DEVELOPING SECOND-YEAR STUDENT TEACHERS' TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE THROUGH MICRO-TEACHING IN A LEARNING MANAGEMENT COURSE

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Abstract

This study aimed to 1) study TPCK development through Micro-Teaching, 2) explore supportive and obstructive factors, and 3) assess post-instruction TPCK development. The sample comprised 92 second-year student teachers who enrolled in a Learning Management Course at a university in Surin Province during the second semester of 2022. A mixed-methods approach was utilized, combining qualitative and quantitative data from lesson plan analyses, field notes of observations, semi-structured interviews, document reviews, and questionnaires. The results demonstrated high post-instruction TPCK proficiency in TPCK components due to Micro-Teaching, with the highest scores in Technological Knowledge (TK) and the lowest in Technological Content Knowledge (TCK). Effective mentorship and robust technological resources were identified as key supporting factors, while challenges included insufficient content knowledge and inappropriate technology integration. Overall, TPCK

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development was high ($\overline{X}$ = 4.19, S.D. = 0.67), highlighting the effectiveness of Micro-Teaching in enhancing the instructional competencies of student teachers.

Keywords: Technological Pedagogical Content Knowledge, Learning Management Course, Teacher Education

Introduction

Improving education quality is a critical policy in Thailand, necessitating continuous development. Evaluations by the International Institute for Management Development (IMD) indicate Thailand's low educational performance across ten key indicators such as student-to-teacher ratios, secondary school enrollment rates, literacy rates, and higher education outcomes (Office of the National Education Commission, 2017). National test results for Grade 9 and 12 students show proficiency in language, mathematics, and analytical thinking below 50% on average, impacting graduates' readiness for national development. Teachers are essential in addressing this crisis. Effective teacher development is foundational for educational reform and national advancement. The National Education Act of 1999 emphasizes that education should be based on the belief that all students can learn and develop, promoting students' natural development to enhance education quality (Office of the National Education Commission and the Asian Development Bank, 2002; Office of the Education Council, Ministry of Education, 2022).

Teacher Knowledge, particularly Pedagogical Content Knowledge (PCK), is fundamental for effective teaching in specific subjects. Shulman (1987) introduced PCK, which integrates Content Knowledge (CK) and Pedagogical Knowledge (PK) to help teachers present, organize, and adapt content to suit diverse student interests and abilities. Research indicates that student teachers' PCK significantly influences student learning. Inadequate or incorrect PCK can

lead to the transfer of misconceptions from teachers to students, resulting in student misunderstandings (Halim & Meerah, 2002; Suksawang & Janthamuttukan, 2021). Moreover, PCK affects teaching efficiency (Van Driel, De Jong & Verloop, 2002; Kapyla, Heikkinen & Asunta, 2009). The absence of both CK and PK can hinder effective PCK development, causing teachers to choose inappropriate teaching methods and perpetuate student misconceptions (Smith & Neale, 1989). PCK is crucial for teaching specific content as it guides teachers in facilitating student understanding of subject matter concepts. Teachers must select suitable teaching methods and learning activities to support student learning and enhance their own content knowledge. In Thailand, previous research indicates that student teachers struggle with content knowledge and its application, often teaching content directly without integrating pedagogical methods. This separation of content and pedagogy leads to difficulties in integrating these elements effectively (Tanak, 2020; Suksawang & Jantamuttukarn, 2021).

With the globalization of education, Thailand's education system is increasingly influenced by international standards, requiring institutions to develop more globally competitive education. This necessitates the rapid development of high-quality human resources, prompting educational institutions to adopt innovative teaching methods to enhance learning efficiency. Media and learning resources are vital tools for teachers to design effective learning activities. Selecting appropriate media that aligns with learning activities and student characteristics is crucial for fostering an engaging and effective learning environment (OECD, 2020). The Teachers Council of Thailand has established professional standards encompassing knowledge, performance, and conduct to guide the qualifications and practices of teaching professionals, emphasizing the integration of knowledge and technology in teaching specific subjects. Technological Pedagogical Content Knowledge (TPCK) involves integrating technology with CK and PK to enhance teaching efficiency. TPCK reflects the

ability to use technology to effectively teach specific content, supporting diverse student abilities and interests, and promoting deeper learning (Koehler & Mishra, 2008). However, past issues indicate that teachers and student teachers often struggle with effectively using TPCK in teaching specific content (Tanak, 2020).

While TPCK has been widely studied in the context of teacher education, few studies have focused on its development through Micro-Teaching, particularly in a Learning Management Course. Additionally, limited research explores how TPCK can be cultivated in specific regional contexts like Surin Province, where resource constraints and local educational practices create unique challenges and opportunities. This study addresses these gaps by examining how second-year student teachers develop TPCK through a Micro-Teaching intervention within a Learning Management Course in Surin Province.

Research Objectives

1) to study TPCK development through Micro-Teaching of second-year student teachers, who enrolled in a Learning Management Course at a university in Surin Province during the second semester of 2022.

2) to explore the supportive and obstructive factors affecting TPCK development of second-year student teachers, who enrolled in a Learning Management Course at a university in Surin Province during the second semester of 2022.

3) to assess post-instruction TPCK development of second-year student teachers who have completed a Learning Management Course at a university in Surin Province during the second semester of 2022.

Research Framework

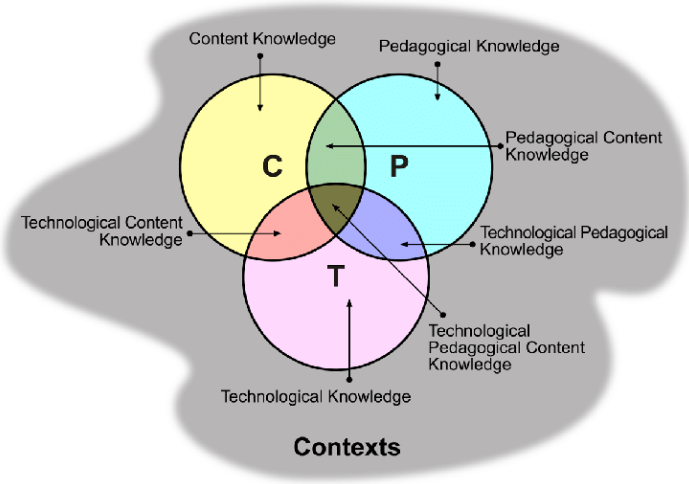

Fig. 1 Technological Pedagogical Content Knowledge (TPCK) framework and its knowledge components (Koehler & Mishra, 2008)

Methodology

This study employed an Exploratory Sequential Mixed-Methods Design (Creswell & Plano Clark, 2011), which involved initial qualitative data collection to inform and complement subsequent quantitative analysis. This approach was selected to provide a comprehensive understanding of the development of TPCK through Micro-Teaching, capturing both subjective experiences and measurable outcomes.

1. Population and Sample

1.1 Population

The population consisted of 25 classes, totaling 649 Thai second-year student teachers, who enrolled in a Learning Management Course during the second semester of 2022 at a university in Surin Province.

1.2 Sample

The sample consisted of 4 classes, totaling 92 Thai second-year student teachers, who enrolled in a Learning Management Course during the second semester of 2022 at a university in Surin Province. The author supervised the practice across all 4 classes of the course. These student teachers were majoring in various interdisciplinary subjects, including programs in Mathematics, Biology, Classical Dance, Physical Education, Thai, Social Studies, Agricultural, Digital Technology for Education, Elementary Education, and Early Childhood Education. The sample was selected purposefully based on their enrollment in the course and their engagement in Micro-Teaching activities. Before embarking on a one-year teaching practice in their final fourth year of the Teacher Preparation Program, the sample was required to pass all courses in education and their respective subject areas taken during the preceding three years. The author who was a lecturer in the course, observed and evaluated the student teachers' lesson plans and document reviews during their Micro-Teaching sessions. Micro-teaching was a pivotal strategy used to investigate the development of their TPCK.

2. Research instruments

2.1 Evaluation Form of Student Teachers' Lesson Plans

2.2 Field Notes of Observation for Student Teachers' Micro-Teaching

2.3 Evaluation Form for Student Teachers' Micro-Teaching

2.4 Evaluation Form for Student Teachers' Teaching Behavior

2.5 Evaluation Form for Student Learning Behaviors

2.6 Semi-Structured Interview on Student Teachers’ TPCK

2.7 Questionnaire on Student Teachers' TPCK Post-Instruction in a Learning Management Course

Five experts with extensive experience in teacher education and TPCK evaluation were involved in the development and validation of the research

tools. These experts included the university lecturers specializing in curriculum and instruction, the university lecturers with expertise in pedagogy and teacher training, and the instructional design specialists with experience in TPCK framework implementation. The experts reviewed the rubric and questionnaire to ensure alignment with TPCK principles and the study's objectives.

3. Data Collection

To study the development of Technological Pedagogical Content Knowledge (TPCK) among second-year student teachers through Micro-Teaching, a comprehensive, multi-faceted methodology was employed to ensure the collection of sufficient and reliable data demonstrating high post-instruction TPCK proficiency. The research design combined qualitative and quantitative approaches, providing a holistic understanding of the student teachers' developmental process. The multi-method data collection approach incorporated lesson planning, Micro-Teaching sessions, reflective practices, semi-structured interviews, document analysis, and questionnaires, ensuring triangulation to strengthen the validity of the findings. This approach facilitated the capture of both subjective insights and objective measures of progress. Quantitative methods, including statistical analysis of questionnaire data, complemented qualitative techniques such as content analysis of reflections, interviews, and teaching artifacts. Furthermore, the integration of video recordings and verbatim interview transcripts added an additional layer of reliability and depth to the analysis. These diverse data sources and methods collectively provided robust evidence of TPCK development, effectively addressing the study's objectives.

The Micro-Teaching activities were designed based on constructivist learning theories and Kolb's experiential learning model, emphasizing active learning and reflection. The process involved the following steps:

1. Design Phase: Student teachers collaboratively designed lesson plans incorporating TPCK principles, aligning content, pedagogy, and technology.

2. Implementation Phase: The lesson plans were used in 40 minutes. Micro-teaching sessions were observed and video-recorded for analysis.

3. Reflection Phase: The student teachers engaged in structured reflection to assess their teaching practices and areas for improvement.

Quality assurance was ensured through:

1. Expert review of lesson plans by experienced educators to confirm alignment with TPCK principles.

2. Use of a standardized rubric for evaluating teaching practices during Micro-Teaching sessions.

3. Guided feedback sessions following each teaching activity to provide actionable insights for improvement.

To study their TPCK development through Micro-Teaching, the second-year student teachers were asked to design and write their lesson plans in groups of 2-3 people. After the author revised their lesson plans, the students were asked to prepare their teaching using Micro-Teaching based on the revised plans. Multiple data sources were used in this study: classroom lessons were observed and video-recorded. Each group's observed lesson lasted about 40 minutes. The student teachers were also asked to reflect on their teaching practices after each class. All interviews were conducted in a semi-structured manner, allowing the sample to discuss their successes and progress. Additionally, the author interviewed them about their teaching after the lessons. All interviews were recorded and transcribed verbatim. Documents such as lesson plans, worksheets, learning materials, assignments, and reflective journals were reviewed as additional data. After completing the Micro-Teaching, the student teachers were asked to complete questionnaires on TPCK development. A 5-point Likert scale questionnaire was developed based on Koehler & Mishra (2008) TPCK framework, assessing key domains: Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), and their integration.

4. Data Analysis

To evaluate student teachers' TPCK development, a combination of quantitative and qualitative methods was employed. Quantitative data from post-intervention questionnaires, designed on a 5-point Likert scale, were analyzed using descriptive statistics (mean, standard deviation) to identify trends in student teachers' perceived TPCK development. Qualitative data, including reflective journals, interviews, and lesson plans, underwent thematic content analysis to uncover patterns of growth, such as enhanced integration of technology and pedagogical strategies. Video recordings of Micro-Teaching sessions were evaluated using a rubric to assess specific TPCK competencies, such as effective technology use, alignment of pedagogy with technology, and student engagement. Document analysis of teaching materials and lesson plans further highlighted the evolution of TPCK practices over the course of the intervention. Triangulation of data sources ensured a robust and reliable analysis, providing comprehensive evidence of students' improvement.

To assess student teachers' Technological Pedagogical Content Knowledge (TPCK) proficiency, a comprehensive evaluation framework was applied. Key domains–Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), and their integration-were systematically analyzed across multiple data sources. Metrics were derived from reflective journals, lesson plans, video-recorded Micro–Teaching sessions, semi-structured interviews, and post-intervention questionnaires. A triangulated approach was employed to enhance the validity and reliability of the findings. The data from the questionnaires were analyzed using descriptive statistics, specifically the mean and standard deviation. The interpretation of the mean scores reflects the Technological Pedagogical Content Knowledge (TPCK) development of Thai second-year student teachers as follows:

4.50 – 5.00: The development of TPCK is at the highest level.

3.50 – 4.49: The development of TPCK is at a high level.

2.50 – 3.49: The development of TPCK is at a moderate level.

1.50 – 2.49: The development of TPCK is at a low level.

Results

1. The development of TPCK through Micro-Teaching

Micro-teaching significantly improved student teachers' lesson planning and teaching skills. The results indicated that micro-teaching helped student teachers develop comprehensive lesson plans with all necessary components such as learning standards, indicators, objectives, content, activities, media, learning resources, and assessment methods. Student teachers demonstrated accurate and well-aligned learning objectives and content. They effectively used engaging learning activities and appropriate media and employed diverse and authentic assessment methods. However, some student teachers struggled with sequencing content and aligning curriculum indicators with learning objectives. Student teachers could introduce lessons with interesting methods and techniques related to the content and students' prior experiences. They effectively used learner-centered teaching methods, structured activities in logical sequences, created conducive learning environments, and used stimulating questions to engage students. Some faced challenges in time management and providing immediate feedback to students.

As a result, the student teachers reported a high level of confidence in their TPCK development, with mean scores across TK (4.30), PCK (4.22), and TPCK (4.21) on the Likert scale. Reflective journals revealed recurring themes of increased self-efficacy in integrating technology with pedagogy. One student teacher noted that the Micro-Teaching sessions helped her understand how to align content with digital tools effectively. In addition, interviews revealed that

the student teachers gained practical skills in addressing real-time classroom challenges. One student teacher stated using digital tools felt natural after practicing in front of peers.

The results revealed the student teachers' TPCK and its components as follows:

1.1 Content Knowledge (CK)

Micro-teaching enhanced student teachers' CK, allowing them to explain subject-specific principles clearly, relate different concepts, and connect content to real-life situations. They understood the structure of topics and could sequence content logically. However, some struggled with organizing content, diversifying learning materials, and using clear questioning techniques.

1.2 Pedagogical Knowledge (PK)

Student teachers showed adequate PK, using diverse learner-centered methods and adjusting teaching strategies to individual student differences. They engaged students through varied teaching methods, promoted group processes, and evaluated learning effectively. Some had difficulties managing undesirable student behavior, providing feedback on assignments, and waiting for student responses.

1.3 Technological Knowledge (TK)

Student teachers effectively used a variety of technologies for research, presentations, and ongoing learning. They quickly adapted to new technologies and applied them efficiently. However, some lacked knowledge about different technologies, essential skills for technology use, and troubleshooting techniques.

1.4 Pedagogical Content Knowledge (PCK)

Micro-teaching improved student teachers' PCK, enabling them to select effective teaching methods that fostered higher-order thinking and learning. They could develop efficient lesson plans and implement appropriate

teaching strategies. Some still needed improvement in using varied methods, focusing on higher-order thinking, and identifying student misconceptions.

1.5 Technological Content Knowledge (TCK)

Student teachers could integrate various technologies to enhance understanding and skills in specific content areas. They used diverse technologies to present content, verify concepts, and access difficult-to-reach resources. Some struggled with selecting appropriate technologies for challenging content and varied educational technologies.

1.6 Technological Pedagogical Knowledge (TPK)

Student teachers showed sufficient TPK, selecting technologies that effectively supported learning. They knew how to choose and adapt technologies to specific content and learning activities. Some still needed to improve in selecting appropriate technologies for different learning contexts.

1.7 Technological Pedagogical Content Knowledge (TPCK)

Overall, student teachers demonstrated sufficient TPCK, integrating content, technology, and teaching methods effectively. They used technologies like Google Maps, Google Earth, e-books, real-life examples, and various educational applications (e.g., Scratch, Kahoot, Plickers, Google Form, Quizlet, Canva, PowerPoint, smartboards, and smartphones). They provided leadership in integrating content, technology, and teaching methods within their educational institutions.

2. Supportive and obstructive factors affecting the development of TPCK

2.1 The supportive factors consisted of seven categories as follows:

1) Content Knowledge: Accurate foundational knowledge allowed for diverse and appropriate teaching methods.

2) Pedagogical Knowledge: Adequate knowledge of the learner-centered methods and effective classroom management.

3) Technological Knowledge: Proficiency in modern technologies and creating new educational innovations.

4) Combined TPCK Knowledge: Enhanced by teachers and mentors, practical teaching experiences, and classroom observations.

5) Active Participation: Engagement in course activities and discussions promoted knowledge development in various TPCK components.

6) Micro-Teaching: Practice designing and implementing effective lesson plans with constructive feedback.

7) Learning Environment: Adequate technological resources and a conducive learning atmosphere supported TPCK development.

2.2 The obstacle factors consisted of three categories as follows:

1) Insufficient Knowledge: Lack of subject-specific, pedagogical, and technological knowledge hindered effective integration and selection of appropriate methods and technologies.

2) Simulation Limitations: Using peers as simulated students caused nervousness and ineffective classroom management.

3) Resource Availability: Limited access to learning materials and budget constraints affected the preparation of diverse learning resources.

3. Post-instruction TPCK development of second-year student teachers.

Regarding post-instruction TPCK development of second-year student teachers, the results are shown in Table 1.

Table 1 Post-instruction TPCK development of second-year student teachers.

TPCK and its components	Post-instruction TPCK development of second-year student teachers			
	$\overline{X}$	S.D.	Meaning	rank
1. Content Knowledge (CK)	4.18	0.63	high	**4**
2. Pedagogical Knowledge (PK)	4.17	0.69	high	**6**
3. Technological Knowledge (TK)	4.30	0.71	high	**1**
4. Pedagogical Content Knowledge (PCK)	4.22	0.66	high	**2**
5. Technological Content Knowledge (TCK)	4.16	0.67	high	**7**
6. Technological Pedagogical Knowledge (TPK)	4.18	0.68	high	**5**
7. Technological Pedagogical Content Knowledge (TPCK)	4.21	0.68	high	**3**
total	**4.19**	**0.67**	**high**	

As can be seen in Table 1, the results revealed that the overall development of TPCK post-instruction among Thai second-year student teachers was at a high level ($\overline{X}$ = 4.19, S.D. = 0.67). The highest level was in Technological Knowledge (TK) ($\overline{X}$ = 4.30, S.D. = 0.71). The next highest was in Pedagogical Content Knowledge (PCK) ($\overline{X}$ = 4.22, S.D. = 0.66) and Technological Pedagogical Content Knowledge (TPCK) ($\overline{X}$ = 4.21, S.D. = 0.68). The lowest level was in Technological Content Knowledge (TCK) ($\overline{X}$ = 4.16, S.D. = 0.67, respectively.

Discussion

The study's findings align closely with Koehler & Mishra (2008) TPCK framework, which emphasizes the integration of technology, pedagogy, and content as critical for effective teaching. The student teachers demonstrated strong post-instruction proficiency in integrating these domains, particularly in their lesson planning and classroom practices. This supports an earlier study

(Koehler, Mishra & Yahya, 2007) highlighting the importance of iterative teaching and reflection in developing TPCK. The success of Micro-Teaching as a strategy aligns with prior research by Fernández (2010), which identifies it as a powerful tool for bridging theory and practice. The reflective practices employed by the student teachers further resonate with Kolb's experiential learning model, where reflection is essential for deeper understanding and growth.

The findings from this study demonstrate the effectiveness of Micro-Teaching in enhancing the Technological Pedagogical Content Knowledge (TPCK) of second-year student teachers. High post-instruction TPCK proficiency in TPCK Components: The data indicates a marked improvement in all TPCK components among the student teachers, with Technological Knowledge (TK) showing the highest improvement ($\overline{X}$ = 4.30, S.D. = 0.71). This is consistent with the findings of Suksawang & Janthamuttukan (2021), who demonstrated that integrating technology into teaching practices through Micro-Teaching can significantly enhance teachers' technological proficiency. The improvement in Pedagogical Content Knowledge (PCK) ($\overline{X}$ = 4.22, S.D. = 0.66) and Technological Pedagogical Content Knowledge (TPCK) ($\overline{X}$ = 4.21, S.D. = 0.68) suggests that student teachers are effectively integrating pedagogical strategies with content knowledge and technology. This aligns with Koehler & Mishra's (2008) framework, which emphasizes the interplay between these knowledge domains for effective teaching. Lower improvement in Technological Content Knowledge (TCK) Despite the overall positive results, Technological Content Knowledge (TCK) had the lowest average improvement ($\overline{X}$ = 4.16, S.D. = 0.67). This finding indicates a need for more targeted interventions to help student teachers integrate technology specifically within content areas. The relatively lower improvement in TCK may reflect challenges in aligning specific technologies with content-specific pedagogical strategies, an area identified as complex by Koehler & Mishra (2008).

Supportive practices and factors affecting the development of TPCK, the high post-instruction TPCK proficiency in TPCK can be attributed to several supportive practices and factors identified in the study. Effective Micro-Teaching: The use of Micro-Teaching allowed student teachers to practice and refine their teaching strategies in a controlled environment. Feedback from peers and the instructor helped them adjust and improve their instructional methods, as supported by Hattie & Timperley (2007). Diverse Teaching Methods: Implementing varied teaching methods and utilizing real-life scenarios and modern technology promoted active participation and critical thinking among student teachers. This approach highlighted the effectiveness of diverse teaching methods in enhancing learning outcomes. Reflective Practice: Encouraging student teachers to reflect on their teaching practices and providing timely feedback was crucial in helping them understand and improve their TPCK. Reflective practice is widely recognized as a key component of teacher professional development (Schön, 1983). Regarding hindering factors, the study also identified factors that hindered TPCK development, such as insufficient knowledge of specific subjects, teaching methods, and technology, and the use of simulated students which led to nervousness and poor classroom management. Addressing these hindering factors through additional training and support can further enhance TPCK development.

Conclusion and Implication

The study shows a high post-instruction TPCK proficiency in Technological Pedagogical Content Knowledge (TPCK) among Thai second-year student teachers following instruction, particularly through Micro-Teaching and diverse teaching methods. The greatest gains were in Technological Knowledge (TK), indicating increased proficiency in using modern technologies. However, there was a relatively lower improvement in Technological Content Knowledge (TCK),

suggesting the need for more targeted strategies to integrate technology into specific content areas. Key practices such as effective Micro-Teaching, diverse teaching methods, and reflective practice were crucial in this development. These findings align with existing literature, highlighting the importance of integrating technology, pedagogy, and content knowledge to create a comprehensive teaching approach. Addressing obstacles like insufficient knowledge and the challenges of using simulated students is essential for optimizing TPCK development.

Implications for Teacher Education

To enhance TPCK, teacher education programs should:

1) Integrate Micro-Teaching to improve instructional competencies.

2) Provide targeted training in integrating technology with specific content areas.

3) Ensure access to technological resources and a supportive learning environment.

4) Encourage continuous professional development through workshops, mentoring, and academic conferences.

By leveraging strengths and addressing weaknesses identified in this research, educational institutions can improve the quality of teacher preparation, equipping future educators with the necessary skills for effective teaching in the 21st century.

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