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Improving English Language Learning Through TPACK-Based Instruction: An Empirical Study on Effectiveness and Student Engagement

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Article info

Abstract

This research aimed to: (1) develop and evaluate the effectiveness of TPACK Model-based learning management plans in English courses, (2) compare students' English proficiency scores before and after implementation, and (3) study student engagement with this approach. Conducted in the 2024 academic year, the research involved 41 undergraduate students from Suan Dusit University, selected through convenience sampling. Four research instruments were employed: (1) TPACK Model-based activity plans designed for 15 weeks with 4-hour sessions per week, (2) the English Discoveries Online program used for both instruction and assessment, (3) a student opinion questionnaire adapted from Schmidt, Baran, Thompson, Mishra, Koehler, and Shin (2009), and (4) an online placement test for pre-test and post-test evaluation of English proficiency. Data analysis included descriptive statistics and a Paired Sample t-test to evaluate changes in English proficiency scores. Results demonstrated a statistically significant improvement, with mean scores increasing from 7.42 (SD = 2.59) on the pre-test to 14.29 (SD = 4.49) on the post-test (t = 15.220, Sig. (2-tailed) = .000). Analysis of student engagement showed that 50% of students expressed high levels of agreement (76-100% range) with the TPACK framework, and 42.5% highly agreed that the instructor effectively integrated technology, pedagogy, and content into out-of-classroom learning. These findings highlight the TPACK Model's significant impact on enhancing students' English proficiency while fostering high levels of engagement in both classroom and out-of-classroom settings. The results support the effectiveness of TPACK-based instruction as a robust framework for meaningful and impactful English language learning experiences.

Introduction

The rapid advancement of information technology, accelerated by the global pandemic, has established educational technology as a key element of 21st - century learning. In English language education, digital tools, online platforms, and artificial intelligence (AI) have transformed traditional instruction, offering learners flexible access to language resources and supporting interactive, student - centered learning. At Suan Dusit University, undergraduate students are expected to

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develop strong English proficiency to meet academic and professional demands. To address this need, the TPACK framework, stands for Technological Pedagogical Content Knowledge—which integrates technological, pedagogical, and content knowledge—offers a structured approach to enhance both language proficiency and student engagement. By involving students from various faculties, the research examines the adaptability of the TPACK model across disciplines while also promoting teacher development in technology integration. Although technology in education has been widely explored, few studies have focused on applying the TPACK model in Thai higher education English courses. This study seeks to fill that gap by evaluating the model's effectiveness in improving learning outcomes and fostering active engagement (Bostancıoğlu & Handley, 2018).

Undergraduate students at Suan Dusit University face a critical need to develop proficient English skills to meet academic and professional requirements. As English increasingly becomes the global language of communication, students must acquire the necessary language skills to compete in both local and international contexts. However, traditional teaching methods may fall short of addressing students' diverse learning needs and ensuring active engagement. To overcome these challenges, instructional models such as the TPACK framework to address this need, in Technological Pedagogical and Content Knowledge, and offer a structured approach to enhance both language proficiency and student engagement, and offer innovative solutions by integrating technology, pedagogy, and content knowledge into teaching practices.

The study aligns with Thailand's 4.0 educational policy, which emphasizes the integration of digital technologies in education to enhance students' digital literacy and critical thinking skills. This policy prioritizes innovation-driven development, requiring educational institutions to adopt advanced teaching methods that equip learners with the competencies needed for a technology-driven economy. As part of this national initiative, Suan Dusit University is committed to leveraging technology to enhance teaching and learning, with a focus on improving students' English proficiency through modern, technology-supported instructional frameworks such as the TPACK.

Although the integration of technology in education has been extensively explored, there is limited research on the practical application of the TPACK Model in English language teaching, particularly in the Thai context. Existing studies broadly address the benefits of educational technology but often lack a targeted examination of how TPACK can improve specific outcomes such as language proficiency and student engagement. This study seeks to fill this gap by investigating how the TPACK framework supports the development of English proficiency and fosters active participation among undergraduate students from diverse academic disciplines.

The study focuses on undergraduate students enrolled in English language courses at Suan Dusit University, representing various faculties and academic backgrounds. This diversity allows the study to assess how the TPACK Model supports English language learning across disciplines, thereby enhancing the generalizability of the findings. Additionally, the research aligns with the university's institutional goals of promoting innovation in teaching and supporting faculty members in adopting technology - driven instructional approaches.

By addressing these challenges and leveraging the opportunities presented by technology, this study aims to evaluate the effectiveness of TPACK Model - based learning management plans in English courses, measure improvements in students' English proficiency, and explore their engagement with this innovative instructional framework. The findings are expected to provide valuable insights into the practical application of TPACK in language education and contribute to the ongoing discourse on technology integration in 21st - century classrooms (Chapelle, 2005, 2009; Nosrati, 2015; Choedchoo, 2014, 2016) (Anderson, Barham, & Northcote, 2013; Liando, Tatipang, & Wuntu, 2023).

The study also contributes to teacher development by emphasizing the integration of technology, pedagogy, and content knowledge in instructional practices. At Suan Dusit University, supporting faculty members in adopting innovative teaching approaches is a key priority. The research not only examines the impact of the TPACK Model on students' learning outcomes but also encourages teachers to refine their instructional strategies in alignment with 21st - century educational needs. This dual focus underscores the importance of equipping both students and teachers with the skills necessary for success in a technology-driven educational environment.

The educational policy in the era of Thailand 4.0, coupled with the global evolution of communication technology through online social networks and the

internet for education has rapidly transformed. These changes have significantly impacted teaching and learning processes, driving educational systems to advance and innovate effective tools for teaching English in various formats. Consequently, learning and teaching management models that incorporate information technology via the internet and mobile phones have become essential for English language teaching activities to promote and stimulate learners to engage in interest-driven learning both inside and outside the classroom through the internet network.

By integrating knowledge in information technology within the framework of the TPACK Model (Technological Pedagogical Content Knowledge), which combines various knowledge areas including English language skills, English language knowledge, pedagogical methods for teaching English, and technological resource knowledge, creative teaching and learning activities in English language teaching during the era of Thailand 4.0 are developed. These activities guide learners towards sustainable self-directed learning suitable for learning models in the 21st century and the context of teaching English in the classroom (Koehler, Mishra, & Cain, 2013; Koehler, Shin, & Mishra, 2012; Yang & Chen, 2010; Koh, & Chai, 2016).

Thailand's 4.0 educational policy is a transformative approach aimed at advancing education in alignment with the global shift toward digital innovation and connectivity. This policy emphasizes the integration of information technology, internet resources, and mobile platforms into teaching and learning processes to prepare students for the demands of a modern, knowledge-based economy. In the context of English language education, the policy encourages using digital tools and resources to engage students in interactive and interest-driven learning both inside and outside the classroom.

This initiative aligns well with the TPACK (Technological Pedagogical Content Knowledge) model, which focuses on combining technological, pedagogical, and content knowledge to create effective and relevant learning experiences. By embedding these principles into language instruction, Thailand's educational system seeks to foster self-directed, lifelong learning, ultimately equipping students with the skills necessary for success in the 21st century.

Objectives

1. To develop and evaluate a learning management plan for the English language course using the TPACK Model framework.

2. To compare the student scores before and after implementing the TPACK Model learning management.

3. To analyze students' opinions on learning management based on the TPACK Model framework.

Literature review

The integration of technology into education has become increasingly essential in the 21st century, especially in the context of English language learning. Educational technology facilitates flexible, personalized, and student-centered learning environments (Blake, 2013; Chapelle, 2009). As digital platforms and mobile applications become more prevalent, their role in enhancing English language proficiency continues to expand (Anderson et al., 2013).

A key model supporting this integration is the TPACK framework—Technological Pedagogical and Content Knowledge—proposed by Koehler and Mishra (2009). This model conceptualizes effective teaching as the intersection of three core knowledge domains: content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). TPACK emphasizes that technology must not be used in isolation, but integrated meaningfully with pedagogy and content to optimize student learning outcomes (Herring, Koehler, & Mishra, 2016).

In English language teaching (ELT), the TPACK model has shown potential for promoting active learning, enhancing digital engagement, and improving language skills through blended or online formats (Bostancıoğlu & Handley, 2018; Koh & Chai, 2016). However, research in the Thai higher education context remains limited. Most existing studies focus broadly on digital learning or general technology use without examining how structured frameworks like TPACK affect specific outcomes, such as language proficiency and student engagement (Tseng, 2016; Ortiz Colón et al., 2023).

Moving from Blended Learning to the TPACK Model Framework

The Technological Pedagogical Content Knowledge (TPACK) model represents a contemporary approach to teaching and learning management in the late 21st - century. Shulman (1986) emphasized that teaching activities should focus on the interaction and integration of information technology, English language teaching methodologies, and English language content knowledge.

This includes CK (Content Knowledge), the essential components of learning content that enable learners to communicate effectively in English. Teachers must possess at least the content knowledge outlined in the curriculum set by the educational system. Pedagogical Knowledge (PK) refers to the diverse knowledge of teaching methods in English language learning and training in techniques to appropriately develop learners' English language proficiency.

Technological Knowledge (TK) encompasses knowledge in utilizing various technologies. Consequently, teachers are required to create teaching activities that involve the interaction and integration of knowledge from other domains, including PCK (Pedagogy Content Knowledge), TCK (Technology Content Knowledge plus AI), and TPK (Technology Pedagogy Knowledge) (Koh, & Chai, 2016).

Guidelines for applying the TPACK Model in teaching English Teaching

In the context of the digital world, English learning aligns with Connectivism Learning Theory and is supported by the TPACK MODEL framework. This teaching method integrates technology into English language instruction, effectively engaging learners in an online society and digital networks. Consequently, this approach addresses the evolving learning behaviors influenced by social networks and digital environments. In today's educational landscape, teaching activities should seamlessly integrate technological knowledge with pedagogical approaches and content, especially in the realm of English language instruction. Following the TPACK framework, 21st - century English language teachers must design and organize teaching activities that are aligned with the evolving learning behaviors of their students. Teachers should be well - versed in the teaching management concepts of the TPACK Model, which emphasizes the integration of technology with content knowledge, to enhance the comprehensiveness of English language instruction. This model involves combining knowledge across three dimensions, known as the Total Package, enabling teachers to use English language subject matter and incorporate technology into teaching methods that align with modern pedagogical processes. By integrating these three dimensions, teachers can effectively address the needs of English language teaching in the 21st - century (Glick, 2008; Herring, Koehler, & Mishra, 2016; Bostancıoğlu, & Handley, 2018).

1) Applying Technological Knowledge (TK) involves teachers' proficiency in using educational technology tools in English language teaching. This includes tools like Kahoot, Wiki, Facebook Live, Facebook, Instagram, Line, and various online language teaching games. These tools can be accessed through technology platforms like YouTube, Facebook Live, Zoom, or Google Classroom.

2) Applying Pedagogical Knowledge (PK) refers to teachers' understanding of teaching methods in English language instruction, which they use to effectively manage and deliver their lessons.

3) Applying Content Knowledge (CK) pertains to the teachers' grasp of English language content, which they employ to enhance their teaching practices and ensure the learners comprehend the subject matter (Koehler & Mishra, 2009).

Pedagogical Knowledge (PK) in the context of English language teaching encompasses the depth of understanding and proficiency that educators possess. This enables them to effectively utilize a diverse array of teaching methodologies to facilitate their students' learning journey. This knowledge base includes the strategies and techniques employed by teachers to create a conducive and engaging learning environment, as well as the methods used to impart knowledge and skills to learners. It involves not only the transmission of information but also the fostering of critical thinking, creativity, and communication skills among students. PK extends to the practical application of language skills in listening, speaking, reading, and writing, ensuring a holistic approach to language learning. Educators draw upon their pedagogical knowledge to design activities and tasks that promote active participation and enhance the learning experience both within the classroom and in extracurricular settings. By leveraging their pedagogical expertise, teachers can tailor their instructional methods to meet the diverse needs and learning styles of their students. This approach fosters a dynamic and inclusive learning environment that nurtures individual growth and development (Mishra, 2016).

Content Knowledge (CK) in the realm of English language education encompasses a rich tapestry of information, language concepts, and cultural insights fundamental to language acquisition and comprehension. It delves into the essence of language itself, exploring not only the structural components and grammar rules of English but also the nuances of language use in different contexts and cultural settings. Within the domain

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of CK, educators are tasked with imparting to students a comprehensive understanding of language functions, essential language skills, and key grammatical principles that form the cornerstone of effective communication in English. This includes equipping learners with the necessary tools to navigate the intricacies of listening, speaking, reading, and writing, fostering holistic language proficiency development. Moreover, CK extends beyond mere linguistic knowledge to encompass broader content-related principles that educators must convey to students. This involves designing instructional activities that align with the content being taught, ensuring that students grasp the intricacies of the language and develop a deeper appreciation for the cultural underpinnings and contextual nuances embedded within it. By integrating content knowledge with language skills across all four language domains, educators can create a robust learning environment that nurtures comprehensive language acquisition and proficiency among students (Mishra, 2016; Bostancıoğlu & Handley, 2018).

The learning management approach in the TPACK Model aims to enable educators to integrate and create innovative technology-based resources that align with teaching theories and subject content. According to the TPACK Model framework, it highlights the crucial interrelationships of the three main components, which are connected in seven aspects. One of the key aspects is the integration and incorporation of technology-based innovations with teaching methods and content in the English language curriculum. This approach is utilized in designing coherent and systematic English language learning systems, comprising subject content (Content: CK), English language teaching methods (Pedagogy: PK), and technology (Technology: TK). This integration enhances student learning, fosters language skills, and facilitates a deeper understanding of English language and various foreign cultures being studied. The specialized knowledge in each aspect is abbreviated as CK, PK, and TK. The more diverse integration is, the more variations can be found, ranging from PCK, TCK, TPK, and TPACK. It is important to consider the following factors (Koehler, Mishra, & Cain, 2013; Koehler, Shin, & Mishra, 2012; Herring, Koehler, & Mishra, 2016; Bostancıoğlu & Handley, 2018; Ortiz Colón et al., 2023).

Pedagogical Content Knowledge (PCK)

This refers to the specialized knowledge and understanding that educators possess regarding the effective integration of teaching methods and approaches tailored to specific content areas within English language instruction. This knowledge enables teachers to skillfully adapt instructional techniques to align with the unique characteristics and requirements of the content being taught.

In the context of English language teaching, PCK involves the collaborative implementation of various teaching strategies, whether through paired activities or group tasks, to foster interactive learning environments that cater to the diverse abilities and skills of students. By promoting active engagement and participation, educators can facilitate meaningful interactions among learners, enhancing their language acquisition and proficiency in English. Moreover, PCK emphasizes the incorporation of student-centered approaches such as Cooperative Learning and the Communicative Language Teaching Approach, as well as engaging activities like Role Play and Information Gap exercises. These methodologies are designed to provide students with opportunities to practice and enhance their language skills across all four language domains – listening, speaking, reading, and writing – in a dynamic and interactive manner. By leveraging Pedagogical Content Knowledge, educators can create engaging and effective learning experiences that not only enhance students' language proficiency but also cultivate a sense of enjoyment and success in learning the English language. Through a diverse range of activities and instructional approaches, teachers can cater to the individual needs and learning styles of students, ultimately fostering a supportive and enriching learning environment for language acquisition (Ortiz Colón et al., 2023).

TCK: Technological Content Knowledge

Using a variety of appropriate technologies for teaching specialized language content allows instructors to consider which information and communication technologies can help learners acquire knowledge based on their predefined objectives. This includes understanding how to use technology to help learners grasp the culture of foreign languages they are studying. The technological content knowledge of instructors reflects the ways in which games and online assessments created on various platforms (Chapelle & Douglas, 2006) impact learners directly and provide immediate feedback (teacher reflection) that stimulates learners to evaluate their own learning and develop themselves both inside and outside the classroom (Ortiz Colón et al., 2023).

TPK: Technological Pedagogical Knowledge

The organization of knowledge management activities recognizes that teaching and learning can evolve with change in the information and communication technologies, including technical knowledge of English language teaching methods. These changes depend on the capabilities or limitations of the technologies used, potentially posing significant obstacles if instructors are not well-versed in the content they are teaching. This can result in teaching that is off-target or misaligned with set objectives.

Instructors can demonstrate their knowledge of using technology to aid in teaching and learning, such as through important vocabulary games and English pronunciation exercises, where students engage with peers in the classroom. They can also facilitate activities like opening English vocabulary, practicing English grammar exercises, and designing collaborative tasks between classmates or instructors during online teaching sessions. When organizing collaborative activities for students, instructors should consider the time and technological skills students (Blattner & Lomicka, 2012; Yang & Chen, 2010; Ortiz Colón et al., 2023).

This study addresses this gap by applying the TPACK model in a Thai university's English language courses to examine its impact on students' language performance and engagement, thereby contributing practical insights for educators and policymakers implementing technology-enhanced instruction.

Independent Variables

This is the factor that is manipulated or changed by the researcher to observe its effect on the outcome. In this study, the independent variable is the TPACK Model-based learning management plans used in the English courses. The study aims to observe how this specific instructional approach influences students' performance and opinions.

Dependent Variables

This is the outcome or the variable that is measured to see how it responds to changes in the independent variable. In this study, the dependent variables are the students' scores (as measured by the pre-test and post-test) and their opinions about the TPACK Model approach. These outcomes are influenced by the independent variable (the TPACK-based instruction).

Conceptual framework

This study is guided by the TPACK framework and its role in supporting English language learning

outcomes. The conceptual model illustrates the relationship between independent and dependent variables:
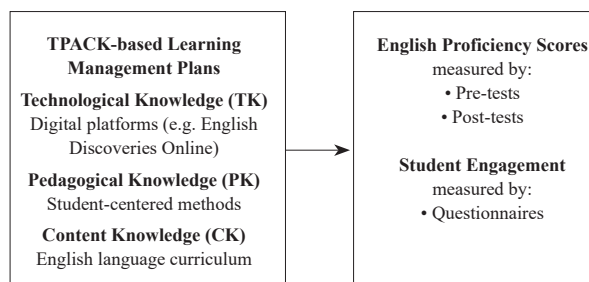

Figure 1 Conceptual framework

Independent variables

TPACK - based learning management plans, integrating:

Technological Knowledge (TK): Use of digital platforms like English Discoveries Online

Pedagogical Knowledge (PK): Student-centered methods

Content Knowledge (CK): English language curriculum

Dependent variables

English Proficiency Scores (measured by pre- and post-tests)

Student Engagement and Opinions (measured through questionnaires)

This framework positions TPACK-based instruction as the central factor influencing measurable learning outcomes and student engagement in English courses. It serves as the basis for data collection, analysis, and interpretation of results in line with the study's objectives.

Research methodology

This study employed a quantitative research design to examine the effectiveness of TPACK Model-based learning management plans in English language instruction for undergraduate students. The research aimed to evaluate both learning outcomes and student engagement resulting from the implementation of this instructional approach.

Population

The study focuses on undergraduate students of Suan Dusit University enrolled in English language courses categorized as English for Self-Direction and English for Reflective Thinking during the first and second semesters of the academic year 2019. These

students come from various faculties and schools and are enrolled in 20 sections of the general education English language courses, totaling 1,200 students.

Statistical Validity and Generalizability

A sample size of 41, when selected randomly, can yield statistically valid results if it aligns with established sample size calculation methods. For instance, using a confidence level of 95% and a margin of error of 10%, a sample size of approximately 40-50 is often adequate for populations in the range of 1,200. This ensures that the findings can be generalized to the broader population with a reasonable degree of accuracy.

Focused Analysis of the Course - Specific Population

The 41 samples were specifically selected from students enrolled in the course with the code 1500121. This subgroup was directly relevant to the research objectives, ensuring that the data collected was highly focused and meaningful for evaluating the TPACK model's effectiveness in this context.

Sampling

The researcher used a convenient sampling method to select students enrolled in the English for Reflective Thinking course (course code 1500121) under the general education category. This section consisted of 41 students during the academic year 2019. The researcher, who is also the instructor for this section, selected 41 participants from the broader population of approximately 1,200 undergraduate students at Suan Dusit University. The convenient sampling method was chosen for practical reasons, as it allowed the researcher to work with a readily accessible group within the English language course, specifically in the "English for Reflective Thinking" course (course code 1500121) during the 2019 academic year.

Justification for this sample size includes the following considerations:

Accessibility and Feasibility

The convenient sampling method made it feasible for the researcher, who also served as the instructor for this specific course section, to gather data directly from students enrolled in a class that aligns with the objectives of the study. This accessibility enabled consistent observation and a straightforward data collection process.

Representative Diversity within the Section

Although drawn from one section, these 41 students represent a cross-section of various faculties within the university (e.g., Humanities and Social Sciences, Management Science, Science and Technology).

This diversity within the convenient sample may still reflect varied perspectives on the TPACK model's effectiveness in enhancing English language proficiency.

Preliminary Investigation

Given the study's scope, the sample size of 41 participants serves as an initial investigation into the effectiveness of TPACK in English courses. This provides foundational data that could inform larger studies in the future.

In summary, while limited in generalizability, this sample of 41 students allows the researcher to conduct a practical, manageable, and focused analysis of the TPACK model within a real classroom setting, providing valuable insights into its potential impact on student learning outcomes.

The research tools used in this study are divided into four types:

1. Activity Management Plan Based on the TPACK Model Framework

The activity management plan was meticulously designed to align with the TPACK Model (Technological Pedagogical Content Knowledge) framework within the English Language course. This plan encompassed a total duration of 15 weeks, with each weekly session allocated 4 hours. The researcher adhered to the TQF.3 standard, ensuring that the plan met the established guidelines for teaching activities and course content.

Characteristics of the Activity Management Plan:

1.1 Integration of TPACK Components: Each session was structured to incorporate technological tools, pedagogical strategies, and content knowledge seamlessly. For example, technology such as interactive whiteboards and online collaboration platforms were used to facilitate language exercises and group activities.

1.2 Weekly Themes and Objectives: The plan was divided into weekly themes, each with specific learning objectives that targeted different aspects of English proficiency, including listening, speaking, reading, and writing skills.

1.3 Diverse Instructional Methods: A variety of teaching methods were employed, including lectures, interactive activities, multimedia presentations, and collaborative projects to cater to different learning styles.

1.4 Assessment and Feedback Mechanisms: Regular formative assessments were integrated into the plan to monitor student progress, along with opportunities for providing timely feedback to enhance learning outcomes.

1.5 Flexibility and Adaptability: The plan

allowed for adjustments based on student performance and feedback, ensuring that the instructional approach remained responsive to the learners' needs.

2. Teacher Opinion Questionnaire on TPACK-based Teaching Management

This questionnaire aimed to assess teachers' perspectives on the effectiveness of the TPACK model in teaching management. It was developed to evaluate the Index of Congruence (IOC) and reviewed by three experts to ensure content validity. The questionnaire contained 15 items, focusing on various aspects of the TPACK framework, such as teachers' experiences with integrating technology, pedagogy, and content knowledge in their teaching practices. The items also explored the challenges and opinions teachers faced when implementing TPACK-based teaching. These insights helped refine the instructional approach by gathering feedback on areas of improvement and effectiveness.

3. Online Placement Test via English Discoveries Online Package

The English Discoveries Online package was used to conduct both pre-placement and post - placement testing. This online assessment evaluated students' English proficiency levels before and after the implementation of the TPACK model - based instruction. The placement test covered key language skills, including listening, reading, and writing, and provided a standardized method for measuring students' initial and post-intervention proficiency levels (Kasper, 1996).

4. Student Opinion Questionnaire on TPACK-based Teaching Management

This questionnaire gathered students' opinions on the TPACK-based teaching management approach in their General Education English course. Adapted and translated into Thai from Schmidt et al. (2009), the questionnaire was structured to reflect the students' perceived effectiveness of the TPACK framework, instructor's integration of technology, and overall satisfaction. It included multiple items rated on a Likert scale to capture the degree of agreement with statements about the TPACK model, enabling a detailed analysis of students' attitudes and experiences with the TPACK-integrated teaching model.

These instruments collectively supported a comprehensive evaluation of the TPACK model's effectiveness, capturing quantitative data on language proficiency improvements as well as qualitative insights from both instructors and students regarding the model's practical implementation in an English language course.

Data Collection

The data collection and compilation process consist of 5 steps:

1) Development Stage

The researcher developed and designed a teaching plan that integrates the technology of the English language program, English Discoveries. This plan was implemented for experimental use, and experts in the field evaluated the teaching management plan using the TPACK Model to determine the IOC value from three qualified individuals.

2) Pre-Placement Test

Students underwent a Pre-Placement Test online to assess their English language proficiency levels. The test results were analyzed to categorize students based on their language proficiency levels.

3) Implementation Stage

Educators instructed students to follow the prescribed curriculum with the integration of technology in teaching methods and course content in alignment with the TPACK Model. The teaching process spanned 15 weeks.

4) Post-Placement Test

Each group of students completed a Post-Placement Test to evaluate their language proficiency skills. The analysis aimed to assess students' English language proficiency levels using the Post-Placement Test results, comparing them with the Pre-Placement Test results.

5) Conclusion and Result Analysis Stage

The researcher compared the scores of students who took the Pre-Placement Test and Post-Placement Test based on their English language proficiency levels. This comparative analysis provided insights into the progression and improvement of students' English language skills throughout the study.

Data analysis plays a crucial role in studying the impact of implementing the TPACK Model in the English language course within the General Education category. In this research, the scholars delved into a comprehensive data analysis, which was segmented into two distinct parts:

1. The first part of the analysis involved a comparative assessment of English language proficiency levels before and after the introduction of the TPACK Model. This comparison aimed to ascertain whether there was a noticeable enhancement in students' English language competencies following the adoption of this innovative learning management approach. Statistical significance was determined at the .05 level, providing

valuable insights into the effectiveness of the TPACK Model on students' language skills.

2. The second part of the data analysis encompassed the utilization of various statistical measures to examine the collected data thoroughly. Key statistical indicators such as percentages, means, and standard deviations were employed to gain a deeper understanding of the outcomes and variations within the dataset. These statistical tools served as essential metrics in evaluating the impact of the TPACK Model on students' learning outcomes and language proficiency levels and scores.

Furthermore, the researcher also undertook an in-depth analysis of feedback obtained through surveys administered to both teachers and students. By incorporating these qualitative insights into the data analysis process, the researcher was able to gather valuable perspectives on the effectiveness and reception of the TPACK Model within the educational context. This multifaceted approach to data analysis not only enhanced the comprehensiveness of the study but also provided a holistic view of the implications of implementing the TPACK Model in the English language curriculum.

Data analysis

Data Collection Procedures

The data collection process for this study followed a structured approach using four research instruments to gather information on student performance, opinions, and proficiency. Here is how data were collected with each instrument:

1. TPACK Model - Based Activity Plans

The researcher developed and implemented a 15-week learning management plan aligned with the TPACK Model. The plan was structured to incorporate technological, pedagogical, and content knowledge components in English language teaching. The activities took place over 4-hour sessions each week, where students engaged in various TPACK-based learning tasks. This part of data collection focused on observing and assessing how well students adapted to the TPACK Model in a structured classroom setting.

2. Experts Opinion Questionnaire

Number of Items: The questionnaire comprised 15 items, each designed to assess different aspects of the TPACK framework integration, including technological proficiency, pedagogical effectiveness, and content delivery.

Response Format: A Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) was used for respondents to express their level of agreement with each statement.

Content Areas: The items covered areas such as the ease of integrating technology into lessons, the effectiveness of teaching methods, the relevance of content delivered, and overall satisfaction with the TPACK-based approach.

Validity and Reliability: The questionnaire was reviewed by three experts in the field of English language teaching and educational technology to ensure content validity. Additionally, a pilot test was conducted to assess the reliability, resulting in a Cronbach's alpha of 0.85, indicating high internal consistency.

Administration: The questionnaire was administered online to the instructors involved in the study, allowing for convenient and timely data collection.

3. English Discoveries Online Program (Pre - Test and Post - Test)

The English Discoveries Online program was utilized to administer both the pre-test and post-test assessments. The Pre - Placement Test was conducted at the beginning of the semester to evaluate students' baseline English proficiency levels. Following the intervention period, the Post - Placement Test was administered to measure any changes in proficiency. Scores from these assessments were used to compare students' abilities before and after implementing the TPACK-based approach, providing quantitative data on its effectiveness.

4. Student Opinion Questionnaire

A questionnaire was developed to collect student feedback on the TPACK Model approach, focusing on their overall attitudes, satisfaction, and perceived benefits of integrating technology, content, and pedagogy in the English course. The questionnaire, adapted from validated models, was administered to students after the completion of the course to gather their insights on various aspects of TPACK - based instruction, both inside and outside the classroom.

5. Online Placement Test

The online placement test was used initially to classify students according to their English proficiency levels, ensuring that the intervention was suited to their existing abilities. The placement test results were also compared with post-test results to analyze any significant improvements in language proficiency.

Through these steps, data were systematically collected, covering multiple dimensions of student engagement, and learning outcomes under the TPACK

framework. Statistical analysis, including a Paired Sample t-test, was subsequently conducted to determine the significance of the changes observed in students' performance and opinions.

Results

Part 1: Enhancing the Effectiveness of Learning Management according to the TPACK Model Framework

The development of the effectiveness of learning management within the framework of the TPACK Model in the English language course under the General Education category was assessed through expert interviews with three qualified individuals. The selected criteria for these experts included holding a Master's or Ph.D. degree in English language teaching or related fields, possessing teaching experience in general education or English language subjects, and having at least three years of teaching experience at the undergraduate level. The experts were either Thai nationals or foreign nationals from English-speaking countries. The analysis of the experts' feedback regarding the TPACK Model revealed an overall approval rating of 0.66.

The research results indicate that the TPACK evaluation criteria were generally deemed acceptable by the experts, with most items receiving positive ratings and high the Index of Item - Objective Congruence (IOC) values. Specifically, the alignment with students' interests, current conditions, content appropriateness, and integration of technology received unanimous agreement from all three experts, each achieving an IOC of 1.0, signifying strong alignment and high acceptance. Additionally, criteria such as alignment with the course standard framework, suitability for student development processes, and appropriateness of teaching and learning activities inside and outside the classroom received moderate acceptance with IOC values ranging from 0.35 to 0.65. However, the alignment with the nature of the English subject scored an IOC value of 0.0, indicating a need for improvement in this area. This suggests that while the overall framework is considered robust, there are specific aspects, particularly regarding the subject's nature, which require further refinement to better meet expert expectations and ensure consistency across all criteria. These findings highlight the strengths and potential areas for enhancement within the pedagogical framework for improving the overall effectiveness of English language instruction.

Part 2: Comparing Students' Proficiency Scores Before and After

Comparing students' probability efficiency scores before and after the implementation of the TPACK Model in the English language course within the General Education category, it was observed that 87.50% of students' placement test scores from the English Discoveries Online program increased, while 2.50% decreased, and 10% remained unchanged.

Table 1 Comparison of English Proficiency Scores Between Pre and Post-Tests (Paired Sample t-test)

Test	N	Full Score	M	SD	t	df	Sig. (2-tailed)
Pre-test	41	40	7.42	2.59	15.220	40	.000*
Post-test	41	40	14.29	4.49			

* $p \leq .05$

Paired Sample t-test Analysis Results

The paired sample t - test results presented in Table 2 reveal a statistically significant enhancement in English proficiency following the implementation of the TPACK model. The mean score for the post - test (M = 14.29) significantly exceeds the pre - test mean score (M = 7.42), indicating a marked improvement in student performance. The computed t - value of 15.220, coupled with a Sig. (2 - tailed) value of .000, which is well below the established significance threshold of .05, confirms that the observed difference in scores is not due to chance. Therefore, it can be concluded with high confidence that the TPACK model significantly improved the students' English proficiency at a statistically significant level of .05.

Detailed Analysis of Research Results Using the TPACK Model

1. Comparison of Mean Scores (M): The comparison of mean scores between the pre-test and post-test clearly indicates an improvement in students' English proficiency following the implementation of the TPACK learning management model. The mean score for the pre-test was 7.42, while the post-test mean increased to 14.29. This substantial increase in the post-test mean demonstrates that the TPACK model effectively facilitated significant learning gains, reflecting an enhancement in the students' overall proficiency in English. The higher post-test mean suggests that the integration of technological, pedagogical, and content knowledge (TPACK) had a positive impact on student outcomes.

2. Standard Deviation (SD): The standard deviation (SD) of the pre - test was 2.59, while the post - test SD increased to 4.49. This increase in standard deviation

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indicates greater variability in the students' performance after the intervention, which may suggest differential rates of improvement among the learners. In other words, while some students exhibited rapid progress in their English proficiency, others may have advanced at a slower pace. The wider spread in the post - test scores is likely a reflection of individual differences in learning trajectories, which is common in educational interventions. Such variability highlights the need for tailored support to ensure all students benefit equally from the learning model.

3. t - value: The t - value of 15.220 provides a crucial statistical measure for hypothesis testing, indicating a significant difference between the pre - test and post - test scores. This high t - value suggests that the observed improvement in student performance is unlikely to have occurred by chance. The large t - value confirms that the TPACK model was effective in producing measurable gains in English proficiency, reinforcing the hypothesis that the intervention had a positive impact on learning outcomes.

4. Degrees of Freedom (df): The degrees of freedom (df) for this study was calculated to be 41, based on the formula N - 1, where N represents the number of paired observations (41). Degrees of freedom play a critical role in determining the significance of the t - value, and in this study, the calculated value supports the conclusion that the difference between pre - test and post - test scores is statistically significant.

5. Significance Level (Sig. 2 - tailed): The significance level (p - value) for the results was .000, indicating that the probability of the observed difference occurring by chance is less than 0.1%. This value is far below the commonly accepted threshold of .05, confirming that the results are statistically significant. Therefore, it can be concluded with a high degree of confidence that the TPACK model led to a meaningful improvement in students' English proficiency.

Interpretation of Findings

The analysis clearly demonstrates a statistically significant difference between pre - test and post - test scores (p ≤ .05), suggesting that the TPACK learning management model had a substantial and positive effect on the development of students' English language skills. The significant increase in the mean score after the intervention provides strong evidence that integrating technological, pedagogical, and content knowledge into the learning process enhanced students' language acquisition.

Additionally, the increase in standard deviation suggests that while the majority of students benefited from the intervention, individual differences in the rate of improvement were evident. Nonetheless, the overall findings point to the effectiveness of the TPACK model in fostering English proficiency and highlight its potential as a valuable framework for educational practice.

Part 3: Students' Feedback on the TPACK Learning Model

A study on students' opinions regarding their English course revealed the following insights on teachers' use of TPACK in their teaching approach: 50% of students (20 students) rated the effectiveness of their instructors' integration of technology, content, and pedagogy at a high level (within the 76-100% range). Another 50% of students (20 students) rated their instructors' integration at a moderate level (within the 51-75% range). Only 2.5% of students (1 student) rated the effectiveness of this integration at a lower level (within the 26-50% range).

These results were gathered from a total of 41 students who responded to the survey. Overall, the feedback suggests that a majority of students view their instructors' use of the TPACK framework positively, with half of them strongly agreeing that the integration of technology, content, and teaching methods was highly effective.

Discussion

This study explored the integration of technology in English language learning, highlighting on literature that emphasizes the advantages of technology in enriching students' learning experiences. The findings indicate a significant shift from teacher - centered instruction to a more student-centered approach, driven by the effective use of technology. This transition led to improved learning outcomes, as technology promoted greater engagement, personalized learning, and accessibility. The findings also demonstrated that technology not only enhanced the convenience of learning but also fostered innovative teaching practices, creating a more enriching learning environment. Additionally, the study emphasized the critical role of teachers in leveraging technology to drive learning outcomes. Teachers who effectively integrated technology with content and pedagogy were able to optimize English language learning and support students' language acquisition more effectively. These outcomes

underscore the importance of equipping educators with the knowledge and skills necessary for meaningful integration of technology into English language teaching. The alignment of technological, pedagogical, and content knowledge (TPACK) was shown to be vital for maximizing student engagement and achievement. Therefore, fostering professional development and providing teachers with practical strategies for technology integration is essential for sustaining and improving learning outcomes in English language education.

Recommendations

While the current study demonstrates the effectiveness of the TPACK model in enhancing students' English proficiency, several areas warrant further research to deepen the understanding and extend the findings.

1. Differentiated Instruction and Learning Variability

Given the increase in post - test standard deviation, further investigation is needed into how the TPACK model can be adapted to meet the needs of diverse learners. Future studies could explore ways to differentiate instruction within the TPACK framework to support students who may be progressing at varying rates. Examining specific factors—such as learning styles, prior knowledge, or engagement with technology—that contribute to the variability in outcomes could lead to the development of targeted interventions.

2. Comparative Studies Across Subject Areas

While this study focused on English proficiency, the applicability of the TPACK model to other subject areas remains an open question. Future research could compare the model's effectiveness across different disciplines, such as science, mathematics, or social studies, to determine whether the integration of technology, pedagogy, and content knowledge yields similar benefits in other fields. A cross - disciplinary approach would offer a broader understanding of the model's potential impact in varied educational contexts.

3. Exploring Teacher Implementation and Professional Development

Considering that the successful integration of the TPACK model relies heavily on teacher competence in balancing technology, pedagogy, and content knowledge, future research could investigate how professional development programs can effectively equip teachers with the necessary skills. Studies focusing on teachers' experiences, challenges, and best practices in using the TPACK framework could inform the design of more effective training programs that promote better educational outcomes.

4. Impact of Technology - Specific Tools and Resources

Technology Integration: Providing specific examples of how technology was utilized in the study (e.g., specific online platforms), clarifies its role in enhancing student learning. As TPACK emphasizes the integration of technology into teaching and learning, future research could focus on the role of specific digital tools and resources in improving English language learning. Comparative studies could analyze the effectiveness of various technologies, such as interactive whiteboards, mobile applications, or online collaborative platforms, within the TPACK framework. These studies would provide valuable insights into which tools best support language acquisition and student engagement.

5. Cultural and Contextual Considerations

Further research could investigate how the TPACK model operates in different cultural and educational contexts. Factors such as the availability of technology, teacher training, and student backgrounds may significantly influence the model's effectiveness. Conducting studies in diverse settings would offer a more comprehensive understanding of how cultural and contextual factors affect the implementation and outcomes of TPACK - based learning.

Proposing Future Studies

1. Future research should explore how the TPACK model could support the development of other language skills, such as critical thinking and cultural competency, through the use of various digital tools. Investigating these areas would provide valuable insights into refining the TPACK model, ensuring its adaptability and effectiveness across diverse educational contexts and student populations.

2. Such studies could also focus on tailoring the TPACK framework to meet the unique needs of specific disciplines, learner groups, and emerging technological advancements. Expanding the scope of research in this way would contribute to optimizing professional development programs for educators, equipping them with the knowledge and skills to integrate TPACK more seamlessly into their teaching. This would empower teachers to create engaging, differentiated, and technology - enhanced learning environments that promote deeper student understanding.

3. Additionally, the findings from these investigations would be invaluable for policymakers and curriculum developers. They could guide the creation of forward - thinking educational policies that meaningfully and sustainably embrace technology. Ultimately, this body of research would advance student learning outcomes, improve teaching quality, and foster innovation in educational settings on a global scale.

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