# *Development of TPCK Creativity-Based Learning Model for Improving Grade 7 Students' Academic Achievement and Creative Thinking*

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**Abstract**
Creativity-based Learning (CBL) is useful in developing several important skills for mathematics students. This research aimed to: a) develop the CBL integrated with Technological Pedagogical Content Knowledge (TPCK) or TPCK-CBL Model to teach mathematics for Grade 7 students; and 2) examine students' development of academic achievement and creative thinking in the Ordered Pairs topic after learning with the TPCK-CBL Model. The mixed-methods research design was employed in this study. The researchers collected both quantitative and qualitative data from 70 Grade 7 students, who enrolled in the first semester of the 2022 academic year at Thungsong School, Nakhonsithammarat province, Thailand. The TPCK-CBL Model and its associated lesson plans, the Learning Achievement Test and the Creative Thinking Test was validated by five experts. The results yielded that the TPCK-CBL Model could foster Grade 7 students' academic achievement and creative thinking. Through the engagement in open-ended tasks, students were encouraged to think critically, generate innovative solutions for mathematical problems from multiple perspectives. The use of technology in TPCK further supported the development of students' digital literacy and enabled them to utilize digital tools and software to further explore mathematical conceptions in fruitful ways. This study highlighted the significance in incorporating TPCK with CBL for teaching mathematics for Grade 7 students in Thailand. Through TPACK-CBL Model, mathematics educators can create learning environment that truly nurtures students' academic achievement and creative thinking. Implementing TPCK-CBL not only enhances students' mathematical knowledge but also equips them with the essential skills needed for success in the current digital age.

Keywords: Creativity-Based Learning, TPCK, Mathematics Education, Academic Achievement, Creative Thinking, Grade 7 Students

## Introduction

Education stands as an indispensable facet of human existence, a fundamental right that every individual should embrace. Its significance resonates through the tapestry of daily life, serving as a catalyst for holistic development. Education is a transformative force, shaping not only one's cognitive prowess but also fostering skills, nurturing mental well-being, and influencing various dimensions of personal growth. In the contemporary landscape, the 21st century, education plays a pivotal role in equipping individuals with the tools to navigate a world marked by rapid, intense, and unpredictable changes. In this era, the ability to learn and adapt swiftly has become a cornerstone of success. Both educators and learners are called upon to cultivate not only subject-specific knowledge but also high-order learning skills, essential for thriving in the dynamic challenges of the modern age. Teachers, as facilitators of knowledge, bear the responsibility of not only imparting information but also honing their own learning skills. The evolving nature of the 21st century demands educators to be dynamic and adept at integrating contemporary teaching methodologies. A symbiotic relationship exists between the proficiency of teachers in acquiring new knowledge and their effectiveness in fulfilling their roles in this ever-changing educational landscape.

Educational institutions, as crucibles of knowledge, must align their curricula with the dual objectives of imparting core subjects and cultivating 21st-century skills. These skills encompass learning and innovation, life and career proficiency, and information, media, and technology literacy. Among these, learning and innovation skills stand out as linchpin competencies, given the perpetual evolution and increasing complexity of our global milieu. In a world where change is constant, individuals devoid of proficient learning and innovation skills find themselves struggling to keep pace with the ever-shifting paradigm. The absence of these critical skills not only hinders personal growth but also poses formidable challenges to navigating the complexities of contemporary life. Thus, education emerges as an imperative force, not merely confined to the transmission of knowledge but as a dynamic process that empowers individuals to confront and conquer the challenges of the 21st century. It is the cornerstone upon which a resilient, adaptable, and enlightened society is built, fostering a continuum of progress and well-being for all.

The methodology for developing learning experiences that authentically instill skills requires the seamless integration of collaborative learning, knowledge creation, and team-based learning. An educational management strategy that harmoniously aligns with these objectives is Creativity-based Learning (CBL). CBL is regarded as a noteworthy form of active learning extensively researched with Thai learners. The primary objective is to devise teaching methods that seamlessly integrate both subject content and essential 21st-century skills. Specifically, this approach naturally cultivates learners' proficiency in creative thinking. The implementation of CBL has yielded positive outcomes, fostering not only analytical but also creative thinking among learners, marking a significant departure from traditional teaching methods.

CBL is a foundational approach in the management of teaching and learning, where learners take a central role. The core structure of this creative learning and teaching method is designed based on the theory of measuring creative thinking by Professor E. Paul Torrance. The development approach of creative thinking, known as lateral thinking by Edward de Bono, has evolved from the Problem-based Learning (PBL). PBL emphasizes learner-centered teaching and has yielded positive results in various countries. The theory of creative thinking has led to the creation of a new model of active learning, where teaching is centered

around learners and utilizes the use of thinking tools in managing teaching and learning. Teaching through creative thinking involves prioritizing learners, similar to the use of representational thinking in instructional management. This process facilitates changing problem situations and enables the development of learning experiences through hands-on activities (Hall, 1996: 235). The use of representational thinking serves as a beneficial tool for learners in creating understanding, communicating information, and demonstrating reasoning (Greeno & Hall, 1997: 361-367). This enables learners to convey and link understanding about thinking processes, problem-solving method choices, and pathways for problem resolution. Communication may be facilitated through the use of graphs, tables, diagrams, maps, models, or symbols to convey the intended meaning.

To enhance the effectiveness of instruction, educators must possess a critical proficiency known as Technological Pedagogical Content Knowledge (TPCK). TPCK encompasses the understanding and skill of teachers to strategically and diversely incorporate technology into learning processes and instructional methods within their specific content domains. This knowledge empowers the creation of conducive learning environments, enabling students not only to absorb information but also to cultivate fresh insights in the subject matter through the adept use of appropriate technology. Educators proficient in managing these interrelationships can demonstrate this expertise in various ways, depending on their specific skills. The deliberate integration of technology across diverse subject matters has been shown to have a substantial impact, as elucidated by Mishra and Koehler in 2006.

This study seeks to outline guidelines for the creation of a novel instructional model, termed the TPCK-CBL Model, which integrates Creativity-Based Learning (CBL) with Technological Pedagogical Content Knowledge (TPCK). The focus is on applying this innovative model in the context of teaching Grade 7 mathematics.

The authors began by reviewing the literature related to CBL. Then, the authors summarized the common characteristics of CBL, resulting in six steps as shown in Table 1.

| Source | | | | | Common characteristics of CBL |
|---|---|---|---|---|---|
| Riangnarong & Silanoi (2015) | Ruachaiphanich (2015) | Numna (2017) | Srisutham (2019) | Nureak (2021) | |
| Stimulate creative thinking | Stimulate interest | Stimulate interest | Stimulate interest | Stimulate interest | Stimulate students' interest to be creative |
| Set individual problems | Pose problems and group according to interests | Pose problems and group according to interests | Pose problems and group according to interests | Pose problems and group according to interests | Pose problems and group students based on common interests |
| Group activities | Research and think | Research and think | Research and think | Research and think | Collaboratively investigate and think |
| Present | Present | Present | Present | Present | Present results |
| Evaluate outcomes | Evaluate outcomes | Evaluate outcomes | Evaluate outcomes | Evaluate outcomes | Evaluate learning |

Table 1: Summary of common characteristics of CBL

The foundation of creative learning management with the integration of technology consists of 6 steps.

**Step 1: Stimulate Interest to Create**
In this stage, the teacher explores the learners' prior knowledge. Then, they stimulate the learners' interest to generate creative thinking by presenting issues, problems, situations, or events encountered in daily life using diverse and contemporary media and technology.

**Step 2: Identify the Creative Problem**
In this stage, learners identify creative problems related to the presented issues, problems, situations, or events. The teacher, in the role of a coach, guides and advises learners in specifying problems within the scope of the presented issues or situations and the content of the lesson.

**Step 3: Investigate to Construct Conceptual Representation and Create Product**
In this stage, learners in each group collaborate to investigate and find answers from chosen learning sources related to their groups problem-solving. Subsequently, they collectively analyze the obtained answers and create a conceptual representation to summarize the knowledge. They then use technology appropriately. The teacher's role is to provide guidance, encourage learners to choose information accurately, monitor group work, offer suggestions, ask questions, and provide opportunities for learners to think independently.

**Step 4: Present the Conceptual Representation and Product**
In this stage, each group of learners presents the conceptual representation used to find answers to the set problem or the creative product of the group. This presentation is done using suitable media and technology. The teacher stimulates questions and comments to prompt learners to express thoughts on the subject and complements the knowledge.

**Step 5: Apply**
This stage involves the teacher encouraging learners to apply the knowledge gained from the search for answers. The teacher verifies the correctness to ensure learners develop accurate ideas and can apply them effectively.

**Step 6: Summarize and Evaluate**
In the final stage, learners collectively summarize all the knowledge acquired during the lesson. The teacher stimulates, checks, and supplements the parts where learners may have missed summarizing.

The authors then applied the 6 steps of the TPCK-CBL learning model to design the TPCK-CBL lesson plans for teaching the content of Graphs and Linear relations. The details of the lesson plan are as follows.

**Step 1: Stimulate Interest to Create (Duration: 50 Minutes)**

A teacher explores students' prior knowledge to ensure they have an adequate foundation for learning about pairs by having students take a pre-learning quiz on pairs, consisting of 10 questions. The quiz is conducted using the Kahoot application.

The teacher stimulates students' interest and encourages creative thinking by requiring them to watch the YouTube video titled "10 Tourist Attractions in Nakhonsithammarat: Travel Thailand." The video is 8.46 minutes long and can be accessed through the link https://www.youtube.com/watch?v=uwsWV2QlLPA.

After students have watched the video, the teacher randomly asks 4-5 students about the relationships they observed in various aspects from the video, using the following questions (10 minutes).

*Teacher:* From the video, what relationships did you observe?

*Expected answer:* relationships between various tourist attractions and their locations in Nakhonsithammarat province, such as the natural beauty of Kiriwong Village in Lansaka District, Nui Nok Nok Island in Khanom District, the sluice gate of Utakawipat and Lalum Phuk in Pakphanang District, the ancient city wall, Wat Mahathat Wora Maha Viharn, the main city shrine, Tha Nakasuksa Ratthawut Wichian Shrine, Nang Talung Suchart, and the halls of Phra Issawar and Phra Naryan in Mueang District.

*Teacher:* Which districts in Nakhonsithammarat have you visited, and what are they known for?

*Expected answer:* Student previous experiences, mentioning various districts in Nakhonsithammarat, such as Lansaka District with the best climate in Thailand, Mueang District with the Royal Park 84 (Thung Tha Lat), Pak Phanang District with the Klong Katun reservoir, Phrom Khiri Kiri District with the City Residency, and Sichon District with the Chedi Temple (Ai Khai), among others.

*Teacher:* What renowned local products or OTOP items do you know, have used, tasted from Nakhonsithammarat? Can you mention some products and specify which district they are from?

*Expected answer:* students' previous experiences, mentioning products like Lala sweets and Taptim Siam pomelos from Pak Phanang District, Taling Plao leather products from Mueang District, and natural dyed fabric and herbal products from Lansaka District.

The teacher commends the students for presenting their thoughts on the relationships observed in various aspects from the mentioned video. The teacher then provides an opportunity for students with additional questions or uncertainties regarding the video to ask further questions (5 minutes).

**Step 2: Identify the Creative Problem (15 Minutes)**

The teacher distributes Worksheet 1.1 on "The Relationships between Various Aspects and Locations in Nakhonsithammarat Province" (as attached in the learning plan). Each student individually specifies a creative problem found in the video clip "10 Tourist Attractions in Nakhonsithammarat: Travel Thailand." The teacher may provide an example of a problem for students to understand. Students can identify problems such as (15 minutes):

1. Is the coffee shop "Bus Cafe" located in the district of Sichon?
2. Is "Khanom La" from the Pak Phanang district the most famous in Nakhonsithammarat province?
3. Which districts in Nakhonsithammarat province are not coastal?
4. What are the renowned OTOP (One Tambon One Product) items in each district of Nakhon Si Thammarat, and in which district are they located?
5. Which seaside tourist destinations in Nakhonsithammarat province are popular among both local and international tourists, and in which district are they located?
6. What are the historical sites in Nakhonsithammarat province, and in which district are they located?
7. Does the Phrom Khiri District have the most waterfalls in Nakhonsithammarat province?

The teacher instructs all students to write down creative problems identified in the video following the guidelines provided in worksheet 1.1 on the relationships between various elements and the locations in Nakhon Si Thammarat. Each student records their problems on the classroom board. Afterward, the teacher and students collaborate to group the problems related to the relationships between the issues students wish to address and the locations in Nakhonsithammarat (20 minutes).

Students form groups of 4-6 members, grouping themselves based on the problems outlined in worksheet 1.1 regarding the relationships between various elements and the locations in Nakhon Si Thammarat. The number of groups depends on how many problem categories were summarized during the classroom presentations (10 minutes).

The teacher distributes Activity Sheet 1.1 regarding the guidelines for designing solutions to relationship-based problems between various elements and the locations in Nakhonsithammarat (as attached in the lesson plan). Each group of students is tasked with designing solutions for the relationship problems between their identified issues and the locations in Nakhon Si Thammarat. During this activity, the teacher acts as a coach, providing guidance on designing solutions that align with the identified problems related to various elements and the locations in Nakhonsithammarat (30 minutes).

**Step 3: Investigate to Construct Conceptual Representation and Create Product (60 Minutes)**

Each group of students collaborates to investigate and find answers to the problems assigned to them by studying information from various learning sources. They use the gathered information to construct conceptual representations and create products related to the assigned problems, utilizing suitable learning resources or databases. This may involve online research, library resources, textbooks, or Knowledge Sheet 1.1 on "Pairs" (as attached in the lesson plan). While students are engaged in research, the teacher observes their interests, curiosity, and questions, and provides suggestions and guidance to ensure that students effectively find solutions to the problems in a suitable and efficient manner (30 minutes).

Students use the information obtained from their research to complete Activity Sheet 1.2 on Creating Representations of Various Places in Nakhonsithammarat (as attached in the lesson plan). Group members work together to analyze the information or answers they have gathered and use them to create the most appropriate conceptual representation. This representation may take various forms such as tables, diagrams, maps, models, etc., aiming for a clear and concrete understanding of the solutions to the assigned problems. The teacher observes students' responsibility for their decision-making process, their efforts to ensure accuracy and precision, and their dedication to the task. Additionally, the teacher provides guidance on analyzing data or answers, ensuring correctness, and addressing any questions that arise during the data analysis and representation creation process (30 minutes).

**Step 4: Present the Conceptual Representation and Product (60 Minutes)**

The teacher randomly selects groups of students for presentation using a spinning wheel. The link shorturl. asia/KFLCI or the QR code is utilized for this purpose.

Representatives from each group present their conceptual representation or creative product using various media and technologies to explain their solutions to the assigned problems. Presentations follow the sequence determined by the randomly selected order. Each group is given a presentation time not exceeding 5 minutes. After each group completes their presentation, the teacher encourages the audience to ask questions, share thoughts, and analyze the accuracy and coverage of the solutions presented by their peers. The teacher provides guidance, stimulates questions, shares comments, and analyzes answers or conceptual representations and creative products from other classmates (30 minutes).

Each group of students verifies the accuracy of their answers to ensure comprehensive coverage. They also make improvements and corrections based on questions, comments, and suggestions from peers and the teacher. Throughout this process, the teacher may ask questions to guide students in refining their answers and ensuring they address the problems comprehensively.

*Question:* Is tie-dye fabric an OTOP product of only Lankasuka District, or is it available in other districts in Nakhonsithammarat Province?

*Expected answer:* Tie-dye fabric is an OTOP product in Lankasuka District, Chawang, and Nopphitam in Nakhonsithammarat Province. However, tie-dye fabric from Lankasuka District is the most renowned OTOP product.

The teacher comments the students' works focusing on researching solutions, creating conceptual representations, and presenting their works excellently. Subsequently, each group of students is to submit Activity Sheet 1.1 and Activity Sheet 1.2 to the teacher (15 minutes). The teacher and students collectively discuss and summarize the knowledge gained from the research, which should be summarized as follows (5 minutes).

Guidelines for summarizing knowledge gained from research:

The problem and the answers obtained revolve around the relationship of pairing between two things. In mathematical terms, the relationship of pairing between members of two groups is referred to as an "ordered pair."

The teacher presents additional knowledge about "Ordered pairs" as follows (takes 5 minutes).

If 'a' is a member of the first group and 'b' is a member of the second group, expressed in symbols as (a, b), it is read as "ordered pair A, B." 'a' is referred to as the first element, and 'b' is referred to as the second element.

The teacher presents an additional example regarding "Ordered pairs" as follows:

*Example:* Write all the ordered pairs from the table showing the relationship between the number of days and the number of hours that your teacher dedicates to teaching at school. Let the first member represent the number of days, and the second member represents the number of hours your teacher dedicates to teaching.

| Number of days | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Number of hours | 6 | 12 | 18 | 24 | 30 | 36 |

*Expected answer:* You can write all the ordered pairs with the first member as the number of days and the second member as the number of hours as follows: (1, 6), (2, 12), (3, 18), (4, 24), (5, 30), (6, 36).

The teacher presents an additional example regarding "Ordered pairs" as follows:

*Example:* Write all the ordered pairs from the table showing the relationship between the number of days and the number of hours that your teacher dedicates to teaching at school. Let the first member represent the number of days, and the second member represent the number of hours your teacher dedicates to teaching.

The teacher gives students the opportunity to ask additional questions or express doubts about ordered pairs and examples of ordered pairs (5 minutes).

**Step 5: Apply (35 minutes)**

The teacher encourages students to apply the knowledge gained from the search for answers by randomly assigning students to write ordered pairs of solutions to problems with the locations in Nakhon Si Thammarat. Students should read and explain the meaning of each ordered pair (5 minutes).

The teacher asks questions for students to compete in answering, aiming to check their understanding and create enthusiasm. The first student to answer correctly will receive a reward from the teacher (5 minutes).

*Question:* Create three different and diverse ordered pairs. The first member can be any number, and the second member is one of three times that number.

*Expected answer:* The answer can vary, such as three different and diverse ordered pairs. The first member can be any number, and the second member is one of three times that number, for example $(3,1)$, $\left(-\frac{1}{2}, -\frac{1}{6}\right)$, $(1.23, 0.41)$ etc.

*Teacher Instructions*: The teacher instructs the students to complete the skills exercise 1.1 on ordered pairs (as provided in the attached document) to assess their understanding. The teacher emphasizes applying the knowledge gained from the activity (20 minutes).

After completing Skills Exercise 1.1 on Ordered Pairs (as attached in the learning plan document), the teacher randomly selects individual students to present their solutions. Each student is required to honestly record their scores in the score sheet. The teacher then collects the exercises for further evaluation. If any student scores below the specified standard, the teacher schedules remedial sessions for those students after school or assigns simpler exercises to reinforce their foundational knowledge (5 minutes).

**Step 6: Summarize and Evaluate (25 Minutes)**

In collaboration, students summarize the knowledge gained from the lesson on "Ordered Pairs" as follows (5 minutes).

Guidelines for summarizing the knowledge gained from the lesson on "Ordered Pairs."

"Ordered Pairs" refer to the relationship of pairing elements between two groups.

If 'a' is a member of the first group and 'b' is a member of the second group, it is represented by the symbol (a, b). Read as 'Ordered Pair AB,' where 'a' is referred to as the first member, and 'b' is referred to as the second member.

The teacher prompts, checks, and fills in gaps in the parts where students may have incomplete summaries. The teacher raises questions related to "Ordered Pairs" by randomly selecting students to answer. Students are asked to match the ordered pairs of the problem's answers with the locations in Nakhonsithammarat that they researched and write them in the form of ordered pairs (a, b) and (b, a). The teacher then discusses the meaning of these ordered pairs (5 minutes).

*Question:* Do (a, b) and (b, a) have the same meaning? Explain.

*Expected answer:* (a, b) and (b, a) do not have the same meaning. For example, (Namtok Phrom Lok, Amphoe Phrom Khiri) means Namtok Phrom Lok is located in Amphoe Phrom Khiri. On the other hand, (Amphoe Phrom Khiri, Namtok Phrom Lok) means Amphoe Phrom Khiri is within Namtok Phrom Lok. Therefore, (Namtok Phrom Lok, Amphoe Phrom Khiri) and (Amphoe Phrom Khiri, Namtok Phrom Lok) have different meanings.

Teachers evaluate learning outcomes by having students complete a post-test on the topic of matching pairs, consisting of 10 questions (10 minutes).

Teachers assess students' learning outcomes through the evaluation of Assignment 1.1 on the topic of the relationships between various elements and the locations in Nakhonsithammarat province. This includes Activity Sheet 1.1 on designing relational problem-solving approaches between different elements and their locations in Nakhonsithammarat province, as well as Activity Sheet 1.2 on creating representations of various ideas in different locations within the province, using appropriate assessment criteria (5 minutes).

## Conclusion: Implications

This article showcases the integration of technology into Creativity-Based Learning (CBL) to formulate the TPCK-CBL model, aiming to augment students' creative thinking and conceptual representation. The authors implement six teaching steps within the TPCK-CBL model while crafting lesson plans tailored for teaching mathematics to Grade 7 students. Demonstrated as beneficial for both educators and learners, the TPCK-CBL model strives to nurture students' analytical and creative thinking alongside fostering knowledge creation.

Facilitating the communication of understanding, the model incorporates the use of graphs, tables, diagrams, maps, models, or symbols. Moreover, active student participation in the learning process promotes effective teamwork and collaboration. These attributes are paramount in the 21st century, and fostering such qualities among the children and youth of Thailand holds the promise of cultivating a high-quality population, ensuring the nation's sustainable future.

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