

THE EFFECTS OF A PLC MODEL USING LESSON STUDY WITH MENTORING TO DEVELOP ASSISTANT TEACHERS' COMPETENCY IN ACTIVE LEARNING MANAGEMENT FOR FOSTERING STUDENTS' CREATIVE INNOVATION ABILITY

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ABSTRACT

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This research aimed to 1) develop and evaluate the quality of a professional learning community model integrating lesson study and coaching and mentoring to enhance assistant teachers' competency in active learning management that fosters students' creative innovation ability; 2) examine assistant teachers' competency in active learning management; 3) investigate students' creative innovation ability; and 4) explore professional learning community members' opinions on the professional learning community model. The research sample included six assistant teachers, six mentor teachers, three educational supervisors, four school administrators, and seventy-six students from six classrooms. The study was conducted during the second semester of the academic year 2024. Statistics used for data analysis included mean, standard deviation, and content analysis. The findings revealed that 1) the professional learning community model consisted of six components: principles, objectives, process, evaluation, implementation conditions, and supporting factors. Specifically, the process component involves a four-step cycle, highlighting a lesson study method that integrates five sub-steps: analyzing and arranging, instructional design, teaching and observation, reflection, and refinement. The model's overall quality was rated at the highest level ($M = 4.79$, $SD = 0.15$). 2) Assistant teachers showed improvement in three areas: knowledge and understanding of active learning management was higher than before ($M = 4.17$, $SD = 0.41$), development of instructional design ability was at the highest level ($M = 3.49$, $SD = 0.38$), and development of learning management ability was at the highest level ($M = 3.36$, $SD = 0.34$). 3) Students' creative innovation ability was also rated at a high level ($M = 2.62$, $SD = 0.19$). 4) The professional learning community members' opinions indicated that the model was effective and beneficial for professional development.

Keywords: Professional learning community; lesson study; mentoring; active learning

1. INTRODUCTION

Human capital is a key driver of national development across multiple dimensions, particularly in the pursuit of becoming a developed country. Achieving this goal requires a systematic foundation for human resource development—one that supports the advancement of individuals across all age groups and domains. The aim is to cultivate citizens who are capable, ethical, and of high quality. Central to this effort is the development of learners who are physically, mentally, and intellectually prepared, with sound mental health, a public-minded spirit, civic responsibility, strong communication skills, and a passion for lifelong learning (Office of the National Economic and Social Development Council, 2018). This vision aligns with the Ministry of Education's policy, which emphasizes lifelong learning, creative application of knowledge, innovation development, and career readiness (Notification of the Ministry of Education Re: Education policy of the fiscal year 2025–2026, 2024). In the 21st century, the ability to create innovation is a critical skill for learners. To foster this capacity, students must develop creative thinking skills—specifically, the ability to generate processes, approaches, and solutions to problems, or to construct new knowledge through creativity-driven learning. Learners who possess innovative capacity are better equipped to thrive in the digital age (Wongyai & Patthaphon, 2019). Supporting learners in achieving success involves guiding them to understand problems, engage with solutions, and independently develop innovations to address challenges. Encouraging students to learn freely from real-world problems and their surrounding environments promotes creative thinking and enhances their potential to become innovators (Csikszentmihalyi, 1997).

Despite ongoing efforts, significant challenges remain in developing learners to meet the desired quality benchmarks. According to the International Institute for Management Development (IMD), Thailand's ranking in global competitiveness has not been notably high in recent years (Office of the Education Council, 2023). The insufficiency of pedagogical skills, technological integration, and classroom management among assistant teachers, compounded by acute teacher shortages significantly undermines instructional quality. These systemic deficiencies not only impede the development of students' 21st-century competencies and innovative capacities but also result in lower standardized assessment scores. Ultimately, such educational gaps diminish global competitiveness and hinder sustainable long-term national development (Office of the Education Council, 2023). A comparative analysis of academic performance data from 2020 to 2022 revealed a decline in Standard 1: Learner Quality Students' Creative Innovation Ability. One of the key obstacles is that many teachers still lack proficiency in using modern technology, designing learning activities that promote analytical and creative thinking, as well as instructional techniques that encourage learners to engage in experimentation and self-directed inquiry (Ban Zong School, 2024). Moreover, assistant teachers often lack a comprehensive understanding of both the core curriculum and the school-based curriculum, which leads to inconsistencies between instructional design and curriculum goals (Office of the Basic Education Commission, 2019). In addition, many teachers face challenges in designing effective learning experiences due to limited knowledge of instructional processes and insufficient skills in creating and utilizing modern educational media and tools appropriate for active learning (Srisaipattanakun et al., 2017). Given these challenges, it is essential to enhance teachers'—particularly assistant teachers'—competencies in active learning management. This approach should be grounded in learner-centered principles, drawing from progressivism and constructionism (Chularut, 2018). Learning designs must prioritize students' ability to think critically, reflect, take initiative, and engage in self-directed learning. Such practices empower learners to generate innovation. Key approaches to teacher development include coaching and mentoring (Chartered Institute of Personnel Development, 2025), as well as the implementation of lesson study within professional learning communities. Collectively, this strategy, called the CM-LS-PLC process (Coaching and Mentoring-Lesson Study-Professional Learning Community) (Dechakupt, 2019), has been shown to effectively support the development of professional teachers (Office of the Education Council, 2017). Accordingly, this research aims to develop a professional learning community model that integrates lesson study and coaching and mentoring to enhance assistant teachers' competencies in active learning management and foster learners' creative innovation ability.

2. THE OBJECTIVES OF THIS STUDY

The research objectives are as follows:

2.1 To develop and evaluate the quality of a professional learning community model integrating lesson study and coaching and mentoring to enhance assistant teachers' competency in active learning management for fostering students' creative innovation ability.

2.2 To examine assistant teachers' competency in active learning management for fostering students' creative innovation ability.

2.3 To investigate students' creative innovation ability after learning through active learning management.

2.4 To explore members' opinions of the professional learning community model integrating lesson study and coaching and mentoring to enhance assistant teachers' competency in active learning management for fostering students' creative innovation ability.

3. MATERIALS AND METHODS

This research was conducted using a Research and Development (R&D) methodology. Data were collected and analyzed using a mixed-methods approach. The research and development process consisted of four steps as follows:

3.1 Phase 1: Developing a professional learning community model

Step 1: Involved synthesizing foundational data to support the development of a professional learning community model and constructing a set of research instruments to guide implementation and evaluation. These included: (1) a professional learning community model, (2) a manual for model implementation, (3) four structured plans for applying the model in practice, (4) an evaluation form to assess teachers' competencies in active learning management, (5) an evaluation form to measure students' creative innovation ability, and (6) a set of discussion prompts for focus group interviews to gather member feedback on the model.

Step 2: Involved evaluating the quality of the professional learning community model and its associated research instruments through a focus group discussion with seven qualified experts. Two instruments were used in this evaluation: (1) a set of five open-ended questions designed to guide the focus group discussion on the development of the professional learning community model, and (2) a quality assessment form for both the model and the research instruments, constructed using a five-point Likert rating scale. The collected data were analyzed using mean (M), standard deviation (SD), and content analysis.

3.2 Phase 2: Experimenting with the developed professional learning community model

The target group of this research consisted of six assistant teachers who were assigned to organize learning management during the first semester of the 2024 academic year. They were selected through voluntary participation. Additional participants included six coaching teachers, six classrooms of Grade 4–6 students, three educational supervisors, and four school administrators. These groups were selected using purposive sampling. The total duration of the model implementation was 38 hours. The research design comprised the following components:

- (1) Assessing assistant teachers' knowledge and understanding of active learning management using a one-group pretest-posttest design;
- (2) Evaluating the development of assistant teachers' ability to design and implement learning management using a one-group pretest-posttest design; and
- (3) Assessing students' creative innovation abilities using a one-group design following the active learning activities implemented by the assistant teachers.

3.3 Phase 3: Evaluating the effectiveness of the professional learning community model

The evaluation of the effectiveness of the professional learning community model consisted of three components: (1) assessing the assistant teachers' competency in active learning management across three dimensions—(1.1) knowledge and understanding of active learning management, (1.2) development in implementing active learning management, and (1.3) development in designing active learning management; (2) evaluating students' creative innovation ability after participating in active learning management designed to enhance their creative innovation ability; and (3) examining the opinions of professional learning community members regarding the developed model. Data were analyzed using mean (M), standard deviation (SD), and content analysis.

4. RESULTS

4.1 Development and quality evaluation of a professional learning community model

4.1.1 Professional learning community model

A focus group discussion conducted with seven qualified experts to assess the quality of the professional learning community model found that: the PLC model comprises six key components: principles, objectives, procedures, evaluation, essential conditions for implementation, and supporting factors. The model demonstrates internal consistency, and the classroom education process serves as an important, multi-stage step resulting in continuous professional development for teaching assistants. The model's process comprises four main steps: (1) setting the vision, (2) sharing knowledge, (3) conducting lesson study—which includes

five sub-stages: (3.1) analyzing and arranging, (3.2) instructional design, (3.3) teaching and classroom observation, (3.4) reflection, and (3.5) refinement—and (4) defining the lesson learned. The results of the model's quality evaluation, which was conducted by seven qualified experts, are presented in Table 1.

Table 1: Results of the appropriateness evaluation of the professional learning community model

Items	<i>M</i>	<i>SD</i>	Results
Principles	4.86	0.38	Highest
Objectives	4.86	0.38	Highest
PLC Process	4.86	0.38	Highest
1. Setting vision	4.57	0.53	Highest
2. Sharing knowledge	4.86	0.38	Highest
3. Conducting lesson study	4.86	0.38	Highest
3.1 Analyzing and arranging	4.86	0.38	Highest
3.2 Instructional design	4.86	0.38	Highest
3.3 Teaching and observation	4.57	0.53	Highest
3.4 Reflection	4.86	0.38	Highest
3.5 Refinement	4.86	0.38	Highest
4. Defining lesson learned	5.00	0.00	Highest
Measurement and evaluation	4.71	0.49	Highest
Conditions for implementing the model	4.71	0.49	Highest
Supporting factors	4.57	0.53	Highest
Overall	4.79	0.15	Highest

According to Table 1, the overall results of the quality evaluation of the professional learning community model indicated that the model was highly appropriate ($M = 4.79$, $SD = 0.15$). When considering each component, the principles, objectives, and process were rated at the highest level of appropriateness ($M = 4.86$, $SD = 0.38$). This was followed by the components of measurement and evaluation, and the conditions for implementing the model, which were also rated at the highest level ($M = 4.71$, $SD = 0.49$). Lastly, the supporting factors received a rating of high appropriateness ($M = 4.57$, $SD = 0.53$). These results demonstrate that the overall structure of the developed learning management model is highly appropriate, particularly in Component 3: the PLC Process.

The professional learning community process, referred to as the 2S2L Model, was developed by the researchers through document synthesis and an analysis of the essential needs of teachers and school administrators. The process comprised four key steps:

Step 1: Setting vision

The initial step of the 2S2L model involved collaborative planning among assistant teachers (who served as model teachers), buddy teachers, mentors, and school administrators. The purpose was to build a shared understanding of the initiative to develop students' creative innovation ability through a professional learning community. In this step, the model teachers explained the need to foster students' creative innovation ability. Following this, all PLC members jointly analyzed foundational data and collaboratively set goals for developing active learning management that explicitly aims to foster students' creative innovation ability.

Step 2: Sharing knowledge

In this step, administrators, experts, mentors, and model teachers engaged in collaborative activities to exchange knowledge and experiences related to active learning management that promoted students' creative innovation ability. The exchange included strategies for integrating media and technology, as well as approaches to measurement and assessment that emphasized hands-on learning aligned with students' interests and individual potential. This step also provided an opportunity for PLC members to reflect on and review their roles in contributing to PLC activities.

Step 3: Conducting lesson study

In this step, assistant teachers—who served as model teachers and owners of the lesson—opened their practice to collaborate with buddy teachers, mentors, administrators, and experts. These professional learning community (PLC) members were invited to listen to and help address challenges and obstacles encountered in learning management. The process encouraged joint lesson development and knowledge exchange to determine the direction of instructional design. PLC members also participated in classroom visits and observations to reflect on the teaching performance of assistant teachers. This cycle was conducted three

times to compare the development of assistant teachers' competency in active learning management. The lesson study process consisted of five sub-steps as follows:

1. Analyzing and arranging: In this sub-step of the 2S2L model (Figure 1), model teachers, buddy teachers, mentors, and administrators held a collaborative meeting to listen to the problems or developmental needs related to classroom learning management. Together, they analyzed the challenges arising from instructional practices, prioritized the issues, and jointly planned solutions or improvements based on the specific needs identified by the teachers.

2. Instructional design: In this sub-step, model teachers designed learning management based on the solutions suggested by professional learning community (PLC) members during the vision-setting stage. Once the plans were developed, the assistant teachers presented them to the PLC members, which comprised buddy teachers, mentors, administrators, and experts. The PLC members collaboratively analyzed the appropriateness of the learning plans, instructional media, teaching innovations, and approaches to measurement and assessment. They also provided constructive feedback to further develop the learning management process, enabling teachers to revise and improve the plans for greater instructional quality.

3. Teaching and observation: This sub-step consisted of two parallel procedures. (1) Model teachers implemented the learning management plan that had been jointly developed by professional learning community (PLC) members, and (2) PLC members jointly observed the classroom and the teaching practice of assistant teachers, and recorded data related to the learning management process.

4. Reflection: This sub-step was a reflection process based on the learning management activities implemented according to the jointly developed learning plans. It began with model teachers providing information about their teaching and learning practices. Then, buddy teachers, mentors, administrators, and experts—who had observed the instructional behavior of teachers and the learning behavior of students—gave feedback to support further development and improvement.

5. Refinement: This sub-step involved synthesizing data gathered from the knowledge exchange among model teachers, buddy teachers, mentors, administrators, and experts. The information was used to improve the learning management plan, instructional activities, media, and methods of measurement and assessment. The goal was to produce a high-quality lesson that could be effectively implemented with learners in future cycles.

Step 4: Defining lesson learned

In this step, professional learning community (PLC) members summarized the outcomes that emerged from the learning management activities and the use of media and innovations implemented by model teachers. PLC members jointly exchanged experiences based on the instructional practices of model teachers and collaboratively synthesized knowledge and approaches appropriate for active learning management to promote students' creative innovation ability. The lesson learned, derived after completing the PLC activities, was a synthesis of findings and learning experiences gained throughout the implementation process.

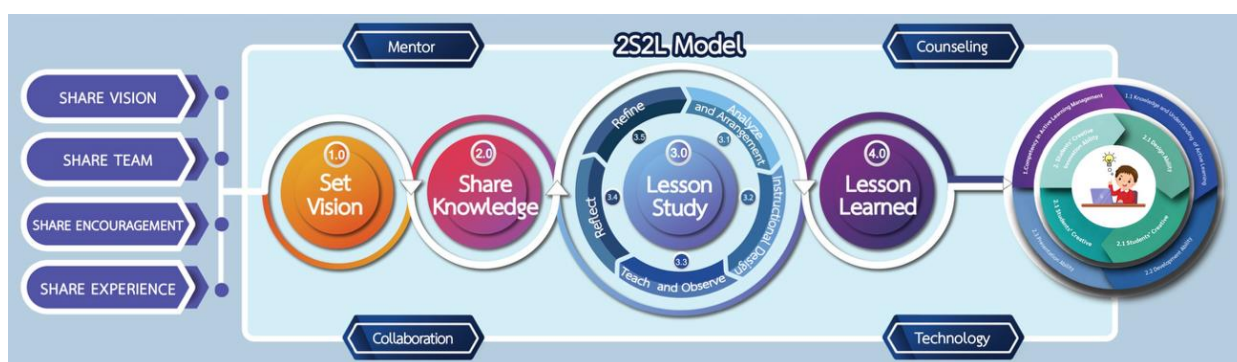


Figure 1: Professional learning community model (2S2L Model)

4.1.2 Implementation plan for the professional learning community model

The researchers designed an implementation plan for the professional learning community model (2S2L model) consisting of four key steps: (1) setting vision, (2) sharing knowledge, (3) conducting lesson study—implemented across three cycles, and (4) defining lesson learned. The implementation plan was evaluated as highly appropriate ($M = 4.71$, $SD = 0.49$), indicating that the overall structure of the developed learning management plan was appropriate at the highest level, as presented in Table 2

Table 2: Implementation plan for the professional learning community model

Plan	PLC learning process	Hours
1. Setting vision	Stage 1: Setting vision	3 Hours
2. Sharing knowledge	Stage 2: Sharing knowledge	8 Hours
3. Conducting lesson study	Stage 3: Conducting lesson study	-
	3.1 Analyzing and arranging	2 Hours
	3.2 Instructional design	2 Hours
	3.3 Teaching and observation	1 Hour
	3.4 Reflection	1 Hour
	3.5 Refinement	2 Hours
4. Defining lesson learned	Stage 4: Defining lesson learned	3 Hours

4.1.3 A test of knowledge and understanding of active learning

One open-ended test was administered to assistant teachers to elicit their opinions on active learning management based on their individual levels of knowledge and ability. The test consisted of five open-ended questions focusing on key concepts related to active learning management. The Index of Item Objective Congruence (IOC) for all test items was evaluated at 1.00, indicating perfect content validity.

4.1.4 Evaluation forms of learning management design ability

Three evaluation forms were developed to assess assistant teachers' ability to design active learning management. These included: (1) an evaluation form based on the GPAS 5 Steps model, (2) an evaluation form based on the project-based learning approach, and (3) an evaluation form based on the design thinking approach. Each form comprised six dimensions and employed a four-level rubric scale (Srisa-ard, 2002): highest (average 3.26–4.00), high (average 2.51–3.25), less (average 1.76–2.50), and least (average 1.00–1.75). The Index of Item Objective Congruence (IOC) for all evaluation forms was 1.00, indicating perfect content validity.

4.1.5 An evaluation form of creative innovation ability

One evaluation form was developed to assess creative innovation ability. It comprised three dimensions: (1) design ability, (2) development ability, and (3) presentation ability. The evaluation employed a three-level rubric scale (Ketsing, 1995): high (average 2.34–3.00), moderate (average 1.67–2.33), and low (average 1.00–1.66). The Index of Item Objective Congruence (IOC) for the evaluation form was 1.00, indicating perfect content validity.

4.1.6 Group discussion issues for PLC member opinions

One set of group discussion issues was developed to gather opinions from professional learning community (PLC) members. The issues were presented as open-ended questions divided into two parts. Part 1 focused on the general personal information of PLC members. Part 2 addressed their opinions on the professional learning community model integrating lesson study and coaching and mentoring to enhance assistant teachers' competency in active learning management for fostering students' creative innovation ability. The Index of Item Objective Congruence (IOC) for the group discussion issues was evaluated at 1.00, indicating perfect content validity.

4.2 Results of the study on assistant teachers' competency in active learning management for fostering students' creative innovation ability

The study of assistant teachers' competency in active learning management to foster students' creative innovation ability was organized into the following key areas:

4.2.1 Evaluation results of knowledge and understanding of active learning management for fostering students' creative innovation ability

Table 3: Evaluation results of knowledge and understanding of active learning management

Evaluation Phase	Mean	SD	Mean	df.	t	Sig. (1-tailed)
Before PLC	10.00	0.89	4.17	0.41	25.00*	0.0000
After PLC	14.17	0.75				

According to Table 3, the comparison of assistant teachers' knowledge and understanding of active learning management to foster students' creative innovation ability—before and after participating in professional learning community (PLC) activities—revealed a significant improvement. Prior to joining the PLC, the average pretest score was 10.00 out of 20.00 ($M = 10.00$, $SD = 0.89$). After participating in the PLC, the

average post-test score increased to 14.17 out of 20.00 ($M = 14.17$, $SD = 0.75$). The comparison indicated that assistant teachers demonstrated higher competency following the PLC activities.

4.2.2 Evaluation results of the development of assistant teachers' ability to design active learning management for fostering students' creative innovation ability

Table 4: Evaluation results of the development of assistant teachers' ability to design active learning management

Items	Cycle 1		Cycle 2		Cycle 3	
	Mean	SD	Mean	SD	Mean	SD
Components of the learning management plan	3.21	0.37	3.63	0.31	3.92	0.13
Learning objectives	3.21	0.36	3.64	0.15	3.85	0.10
Content/Learning substance	3.08	0.38	3.63	0.26	3.92	0.13
Learning activities	2.72	0.30	3.31	0.09	3.72	0.38
Instructional media/Learning resource	3.04	0.57	3.63	0.19	3.80	0.24
Assessment and evaluation of learning outcomes	3.22	0.43	3.58	0.19	3.81	0.07
Overall average	3.08	0.38	3.57	0.17	3.83	0.12
Quality level	High		Highest		Highest	

According to Table 4, the overall development of assistant teachers' ability to design active learning management to foster students' creative innovation ability was rated at the highest level ($M = 3.49$, $SD = 0.38$). When considering the progression across each cycle, the evaluation results indicated a consistent improvement in assistant teachers' design competency for active learning management.

4.2.3 Evaluation results of assistant teachers' development in active learning management to foster students' creative innovation ability

Table 5: Evaluation results of assistant teachers' development in active learning management

Items	Cycle 1		Cycle 2		Cycle 3	
	Mean	SD	Mean	SD	Mean	SD
Introduction to the lesson	3.06	0.22	3.50	0.17	3.70	0.24
Learning management	2.99	0.43	3.36	0.22	3.76	0.14
Activity summary	2.96	0.45	3.40	0.27	3.71	0.15
Assessment and evaluation	3.02	0.43	3.33	0.25	3.54	0.14
Overall Average	3.01	0.36	3.40	0.19	3.68	0.14
Quality Level	Highest		Highest		Highest	

According to Table 5, the evaluation results of assistant teachers' development in active learning management to foster students' creative innovation ability were rated at the highest level overall ($M = 3.36$, $SD = 0.34$). The findings indicated that assistant teachers demonstrated continuous improvement in their competency in active learning management.

4.3 Results of the study on students' creative innovation ability after receiving active learning management designed to foster creative innovation ability

Table 6: Results of the study on students' creative innovation ability after receiving active learning management

Items	Ability level		
	Mean	SD	Quality level
Design ability			
1. Students can explore and gather useful knowledge from reliable sources.	2.60	0.70	High
2. Students can analyze and synthesize ideas to develop innovative approaches.	2.60	0.52	High
3. Students can design and develop innovations that align with identified problems or needs, covering feasible development processes.	2.90	0.32	High
4. Students can create innovations that are distinctive, appealing, and reflect original thinking.	2.50	0.53	High
Average for design ability	2.65	0.29	High
Development ability			
5. Students can investigate the needs of the school or community and analyze/synthesize problem priorities before selecting an innovation to develop.	2.40	0.52	High
6. Students can revise and improve innovations based on feedback.	2.50	0.53	High
7. Students can plan and develop innovations systematically according to the set plan.	2.70	0.48	High

Table 6: Results of the study on students' creative innovation ability after receiving active learning management (continued)

Items	Ability level		
	Mean	SD	Quality level
8. Students can design innovations using accessible, convenient, and low-cost materials.	2.90	0.32	High
9. Students can develop innovations according to the designed process.	2.70	0.67	High
10. Students can produce innovations that are valuable and applicable to daily life.	2.80	0.42	High
11. Students can create innovations that are beneficial, well-received, and shareable.	2.60	0.52	High
Average for development ability	2.71	0.21	High
Presentation ability			
12. Students can present the innovation in a clear, systematic, and understandable sequence.	2.70	0.48	High
13. Students can disseminate the outcomes of their practice to others, fostering collaborative learning.	2.40	0.70	High
14. Students can use diverse and engaging media to present the innovation.	2.40	0.52	High
15. Students can present the innovation clearly and confidently.	2.60	0.52	High
Average for presentation ability	2.63	0.36	High

According to Table 6, the evaluation results of students' creative innovation ability—developed through active learning management conducted by assistant teachers—indicated an overall high level of competency ($M = 2.62$, $SD = 0.19$). The instructional process was developed through a professional learning community (PLC) model using lesson study and coaching and mentoring to enhance assistant teachers' competency in active learning management for fostering students' innovation ability.

When considering each dimension, the highest average score was found in Development Ability ($M = 2.71$, $SD = 0.21$), followed by Presentation Ability ($M = 2.63$, $SD = 0.36$), and Design Ability ($M = 2.65$, $SD = 0.29$), all rated at a high level.

4.4 Results of members' opinions on the professional learning community (PLC) model

According to the content analysis, professional learning community (PLC) members agreed that PLC activities were beneficial to the development of active learning management aimed at fostering students' creative innovation ability. They were able to reflect on their own teaching experiences, synthesize lessons learned, and apply the acquired knowledge to improve their instructional practices. Moreover, teachers learned from challenges encountered in other classrooms and adapted shared solutions to their own teaching. The developed PLC model was implemented in four participating schools, which shared similar characteristics as small-sized institutions with a limited number of teachers. Participation in the PLC expanded their networks for professional learning and knowledge exchange. Teachers reported having access to more approaches to learning management, and cross-disciplinary collaboration enabled more holistic development of student learning.

5. DISCUSSION

5.1 The professional learning community (PLC) model integrating lesson study and coaching and mentoring

The results of expert group discussions indicated that the six components of the PLC model demonstrate internal consistency, highlighting Step 3 (Lesson study) as the most critical phase. This process leads to continuous professional development for assistant teachers. Furthermore, a quantitative assessment utilizing a five-level rating scale determined that the model's appropriateness was at the highest level. This is because the model was systematically developed using a research and development methodology (Nilapun, 2015). Its structural and content validity were verified through expert focus group discussions with the highest level of appropriateness. The PLC model developed in this study comprises six core components: principles, objectives, procedures, evaluation, conditions for implementing the model, and supporting factors. The learning process follows the four-step 2S2L model—Step 1: setting vision, Step 2: sharing knowledge, Step 3: conducting lesson study (subdivided into 3.1 analyzing and arranging, 3.2 instructional design, 3.3 teaching and observation, 3.4 reflection, and 3.5 refinement), and Step 4: defining lessons learned. The researchers developed the model based on the analysis of basic data and current conditions, compared with desirable outcomes. The model design was informed by relevant theoretical frameworks, documentary sources, and expert opinions. Moreover, a needs assessment was conducted with the target group to ensure that the developed model was appropriate and practical in developing target teachers' competencies. In addition, each step of the model promotes systematic knowledge exchange among teachers regarding instructional development. This finding aligns with the research of Thipnet (2018), who studied teacher development in

instructional innovation through PLC processes. Her study revealed that teachers increasingly engaged in knowledge exchange related to teaching and learning.

In developing the PLC model, specifically the 2S2L Model in this study collaborative lesson study was emphasized as a core strategy for teacher professional development. This approach prioritizes collaboration among classroom teachers, with the goal of enhancing instructional practices that fit their teaching contexts. This aligns with the concept proposed by Po Ngern et al. (2021), who stated that lesson study is a process in which school administrators, teachers, coaches, and qualified experts jointly build a professional learning community. This process aims to facilitate communication and the sharing of supervision practices in order to reflect on teaching outcomes and student learning behaviors after each classroom observation. The model developed in this study also integrates mentoring and coaching. The PLC framework developed in this study aims to enhance active learning management competency among assistant teachers with limited teaching experience (0 to 24 months). Therefore, mentoring and coaching play a crucial role in supporting the development of their instructional management. This is consistent with the concept of Mavuso (2007), who emphasized that mentors are responsible for guiding or coaching new staff or trainees on strategies, values, vision, and organizational culture. Mentors also share experiences, skills, knowledge, strategies, and relevant lessons, while offering advice and support to help new staff succeed in their roles.

5.2 Assistant teachers' competency in active learning management to foster students' creative innovation ability

The evaluation results of assistant teachers' competency in active learning management are presented as follows.

1) The evaluation of assistant teachers' knowledge and understanding of active learning management for fostering students' creative innovation ability revealed that the scores after participating in the professional learning community (PLC) activities were higher than those before participation. This may be because the development process of the PLC model, which integrates lesson study and coaching and mentoring to develop assistant teachers' competency in active learning management for fostering students' creative innovation ability, was verified by experts to be highly consistent with relevant theoretical frameworks. Within the PLC implementation process, Step 2, Sharing Knowledge, played a significant role in developing assistant teachers' understanding of active learning management. This finding aligns with the research of Po Ngern et al. (2021), who emphasized that the knowledge-sharing step involves coaches and experts holding knowledge exchange activities and presenting examples of teaching innovations, media, and assessment methods. These activities help school administrators and teachers gain a deeper understanding of instruction management, media and technology adoption, assessment methods, and evaluation of performance and student innovation. Furthermore, the findings are consistent with the research of Chansanong and Sithsungnoen (2023) who studied the development of a hybrid PLC model integrated with coaching to enhance teachers' competency in STEM-based learning management and innovation creation of secondary students. This study found that collaborative professional development processes significantly contributed to teachers' understanding of instructional management.

2) The evaluation of assistant teachers' development in designing active learning to foster students' creative innovation ability was conducted using an ability evaluation form on active learning management. The form comprised six dimensions: (1) components of a learning management plan, (2) learning objectives, (3) learning content or essence, (4) learning activities, (5) instructional media and learning resources, and (6) assessment and evaluation of learning outcomes. The results indicated that teachers demonstrated improvement in their abilities at the highest level. Conversely, assistant teachers showed the least progress in the area of learning activities. This discrepancy may stem from the complex nature of fostering innovative capabilities, which requires educators to possess a deep understanding of each stage of instructional design. Moreover, these activities must align with both students' needs and the principles of creativity-enhancing pedagogy.

This may be attributed to the systematic planning process adopted by assistant teachers in designing active learning management to promote students' creative innovation ability. The process began with curriculum analysis—at both institutional and subject levels—followed by systematic analysis of learners and formulation of goals for learner development. These steps led to the design of learning management with a shared goal of enhancing student quality in a unified direction. Moreover, the integration of the lesson study approach contributed to the knowledge sharing process among teachers. In addition, the implementation of the 2S2L Model includes a systematic process for developing lessons together, specifically Step 3: Lesson Study (L). This step encourages teachers to analyze and prioritize problems and then use the results to inform instructional design. The findings of this study align with the concept proposed by Fernandez and Yoshida (2004) who emphasized that collaborative lesson development is a strategy in which teachers work together to set learning goals and design instruction with the aim of enhancing students' learning capacity. This finding

is further supported by the research of Wongsapan et al. (2019) who studied the development of Lesson Study (LS). findings revealed that the use of lesson study processes impacted teachers' professional development and created opportunities for them to learn and grow alongside their students in the 21st century. Teachers were able to design learning experiences that allowed students to participate in the learning management process through various instructional methods.

3) The evaluation of assistant teachers' ability development in active learning management to foster students' creative innovation ability was conducted using an ability evaluation form. The assessors evaluated teachers' ability in active learning management across three cycles and focused on four dimensions: (1) introduction to the lesson, (2) learning management, (3) activity summary, and (4) assessment and evaluation. The results indicated teacher improvement rated at the highest level. This development may be due to the nature of active learning management, which emphasizes learner participation and positions students at the center of the learning process. The goal of active learning is to cultivate analytical thinking, problem-solving, and innovation creation. In this approach, teachers serve as facilitators, motivators, and learning guides for learners through a variety of instructional techniques and activities—such as group discussions and project-based learning. These findings align with the concepts proposed by Sonsalee (2018) and Uamphrom (2017), who emphasized that professional learning communities empower all members to learn together independently, generate diverse knowledge, co-create and transform instructional practices, and share expertise to enhance competencies and drive continuous progress toward shared goals. When examining the details of assistant teachers' development in active learning management, the 2S2L Model provides a process that promotes collaborative learning through PLC activities. A core element of instructional competency development is Step 3: Lesson Study, which consists of five sub-steps: analyzing and arranging, instructional design, teaching and observation, reflection, and refinement. The lesson study process is consistent with the framework proposed by Woranetsudathip (2021), who described lesson study as a collaborative process involving joint instructional planning, shared classroom observation, and collective reflection among teachers, supervisors, and school administrators. In conclusion, collaborative lesson development promotes professional relationships and supports ongoing teacher development.

5.3 The evaluation of students' creative innovation ability after receiving active learning management designed to foster creative innovation ability

The evaluation revealed that overall performance was rated at a high level. When considering each aspect, students' innovation development ability was rated at a high level with the highest average, followed by presentation ability and design ability, respectively. This may be due to characteristics of the innovation creation process, which requires learners to apply knowledge acquired through learning to develop innovations. These innovations may take the form of methods, processes, inventions, or problem-solving approaches that respond to students' needs and challenges. During innovation development, students must learn through group-based learning processes, actively contribute to learning activities, and create innovations through hands-on experience. These actions provide opportunities for students to design, develop, test, implement their innovations, and then present the developed innovation to the public. To foster students' creative innovation ability, teachers should select instructional models that are appropriate for promoting innovation creation. In this study, three learning activity models were employed based on subject-specific contexts, including project-based learning, problem-based learning, and design thinking. These models guided students through a process from knowledge acquisition and background research, followed by data analysis, innovation planning and design, experimentation, and dissemination of innovation outcomes to the public. This approach aligns with the finding proposed by Sittijan (2017), who emphasized that problem-based learning enables students to learn through meaningful, real-world problems. Learners must investigate, develop, and validate solutions over an extended period, often producing workpieces to address the identified issues. It also corresponds with Laoriandee et al. (2017) who stated that project-based learning is designed to help students identify problems, collaborate in learning, engage in discussions, share ideas, plan solutions, jointly solve problems, select solutions for identified problems, and present their learning outcomes or problem-solving results.

5.4 The survey of professional learning community (PLC) members' opinions

This survey showed that the PLC model is appropriate and beneficial for enhancing assistant teachers' competency in learning management. Teachers reported that they could effectively apply the model to develop their own competency in active learning management, including knowledge and understanding, instructional design ability, and implementation of active learning strategies, which are aimed at enhancing students' creative innovation abilities. Assistant teachers also received guidance on designing and organizing active learning management that fosters students' creative innovation abilities, suitable for subject-specific contexts. Through participation in knowledge-sharing activities, teachers developed ideas for lesson planning that aligned with

learners' needs. They adopted instructional design principles, assessment and evaluation strategies, and media production and selection to ensure learner engagement and participation. This may be because the PLC is essential for the development of teachers and educational personnel. Specifically, knowledge exchange among teachers is crucial in enhancing instructional quality. The key process is encouraging teachers, educators, and stakeholders in instructional management to exchange perspectives on instructional improvement. It not only provides access to new knowledge and experiences but also promotes positive relationships and teamwork among teachers. Teachers, therefore, develop a collaborative mindset and are encouraged toward continuous self-development. These findings are consistent with the research of Dan (2012), who studied the impact of PLC implementation on classroom practices among science teachers. This study found that schools implemented PLCs in various formats. PLC activities enable teachers to recognize the value of different learning, communication, and collaboration. They also promote knowledge sharing, enabling teachers to receive constructive feedback that enhances teaching practices. In conclusion, the implementation of the PLC supports teachers in improving teaching practices, leading to effective instructional management and better student learning outcomes.

6. RECOMMENDATIONS

6.1 Recommendations from the research results

The evaluation of the effectiveness of the professional learning community model—the 2S2L Model in this study—revealed that the learning activity dimension had the lowest average. Therefore, when applying the PLC model to develop assistant teachers' competency in instructional design, it is recommended to strengthen their knowledge and understanding of techniques and procedures for designing learning activities that align with subject-specific contexts. Teachers must possess both theoretical knowledge and practical expertise in the instructional models they choose to implement. This challenge can be addressed during Step 2: Sharing Knowledge of the 2S2L Model, which serves as a platform for developing teachers' proficiency in learning management approaches.

The evaluation of mentor teachers' competency in coaching and mentoring revealed an overall high level of performance. However, when analyzed by dimension, the lowest average scores were found in their ability to continuously facilitate, support, and solve problems related to active learning for assistant teachers, as well as in their ability to offer diverse recommendations for developing learning activities. Therefore, when implementing the professional learning community model, emphasis should be placed on providing varied and context-responsive mentoring that aligns with the assistant teachers' needs in developing learning activities.

6.2 Recommendations for future research

Future research should focus on developing professional learning community (PLC) models that integrate collaborative lesson study with other coaching approaches, such as peer coaching, administrator coaching, expert coaching, or differentiated coaching. Additionally, technology should be incorporated to support and enhance the clarity of knowledge-sharing processes within the PLC framework.

Further studies should explore the development of PLC models aimed at enhancing other areas of teacher competency, and the application of technology as a medium for facilitating PLC activities. These may include competencies in educational media or innovation production, and technology integration for teaching and learning.

DECLARATION

1. Conflict of interest

The authors declare no conflict of interest.

2. Generative AI and AI-assisted technologies in the writing process

AI-assisted tools were not used in the writing process. The authors carefully reviewed and revised the content in collaboration with a professional translation institute and take full responsibility for the content of the published article.

3. Data availability statement

All data supporting the findings of this study are included within the article.

4. Ethics statement

The authors affirm that this study was conducted in accordance with established ethical standards and guidelines.

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6. Contributor Role Taxonomy (CRediT)

Mutita Eamtip: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing.

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