ວາລະສານການສຶກສາຄູລາວແບບຍືນຍົງ ວິທະຍາໄລຄູສາລະວັນ ປີທີ 1 ສະບັບທີ 2 (ເດືອນ ທັນວາ , ປີ 2025) ໜ້າ 148 – 158

Lao Journal of Sustainable Teacher Education SALAVAN Teacher Training College, Volume 1 No. 2 (December, 2025) Page 148 – 158

ບົດຄວາມວິໄຈ
(Research Article)

ວາລະສານການສຶກສາຄູລາວແບບຍືນຍົງ
ວິທະຍາໄລຄູສາລະວັນ
https://www.sttcjournal.edu.la
ດຳເນີນການວາລະສານໂດຍ ວິທະຍາໄລຄູສາລະວັນ

ການພັດທະນາຄວາມຮູ້ກ່ຽວກັບເນື້ອໃນວິທີສອນຂອງອາຈານສອນຄະນິດສາດ ຜ່ານການສຶກສາການສອນທີ່ບູລະນາການກັບວິທີການແບບເປີດ

Developing Mathematics Teacher Educators' Pedagogical Content Knowledge through the Lesson Study incorporated Open Approach

ໄພລັດ ສີທອງ[1]
Phailath Sythong

ບົດຄັດຫຍໍ້

ຈຸດປະສົງຂອງການຄົ້ນຄວ້ານີ້ເພື່ອສຶກສາການພັດທະນາຄວາມຮູ້ກ່ຽວກັບເນື້ອໃນວິທີສອນ ຂອງອາຈານສອນຄະນິດສາດຜ່ານການດຳເນີນການສຶກສາການສອນທີ່ໄດ້ບູລະນາການກັບວິທີການແບບເປີດ ຢູ່ໂຮງຮຽນປະຖົມສາທິດ ວິທະຍາໄລຄູສະຫວັນນະເຂດ ສົກຮຽນ 2023-2024.

ການຄົ້ນຄວ້າດ້ານຄຸນນະພາບ (Qualitative Research) ຄັ້ງນີ້ໄດ້ນຳໃຊ້ຮູບແບບກໍລະນີສຶກສາ (Case Study) ກັບກຸ່ມຕົວຢ່າງທີ່ເປັນອາຈານສອນຄະນິດສາດ ຈຳນວນ 3 ທ່ານ, ໂດຍຖືກຄັດເລືອກດ້ວຍວິທີການເລືອກແບບສະເພາະເຈາະຈົງ (Purposive Sampling). ເຄື່ອງມືທີ່ໃຊ້ໃນການເກັບກຳຂໍ້ມູນປະກອບມີບັນທຶກພາກສະໜາມ, ແຜນການສອນ ແລະ ວິດີໂອບັນທຶກ. ຂໍ້ມູນໄດ້ຖືກວິເຄາະດ້ວຍການວິເຄາະເນື້ອໃນ (content analysis).

ຜົນການຄົ້ນຄວ້າ:

ຜົນການວິໄຈຊີ້ໃຫ້ເຫັນວ່າ ຂະບວນການຂອງ TLSOA ຊ່ວຍພັດທະນາອົງປະກອບສ່ວນໃຫຍ່ຂອງຄວາມຮູ້ກ່ຽວກັບເນື້ອວິທີສອນຂອງອາຈານສອນຄະນິດສາດຢ່າງມີຄວາມໝາຍສຳຄັນ; ໂດຍໃນຂັ້ນຕອນທີ 1 ອາຈານສອນຄະນິດສາດໄດ້ພັດທະນາການວາງແຜນການສອນ ແລະ ຄວາມຮູ້ດ້ານເນື້ອຫາລາຍວິຊາໂດຍການອອກແບບສະຖານະການບັນຫາທີ່ເຊື່ອມໂຍງກັບປະສົບການຕົວຈິງ ແລະ ຄວາມຮູ້ເດີມຂອງນັກຮຽນ ເຮັດໃຫ້ສາມາດຄາດ

[1] ພາກວິຊາສ້າງຄູປະຖົມສຶກສາ ວິທະຍາໄລຄູສະຫວັນນະເຂດ/ ສປປ ລາວ
Corresponding Author: Phailath Sythong, Email: phailath_sy@kkumail.com, Tel: +856 20 22599988

ຄະເນແນວຄິດ ແລະ ຂໍ້ຍຸ້ງຍາກຂອງນັກຮຽນໄດ້ດີຂຶ້ນ, ຂັ້ນຕອນທີ 2 ໄດ້ພັດທະນາວິທີການສອນໃນການນຳສະເໜີເນື້ອຫາຜ່ານສະຖານະການບັນຫາທີ່ໜ້າສົນໃຈ ໂດຍເນັ້ນແນວຄິດຂອງນັກຮຽນເປັນຫຼັກ ແລະ ໃຊ້ການຕັ້ງຄຳຖາມທີ່ມີຄວາມໝາຍເພື່ອຊຸກຍູ້ການສົນທະນາໃນຫ້ອງຮຽນ, ແລະ ໃນຂັ້ນຕອນທີ 3 ອາຈານສອນຄະນິດສາດໄດ້ລົງເລິກຄວາມຮູ້ດ້ານເນື້ອຫາ ແລະ ຫຼັກສູດ ໂດຍສາມາດອະທິບາຍແນວຄິດຂອງນັກຮຽນໃນສະຖານະການຕ່າງໆໄດ້ຢ່າງຈະແຈ້ງ ພ້ອມທັງກຳນົດຂໍ້ເຂົ້າໃຈຜິດທາງຄະນິດສາດໄດ້ຢ່າງຊັດເຈນ ເຊິ່ງຄວາມເຂົ້າໃຈທີ່ເພີ່ມຂຶ້ນນີ້ໄດ້ຖືກສະທ້ອນໃຫ້ເຫັນຢ່າງມີປະສິດທິພາບກັບຄືນສູ່ການອອກແບບແຜນການສອນ ແລະ ການສິດສອນທີ່ເນັ້ນໜັກໃສ່ຂະບວນການຄິດ ແລະ ການແກ້ໄຂບັນຫາຂອງນັກຮຽນ.
ຄຳສັບສຳຄັນ: ການສຶກສາການສອນ, ຄວາມຮູ້ກ່ຽວກັບເນື້ອໃນວິທີສອນ, ວິທີການແບບເປີດ.

Abstract

The purpose of this research is to study the development of Mathematics Teacher Educators (MTEs)' Pedagogical Content Knowledge (PCK) through the implementation of Thailand Lesson Stuidy incorporated Open Approach (TLSOA) model (Inprasitha, 2022) at the Savannakhet Teacher Training College Demonstration Primary School during the 2023–2024 academic year.

This qualitative research utilized a Case Study design involving a sample of three MTEs, they were selected through a purposive sampling method. The data collection instruments included field notes, lesson plans, and video recordings. The data were analyzed through content analysis.

The findings indicate that the cycles of TLSOA significantly developed most components of the MTEs' Pedagogical Content Knowledge. In Step 1, the MTEs enhanced their instructional planning and subject matter knowledge by improving their ability to design problem situations that closely connected with students' real-world experiences and prior knowledge. This led to a greater capacity to anticipate student ideas and potential difficulties in problem-solving. In Step 2, the MTEs developed their teaching methods, learning to represent content effectively by presenting engaging problem situations that captured students' attention, prioritizing student ideas, and asking meaningful questions to facilitate better classroom discussions. Finally, in Step 3, MTEs further deepened their Content Knowledge and Curriculum Knowledge by developing the ability to clearly explain students' ideas in various problem situations and recognize specific misconceptions about the mathematical content. This enhanced understanding was then effectively reflected back into the design of lesson plans and instruction that emphasized students' thinking and problem-solving processes.
Keywords: Lesson Study, Open Approach, Pedagogical Content Knowledge.

Introduction

Teacher educators are the ones mostly involved in developing the quality of teachers. (**Cochran-Smith, 2005**).Currently, studies focusing on mathematics education get paid more attention to the study on the teacher educators' knowledge, aiming to understand its development, and how it is reflected in the practice of teaching (**Biza et al., 2007**). Reflection and analysis of one's own practices constitute an important part of professional development (PD) experiences for teacher educators (**Loughran, Berry, & Mulhall, 2012**). In Lao PDR, teacher competency is a critical concern, leading the Teacher and Personnel Development

Strategy for Education and Sports (TPDSES) to aim for systematic knowledge and methodology upgrades by 2025 (MoES, 2020). However, the situation is challenging: a study found primary teachers suffer from poor mathematics content knowledge and low pedagogical skills, which negatively impacts student learning (**World Bank, 2016**), and primary student achievement in mathematics is significantly low compared to other subjects (**Rire, 2012**). Although the Education and Sports Sector Development Plan (ESSDP 2021-2025) designates Teacher Training Colleges (TTCs) as professional development centers, a Training Needs Analysis (TNA) revealed that many TTC lecturers lack primary classroom experience, knowledge of child development, and learning principles, directly linking teacher education to the poor learning outcomes (**BEQUAL, 2016**). Consequently, the TNA strongly implies that the TTC Professional Development Program (PDP) must be school-based, focusing on the realities of the primary classroom, and strengthen the cooperation between TTCs and schools, potentially through mechanisms like Lesson Study (**BEQUAL, 2016**).

Lesson Study (LS) was originally developed in Japan, Japanese LS is a practice-based, provides a collaborative model for sustainable professional development (**Murata, 2011**). LS is a professional development activity that has been used in Japan to improve the instruction of mathematics and science (**Fernandez & Yoshida, 2004**), and improving students' learning (**Perry and Lewis, 2011**). It involves teachers working together to set goals, implement "research lessons," and refine them through observation and discussion (**Lewis, 2002**). In the last few decades, LS has been introduced in mathematics teacher education (**Suh and Fulginiti, 2012**). The LS process functions as a catalyst for professional development, significantly bolstering teachers' pedagogical skills in mathematics. According to Lott (2006), this approach not only refines their instructional techniques but also deepens their insight into students' cognitive processes and the intricacies of the mathematics curriculum (**Lott, 2006**). The implementation of the reflection process in LS has significantly enhanced the Pedagogical Content Knowledge of MTEs (**Mitcheltree, 2006**). LS was introduced to Laos in 2004 by the Japanese International Cooperation Agency (JICA) through the "Improving Science and Mathematics Teacher Training (SMATT)" project (**Saito, 2007**). In 2015, LS was included in the 2016-2020 Teacher Education Development Plan by the Ministry of Education and Sports (MoES) to establish professional networks and school-based training (**MoES, 2017**).

The Japanese mathematics teaching approach, known as "structured problem solving," encourages students to find their own solutions (**Stigler & Hiebert, 1999**). Fujii (2017) calls this "teaching mathematics through problem solving," focusing on multiple solutions and processes. Similar methods include the "open-approach method" (**Nohda, 2000**) and the open-ended approach. These approaches emphasize understanding students' thinking, encouraging discussions, and mathematically elaborating activities. Students start with an "incomplete problem" and explore solutions through their prior knowledge and mathematical thinking (**Becker & Shimada, 1997**). The Lesson Study (LS) was introduced to the Thai educational context in 2004 through a model that integrates the three steps of Japanese Lesson Study collaborative design (Plan), collaborative observation (Do), and collaborative reflection (See) with the four phases of the Open Approach (OA) to emphasize a "unique collaboration" throughout the instructional cycle. Known as the Thailand Lesson Study incorporated Open Approach (TLSOA) model (Inprasitha, 2022), shown in Figure 1. This synergy utilizes the LS cycle as a collaborative structural foundation, while the Open Approach serves as the core teaching methodology consisting of four critical phases: posing open-ended problems, fostering student self-learning, facilitating whole-class discussion and comparison, and concluding by connecting the mathematical ideas that emerge from the students. By embedding these four OA phases within the second step (Do) of the LS cycle, the TLSOA model creates a robust pedagogical environment that prioritizes students' mathematical thinking and collaborative professional development.

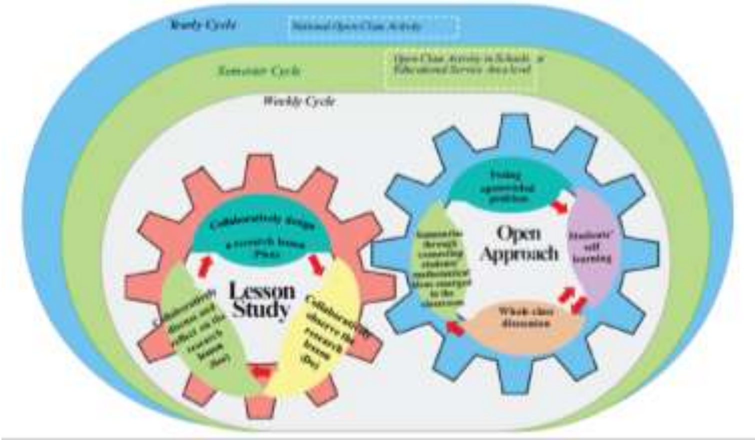

Figure1. TLSOA model (Inprasitha, 2022)

Shulman (1986) asserted that "content knowledge alone is likely to be as useless as pedagogical skills without content," suggesting that a singular focus on either subject matter or instruction creates a critical gap in professional expertise. Consequently, educators must possess the ability to bridge these domains through Pedagogical Content Knowledge (PCK), shown in Figure 2, an integrated form of knowledge that synthesizes content expertise with pedagogical strategies to facilitate effective student learning. Shulman (1986) defined Pedagogical Content Knowledge (PCK) as the essential integration of Content Knowledge (CK) which encompasses the subject matter like concepts, rules, and theories and Pedagogical Knowledge (PK) which involves the methods of teaching, curriculum knowledge, instructional planning, and assessment (**Shulman,1986**).

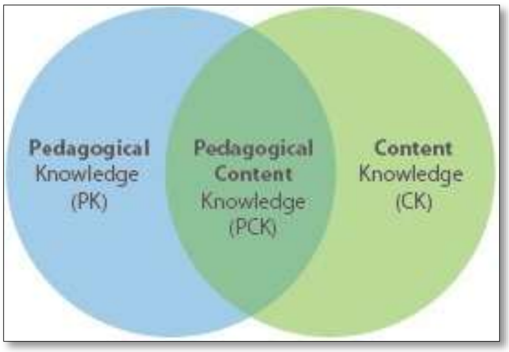

Figure2. Pedagogical Content Knowledge (PCK) (Shulman, 1986)

Laos has implemented LS for almost 20 years, with strong support from the Ministry of Education and Sports. However, LS in Laos remains in its "initial stage of learning how to use lesson study as a professional development activity" (**Shingphachanh, 2018**).The study of

Shingphachanh (2018) also found that a lot of issues hindered the effectiveness of the lesson study in Laos. These issues included lack of analysis of the main mathematical content, and lack of analysis of the connection of the curriculum. However, there is not a large body of research on teacher educators, and this fact is echoed in the research literature, (**Chapman, 2008**). Thus, conducting further research on LS in teacher education in Laos is important. In addition, research on LS as a vehicle for development of mathematics teacher educators' Pedagogical Content Knowledge is scarce, not only in Laos, but all around the world.

Research Objectives

To study the development of Mathematics teacher Educatoes' Pedagogical Content Knowledge through the implementation of Lesson Study integrated with Open Approach at the Demonstration Primary School of Savannakhet Teacher Training College.

Research Methodology

1. Samples

The samples consisted of 3 Mathematics Teacher Educators (MTEs) selected from a total population of 6 MTEs who teach in Department of primary school teacher education at Savannakhet Teacher Training College. The samples were purposively chosen for the following reasons: 1) they were personally interested in conducting Lesson Study in primary schools, and 2) they had already been trained on how to conduct Lesson Study.

2. Research Instruments

The research instruments consisted of field note, lesson plans and the video-tape recording; the qualitative data was analyzed through content analysis.

3. Data Collection

Given the cultural similarities between the classroom contexts of the Lao PDR and Thailand, this research seeks to implement the Thailand Lesson Study incorporated Open Approach (TLSOA) model (Inprasitha, 2022) integrated with Shulman's (1986) Pedagogical Content Knowledge (PCK) framework, utilizing a weekly three-step TLSOA cycle as the primary method for data collection and professional development. During data collection, researchers conducted participatory observations by collaborating with the lesson study team in 3 steps:

1. Collected data during the collaboration in designing the research lesson: collaborated in designing problem situations, anticipating students' ideas and their difficulties in solving problems, discussing the lesson objective, and designing teaching aids, which resulted in 6 lesson plans for grade 5 on the topic of angles.
2. Collaborated in observing the classroom, recording the students' ideas, whole-class discussions, and connections for concluding mathematical ideas.
3. Collaborated in reflecting on students' ideas, associations of ideas, students' thinking, problem-solving processes, developing lesson plans, and evaluating the appropriateness of problem situations and teaching aids.

- Field notes: Researchers collected the lesson study team's field notes from all 3 steps.
- Lesson plans: Researchers collected the lesson plans designed in step 1.
- Video recordings: Researchers recorded videos of the lesson study team's work during all 3 steps.

4. Data Analysis

This study used descriptive analysis to understand the planning process by MTEs. By analyzing classroom conversations during LS, the researchers identified key dialogues that led to consensus on lesson plan design. Thematic analysis was performed on lesson plan conversations, coded with keywords, and examined post-teaching reflections. The data from lesson plans were compared with recorded discussions among MTEs during planning, teaching, and reflections. This emphasized speeches explaining various events. MTEs' PCK was analyzed through the LS analyzed based on the research's conceptual framework. The data were analyzed through content analysis.

This study using a descriptive qualitative design, this study examined the MTEs' planning process by analyzing classroom discourse and collaborative dialogues during Lesson Study cycles. qualitative content analysis were employed to identify key consensus-building dialogues in lesson design, utilizing a coding system based on the research's conceptual framework to evaluate the MTEs' Pedagogical Content Knowledge. By triangulating data from lesson plans, recorded planning discussions, and post-teaching reflections, the study highlighted the developmental shifts in teaching strategies and the professional reflections of the participants.

Results and discussion

Results

The development of Mathematics Teacher Educators' Pedagogical Content Knowledge in each steps of the lesson study cycle as follows:

1. The Step 1: Collaboratively design a research lesson (Plan)

The MTEs collaborated in planning lesson plans regularly every week, based on the 4 phases of the open approach framework as the teaching method of problem-solving, Consequently, the lesson study team developed knowledge due to:

- MTEs discussed for create problem situations from real-world contexts of students as can be seen in the following protocol

Table 1. Protocol of MTEs' Discussion for create problem situations (Step 1: Plan)

Item 9	MTE 3: Can we establish which of these animals has the largest angle mouth size and then give the order of mouth size from smallest to largest?
Item 10	MTE 1: If Analyzing the answers, students might answer hippo' mouth or crocodile' mouth, because these animals are big and their food is also big. This might not align with the objective of the activity...
Item 11	MTE 2: According to the textbook, it should be like this. Observe the animals 'mouth from pictures A to E: 1. Which animal in the pictures has the widest mouth? 2. Which animal in the pictures has the narrowest mouth?
Item 12	MTE 1: Try inserting one question after the second question like this: 'Have the students explain the method of comparing the mouth sizes of each animal. This will prompt the students to explain the comparison method...

- MTEs discussed for anticipate students' ideas, students' misconception, students' difficulties and connections of students' previous concepts, as can be seen in the following protocol

Table 2. Protocol of MTEs' Discussion for anticipate students' ideas (Step 1: Plan)

Item 16	MTE 3: ...Students will choose the hippo's mouth, because, in general, from the pictures, they will see that the hippo's mouth appears wider than the others. However, it is the angle of snake's mouth is largest...
Item 17	MTE 1: Students might answer that the angle of crocodile's mouth is the narrowest, if they rely on their experience from lesson 1, where they identified the sharpest angle of a triangle ruler. This is because the angle of crocodile's mouth is similar to the sharpest angle of the triangle ruler.
Item 18	MTE 3: Students might find it difficult to use the angles of a triangle ruler to compare the angle of animals' mouth, because they haven't learned about angles yet...
Item 19	MTE 2: If they use the 45-degree and 60-degree angles of a right triangle ruler, it might be difficult because they are wider than the angles of the crocodile's and lion's mouths.

2. The Step 2: Collaboratively observe the research lessons (Do)

- MTE pose problem situations to engage students to solve the problems, as can be seen in the following protocol:

Table 3. Protocol of MTEs' pose problem situations (Step 2: Do)

Item 24	MTE 1: Today the teacher has pictures of animals for us to see, and whether you have seen these animals before. Are there any others?...
Item 25	MTE 1:...Task 3, do you know what the problem wants you to do? Explain the method used for comparison. Task 4 is to indicate the order of the size mouth angle from narrow to wide. Then, how can we apply the previous lesson to solve these problems?

- MTE prioritizing student ideas to facilitate better classroom discussions, as can be seen in the following protocol:

Table 4. Protocol of MTEs' prioritizing student ideas (Step 2: Do)

MTE 2:	...Next, it is Group 2's turn. Please come forward.
ST 7:	The animal that opens its mouth the widest is the snake (E).
ST 8:	The animal that opens its mouth the narrowest is the crocodile (B), we are use a comparison method by observing the angle and size of the mouth opening.
ST 10:	...The ranking is as follows: 1st is E (Snake), 2nd is D (Hippo), 3rd is C (Vulture), 4th is A (Lion), and the last one is B (Crocodile).

3. The Step 3: collaboratively discuss and reflect on research lessons (See)

MTEs reflected 4 point from step 1 and step 2 of lesson study cycle as shown in Figure 3 including:

- Reflecting on post problem situation to engage student doing problem-solving
  "I try to connect problem situation to the real world of the students by asking them about their real experiences of going to the zoo, then, gradually introducing the problem situation by discussing what the animals in the pictures are doing. Then post problem situation."
- Reflecting on students' ideas and students' misconception
  "The students' ideas that emerged were as predicted by our team, such as some students choosing the hippo's mouth as the widest and the lion's mouth as the narrowest. For the comparison method, student able to come up with three methods: observation, using a ruler to measure the animal's mouth, and using thin paper for comparison."

- Reflecting on students' difficulties
  "Students might still not understand task 3. It appears that group 4 and group 2 did not explain their comparison methods. ...Students are still unable to write explanations and reasons for their comparisons. In teaching mathematics, we often focus on calculations. This might be why they cannot write explanations..."
- Reflecting on develop mathematic problem situation be better for student to understand
  "Revise the word 'opening the mouth' with 'mouth angles'. Task 3 will become "Have students explained the method in comparing the size of animals' mouth angles."

The findings indicate that the cycles of TLSOA significantly developed most components of the MTEs' Pedagogical Content Knowledge. In Step 1, the MTEs enhanced their instructional planning and subject matter knowledge by improving their ability to design problem situations that closely connected with students' real-world experiences and prior knowledge. This led to a greater capacity to anticipate student ideas and potential difficulties in problem-solving. In Step 2, the MTEs developed their teaching methods, learning to represent content effectively by presenting engaging problem situations that captured students' attention, prioritizing student ideas, and asking meaningful questions to facilitate better classroom discussions. Finally, in Step 3, MTEs further deepened their Content Knowledge and Curriculum Knowledge by developing the ability to clearly explain students' ideas in various problem situations and recognize specific misconceptions about the mathematical content. This enhanced understanding was then effectively reflected back into the design of lesson plans and instruction that emphasized students' thinking and problem-solving processes.

Discussion

The research findings clearly demonstrate that the structured cycles of the TLSOA serve as a powerful catalyst for developing Pedagogical Content Knowledge among MTEs, mirroring the foundational theories of Shulman (1986) which advocate for the essential blending of subject matter and pedagogy. By systematically progressing through instructional planning, active teaching, and curricular reflection, the MTEs in this study effectively bridged the "teaching gap" identified by Stigler and Hiebert (1999), moving from traditional lecture-based methods to a more dynamic, student-centered "Open Approach". This development aligns with the work of Inprasitha (2010), as the MTEs' enhanced ability to anticipate student difficulties and utilize meaningful questioning confirms that professional growth is most effective when situated within collaborative, practice-based communities. Ultimately, the study reinforces the principle that deepening an educator's Curriculum Knowledge and Content Knowledge allows for a more sophisticated "reflection-in-action," where teachers can identify and address specific misconceptions in real-time to foster deeper student thinking and problem-solving processes.

Summary of research results

The research findings demonstrate that the Thailand Lesson MTEs' Pedagogical Content Knowledge by bridging the gap between theoretical subject matter and classroom practice. Through the cycles of TLSOA, MTEs moved beyond static content knowledge to a sophisticated understanding of how students learn. In the collaborative design phase (Step 1), they successfully synthesized curriculum requirements with students' real-world contexts to anticipate cognitive difficulties. During the observation and implementation phase (Step 2), MTEs refined their pedagogical delivery by shifting from traditional teacher-led instruction to a student-centered model that prioritizes student ideas and meaningful inquiry. Finally, the reflection phase (Step 3) solidified their professional growth, as evidenced by their newfound ability to identify mathematical misconceptions and refine curriculum design based on actual student thinking. This iterative process essentially creates a self-sustaining professional development loop where classroom-based evidence directly informs and improves instructional planning and pedagogical expertise.

Recommendations

Recommendations based on Research Findings

- Linking Impact to Student Learning Outcomes: Future research should establish a mechanism to measure the direct empirical link between the development of Mathematics Teacher Educators' (MTEs) Pedagogical Content Knowledge (PCK) and the measurable improvements in students' mathematical proficiency and problem-solving abilities. This would provide education administrators with a holistic evaluation of the impact of the Thailand Lesson Study incorporated Open Approach (TLSOA) framework on overall educational quality at a macro level.
- Promoting Context-Based Lesson Design: Teacher educators should be continuously supported in practicing the design of problem situations that are closely connected to students' real-world experiences. Focusing on familiar contexts will enable educators to more accurately anticipate student ideas and potential misconceptions, which is a cornerstone for sustainable PCK development.
- Establishing Professional Learning Communities (PLCs): The Lesson Study and Open Approach processes should be utilized as primary platforms for professional exchange between teacher educators and primary school teachers. Collaboratively engaging in the "Plan-Do-See" cycle facilitates the transfer of student-centered pedagogical skills and the effective use of open-ended questioning.

Recommendations for Future Research

- Longitudinal Sustainability Studies: Future research should conduct longitudinal studies to track the evolution and long-term sustainability of MTEs' Pedagogical Content Knowledge. This will help researchers understand how skills developed through the TLSOA framework stabilize or evolve over multiple academic years.
- Testing Skill Stability Across Diverse Contexts: Research should further examine the consistency and stability of teaching skills developed through Lesson Study across diverse classroom environments. This includes studying various student performance levels to verify that the TLSOA model can be implemented effectively in a wide range of educational settings.
- Comparative Research Across Mathematical Domains: Future investigations should expand beyond geometry (angles) to other mathematical domains, such as algebra or statistics. Comparative studies would reveal how PCK development through TLSOA differs across various content areas, providing a basis for a more comprehensive teacher education curriculum.

Acknowledgements

The author would like to express profound gratitude to the Savannakhet Teacher Training College (TTC) and its Demonstration Primary School for providing the opportunity and a supportive environment to conduct this research during the 2023–2024 academic year. This study would not have been possible without the dedication and cooperation of the MTEs and primary school teachers involved in the Lesson Study cycles.

Special thanks are extended to the three MTEs who participated as the study's sample group. Their commitment to professional development and their willingness to collaboratively engage in the Thailand Lesson Study incorporated Open Approach (TLSOA) model were instrumental in uncovering the insights regarding Pedagogical Content Knowledge (PCK) development.

Furthermore, the author is deeply grateful to the Institute for Research and Development in Teaching Profession for ASEAN, Khon Kaen University, and the framework provided by Inprasitha (2022), which served as the theoretical cornerstone for the Lesson Study and Open Approach integration used in this research.

References

Becker, J. P., & Shimada, S. (Eds.). (1997). *The Open-Ended Approach: A New Proposal for Teaching Mathematics*. National Council of Teachers of Mathematics (NCTM).

BEQUAL. (2016). Teacher Education & Support TTC Training Needs Analysis Report. Vientiane: MOES

Biza, I., Nardi, E. & Zachariades, T. (2007). Using tasks to explore teacher knowledge in situation-specific contexts. *Journal of Mathematics Teacher Education, 10*, 301-309.

Chapman, O. (2008). Mathematics teacher educators' learning from their practice. In B. Jaworski & T. Wood (Eds.), *the Mathematics Teacher Educator as a Developing Professional* (pp. 117–134). Sense Publishers.

Cochran-Smith, M. (2005). Teacher educators as researchers: Multiple perspectives. *Teaching and Teacher Education, 21*(2), 219-225.

Ebaeguin, M., & Stephens, M. (2014). Cultural Challenges in Adapting Lesson Study to a Philippines Setting. *Mathematics Teacher Education and Development*, *16*(1).

Fernandez, C. & Yoshida, M. (2004). Lesson Study: A case of a Japanese approach to improving instruction through school-based teacher development. Mahwah, NJ: Lawrence Erlbaum.

Fujii, T. (2017). Using lesson study with teaching mathematics through problem solving. In T. McDougal. (Ed.). *Essential mathematics for the next generation: What and how student should learn* (pp. 93). Japan: Tokyo Gakugei University Press.

Inprasitha, M. (2010). One flagship project toward internationalization: Lesson study and open approach. *Journal of Science and Mathematics Education in Southeast Asia*, 33(1), 1-28.

Inprasitha, M. (2022). Lesson study and open approach development in Thailand: a longitudinal study. *International Journal for Lesson & Learning Studies, 11*(5), 1-15.

Lewis, C.C. (2002). Lesson Study: *A handbook of teacher–led instructional change*. Philadelphia, PA: Research for better School.

Lott, J. G. (2006). *Teachers' Perceptions of the Effectiveness of the Lesson Study Process in Improving Teaching and Student Learning*. Doctoral dissertation, University of New Orleans.

Loughran, J.J., Berry, A. & Mulhall, P. (2012). *Understanding and developing science teachers' pedagogical content knowledge*. 2nd ed. Rotterdam, the Netherlands: Sense.

Ministry of Education and Sport, Lao PDR. (2018). *Annual Report Academic year 2017-2018*. Vientiane: Ministry of Education and Sport.

Ministry of Education and Sport, Lao PDR. (2020). *Teacher and Personnel Development Strategy for Education and Sports (TPDSES) by 2025*. Vientiane: Ministry of Education and Sport.

Mitcheltree, M. K. (2006). *Exploring lesson study as a form of professional development for enriching teacher knowledge and classroom practices* (Doctoral dissertation). University of New Hampshire, Durham, NH.

Murata, A. (2011). Introduction: Conceptual overview of lesson study. Lesson study research and practice in mathematics education: Learning together, 1-12.

Nohda, N. (2000). Teaching by open-approach method in Japanese mathematics classroom. *Proceedings of the 24th Conference of the International Group for the Psychology of Mathematics Education*, 1, 39-53.

Perry, R. R., and C. C. Lewis. "Improving the mathematical content base of lesson study summary of results." *Retrieved January* 24 (2011): 2013.

Ries. (2012). Assessment of Student Learning Outcomes III: Grade 3. Vientiane: MOE, RIES.

Stigler, J. W., & Hiebert, J. (1999). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom*. Free Press.

Saito, N. (2007). Lesson Study in Laos. In M. Isoda, M. Stepens, Y. Ohara, & T. Miyakawa, (Eds). *Japanese Lesson Study in MATHEMATICS: Its Impact, Diversity & Potential for Educational Improvement*. Danver, MA: World Scientific Publishing.

Shingphachanh, S. (2018), "Teachers' understanding and concerns about the practices of lesson study in suburb school in Laos". *International Journal for Lesson and Learning Studies, 7*(2), 150-16.

Shulman, L.S. (1986). Those who understand: Knowledge growth in teaching. *Educational researcher*, *15*(2), 4-14.

Suh, J. M., & Fulginiti, K. (2012). " Situating the Learning" of Teaching: Implementing Lesson Study at a Professional Development School. *School-University Partnerships*, *5*(2), 24-37.

World Bank. (2016). *Lao PDR - Secondary Education Sector Development Program: School Autonomy Study*. Washington, D.C.: World Bank Group.