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The development of a training course for enhancing the production of innovative learning and classroom action research for physical education teachers

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ABSTRACT

The objectives of this research were: i) to study the essential needs; ii) to develop a training course; and iii) to test the effect of the training course for enhancing the production of innovative learning (IL) and classroom action research (CAR). The researcher used cluster sampling to study essential needs with a sample of 165 physical education teachers. The tool was an essential needs assessment. Data were analyzed by finding the priority needs index (PNI)-modified. The course was developed by checking the utility, feasibility, propriety, and accuracy of five experts. Data were analyzed using a one sample t-test. Then the researcher experimented of the course with a sample group of 30 physical education teachers from the Office of Secondary Education Service Chon Buri Rayong, obtained by purposive selection. The tools used were a training course, a knowledge test, an attitude test, and a practical skills assessment form. Data analysis was conducted to determine the efficiency of a training course according to the training process outcome (E1/E2) correlation criterion, which stipulated the 80/80 standard. Results found that the training course to produce IL and CAR for physical education teachers had an efficiency was by the established criteria.

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1. INTRODUCTION

Education is essential for both individual and societal development. It shapes people to meet societal needs and drive social progress. In the 21st century, with global interconnections and rapid changes in knowledge, 21st century skills are vital for learners. These skills prepare individuals for the workforce and enable effective collaboration. Education must integrate diverse disciplines to support student success, contributing to national development. The goal is to nurture well-rounded citizens with intellectual, moral, and ethical values, as well as essential life skills. Teachers play a crucial role as guides, helping students develop creativity, leadership, and a continuous learning mindset [1]–[3]. Currently, teaching quality is evaluated through indicators such as the use of appropriate media, technology, learning resources, and innovative learning (IL) or classroom action research (CAR) to address teaching challenges and improve student development.

In physical education, creating engaging and effective learning experiences is crucial for promoting children's health, skills, and values. However, challenges such as lack of experience, inadequate facilities, and limited creativity in teaching materials hinder progress. As technology advances, physical education teachers must adapt, transitioning from instructors to facilitators. Nevertheless, the limited focus on IL and CAR in

physical education underscores the need for specialized training to enhance teaching effectiveness and student outcomes [4]–[6].

From the outbreak of COVID-19 until spring 2022, teachers swiftly adapted to digital education, leveraging peer support through both online and offline learning communities. This shift fostered innovative teaching practices with technology integration. In physical education, the emphasis on self-learning post-pandemic sparked student creativity. Still, physical education and online sports created stress for students, highlighting the need for appropriate materials and innovations to maximize learning potential. Many teachers lacked information and communication technology (ICT) training during their initial education, and rural schools faced challenges in accessing necessary infrastructure. Therefore, continuous professional development is essential for teachers to effectively apply technological innovations in education.

Technology serves as a key resource to enhance teaching efficiency and support independent learning through various online tools [7]–[11]. Technology remains important for realizing practical solutions to challenges in everyday life, especially during times of crisis when innovation is essential. Wearable technologies are devices worn in proximity to the body, providing their users with data and information that could enhance learning in many ways. In the educational context, these technologies offer promising applications in key areas such as teacher-student interaction, learner engagement, assessment practices, and feedback mechanisms, thereby presenting innovative and practical solutions for physical education [12]. This aligns with the work of Abe-Hiraishi et al. [13], who established a sports training program designed to deliver both instructional and clinical sports experience in accordance with international standards. The program integrated innovation and technology use in sports, enabling trainers to enhance their competencies through effective program development methods. Dužević et al. [14] stated that educational management should prioritize innovative practices to improve the quality of higher education, recommending management guidelines to enhance learning quality.

CAR is a form of research conducted by teachers within their own classrooms, aimed at improving instructional practices and student learning outcomes. It addresses real-time challenges in the teaching-learning process, allowing educators to test and refine new strategies, methods, or materials. The findings are directly applicable, enabling immediate reflection and collaboration among colleagues for continuous improvement. CAR supports informed decision-making in instructional planning and educational management, contributing to the development of effective teaching practices. Ultimately, it fosters professional growth and positions research as a central element in educational development. Previous studies [15]–[20] found that most teachers conducted informal CAR to address behavior issues and promote child development, using their findings more frequently, though still in a limited manner. Also, the impact of CAR was significantly greater than standard teaching, with a statistical significance at the 0.05 level. Action research is a key tool in teacher education, fostering positive change in educational practices. Studies in physical education demonstrate that CAR can improve programs, benefiting students. Teacher development approaches, such as training courses, are essential for enhancing educators' knowledge and skills, enabling them to integrate technology and adopt student-centered teaching methods.

Although previous studies have found continuous development of teacher training course related to produce IL and CAR, there has been no mention of specific training curricula for physical education teachers who may organize learning activities that emphasize practical skills, use sports-related concepts in innovation design, and implement classroom research experiments to ensure students achieve comprehensive learning outcomes including knowledge, attitudes, sports skills, physical fitness, and characteristics, which may differ from teachers in other subject areas. Therefore, developing this training course is one of the activities that help strengthen teachers to be more efficient and complete. In developing the training course, the researcher has studied the necessary needs for enhancing the capacity to produce IL and CAR so that physical education teachers can benefit from the training course as much as possible with quality that meets the educational professional standards of the Teachers Council of Thailand and are ready in the teaching profession to serve the society and the nation. It can also serve as a guideline for physical education teacher training institutions both in Thailand and abroad to develop specialized training course for physical education teachers that align with their specific contexts.

2. LITERATURE REVIEW

The researcher studied the course development guidelines of studies [21]–[23] and found that the steps of training course development consisted of: i) study for essential needs; ii) course outline preparation, iii) course trial and evaluation; and iv) course effectiveness finding. Then, the researcher studied the components of the training course in the study by Tyler [24] which found that the components of the training course consisted of: i) objectives of the training course; ii) contents of the training course; iii) training methods; iv) training materials;

and v) measurement and evaluation of training courses. The research on developing of a training course to produce IL and CAR for physical education teachers was a research and development study.

There were three phases of research methods. Phase 1 is about studying the needs needed to enhance the production of IL and CAR for physical education teachers. Phase 2 is about development of a training course enhancing the production of IL and CAR for physical education teachers. Phase 3 is about trial and evaluation of the training course for enhancing the production of IL and CAR for physical education teachers. It includes studying research related to the study by Syahid *et al.* [25] which examined the development of a structured training course aimed at enhancing ICT competencies in elementary school teachers. A survey of teachers' abilities informed the design of the course, which was found to align well with their needs. Fu *et al.* [26] identified key factors influencing teacher training needs, including the training format, content, intensity, opportunities, and practicality, as well as subjective, organizational, and environmental factors. Furthermore, Waltz [27] evaluated the effectiveness of tutor training and field experiences for service-prepared teachers, concluding that such training significantly enhanced teachers' self-efficacy and content knowledge, as shown in the conceptual framework in Figure 1.
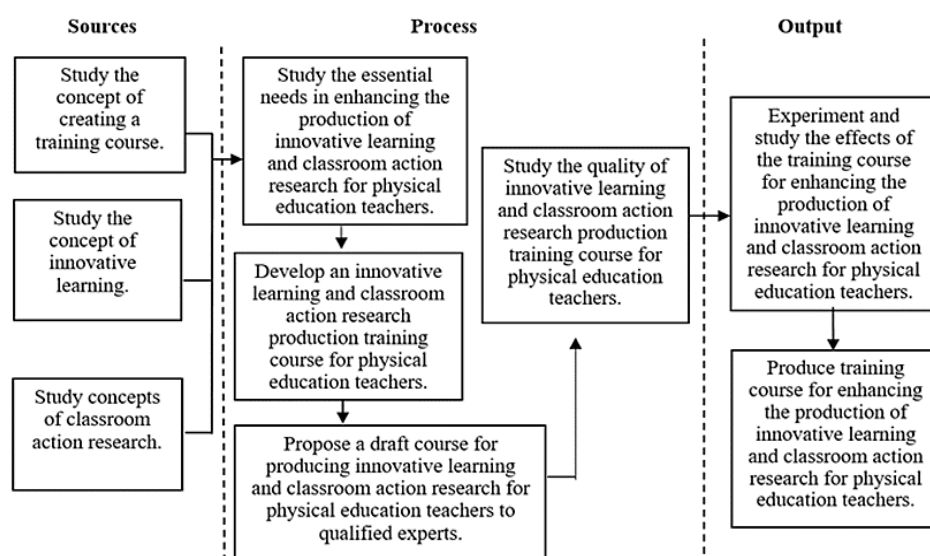

Figure 1. Conceptual framework

3. METHOD
3.1. Objectives
This study is conducted with three main objectives. First, to study the essential needs for enhancing the production of IL and CAR for physical education teachers. Second, to develop a training course for enhancing the production of IL and CAR for physical education teachers. Third, to test and study the effect of the training course on enhancing the production of IL and CAR for physical education teachers.

3.2. Methodology
The sample group were 165 physical education teachers, Office of Secondary Education Service Chon Buri Rayong in academic year of 2021 by studying the essential needs for enhancing the production of IL and CAR, obtained by cluster random sampling; and the group of informants to examine the standards of utility, feasibility, propriety, and accuracy [28], consisted of five experts selected by purposive sampling; and the sample group in the experiment and study the effect of the training course for enhancing the production of IL and CAR included 30 physical education teachers, derived from purposive sampling.

The tools used in the research were essential needs assessment, standard assessment, and a training course for enhancing the production of IL and CAR for physical education teachers. Knowledge assessment instruments on IL and CAR: i) knowledge enhancement worksheet No. 1.1: the principles and production process for IL (IOC=0.80-1.00, α=0.86); ii) knowledge enhancement worksheet No. 1.2: use of technology in teaching and assessment (IOC=0.80-1.00, α=0.89); iii) knowledge enhancement worksheet No. 1.3: determination of process efficiency (E1) and outcome efficiency (E2) (IOC=1.00, α=0.90); iv) knowledge enhancement worksheet No. 2.1: title, objectives, study variables, hypothesis, action, and data analysis

(IOC=1.00, α=0.84); v) knowledge enhancement worksheet No. 2.2: tools used in research and tool quality determination (IOC=1.00, α=0.88), and vi) knowledge enhancement worksheet No. 2.3: interpretation of research findings in class (IOC=1.00, α=0.88). A measure of attitudes toward training courses for enhancing the production of IL and CAR for physical education teachers according to the Likert model, which was a 5-point rating scale. (IOC=0.80-1.00, α=0.92), and an assessment form for practical skills to produce IL and CAR for physical education teachers (IOC=0.60-1.00, α=0.83).

Data analysis employed three methodological approaches. First, essential needs were conducted using the modified priority need index (PNI modified). Second, utility, feasibility, propriety, and accuracy standards were validated through one-sample t-test with a threshold value of 3.50. Third, training course to produce IL and CAR for physical education teachers was evaluated using the process-outcome criterion (E1/E2) with which specified criteria of 80/80.

The training course for enhancing the production of IL and CAR for physical education teachers takes two days of training, totalling 15 hours, which has a course structure as in Table 1. Before the training course, there was a meeting conducted for participants. It is to know the purpose of the training course, including providing training handbook, tools, media, and equipment. Also, it is to explain the training method, emphasizing enhanced knowledge, skills, and attitudes through lectures, group discussion, brainstorming, case study, and practice.

Table 1. Structure the training course to enhance productivity, innovation, learning, and CAR for physical education teachers

Course components	Course details
Course principle	1. It is a training course developed to enhance the production of IL and CAR for physical education teachers. 2. It is a training course developed per with professional educational standards. 3. The training course focuses on trainees as the centre. Emphasis on learning from speakers and experienced people. Along with hands-on learning from activities that are designed to enhance the learning experience for physical education teachers
Topic 1: IL	
Objectives	1. To provide physical education teachers with knowledge and understanding of analysis, design, development, application, and evaluation of IL, etc. 2. For physical education teachers to have a good attitude towards the production of IL. 3. For physical education teachers to have basic skills in analyzing, designing, developing, applying, and evaluating IL.
Contents	Unit 1 principles and production processes for IL (120 minutes) Unit 2 applying IL to organize activities (90 minutes) Unit 3 Validating the effectiveness of IL (60 minutes) Workshop 1 IL design (90 minutes) Workshop 2 summarizing results of IL (90 minutes)
Topic 2: CAR	
Objectives	1. To provide physical education teachers with knowledge and understanding of CAR, CAR design for learner development, CAR tools, research statistics in data analysis, and conclusions and discussions, including result reports, etc. 2. For physical education teachers to have a good attitude towards CAR production. 3. To provide physical education teachers with basic skills in designing, using research statistics to analyze data, creating CAR tools, and writing CAR projects.
Contents	Unit 1 CAR design (150 minutes) Unit 2 creation of CAR tools (60 minutes) Unit 3 summary of CAR (90 minutes) Workshop 1 CAR proposal (60 minutes) Workshop 2 data analysis and CAR conclusions (90 minutes)

4. RESULTS

Matrix analysis comparing current and expected conditions revealed priority needs below the 3.50 cut-off point, which is considered below the high-level criterion. The top five essential needs to produce IL for physical education teachers were: i) creating IL; ii) utilizing IL to organize learning activities; iii) examining IL efficiency; iv) designing IL; and v) summarizing IL outcomes and the essential needs to produce CAR for physical education teachers in the top five aspects including i) statistical analysis of research data; ii) discussion of research findings; iii) summarization of research outcomes; iv) interpretation of research data; and v) development of research instruments.

Evaluation of the training course for enhancing the production of IL and CAR for physical education teachers showed that the utility, feasibility, propriety, and accuracy, based on one-sample t-test analysis, were higher than the 3.50 criterion with statistical significance at a 0.05 level. From the experiment and evaluation of the training course for enhancing the production of IL and CAR for physical education teachers, it was found

that the training course to produce of IL and CAR for physical education teachers had efficiency values of E1/E2, equal to 84.04/85.37 which as per the specified criteria. Therefore, the effectiveness of the training process for enhancing the production of IL and CAR for physical education teachers was at a reasonable level overall. Thus, the efficiency of the training outcomes for enhancing the production of IL and CAR for physical education teachers was found to be at a reasonable level, as shown in Tables 2 to 4. Also, the attitude toward training courses for enhancing IL and CAR production for physical education teachers was at the highest level.

From Table 2, the efficiency of the training process for enhancing IL and CAR production for physical education teachers overall was high. From Table 3, the efficacy of IL and CAR enhancement training outcomes for physical education teachers overall was high. From Table 4, the training course for producing IL and CAR for physical education teachers had efficiency values of E1/E2, equal to 84.04/85.37, per the specified criteria.

Table 2. The effectiveness of the training process for enhancing IL and CAR production for physical education teachers

Item	$\overline{X}$	SD	%	Level
1. IL (total score=75)	62.33	3.59	83.11	High
2. CAR (total score=75)	63.73	3.96	84.98	High
Items in total (total score=150)	126.07	5.11	84.04	High

Table 3. The effectiveness of IL and CAR enhancement training outcomes for physical education teachers

Item	$\overline{X}$	SD	%	Level
1. IL (total score=50)	42.00	1.29	84.00	High
2. CAR (total score=50)	43.37	1.22	86.73	High
Items in total (total score=100)	85.37	1.67	85.37	High

Table 4. E1 and E2 of IL and CAR enhancement training courses for physical education teachers

Test	E_1	E_2
Efficiency	84.04	85.37
Interpret	Meet the criteria	Meet the criteria

5. DISCUSSION

The training course for enhancing the production of IL and CAR for physical education teachers developed by the researcher was developed by studying the needs of physical education teachers and taking them to quality checks by qualified experts. Then, the experiment and evaluation were conducted with physical education teachers. It was found that the training course for enhancing the production of IL and CAR for physical education teachers was adequate according to the established criteria. We found that the outcomes after the training course in this study showed a tendency for participants to develop positive knowledge, skills, and attitudes.

The training course designed to enhance the production of IL and CAR for physical education teachers proved effective, meeting established criteria. The course development followed a structured process, prioritizing societal needs. It involved careful planning, defining principles, goals, and course content, alongside the nature of teaching and learning experiences. The implementation phase identified challenges, while the evaluation of results assessed whether the course led to behavioral changes in learners, aligning with course development principles outlined by previous studies [21], [22]. Additionally, the study by Pandya [29] highlighted the need for teacher training reforms in response to the New Education Policy and Revised National Credit Framework, emphasizing the critical role of effective teacher training in improving learning outcomes. According to Karolčík and Marková [30], teachers perceive systemic and environmental factors as significant impediments to instructional quality. Despite independently creating innovations, resource limitations and lack of institutional support restrict implementation, consequently increasing teachers' motivation for continuous professional growth.

Additionally, study of Demchenko et al. [6] stated that the pedagogical conditions for preparing future physical education teachers for inclusive education emphasize prioritizing program content and instructional methods. This includes enhancing theoretical and practical foundations in normative, psychological, pedagogical, and correctional aspects, alongside integrating didactic and developmental technologies within professional methodology courses. The approach also involves reinforcing professional competencies through simulation, reflective practice, and updated teaching placements. Experimental results confirm the effectiveness of this methodology in equipping future educators for inclusive teaching environments. These approaches are consistent with study of Fauziah et al. [31] which stated that training activities to increase writing skills for teachers can improve teachers' understanding and ability to master and implement CAR and can compose writing in the form of CAR. Moreover, Yang et al. [32] highlighted the importance of synchronized course design and team building in clinical skills training to enhance the overall competence of medical students.

Training on enhancing the production of IL for physical education teachers consisted of learning units consisting of principles and production processes for IL, application of IL to organize activities, and validating the effectiveness of IL. There are practical activities consisting of IL design and the conclusion of IL which is suitable for training. Our study indicates that training course participants demonstrated high levels of knowledge and skills in production of IL. They were able to benefit from extending this knowledge to implement it in physical education instruction; using learning innovations to help students achieve their learning outcomes. This aligns with study of Lozano *et al.* [33] which stated that teachers demonstrated a strong interest in exploring various instructional methodologies and strategies, with particular enthusiasm for audiovisual technologies, digital resources such as presentations and infographics, and the integration of virtual reality into teaching practices. Also, another study by Robinson [19] highlighted the role of innovative practices in enhancing education quality in Croatian higher education institutions. Further, Koh and Lee [34] explored how research-based learning methods and IL can be effectively used by teachers to improve teaching practices. This is supported by Wu and Chen [35], which claimed that pedagogical approaches of experiential learning and constructivist learning were effective for teaching innovation management, knowledge management, project management, and risk management in courses at schools. Choktanaprasit *et al.* [36] also reported that teacher development innovations led to improved learning, with results exceeding the expected standards for both activities and tests.

Training on enhancing CAR production for physical education teachers consisted of CAR design, creation of CAR tools, and conclusions of CAR. There were practical activities consisting of designing CAR and summarizing the results of CAR that were suitable for training. Our study indicates that training course participants demonstrated high levels of knowledge and skills in CAR. This can be beneficial for further application in addressing learning outcome problems in physical education subjects. In line with study of Dahniar *et al.* [37], the program's outcomes demonstrate that, in general, the execution of training activities up to mentoring goes without a hitch. Through the use of draft proposals created by teachers who participated in the training, it was determined that the training activities had increased the knowledge of teachers on CAR. Additionally, the response from the participants was quite encouraging; they appeared to be very passionate about taking part in the training session, and they expressed a wish that this activity would continue on a constant schedule.

Putra *et al.* [38] employed CAR following four key stages: planning, acting, observing, and reflecting. Findings revealed progressive improvement in students' speaking skills across each cycle, as evidenced by both behavioral changes and academic performance. The use of action learning strategies effectively reduced students' anxiety, enhanced their motivation, and encouraged freer expression. Aldridge *et al.* [16] emphasized the value of CAR in providing teachers with opportunities to build research skills, which can improve schools and foster leadership in change. Highlighted by Knight [39], training in research ethics positively impacts teachers' development as researchers, particularly in enhancing critical thinking and project design. Tuffrey-Wijne *et al.* [40] demonstrated that students, after completing research training, gained confidence and new opportunities through their projects. Al-Shudaifat [41] stated that the importance of field training in bridging the gap between theory and practice in teacher preparation, with cooperative efforts between university professors and in-service teachers. According to Rusconi and Squillaci [42], the training initiative significantly enhanced educators' abilities to appreciate and accommodate learner diversity, supported the development of universally accessible instructional practices, and empowered teachers to engage in classroom-based inquiry for improving student achievement. While the study of Laily *et al.* [43] outlined that effective course implementation involves planning, needs assessment, and resource provision, with internal and external factors influencing training success and teacher competence.

6. CONCLUSION

The training course on enhancing the production of IL and CAR for physical education teachers created by the researcher is practical according to the criteria, can provide training, and enable participants to have the ability to produce IL and CAR. Recent empirical evidence suggests that participants attained high proficiency levels in both cognitive knowledge and practical skill domains, with attitudinal measures demonstrating the most favorable outcomes. Our findings provide clear evidence that the 15-hour training led to an increase in these outcomes. Therefore, it is proposed that the administrators of the National Sports University can use the research results as guidelines for conducting academic services to the community by training and enhancing the production of IL and CAR for physical education teachers in the responsible province to develop their ability to produce and IL and CAR, making school education management develop effectively.

Furthermore, teachers in subjects related to IL and CAR, and training course development in physical education can use it as an example for teaching and learning to students, including students and those interested in bringing research results to study for further development. The benefits extend beyond developing physical

education teachers specifically in Thailand. The study results can also serve as guidelines for other educational institutions to adapt the model, structure, and methods of the curriculum to design appropriate curricula for developing physical education teachers according to their contexts.

This study focused on developing a comprehensive training course, including training efficiency and effectiveness. However, further in-depth studies may be needed to confirm the short-term and long-term effects of physical education teachers implementing these methods in producing innovations and classroom research with students, as well as feedback from relevant stakeholders. Future research should investigate training programs designed to develop additional competencies among physical education teachers, including authentic assessment and evaluation practices, English language proficiency for professional communication, and the integration of artificial intelligence technologies in physical education pedagogy.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
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Kamonwan Pechsri				✓	✓		✓	✓		✓	✓		✓	

C : **C**onceptualization	I : **I**nvestigation	Vi : **Vi**sualization
M : **M**ethodology	R : **R**esources	Su : **Su**pervision
So : **So**ftware	D : **D**ata Curation	P : **P**roject administration
Va : **Va**lidation	O : Writing - **O**riginal Draft	Fu : **Fu**nding acquisition
Fo : **Fo**rmal analysis	E : Writing - Review & **E**diting	

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

The researchers protect the rights of the participants according to the rights they are entitled to in the research study, including receiving accurate and sufficient information before deciding to participate in the study, and signing a consent form. The use of pseudonyms instead of real names, as well as the non-disclosure of the names of individuals involved or those who may impact the participants, is ensured. The research findings will be presented in the form of conclusions and will be stored on a personal computer with a password to prevent unauthorized access. All documents, CDs, or files will be destroyed at the end of the research. For this research, we have obtained consent from all individuals involved in the study.

ETHICAL APPROVAL

The researcher clearly explained the purpose and the procedures of the study to the participants, and then obtained, in this research, the researcher mainly considered the consent of the sample by selecting the

sample group that met the research objectives. The researcher conducted an ethics request for a research project on human beings, which was reviewed by the Ethics Committee and licensed under Certificate No. 011/2564. All subjects will be informed of the conditions and voluntarily be subjects for the study. The researcher would explain the research details by himself and give the participant a written consent form to sign the consent to be a sample. The researcher protected the samples based on their rights to be informed as samples in the research, i.e., obtaining sufficiently accurate information before deciding to participate in the research, using fictitious names instead of real names, and not revealing the names of those involved or affecting the sample. All names were fictitious, and results were presented in conclusive form without affecting the sample.

DATA AVAILABILITY

Derived data supporting the findings of this study are available from the corresponding author [TS] on request.

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