition, and optical character recognition. The semantic analysis assesses the morphology, syntax, and meaning of sentences through machine learning. The machine obtains semantic connection information of part of speech, meaning, and other information using corpus and dictionary, analyzes the structure of sentences according to the rules of grammar, and subsequently determines the true meaning of the language combined with textual structure. Semantic analysis is usually utilized in the homework grading system and emotional analysis of user portraits on social media. In homework grading, Semantic analysis can identify the mistakes and grade automatically, like checking if the tense is consistent or singular and plural are correct. The ASR, a typical representative of computer deep learning methods, converts a speech signal into a corresponding text message, which has been widely used in intelligent robots, small household appliances, communications, automobiles, electronics, and other industries.

AI interactive education is the major case of automatically evaluating students' learning using intelligent assessment and other AI technologies like NLP (natural language processing) and intelligent voice interaction.

Teachers should have high TPACK ability when using machines to compile test questions, which is mainly reflected by the difficulty level and scope and the number of questions. Only in this way can the questions be specific. After the questions are set, the students conduct manmachine interactive exercises. The machine corrects the learners' oral training effect through a series of intelligent assessment means such as speech collection, sentence meaning analysis and accuracy comparison. It can also give an estimated report on learners' learning ability and knowledge weaknesses and puts forward corresponding suggestions to stimulate learners' learning autonomy and improve learning efficiency through the comparison and analysis with the standard answers in multiple datasets. Intelligence assessment requires teachers to have corresponding TPACK ability. Only based on it can English teachers make good use of AI technology to further liberate teachers, train students' critical thinking ability, and promote students' overall development.

4. Conclusion

At present, the potential of AI in English teaching is constantly being explored. After AI enters the education area, a series of method changes have taken place both in teaching and learning. In teaching, pre-class intelligent preparation, in-class accurate teaching, and postclass intelligent Q&A (question and answer) and tutoring are all new challenges for teachers. In learning, intelligent methods, auto-adaptive preview and review,

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interactive methods, and accompanying practice rid students out of traditional rigid teaching methods, adapt to the educational reform of the new era. and cultivate more innovative new talents for society. As the new intelligent pedagogy must be directed by human intelligence, English teachers must integrate and innovate their subject knowledge and information technology, and use the TPACK concept framework to effectively improve their pedagogical ability. They should stand at the forefront of teaching innovation and reform, integrate AI and education, strengthen the practical application of AI in teaching, and promote the faster and better development of pedagogy.

English teachers and freshmen and sophomores in normal universities are selected as the samples, the cognition and application level of TPACK in college English class are analyzed using the TPACK framework and research method. The data obtained assesses the effect of TPACK on improving pedagogical ability, and the intelligent evaluation technology is employed in effect appraisal to verify TPACK's unique advantages in promoting the reform of teaching methods, teachers' information technology integration ability, teaching management, and innovation. However, the methods adopted in the assessment techniques are not comprehensive enough, so in the future, the analysis and prediction model should be constantly improved.

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