

Enhancing Teachers' Potential in Implementing the Project-based Learning Approach through Activity-based Professional Development: A Case Study of Chonburi Science-Based Technology Vocational College**Wisitsree Wiyaratn¹, Pichet Pinit¹, Mongkhon Narmluk¹, Anusit Anmanatarkul,
Ekarut Ruayruay¹, Santirat Nansaarn¹, Komkrit Chomsuwan¹, Pinit Rangsitiyagorn²**¹ Faculty of Industrial Education and Technology, King Mongkut's University of Technology, Thonburi, Thailand.² Faculty of Science, King Mongkut's University of Technology Thonburi, Thailand.Email: ¹ wisitsree.wiy@kmutt.ac.th, ² pichet.pin@kmutt.ac.th, ³ mongkhon.nar@kmutt.ac.th, ⁴ anusit.anm@kmutt.ac.th, ⁵ ekarut.rua@kmutt.ac.th, ⁶ santirat.nan@kmutt.ac.th, ⁷ komkrit.cho@kmutt.ac.th, ⁸ pinit.run@kmutt.ac.th**Corresponding Author*:** Wisitsree Wiyaratn**ABSTRACT:**

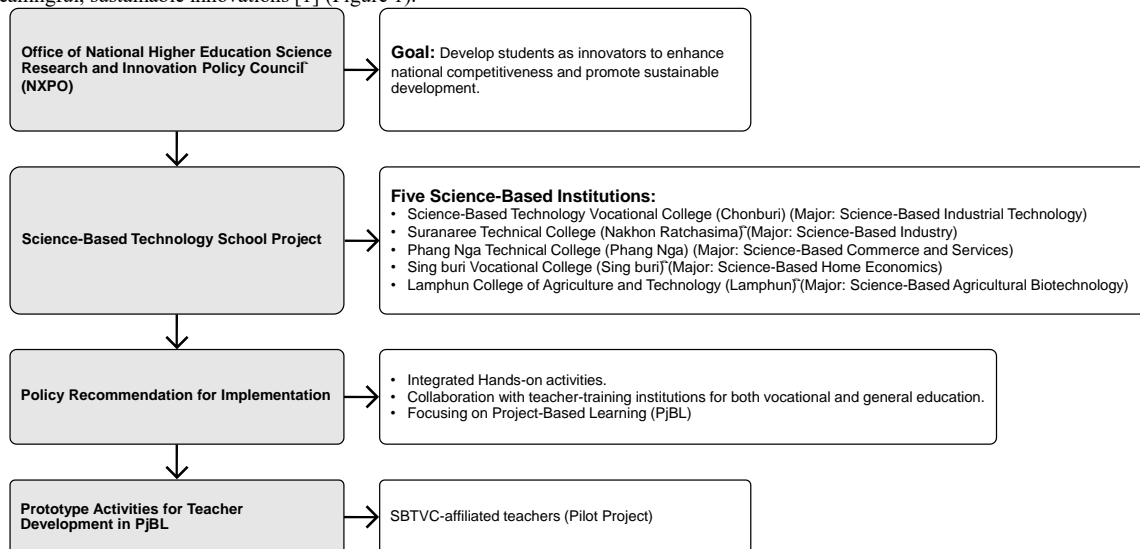
This research aimed to develop a comprehensive framework for enhancing the instructional capacity of 35 teachers at a science-based technology vocational college in Chonburi Province through the Project-Based Learning (PjBL) approach. The activity framework consisted of four key components: consultations with school administrators to present a prototype model and gather alignment recommendations; interactive workshops and knowledge exchange sessions; establishment of Professional Learning Communities (PLC); and structured reflective learning sessions. The training focused on the five-step PjBL instructional process, specifically tailored to the college context, and supported teachers in designing lesson plans, assessment strategies, and practical PjBL applications. Results demonstrated significant improvements in teacher understanding of PjBL methodology. Participating teachers developed more positive attitudes toward PjBL and increasingly viewed their roles as facilitators, mentors, and assessors rather than traditional instructors. Post-training analysis revealed a deeper understanding of learner-centered approaches and enhanced ability to apply PjBL tools appropriately within the vocational education context. The proposed framework represents a strategic approach for developing vocational teachers' instructional capacity to deliver competency-based education effectively, aligned with the mission of science-based technology colleges.

KEYWORDS: teacher development activity design, project-based learning (PjBL), science-based technology college.**1) Introduction**

Thailand's approach to developing science and technology talent has concentrated on training more researchers, especially those with doctoral degrees, while vocational programs have focused on creating skilled technicians. However, the two-pronged strategy falls short of building the diverse workforce needed to enhance national competitiveness. Vocational graduates frequently lack critical skills, such as collaboration, peer support, and lifelong learning habits. Their limited foundational knowledge and core competencies leave them unable to meet industrial demands. Rather than becoming innovators, they typically function as technology users or equipment maintainers. This role restricts their ability to adapt to rapid changes of technology and limits their potential for knowledge growth and application. To address these challenges, the Office of the Vocational Education Commission (OVEC) and the Ministry of Science and Technology—through the National Science Technology and Innovation Policy Office (STI)—launched a pilot project known as the “Science-Based Technology School” (SBTS), being implemented in five vocational institutions:

- Science-Based Technology Vocational College (Chonburi) (Major: Science-Based Industrial Technology)
- Suranaree Technical College (Nakhon Ratchasima) (Major: Science-Based Industry)
- Phang Nga Technical College (Phang Nga) (Major: Science-Based Commerce and Services)
- Sing buri Vocational College (Sing buri) (Major: Science-Based Home Economics)
- Lamphun College of Agriculture and Technology (Lamphun) (Major: Science-Based Agricultural Biotechnology)

This project develops skilled technologists and innovators by combining a rigorous scientific mindset and practical vocational training. Students engage with interdisciplinary science alongside traditional craftsmanship and engineering expertise, preparing them to drive technological advancement across multiple industries. The SBTS project emphasizes experiential learning through the Project-Based Learning (PjBL) approach, enabling learners to solve real-world problems and create meaningful, sustainable innovations [1] (Figure 1).

**Figure 1:** Initiative of the Science-Based Technology School (SBTS) project

Recognizing the need for effective PjBL delivery, the research team developed a comprehensive prototype activity aimed at building teachers' instructional capacity. This strategic initiative targets improving student learning outcomes and cultivates genuine innovation within the SBTS project. The team began with a thorough needs assessment, gathering detailed insights into teachers' existing knowledge and specific professional development requirements. This data-driven approach ensures that training activities are both relevant and immediately applicable in classroom settings. The program also establishes a Professional Learning Community (PLC) to facilitate knowledge sharing, peer collaboration, and reflective practice among teachers. This program enhances teachers' understanding and implementation of PjBL while simultaneously developing students' essential cognitive abilities—critical thinking, evaluation, and creativity. The initiative supports the sustainable development of vocational science and technology professionals to advance the national strategic goals.

2) Research Objectives

1. To design and create a prototype program that strengthens teachers' knowledge and instructional expertise in implementing Project-Based Learning (PjBL) within Science-Based Technology Vocational Colleges.
2. To foster collaborative teacher development through a Professional Learning Community (PLC) framework that supports effective PjBL implementation at Science-Based Technology Vocational Colleges.

3) Literature Review

Instructional Approach: Project-Based Learning (PjBL) PjBL is an instructional approach that develops essential skills by engaging students in authentic, real-world projects and problem-solving activities within structured timeframes [2]. Research from the Policy Innovation Center at King Mongkut's University of

Technology Thonburi (2014) [3] established a professional development framework specifically designed to enhance teachers' PjBL literacy within Science-Based Technology Schools.

This framework is grounded on the two assumptions:

1. Teachers will successfully implement Project-based Learning while enhancing their instructional capacity.
2. Teachers will collaborate more productively by embracing the 'Teacher Leader' model, which promotes the sharing of specialized knowledge and diverse educational experiences.

The developed PjBL comprises five key steps [4-5]:

- 1) **Exploring the ideas:** Students explore comprehensive topics or real-world challenges involving science and technology innovation, aligned with the integrated school themes.
- 2) **Reviewing the possibilities:** Students collect scientific evidence, theoretical frameworks, and established principles to support and validate various approaches to addressing project challenges.
- 3) **Selecting the Topic... that Clicks!:** Students review, analyze available project alternatives, and choose the most feasible option as their project topic.
- 4) **Producing and Testing:** Students design, build, and test their solutions by conducting experiments grounded in selected theories and methods, recording all outcomes, and performing thorough result analysis.
- 5) **Presenting and Getting Buy-In:** Students construct persuasive presentations employing appropriate tools and communication strategies to articulate project value and convince audiences of their work's merit.

This PjBL encourages students to think critically and solve problems related to real-life situations effectively. At each stage, both teachers and students go through performance-based assessments to monitor progress and ensure alignment with the learning goals (Figure 2). Implementation of the PjBL creates a continuous learning pathway in which students experience three progressive stages: motivating, practicing, and mastering (Figure 3), promoting the acquisition of incremental required knowledge and skill.

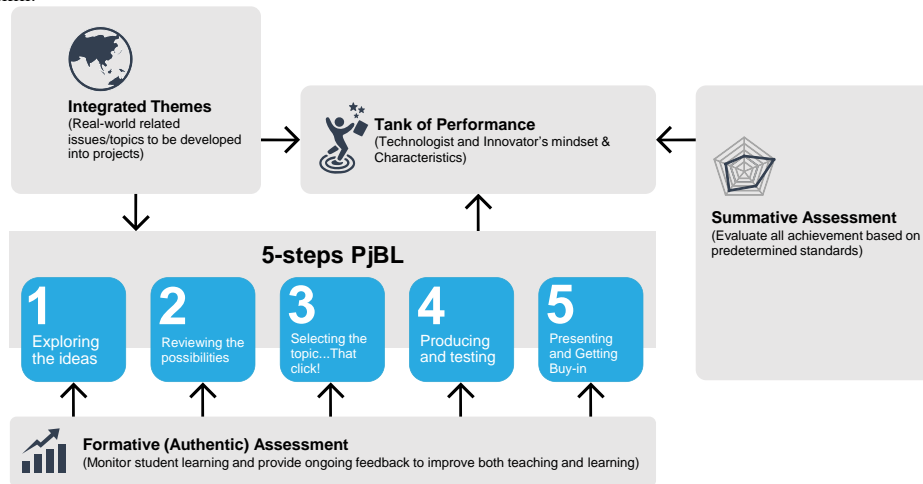


Figure 2: 5 Steps of PjBL

(Source: Policy and Innovation Center – PI (KMUTT), Teaching and Learning Using the Project-based Learning Approach for Science-Based Technology Vocational College. (Research Report). Office of the Education Council, Ministry of Education of Thailand. 2017.)

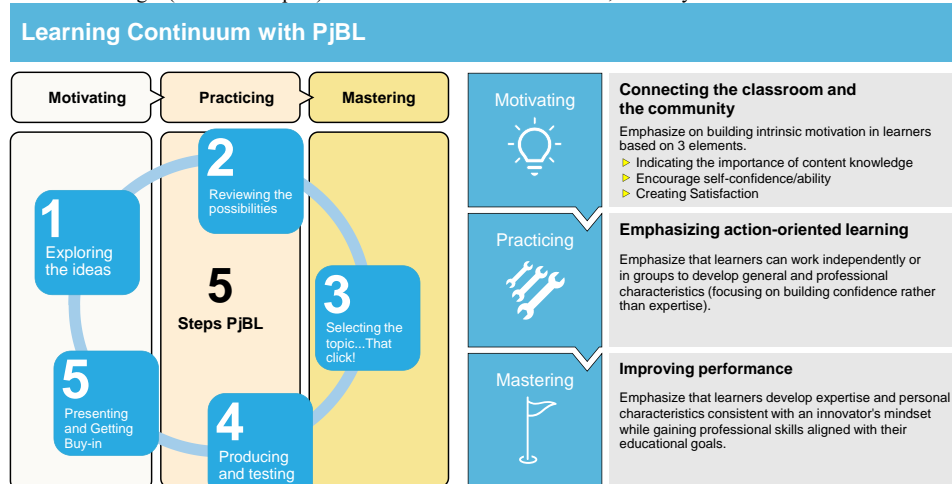


Figure 3 Continuity in the Learning Process

(Source: Policy and Innovation Center – PI (KMUTT), Teaching and Learning Using the Project-based Learning Approach for Science-Based Technology Vocational College. (Research Report). Office of the Education Council, Ministry of Education of Thailand. 2017.)

Innovation and Innovator. Innovation means the integration of innovative concepts derived from personal knowledge, skills, and creative thinking with technology to generate new, effective, and life-enhancing solutions [5]. Innovation possesses various characteristics: Desirable to users (needs), Viable in the marketplace (competitiveness), Remarkable with its own characteristics (attraction), and Possible with technology (feasibility). Knowing these characteristics benefits the design of the learning process and assessment. An innovator is an individual who introduces change and new ideas, or one who develops and designs new products, systems, or methods. Innovators are unafraid of failure; they consistently demonstrate their willingness to think deeply, ask probing questions, observe systematically, engage in hands-on practice, and share insights while learning from others [5].

Professional Learning Community (PLC) The PLC is a collaborative approach where educational stakeholders, especially the teachers, work together to improve student learning quality. The research team utilizes the developed PLC model, which combines dialogue and contemplative education approaches (Figure 4) [6], to establish strong collegial bonds among teachers through the four ways depicted in Figure 5. This framework is systematically integrated into prototype training activities. The PLC model contains three main layers:

- 1) the underground layer: This is for preparation and readiness. It focuses on how to be aware of and control feelings, listen deeply, and understand the diversity of people.

- 2) the ground-level layer: This is to invite fruitful participation and open discussion in the way to promote unity, and
- 3) the above-ground layer: This is to share experience, exchange knowledge, get insight, and transfer learning to classroom implementation. This layer interacts in a circular loop.

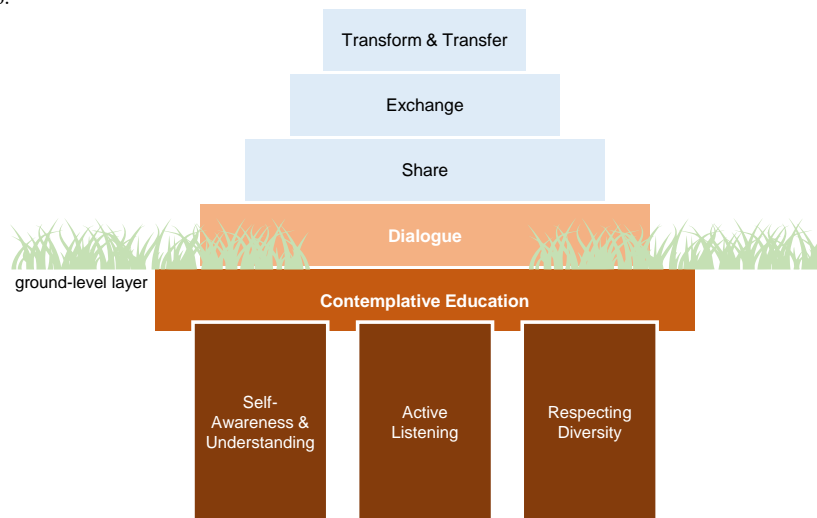


Figure 4: KMUTT-PLC model

(Source: Ruayruay E., etc., & colleagues. Conceptual framework for developing professional learning communities (PLC) according to the community process approach of the Department of Vocational Education. National and International Academic Conference on Interdisciplinary Innovation for Sustainable Development 2, 2017.)

When teachers adopt the Teacher Leader role (Figure 5) with the PLC (Figure 4), classrooms become more dynamic learning spaces that encourage active student engagement and deep learning. The curriculum connects meaningfully to students' lived experiences, while instruction and evaluation emphasize performance-based approaches. This approach strengthens students' critical thinking, problem-solving, communication, inquiry, and creative abilities, resulting in more impactful learning outcomes compared to conventional instructional methods. Also, the approach promotes team teaching and unity among teachers.

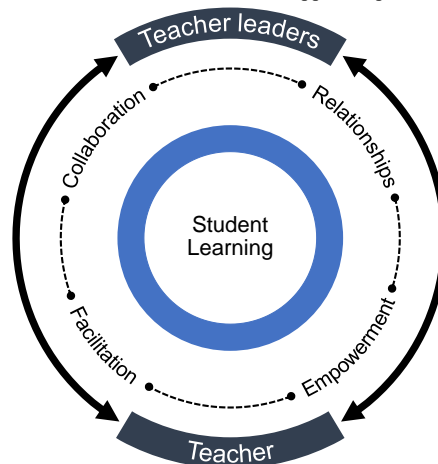


Figure 5: Four ways in which teacher leaders influence their peers with the goal of students' learning (Adapted from: Angela L., Heather C., Amamda W., <https://dc.swosu.edu/aij/vol4/iss2>.)

4) Methods and Methodology

This study focused on designing prototype activities to enhance teachers' capacity in implementing PjBL at the Science-Based Technology Vocational College in Chonburi (SBTVC). The research process was divided into four core activities (Figure 6).

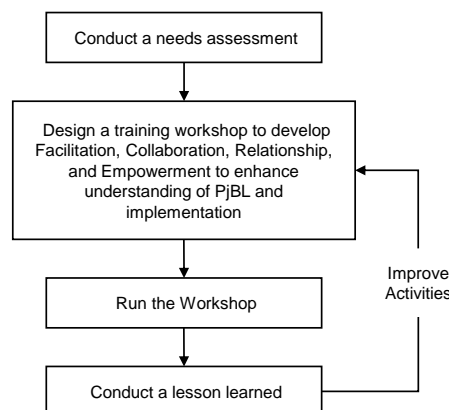


Figure 6 Research Implementation Process

Activity 1: Conduct a Needs Assessment. This activity examined participating teachers' current instructional practices while communicating the research project's objectives and procedures to ensure shared understanding (Figure 7). The activity prepared teachers and schools for full engagement and identified specific needs for the subsequent phase of designing prototype training activities. The survey instrument was designed to cover four key areas: 1) Teachers, 2) Students, 3) Institutional Support, and 4) Curriculum and Management. The instrument encompassed 10 dimensions (Figure 7) and contained 48 items total, incorporating both closed- and open-ended questions. Thirty-five SBTVC-affiliated teachers completed the online survey, and the results were used to design the prototype training activities.

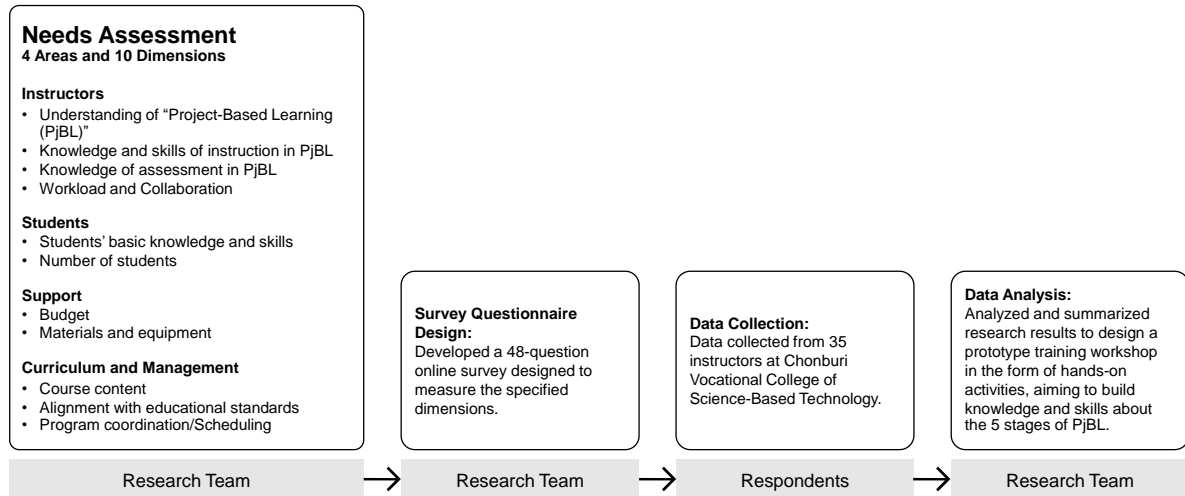


Figure 7: Needs assessment for workshop design to enhance knowledge and skills about PjBL

Activity 2: Design a Training Workshop

In this activity, the research team designed a prototype training workshop for teachers, focusing on the 5-step PjBL (Figures 2 and 3), utilizing the informed data from Activity 1. The design also considered the expected attributes and skills of students as illustrated in Table 1 and the PLC model in Figure 5. Note that many attributes and skills are common across steps. Furthermore, the research team administered a pre-training assessment to evaluate instructors' current understanding of PjBL.

Table 1. Expected Student Attributes and Skills for the 5-Step PjBL

Exploring the Ideas	Reviewing the Possibilities	Selecting the Topic... that Clicks	Producing and Testing	Presenting and Getting Buy-In
<ul style="list-style-type: none"> • Creativity • Teamwork • Inquiry and Observation • Note-taking skills • Analytical thinking • Communication and Presentation skills • Evaluation and Decision-making skills 	<ul style="list-style-type: none"> • Perseverance and Determination • Questioning skills • Data collection skills • Analytical and Synthesis skills • Teamwork • ICT skills • Communication and presentation skills 	<ul style="list-style-type: none"> • Comparative thinking skills • Evaluation and Decision-making skills • Teamwork • Communication and Presentation skills 	<ul style="list-style-type: none"> • Patience and Attention to detail • Craftsmanship and Responsibility • Use of ICT and Practical tools • Scientific inquiry and Hypothesis formation • Problem-solving and Mathematical skills 	<ul style="list-style-type: none"> • Creativity • ICT proficiency • Strategic thinking • Communication and Presentation skills

Activity 3: Run the Workshop

This activity aimed to deepen teachers' understanding and readiness for implementing the 5-step PjBL approach. It commenced with a meeting involving school administrators to align the training program with institutional objectives. The workshop then proceeded with a comprehensive review of the SBTS project background and the 5-step PjBL framework (Figure 8).

Teachers engaged in knowledge exchange activities through a 'marketplace discussion' to share their PjBL implementation experiences, expectations, and challenges. Additionally, new instructional and assessment tools specifically aligned with the five-step PjBL model were introduced and demonstrated. Teachers, then, engaged in authentic role-playing activities replicating teacher-student interactions, allowing teachers to practice and refine PjBL applications. Next, teachers collaborated in designing lesson plans, articulating expected learning outcomes, and formulating implementation strategies.

A comprehensive follow-up phase incorporated both group and individual mentoring sessions, complemented by the establishment of PLC (Figure 4). This support structure facilitated ongoing reflection and continuous reinforcement of PjBL practices. The key follow-up activities included:

- 1) Teachers reflected on the implementation of PjBL steps 1–3 (successes, challenges, and solutions).
- 2) Facilitators conducted focused consultation sessions with small groups of teachers.
- 3) Administrators, teachers, and facilitators jointly revised instructional plans and established practical problem-solving strategies.

Afterward, external experts conducted group and individual evaluations using competency-based assessments, including classroom observations, questioning, interviews, student work analysis, scoring rubrics, and evaluation of teaching and learning skills demonstrated during each PjBL step. The cycle concluded with reflection on lessons learned and preparation for a project exhibition or forum, as illustrated in Figure 8.

Activity 4: Conduct a Lesson Learned

This activity involved a reflection-based lesson-learned process. The researchers conducted three rounds of reflective activities to gather feedback/reflection. This session encouraged teachers to share their teaching experiences and the insights gained to contribute to the development of more effective instruction to support students' learning and promote those ways to unite the teachers and teacher leaders (Figure 5).

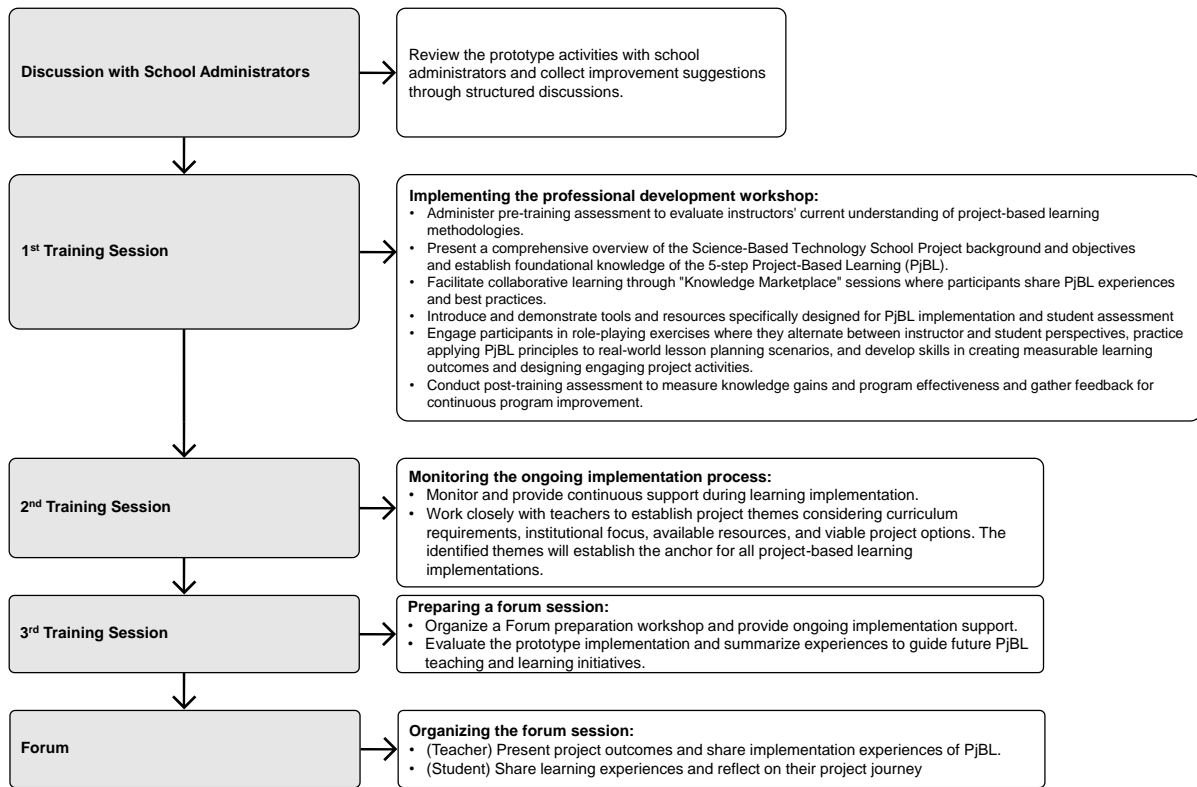


Figure 8: Prototype training workshop

5) Results

Survey Results: Teachers' Understanding of PjBL. Survey results from 35 SBTVC teachers indicated that 21 teachers (60%) possessed prior experience with PjBL implementation, whereas 14 teachers (40%) lacked such experience. Teachers taught primarily at the Certificate of Vocational Education level (54%), with others at the Higher Certificate (37%) and bachelor's degree levels (9%). In terms of PjBL knowledge and understanding, teachers exhibited moderate comprehension levels, with mean scores distributed across the five steps as shown in Figure 9.

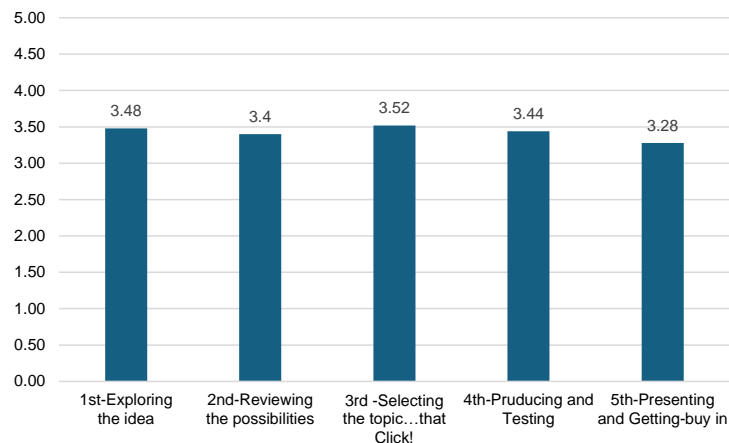


Figure 9: Teachers' knowledge and understanding of each step in the PjBL Process

These findings suggest that while some teachers had practical experience with PjBL, there is still a significant need for deeper pedagogical support, especially in the later stages of the process, such as Step 5: Presenting and Getting Buy-In. Regarding roles that teachers perceived as appropriate for themselves in PjBL contexts (selecting up to four roles), the distribution was as follows: Academic advisor (21%), Facilitator (19%), Content Provider (17%), Observer (15%), Expert (12%), Project Evaluation Committee (9%), and Demonstrator (7%).

Test Results: Teachers' Understanding of PjBL. All 35 teachers (100%) participated in the professional development workshop on the five-step PjBL. To evaluate training effectiveness, teachers completed a 10-item knowledge assessment both before and after the workshop. Results were analyzed using mean scores, and the findings are presented in Table 2.

Table 2: Teachers' Mean Scores Before and After the PjBL Workshop

Question Item	Pre-Test Mean	Post-Test Mean
1. What is the general sequence of project implementation steps?	60.50	69.40
2. What are the five steps in the PjBL instructional process?	62.28	83.30
3. What are the expected learner attributes in Step 1: Exploring the Ideas?	51.20	69.40
4. What are the expected learner attributes in Step 2: Reviewing the Possibilities?	23.30	66.70
5. What are the expected learner attributes in Step 3: Selecting the Topic... that Clicks?	32.60	58.30
6. What are the expected learner attributes in Step 4: Producing and Testing?	41.90	69.40
7. What are the expected learner attributes in Step 5: Presenting and Getting Buy-In?	67.40	86.10
8. What is the appropriate method for assessing students in the SBTS PjBL framework?	44.20	55.60
9. What are the primary assessment focuses within the SBTS PjBL framework?	41.90	75.00
10. Which of the following is not involved in the PjBL instructional process?	65.10	86.10

The results in Table 1 demonstrate that mean post-test scores were higher than pre-test scores for all items, indicating an improvement in teachers' knowledge after the workshop. The greatest improvement was observed in Question 4, which assesses understanding of learner attributes in Step 2: Reviewing the Possibility. The highest post-test scores were achieved on Question 7: Learner attributes in Step 5: Presenting and Getting Buy-In, and Question 10: Identifying non-relevant roles in PjBL.

Key Post-Training Learning Outcomes Reflection. As the objective was to empower participating teachers to effectively design and deliver PjBL instruction, the training emphasized a learner-centered approach, integrating a variety of instructional techniques such as group processes, critical thinking exercises, problem-solving, process-oriented teaching, inquiry-based tasks, and collaborative learning strategies (Figure 10) to promote the PLCs with the four ways (Figure 5). Reflective activities were conducted both during and after the workshop. Teachers were asked to articulate their understanding of various instructional approaches, including: PjBL (Project-Based Learning), PBL (Problem-Based Learning), IBL (Inquiry-Based Learning), RBL (Research-Based Learning), STEM (Science, Technology, Engineering, and Mathematics), STEAM (STEM with Arts), and CBL (Challenge-Based Learning). These activities were designed to help teachers deepen their understanding of the distinctions between these approaches and learn how to integrate them effectively when designing learning experiences for students while focusing on PjBL. The results of this reflection are illustrated in Figure 11.



Figure 10: Scenes from the Professional Development Workshop on PjBL

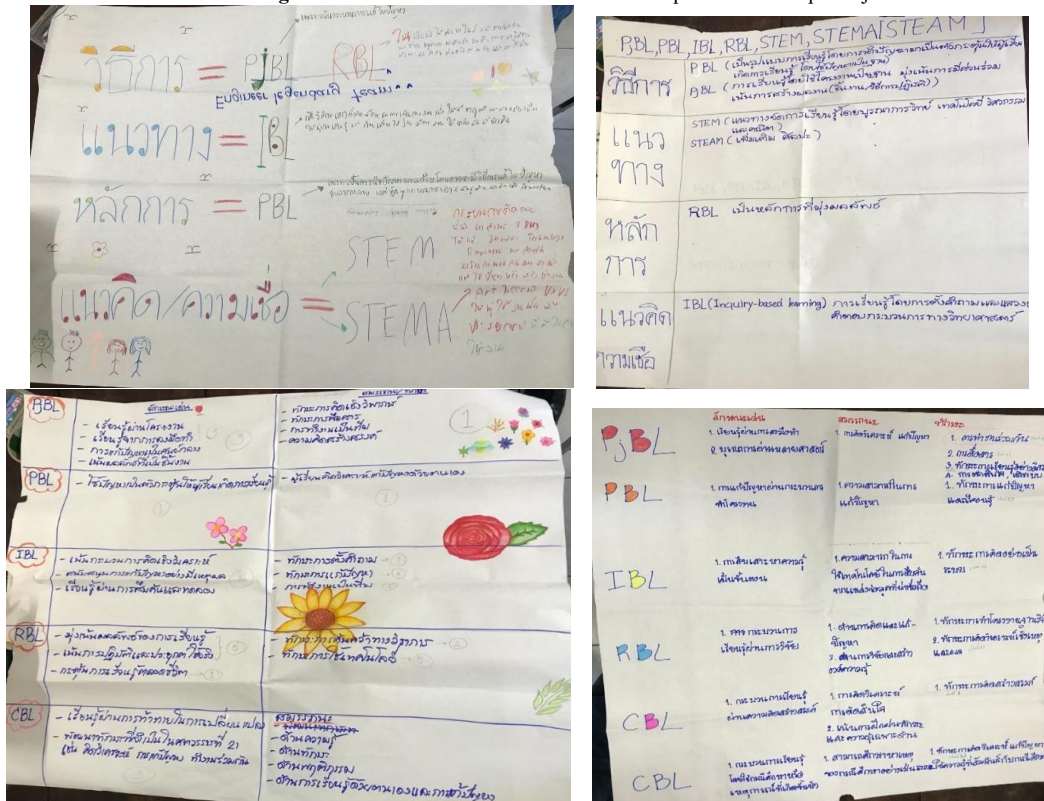


Figure 11: Reflections on teachers' understanding of various Instructional approaches

6) Discussion

The study results provide compelling evidence that targeted professional development through structured workshops significantly enhances teachers' understanding and instructional competence in PjBL. Teachers demonstrated substantial improvements in post-test scores across all five steps of the PjBL. The most notable improvement was observed in understanding learner attributes associated with Step 2: Reviewing the Possibilities. This improvement shows that the training effectively addressed both conceptual and procedural knowledge gaps. The training was particularly effective in the planning and conceptual phases of PjBL, where abstract thinking and strategic planning are most critical. This suggests that structured professional development can successfully bridge the gap between theoretical understanding and practical application of the PjBL approach. Furthermore, the highest post-training scores were achieved in Step 5: Presenting and Getting Buy-In, as well as in teachers' ability to distinguish appropriate from inappropriate instructional roles in PjBL contexts. These results suggest that teachers gained a comprehensive understanding of PjBL, developing both structural knowledge of the instructional model and critical analytical skills. Teachers demonstrated they could identify which instructional roles support effective PjBL implementation and which ones hinder it. This nuanced understanding is crucial for successful classroom implementation, where teachers must transition from traditional authoritative roles to more facilitative and supportive ones. The ability to recognize and avoid counterproductive teaching behaviors is essential for creating authentic project-based learning environments.

The reflection activities provided additional insights into the training's impact. Teachers were asked to articulate their understanding of various instructional models. Through this process, teachers developed the ability to recognize both similarities and key distinctions between different pedagogical approaches. This reflective practice helped teachers think critically about their teaching methods and understand the underlying principles of learner-centered instruction. The activities also revealed an encouraging trend: teachers expressed interest in integrating PjBL with interdisciplinary approaches, particularly STEM and STEAM principles. This suggests that teachers are moving toward more innovative, cross-curricular teaching practices that can better prepare students for real-world challenges.

Another critical outcome was the confirmation that the PLC effectively facilitates knowledge sharing and peer coaching (Figure 5) [6]. The PLC established during and after the workshop fostered ongoing collaboration, constructive feedback, and collaborative development of teaching strategies. These communities reinforced a key principle: professional development achieves the greatest impact when it is continuous, contextually relevant, and community-driven. Rather than just one-time training events, sustained collaborative learning through PLCs enables teachers to refine their practice over time and adapt new methodologies to their specific classroom contexts. Furthermore, teachers demonstrated growing confidence in instructional design through their ability to practice teaching scenarios and collaboratively develop lesson plans. This hands-on approach to professional development proved effective in building practical skills alongside theoretical knowledge. This outcome aligns with the underlying philosophy of the SBTS, which emphasizes integrating scientific knowledge with vocational skills to cultivate innovation. The training successfully supported this mission by helping teachers develop the pedagogical tools needed for innovation-focused education. Significantly, teachers showed a clear shift in their perceived roles—from traditional 'knowledge givers' to 'advisors and facilitators.' This transformation reflects an evolving teaching culture that is more conducive to fostering students' innovative and critical thinking and autonomy.

In summary, the workshop achieved comprehensive professional development outcomes, enhancing both teachers' understanding of the PjBL approach and their broader teaching competencies. Teachers developed essential skills in reflective practice, interdisciplinary thinking, and collaborative teaching approaches. These developments directly support the long-term goals of the SBTS. By equipping teachers with innovative pedagogical tools and mindsets, the training creates a foundation for preparing students to become skilled innovators who can effectively apply scientific knowledge to solve real-world challenges in vocational and professional contexts. The workshop's success demonstrates that targeted professional development can create a ripple effect: better-prepared teachers lead to more engaging learning experiences, which ultimately produce graduates who are ready to drive innovation in their chosen fields.

7) Conclusion

This study demonstrates that systematically designed professional development activities, grounded in the Project-Based Learning (PjBL) approach, can significantly enhance teachers' instructional capabilities in vocational education settings. Using action research and reflective practice methodologies, the research team successfully developed and delivered a prototype training model. This model achieved dual objectives: it increased teachers' knowledge of the five-step PjBL process while simultaneously promoting important pedagogical shifts toward learner-centered and innovation-focused teaching approaches. The results confirm that well-structured professional development can effectively bridge the gap between educational theory and classroom practice, enabling teachers to transform their instructional methods in ways that better prepare students for real-world challenges.

The results show measurable improvements in teachers' understanding across all key areas of PjBL, particularly in identifying learner competencies and integrating them into project-based instruction. The combination of pre- and post-training assessments, reflective learning activities, and the PLC successfully fostered a culture of continuous improvement and collaborative learning among teachers. The study also highlights the critical importance of aligning teacher training with real classroom contexts, expected student outcomes, and institutional objectives. The training's emphasis on practical application—through scenario-based learning, collaborative lesson planning, and critical reflection—contributed to deeper and more sustainable adoption of PjBL practices. This comprehensive approach ensured that teachers not only understood PjBL theory but could also effectively implement it in their specific teaching environments, leading to lasting pedagogical change.

These findings contribute significantly to vocational education reform in Thailand, particularly within the Science-Based Technology School (SBTS) initiative. By equipping teachers with the tools, knowledge, and confidence to deliver PjBL effectively, this training model represents a crucial step toward preparing future technologists and innovators. The ultimate goal is to produce graduates who can successfully navigate and contribute to Thailand's evolving technology-driven economy. When teachers can effectively implement project-based learning, they create educational experiences that mirror real-world problem-solving, better preparing students for the challenges and opportunities they will face in their professional careers.

8) Acknowledgement

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