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RESEARCH ARTICLE

Integrating Professional Learning Communities into a Blended Learning Framework for Thai Vocational Water Management Education

Ratchita Sarimanond[1], Chantana Viriyavejakul[2*], and Paitoon Pimdee[3]

[1,2,3] School of Industrial Education and Technology (SIET), King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand

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***Corresponding Author:**

chantana.vi@kmitl.ac.th

ABSTRACT

This study addresses the need for an innovative approach to water management education in Thailand's agricultural and technology vocational colleges by developing and evaluating a blended learning model integrated with a Professional Learning Community (PLC). The model enhances instructional quality in water management courses through collaborative and applied learning. Research methods included semi-structured interviews, small group discussions, and a suitability assessment. Data were analyzed through content analysis and statistical measures, including mean and standard deviation. Findings revealed four core components of the blended learning (BL) model, termed KUCAT: Knowledge Understanding (KU), Collaboration (C), Application (A), and Training (T). Additionally, the PLC framework incorporated four key elements: Brainstorming (B), Experience Sharing (E), Support (S), and Practical Transfer (T). Expert evaluations indicated a high level of suitability for this blended model, underscoring its potential to bridge current gaps in water management education by providing a practical, community-oriented curriculum design. This study contributes to vocational education literature by filling a gap in water management education and offering a scalable model that merges blended learning and PLCs, which can be adapted in similar contexts globally.

INTRODUCTION

The integration of water management education within Thailand's vocational curriculum represents a vital reform, given the growing challenges of water scarcity and sustainable resource management. Recognizing the need for skilled professionals, Thailand's Ministry of Education has proactively launched initiatives like the Royal Chonlakorn Community Water Management Project to embed water management skills within agricultural colleges nationwide (AGS International, 2020). Established through an MOU, this project aims to foster collaboration among water management stakeholders, including educational institutions and local communities, by providing vocational students with specialized training to become "Chonlakorn" or water experts (Phanthuwongpakdee, 2016). By emphasizing community engagement, the curriculum aspires to elevate students' ability to apply science, technology, and innovation (STI) to local water management challenges, thus enhancing rural quality of life.

The curriculum's unique focus on hands-on, community-based education allows colleges to tailor content to local needs, empowering graduates to directly contribute to their communities upon completing their studies. This model aligns with Thailand's broader goals for sustainable development, as the curriculum prepares students to lead in local water management initiatives, leveraging modern technology and scientific practices. According to Sarimanond and Viriyavejakul

(2021), integrating vocational education with advanced technological resources can serve as a bridge to modernize water education, aligning with Thailand's educational modernization goals.

As vocational colleges shape future water management leaders, this initiative dovetails with broader educational reforms advocating green skills development within Thai vocational institutions (Napathorn, 2022). Thailand's shift towards a bioeconomy, circular economy, and green economy (BCG) further underscores the need for environmental awareness and practical green skills in educational programs. The Chonlakorn project exemplifies a crucial step toward this transition, as vocational institutions can create a new generation of eco-conscious practitioners well-equipped to address local and national environmental challenges.

In parallel, recent studies indicate that sustainable development (SD) integration is gaining traction within Thailand's higher education institutions (HEIs) (Dawodu et al., 2022), mainly through sustainability assessment initiatives like the UI Green Metric (Tabucanon et al., 2021). This trend highlights an opportunity for vocational education to incorporate similar sustainability metrics, ensuring programs like Chonlakorn remain relevant and aligned with global and national sustainability standards.

This paper contributes to the growing body of research advocating blended learning models within vocational education (Jayalath & Esichaikul, 2022; Krismadinata et al., 2020). In the initial phase, researchers developed a *professional learning community* (PLC) among vocational educators specializing in agriculture and technology (Ellis, 2024; LaFlamme, 2023), which involved the creation of a blended water management curriculum. This development process included a structured approach: synthesizing research, designing a blended curriculum, forming a collaborative learning model, implementing the blended learning curriculum, and evaluating its effectiveness with input from subject matter experts. The collaborative process provided essential feedback, enriching the research approach and laying a foundation for enhancing vocational education in Thailand to meet both local and global sustainability goals.

Research objectives

RQ1: To develop a blended learning model for a water management curriculum within the PLC for teachers at agricultural and technology colleges.

RQ2: To evaluate the suitability of the blended learning model for a water management curriculum within the PLC for teachers at agricultural and technology colleges.

LITERATURE REVIEW

Blended learning (BLARN)

Blended learning (BLARN) integrates virtual and physical learning components, combining online and traditional methods to create a hybrid approach that enhances educational delivery and student engagement (Al-Qatawneh et al., 2020; Yu et al., 2022). Defined by a fusion of instructional modalities, BLARN has evolved as an effective model across educational settings, merging online and face-to-face formats to foster a multifaceted learning experience (Cao, 2023). Studies have shown that BLARN increases learner performance by promoting critical thinking, increasing knowledge retention, and developing language skills, ultimately creating a more comprehensive learning environment (Spanjers et al., 2015). Furthermore, research consistently highlights BLARN's impact on student motivation, satisfaction, and engagement, which are vital contributors to academic success (McCutcheon et al., 2018; Mueller et al., 2020).

For vocational education, particularly in fields requiring hands-on skills like water management, BLARN offers distinct advantages. Vocational students benefit from interactive, practical learning models that allow them to engage actively in problem-solving and application-based learning. Studies indicate that BLARN fosters higher-order cognitive skills, enhancing communication and analytical abilities—attributes essential for technical professions (Liu, 2016; Shorey et al., 2018). In the Thai context, where vocational education is vital in preparing skilled workers for sectors such as agriculture and technology, implementing BLARN can bridge the gap from theoretical knowledge to real-world application.

The flexibility inherent in BLARN also supports personalized learning, allowing students to move at their own pace and revisit material as needed, a benefit crucial for diverse learners in vocational programs. Research indicates that BLARN can improve language and technical skills through varied online and offline interactions, reinforcing students' grasp of practical competencies necessary in the workplace (Zhou, 2018; Yang et al., 2013). By blending traditional and digital learning environments, vocational education can better accommodate individual learning styles and enhance student engagement, a significant advantage given the practical orientation of these programs.

Moreover, vocational education requires a strong focus on industry readiness. In this regard, BL offers a model that incorporates active, real-world problem-solving, which is crucial for programs aiming to develop job-ready graduates. Integrating BLARN with a professional learning community (PLC) offers additional support (Ellis, 2024; LaFlamme, 2023), promoting collaboration and exchanging best practices among educators. In this study, the integration of BLARN into Thailand's water management curriculum for vocational educators was aimed at preparing students for community-based environmental challenges through a structured, collaborative approach to teaching and learning.

Research also shows that BLARN models incorporating PLCs benefit from teacher collaboration and knowledge-sharing. A PLC provides a platform where educators can engage in continuous professional development, refine teaching strategies, and discuss curriculum improvements based on real-time classroom experiences (Inal & Korkmaz, 2019). This collaborative model can be particularly impactful in water management education, as it allows teachers to integrate feedback and adapt the curriculum based on local environmental conditions, a vital component in Thailand's agriculture-focused regions.

While BLARN has shown success in various educational contexts, it has challenges. Studies suggest that instructional design, student self-regulation, and technological access can affect BLARN outcomes. For example, a study by Siripongdee et al. (2020) showed that the success of BLARN in integrating technologies hinges on providing adequate support systems, such as IT skills training for teachers and reliable online resources. The lack of standardized approaches to combining online and traditional methods has led to mixed results in some studies, suggesting the need for more targeted research to optimize BLARN in vocational settings (Chang et al., 2014; Yick et al., 2019).

In Thai vocational education, particularly in specialized fields like water management, BLARN combined with a PLC framework offers a promising model for developing industry-relevant skills. The PLC component fosters a community of practice among teachers, where they can collaboratively address challenges and refine pedagogical strategies. This integration of BLARN and PLCs can enhance vocational training by creating a dynamic learning environment that shifts with the ever-changing requirements of industries and communities, helping bridge the skills gap in Thailand's green economy goals.

In summary, BLARN's adaptability suits vocational education's practical requirements well, especially with a PLC framework that encourages collaborative professional growth among educators. By leveraging BLARN and PLCs, vocational programs can provide a positive educational experience that balances online accessibility with hands-on learning, making it a valuable tool for preparing students for the demands of the modern workforce.

Professional learning communities (PLCs) and school learning communities (SLCs)

A PLC is a collective effort wherein teachers, administrators, and educators collaborate and learn together within a culture of relationships (Armwood, 2023; Yu & Chao, 2023). This collaboration grows from a shared vision, common values, goals, and missions, fostering teamwork (Clark et al., 2023; Sam, 2024). In this learning community, teachers lead collectively, and administrators support learning and professional development. Thus, the emphasis is on cultivating a culture that underscores the success and effectiveness of learners and fosters the happiness and collaboration of all stakeholders within the learning community.

Similar to PLCs is the concept of SLCs, which are educational environments designed to ensure equitable access for all students (Kunlasomboon et al., 2015; Mala, 2019). Originating in Japan in the 1990s with Manabu Sato of the University of Tokyo, SLCs are rooted in collaborative learning

involving students, teachers, and parents in continuous school reform (Sato, 2018). Over 4,000 SLCs were established in Japan, subsequently expanding throughout Asia as an effective model for school improvement (Lim, 2015). Murase (2018) attributes the appeal of SLCs to their support of teacher autonomy, collaborative vision, and alignment with educational theories such as Vygotsky's Collaborative Learning, Schön's Reflective Practice, and Dewey's Democracy in Education.

SLCs emphasize cross-disciplinary collaboration, where teachers engage beyond subject boundaries, sharing teaching practices and reflecting on observed lessons. This reflective approach, Lesson Study for Learning Community (LSLC), promotes a deep understanding of student learning (Saito et al., 2014). In SLCs, teachers work in groups based on grade level rather than subjects, facilitating discussions that transcend traditional lesson planning to focus on observations and refinements. Regular bi-monthly meetings allow teachers to exchange insights, enhancing collective understanding and improving student learning experiences.

This collaborative model aligns closely with the Professional Learning Community (PLC) framework, which is widely adopted in Thailand to improve teaching quality through continuous professional development (Tanyarattanasrisakul, 2017). Like PLCs, SLCs empower educators to address challenges collaboratively, improving teacher morale, fostering student motivation, and increasing job satisfaction (DuFour & Eaker, 2009; Kenan Foundation Asia, 2019). Research shows that Thai PLCs are most effective when community members actively participate, promoting shared visions and values (Tanyarattanasrisakul, 2017).

Thailand's educational strategy aligns with these principles, mainly through the National Strategy 2018-2037, which underscores competency-based education and community engagement for local development (Wannapiroon & Pimdee, 2022). This alignment with SLC/PLC methodologies supports Thai education in adapting to the evolving demands of the 21st century.

In the context of recent educational shifts—accelerated by the COVID-19 pandemic—PLCs and SLCs are instrumental in overcoming challenges associated with remote learning. The pandemic underscored the need for flexible, technology-integrated learning environments, pushing educators toward digital, collaborative, and self-directed learning models (Klinbumrung, 2020; UNESCO, 2020). These models have helped navigate pandemic-related disruptions and opened avenues for more personalized learning approaches (Chinchua et al., 2022). Today's rapidly changing society demands that students develop digital literacy, critical thinking, and creative problem-solving skills, which are essential in building a digitally skilled workforce aligned with Thailand 4.0's vision for a sustainable, knowledge-based economy (Changwong et al., 2018; Duangpummes & Kaewurai, 2017).

Adapting to these changes requires transforming teaching roles, with educators evolving from knowledge transmitters to learning facilitators and mentors. Studies indicate that teachers in digital environments must support students in integrating knowledge into real-life contexts, an approach consistent with 21st-century learning principles (Binheem et al., 2021; Jukes & Schaaf, 2018). Effective use of digital tools and continuous self-improvement is essential for teachers to remain relevant in this dynamic landscape (Jukes & Schaaf, 2018).

Thus, SLCs and PLCs offer structured approaches to Thai education to meet these needs. By fostering shared values, open communication, and active parental involvement, SLCs create a supportive, collaborative culture where educators and students learn continuously from one another (Sato, 2016).

Community-based water management project under royal initiatives

The Community-Based Water Management Project, initiated under royal patronage (GC, 2024), is a collaborative effort that involves colleges specializing in agriculture and technology. This project aims to create a prototype for effective water management and rainwater storage tailored to the needs of each participating institution. This initiative is central to fostering knowledge development through Science, Technology, and Innovation (STI), particularly for agricultural vocational students. The project organizes activities where selected students from each college receive mentorship from senior university students, working together under the guiding principle of ‘Our Water.’

The project extends its impact beyond the institutions, reaching out to surrounding communities to ensure the knowledge gained is shared and integrated locally. The core objective is to increase awareness of water usage in daily life, its role in various occupations, and its importance in income generation. Ultimately, the project aims to enhance the quality of life for community members by promoting sustainable water practices and improving the local agricultural landscape.

Educational technology and innovation in water resource management

An earlier study by the authors explored the modernization of education in the northeastern region of Thailand, with a particular focus on integrating technology into primary education. The study involved a comprehensive analysis of documents and reports on the region's educational landscape. Its objective was to identify how educational modernization and technological innovations were being applied in the context of local schools and vocational training.

The study highlighted four key initiatives exemplifying the intersection of educational advancement and technology use in northeastern Thailand:

- A model for upgrading STEM education.
- Teaching via television.
- Utilization of the three innovations principles.
- Community-based water management education for agricultural vocational students.

These initiatives reflect the growing role of technology in education, particularly in areas like water resource management and vocational training, and underscore the importance of educational innovation in fostering practical, community-based solutions to regional challenges.

METHODOLOGY

This study utilized a qualitative research design to establish a Professional Learning Community (PLC) for blended learning in the College of Agriculture and Technology water management curriculum. The research aimed to develop and assess a blended learning model for water management within the context of a PLC. Critical stages of the methodology included conducting interviews, facilitating a focus group discussion for expert feedback, and evaluating the model's suitability. The conceptual framework guiding this research is illustrated in Figure 1.

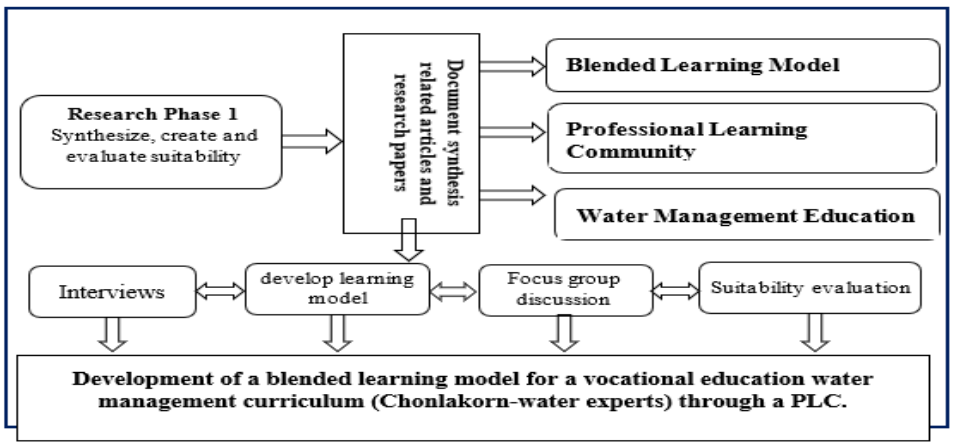

Figure 1: Conceptual framework for phase 1

Source: The authors

Research design

The study adopted a qualitative approach, with interviews as the primary method to explore the formation of a PLC that supports blended learning in water management education. The initial phase involved synthesizing relevant principles and theories from research articles, books, and journals to establish a foundation for the PLC. This literature review provided an understanding of the target population, including educational institutions and teaching personnel, to identify members for the

PLC at a Thai college involved in teaching agriculture and technology. The research aimed to promote a collaborative learning environment within the PLC, focusing on addressing water management challenges and student needs, thereby informing the development of an appropriate blended learning model.

Following the model development, a focus group discussion was organized to collect expert feedback on the model. This group comprised water management professionals and education specialists who provided insights on refining and enhancing the learning model.

Data sources

1. Data were obtained from three key groups:
2. Directors of 10 colleges of agriculture and technology
3. Three experts in water management
4. Two experts in educational technology

Research tools

This study used two primary qualitative research tools: a semi-structured interview form and a suitability evaluation form for the blended learning model.

1. **Interview form for establishing the PLC:** This tool gathered foundational data on the target group to establish the PLC. The interview form comprised three sections:

   Section 1: Personal information of interviewees.

   Section 2: Insights on establishing a PLC for blended learning in water management for teachers.

   Section 3: Solutions to learning challenges in water-based management through the PLC process.

The interview form was validated by five experts, achieving an IOC between 0.75–1.00, which indicates strong validity.

2. **Suitability evaluation form for the blended learning model**: This form evaluated the appropriateness of the model with five measurement levels. It was divided into two main parts:

   Part 1: Expert demographic information

   Part 2: Feedback on the blended learning model for water management through the PLC, organized into four sections:

      Section 1: Knowledge Understanding (KU)

      Section 2: Collaboration (C)

      Section 3: Application (A)

      Section 4: Knowledge Transfer (T)

This form's validity was also reviewed by five experts, resulting in an IOC of 0.60–1.00, confirming its suitability.

Data collection

1. Interviews for establishing the PLC

The researcher began data collection by sending a formal request for cooperation to each agriculture and technology college director, explaining the study's goals. Individual interview appointments were scheduled with participants, during which the researcher outlined the interview objectives and recorded responses.

2. Focus group discussion

A focus group discussion was held on December 16, 2022, from 9:00 a.m. to 12:00 p.m. The discussion, guided by open-ended questions, allowed experts to provide critical feedback on the blended learning model. The moderator presented the discussion structure and objectives,

facilitating an interactive exchange of ideas and suggestions. Experts contributed opinions on various aspects of the model, enhancing the overall understanding of its effectiveness and areas for improvement.

3. Evaluation of model suitability

Experts in educational technology and water management education assessed the developed blended learning model for its suitability in vocational training for the water management curriculum.

Data analysis

1. Content analysis of interview and focus group data

Data from the interviews and focus group discussions were analyzed through content analysis, synthesizing feedback to refine the blended learning model. After the focus group, key insights were summarized, presented to participants for confirmation, and carefully documented for analysis.

2. Suitability evaluation analysis

The model's suitability was analyzed using the mean and standard deviation (SD). A five-point Likert scale rated the model's suitability as follows: 4.50–5.00: Most Suitable, 3.50–4.49: Very Suitable, 2.50–3.49: Moderately Suitable, 1.50–2.49: Less Suitable, and 1.00–1.49: Least Suitable.

RESULTS

Figure 2 details the steps leading to the final blended learning model.

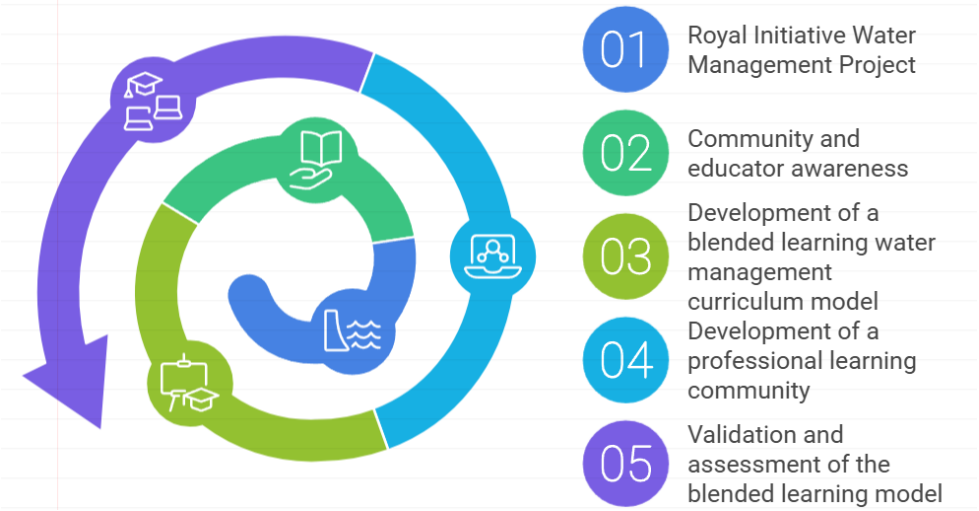

Figure 2: Blended model development steps

Source: The authors

Development steps for the blended learning model for water management curriculum (KUCAT-BEST model)

The development of the blended learning model for water management in the College of Agriculture and Technology progressed through a structured series of steps, incorporating both blended learning strategies and professional learning community practices. This led to the creation of a comprehensive model, known as the "KUCAT-BEST Model," aimed at enhancing teaching and learning outcomes.

1. Blended learning (KUCAT model)

The initial phase of development focused on constructing a blended learning model tailored to the water management curriculum. Researchers identified four foundational elements, termed the KUCAT model:

- **Knowledge understanding (KU):** Emphasizing a solid grasp of fundamental concepts.
- **Collaborative learning (C):** Encouraging cooperative learning among students.
- **Application (A):** Focusing on practical, real-world application of knowledge.
- **Training (T):** Prioritizing skill-building through structured practice.

These elements were integrated to establish a dynamic and interactive learning environment, where collaborative and hands-on activities support theoretical knowledge. It should be noted that the model initially established a 70/30 proportion between online learning and classroom learning for KU. Collaborative learning (C) was also assigned 30% to online learning and 70% to classroom learning. The application process (A) was assigned 40% to online learning and 60% to classroom learning. The training process (T) was assigned 50% to online learning and 50% to classroom learning.

2. Professional learning community (BEST model)

Parallel to developing the KUCAT Model, researchers formulated a Professional Learning Community (PLC) model to support the water management curriculum. This model, known as BEST, comprises:

- **Brainstorming (B):** Facilitating creative problem-solving and idea-sharing among teachers.
- **Experience Exchange (E):** Promoting the sharing of teaching experiences and best practices.
- **Support (S):** Providing peer and institutional support to foster a collaborative teaching environment.
- **Transfer (T):** Encouraging the transfer of effective teaching methods and practices.

The BEST model enables teachers to collaborate within a community setting, helping them to refine their teaching strategies and adapt to curriculum needs continually.

3. Integration into the KUCAT-BEST model

Finally, the researchers combined the blended learning (KUCAT) and PLC (BEST) components, creating a unified KUCAT-BEST Model. This model leverages blended learning and professional collaboration strengths to foster a supportive educational environment that emphasizes knowledge development, application, and community-based teaching practices.

Figure 3 shows the KUCAT-BEST Model which aims to improve educational outcomes by supporting continuous professional development for teachers and engaging students in an enriched, blended learning experience. This model is proposed as a framework for effectively teaching a water management curriculum in Thailand, with the ultimate goal of 'Learning Achievement.'

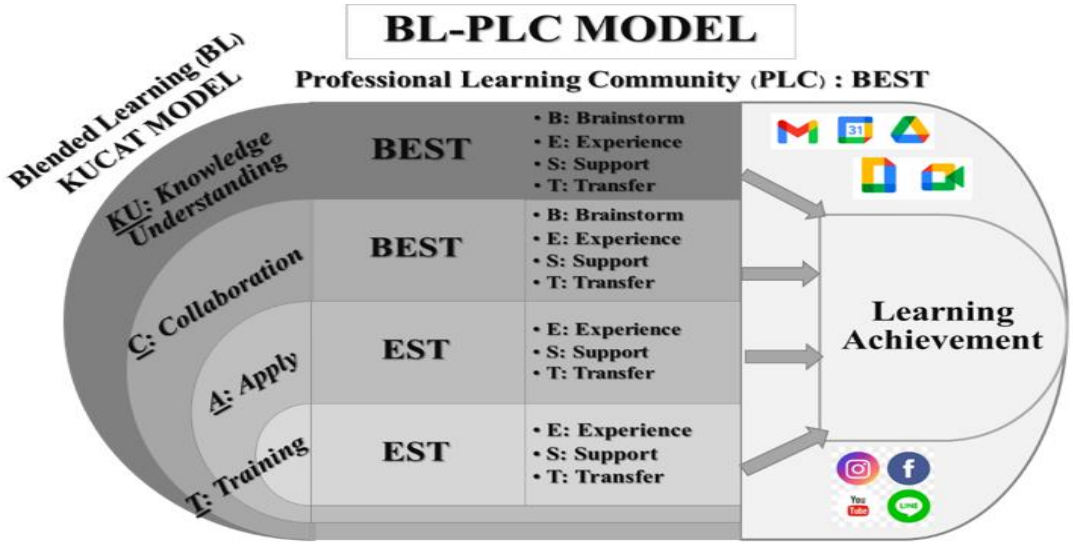

Figure 3: Final blended learning PLC model

Source: The authors

Suitability evaluation of the blended learning model for water management through a professional learning community

The blended learning model for water management, was evaluated for its suitability in a PLC context. Table 1 presents each model component's mean, standard deviation, and suitability ratings.

Table 1: Suitability evaluation of the blended learning model

Components	$\bar{x}$	S	Suitability
Knowledge Understanding: KU & PLC: BEST	4.59	0.39	Most
Collaboration: C & PLC: BEST	4.40	0.44	Very
Apply: A & PLC: EST	4.52	0.53	Most
Training: T & PLC: EST	4.46	0.52	Very
Summary	4.49	0.45	Very

The data indicate that the blended learning model achieved a high overall suitability rating ($\bar{x}$= 4.49, S = 0.45), with each component rated at or near the highest level. Moreover, knowledge understanding (KU) received the highest suitability rating, followed by application and collaboration. These results reflect experts' agreement on the model's suitability for teaching water management, especially given its new integration into vocational education.

DISCUSSION

Expert recommendations from focus group discussion

Based on a focus group discussion, experts provided valuable recommendations for refining the blended learning model for water management. The essential suggestions are as follows:

1. Practical application of the model

Experts noted that while the model is clear, additional clarity was needed for its practical application. Developing an actionable learning plan incorporating social media platforms was recommended to enhance the model's relevance and ease of implementation.

2. Balancing online and classroom learning

Experts advised carefully determining the balance between online and classroom activities to optimize blended learning. They also suggested defining the percentages of academic (theoretical) and technical (practical) activities to create a well-rounded learning experience.

3. PLC component tools and models

For each PLC component, experts recommended exploring tools and models suited explicitly for classroom and online environments to support blended learning effectively.

4. Inclusion of contemporary educational keywords

To modernize the research, experts advised incorporating current educational terms such as "hard skills," "soft skills," and "mindset" to reflect recent educational trends.

5. Alignment with the chonlakorn curriculum

When planning data collection, it is crucial to ensure alignment with the Chonlakorn (water experts) curriculum used in each college. This will ensure that the research goals and data collection methods correspond with the curriculum's teaching plans.

Development and structure of the blended learning model

The blended learning model for water management through a professional learning community integrates four essential blended learning elements:

1. Knowledge Understanding (KU)
2. Collaboration (C)
3. Application (A)
4. Training (T)

These are further reinforced through four PLC elements:

1. Brainstorming (B)
2. Experience Exchange (E)
3. Support (S)
4. Transfer of Practice (T)

The KUCAT-BEST Model, offers a unique approach for vocational teachers by combining direct learning with community-based collaboration. Teachers benefit from peer support and self-paced online content, allowing flexibility and enhanced accessibility to educational resources. These elements align with numerous blended learning principles and support the flexible learning needs emphasized by Saengrith et al. (2022). The model promotes ongoing professional collaboration within the college, establishing a system where teachers and administrators work together to address challenges and develop solutions. This approach reflects the community-focused, collaborative learning models described by Lim (2015), Murase (2018), and Sato (2018)

CONCLUSION

Experts found the KUCAT-BEST blended learning model highly suitable for implementation in the water management curriculum ($\bar{x}$ = 4.49, S = 0.45). Among the components, *knowledge understanding* was rated highest, followed by *application*. The slightly lower rating for *collaboration* reflects the unique challenges of implementing community-based water management education, which introduces new content at the vocational level.

Given the diverse educational backgrounds of vocational teachers, this model emphasizes a foundational understanding of water management. Experts highlighted the importance of integrating theoretical knowledge with practical skills, facilitating the application of learned concepts in community contexts. By doing so, the model supports knowledge acquisition and fosters community-based knowledge sharing, empowering teachers to deliver water management education effectively.

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