Empowering Teachers' Learning into Action to Enhance Active Learning in the Classroom

Chalermchai Pondongnok[1,*] & Phrakhrusutheejariyawattana[1]

[1]Mahamakut Buddhist University, Isan Campus, Khon Kaen Province, Thailand

*Correspondence: Mahamakut Buddhist University, Isan Campus, Khon Kaen Province, Thailand. Tel: 66-636-392-519

Received: March 12, 2024 Accepted: May 27, 2024 Online Published: August 26, 2024

doi:10.5430/wje.v14n3p43 URL: https://doi.org/10.5430/wje.v14n3p43

Abstract

This research is a Research and Development (R&D) study aimed at developing educational innovation entitled "Online Self-Training Program to Empower Teachers' Learning into Action to Enhance Active Learning in the Classroom", and implemented in schools. The online self-training program consists of 2 projects 1) a Development project for teacher learning which includes 7 self-training modules, and 2) the implementation of an online self-training program project which includes 1 self-training module to be used as a teaching guideline. The research consists of 4 steps. The final step was an experimental study. The results of the first project found that 12 participating teachers achieved post-test scores that met the standard of 90/90. The average post-test score was statistically significantly higher than the average pre-test score. Additionally, results from the second project found that, according to students' perception scores, the average post-test score was statistically significantly higher than the average pre-test score among 500 students. The results confirm that the "Online Self-Training Program to Empower Teachers' Learning into Action to Enhance Active Learning in the Classroom," is an effective educational innovation for teachers. Therefore, it can be disseminated for the benefit of teachers in schools on a broader scale in the future. Additionally, results from the second project found that, according to students' perception scores, the average post-test score was statistically significantly higher than the average pre-test score among 500 students. The results confirm that the "Online Self-Training Program to Empower Teachers' Learning into Action to Enhance Active Learning in the Classroom" is an effective education innovation for teachers. Therefore, it can be disseminated for the benefit of teachers in schools on a broader scale in the future.

Keywords: online self-training program, teachers' learning, active learning

1. Introduction

Active learning refers to a broad range of teaching strategies that engage students as active participants in their learning during class time with their instructor. Typically, these strategies involve some amount of students working together during class, but may also involve individual work and/or reflection. These teaching approaches range from short, simple activities like journal writing, problem solving, and paired discussions, to longer, involved activities or pedagogical frameworks like case studies, role plays, and structured team-based learning. (Center for Educational Innovation, University of Minnesota, n.d.).

Whenham (2018) stated the benefits of active learning in several dimensions; 1) Develops collaborative skills; 2) Encourages risk-taking; 3) Requires student preparation; 4) Increases engagement; 5) Improves critical thinking; 6) Increases retention; 7) Makes tech more powerful; 8) Sparks creative thinking; and 9) Fosters real problem-solving.

The Open Polytechnic, New Zealand Institute of Skills and Technology (n.d.), provided recommendations for techniques that should be employed to foster active learning in the classroom. These include: writing down what you already know, asking questions as you read, making notes of the main points in your own words, summarising what you read, explaining what you have learned to someone else, and completing all your course activities, not just the reading, take part in course discussions by sharing your ideas and asking questions. New York University (n.d.) suggested recommendations for creating an active learning environment; 1) analyzing needs for implementing an

active learning strategy; 2) identifying topics and questions; 3) identifying learning objectives & outcomes; 4) planning and designing the activity; 5) identify sequence of learning events; 6) evaluate and assess

The aforementioned discussion underscores the significance of active learning and the diverse array of recommendations provided by various experts for its practical implementation within the classroom. These viewpoints encompass a broad spectrum of topics such as definitions, importance, characteristics, developmental approaches, developmental stages, challenges, and challenges in development, as well as assessment methods. These multifaceted perspectives are regarded by the research team as a valuable body of knowledge to be harnessed for guiding classroom practices. In light of this backdrop, the research team employed the Research and Development (R&D) methodology to cultivate an educational innovation entitled the "Online Self-Training Program to Empower Teachers' Learning into Action to Enhance Active Learning in the Classroom."

This educational innovation has been developed based on the concept that "knowledge and action are power." It integrates various perspectives on active learning, drawn from diverse contexts, to shape the development of teachers. The central premise is to prioritize teacher learning, enabling them to perceive the innovation and consequently encourage teachers to implement it in the classroom under predefined indicators. Research implication is beneficial to schools across the nation especially the secondary schools, which are research populations under local governing bodies. According to the underpinning principles of R&D methodology, any innovation developed through research and development, once validated in representative test environments, can be effectively propagated to the broader target audience if its efficacy aligns with predefined standards. This dissemination is intended to serve as an instrument of research utilization, impacting the education landscape with a validated and quality-assured innovation.

1.1 The Purpose of Research

This research is a Research and Development (R&D) study aimed at developing educational innovation entitled "Online Self-Training Program to Empower Teachers' Learning into Action to Enhance Active Learning in the Classroom", and implemented in schools. The online self-training program consists of 2 projects 1) a Development project for teacher learning which includes 7 self-training modules, and 2) the implementation of an online self-training program project which includes 1 self-training module to be used as a teaching guideline. (See program structure in Figure 1)

1.2 Research Hypothesis

Various studies focus on the development of educational innovations through teacher development, and teachers are as mechanism to implement innovation to students; for instance, research entitled "Online Program to Empower Teacher Learning to Develop Students' Digital Literacy Skills" (Promrub and Sanrattana, 2022), "Empowering Teachers' Learning to Develop Students' Inspirational Skills" (Kromthamma and Supakicco, 2023), and "Enhancing Teachers' Learning to Develop Students to Become Successful Students" (Thammabut and Thacha, 2023). According to concepts and various studies reviewed, research hypotheses are formulated as follows.

- The first project results in teachers in the experimental group attained post-test scores by the established standard of 90/90, and the post-test score is significantly higher than the pre-test score.
- The second project presents the post-test scores of student perception as significantly higher than the pre-test score.

1.3 Literature Review

This research highly focuses on literature reviews about active learning to create self-training modules for teachers in various dimensions including: 1. The definition from the perspectives of Brame (n.d.), Gifkins (2015), Nata and Tungsiriwat (2017), Prince (2004), and Surakarn et al (2020). 2. The importance from the perspectives of Doyle (2019), Gifkins (2015), Shaaruddin and Mohamad (2017), Wasserman (2019), and Whenham (2020). 3. The characteristic from the perspectives of Bonwell (n.d.), Knight (2004), Silberman (2006), Twinkl (n.d.), and Unta (2009). 4. The obstacles and ways to overcome obstacles from the perspectives of Davidson (2019), Gardiner (2020), and Salsich (2018). 5. The development guidelines from the perspectives of Ahmad and Keeley (2021), Andriotis (2017), Dhami (2021), and Duke Learning Innovation (2021). Fulbright (2018), Honeycutt (2018), Nata and Tungsiriwat (2017), Open Polytechnic (2020), Raudys (2018), and Whenham (2020). 6. The development stage from the perspectives of the Education Advisory Board (2019), New York University (n.d.), and the University of Plymouth (2020). 7. The evaluation from the perspectives of Gardner and Jewler (2005), University of Ottawa (n.d.), and Zheng (n.d.).

From the earlier seven aspects, the aspect relating to "development guidelines" is essential because it is a

recommendation that reviews the "principles/concepts/techniques/methods/activities" for teacher learning at the primary step before implementing them in the classroom. The research team, therefore, synthesized the issues related to “development guidelines” from the perspectives of Ahmad and Keeley (2021), Andriotis (2017), Dhami (2021), and Duke Learning Innovation (2021). Fulbright (2018), Honeycutt (2018), Nata and Tungsiriwat (2017), Open Polytechnic (2020), Raudys (2018), and Whenham (2020) and 45 following approaches were obtained: 1) concept maps, 2) debates, 3) chain notes, 4) idea lineup, 5) scavenger hunts, 6) role-playing, 7) mystery quotation, 8) idea speed dating, 9) sketch noting, 10) empathy mapping, 11) the jigsaw technique, 12) the ‘flipped classroom’, 13) think-pair-repair, 14) improv games, 15) brainwriting, 16) quick quizzes, 17) problem-based learning, 18) thinking based learning, 19) task-based learning, 20) project-based learning, 21) experiment learning, 22) research-based learning, 23) animated response, 24) cooperative learning, 25) organizational outlets, 26) movement, 27) interactive lessons, 28) reciprocal questioning, 29) peer teaching activities, 30) game-based learning platforms, 31) rotating chair group discussions, 32) case studies and simulations, 33) one-minute papers, 34) online discussion boards, 35) learning by teaching, 36) real-time reactions, 37) the devil's advocate approach, 38) the pause procedure, 39) collaborative virtual classrooms, 40) mind mapping/brainstorming, 41) data and tools for problem-solving, 42) case studies and problem-solving, 43) work together in groups, 44) three step interviews, and 45) the muddiest point technique. It is noted that some development guidelines are generally known to teachers, but some have never been known before, while some have already been seen and reminded of. Details of each development approach mentioned above have been presented by the research team in modules for teacher learning in both Thai and English.

2. Research Methods

2.1 Concepts and Process

This research utilizes the Research and Development (R&D) methodology as per the perspective of Sanrattana (2023), who states that educational innovations developed through this research methodology aim to empower individuals with knowledge, with the expectation that they will translate this knowledge into action, thereby generating efficiency in their work. This aligns with the saying, "Knowledge and action are power." This statement leads to the conceptual framework of this research, which is to "begin with developing teachers' learning and then have teachers apply that learning to students continuously." The research is carried out in four stages, as follows:

Step 1 involves studying the literature related to active learning in seven aspects: definition, significance, characteristics, development approaches, development processes, challenges and obstacles in development, and assessment methods. This is done to create online self-training modules for teachers' learning and practice.

Step 2 consists of assessing the quality of the online self-training modules in two phases: the first phase involves preliminary field testing and revision by 5 teachers in a non-research experimental school, and the second phase involves main field testing and revision by 10 teachers in another non-research experimental school, using the focus group discussion method in both phases.

Step 3 involves creating two sets of research tools to be used in the experimental research phase: 1) A test to assess teachers' learning outcomes and 2) An assessment to evaluate students' perception of the level of active learning practices by their teachers (details will be discussed in the "research tools" section).

Step 4 involves testing the effectiveness of the online self-training program according to the research hypothesis. The research will be conducted in a one-group pretest-posttest experimental format in a school that has been selected as the research site. The experimental group will consist of 12 teachers and the target group will be composed of 500 students who will benefit from the teachers' practices. This research will take place in the second semester of the 2023 academic year and will be divided into two phases: 1) an experimental research phase focused on developing teachers' learning, lasting one month, and 2) an experimental research phase focused on teachers applying their learning outcomes in the classroom, lasting two months.

2.2 Research Tools

2.2.1 Teacher Learning Outcome Test

Teacher Learning Outcome Test is a multiple-choice questionnaire designed to assess teachers' learning outcomes before and after the experimental research in the Teacher Learning Development project.

The research team developed this test based on the predefined content areas, comprising six key aspects: definition, significance, characteristics, development approaches, development processes, and assessment. Each aspect has questions organized according to the cognitive domain, ranging from lower-order thinking skills to higher-order

thinking skills, specifically: remembering, understanding, applying, analyzing, evaluating, and creating, following Benjamin S. Bloom's Revised Taxonomy 2001 (Armstrong, 2010). The test underwent a quality assessment in two phases:

First Phase: Content validity was examined using Rovinelli and Hambleton's (1977) method known as Indexes of Item-Objective Congruence (IOC). Five experts in the fields of Curriculum and Instruction and Educational Measurement and Evaluation analyzed the data. The results showed that all questions had IOC values higher than the threshold of 0.50 (Chaichanawirote & Vantum, 2017).

Second Phase: The test's quality was evaluated by administering it to a sample of 30 teachers from a non-research experimental school.

The analysis revealed all questions fell within the index of difficulty range, between 0.20 and 0.80, and had power of discrimination values within the range of 0.20 to 1.00. The KR-20 reliability coefficient, indicating internal consistency was 0.94 which exceeds the 0.70 threshold. The test's level of difficulty was 56.85.

2.2.2 Student Perception Assessment of Teacher's Active Learning Practices

The Student Perception Assessment is a rating scale with five levels: Excellent, Good, Average, Poor, and Very Poor. It is designed to evaluate students' perceptions of their teacher's level of active learning practices. The research team developed this assessment based on characteristics of active learning as described by Bonwell (n.d.), Knight (2004), Silberman (2006), Twinkl (n.d.), and Unta (2009). Additionally, the assessment was informed by concepts of active learning assessment from Gardner and Jewler (2005), University of Ottawa (n.d.), and Zheng (n.d.). This assessment underwent a quality assessment in two phases:

First Phase: Content validity was assessed using Rovinelli and Hambleton's method. Five experts in Educational Administration and Educational Measurement and Evaluation analyzed the data. The results indicated that all assessment items had IOC values exceeding the 0.50 threshold, suggesting that the items are suitable for measuring the intended objectives (Chaichanawirote & Vantum, 2017).

Second Phase: Reliability or internal consistency was examined by administering the assessment to a sample of 30 students from a non-research experimental school. The alpha coefficient of reliability was calculated using Cronbach's method. The analysis revealed that the alpha coefficient of reliability for the entire assessment was 0.88. When analyzed by dimensions, the reliability coefficients for the dimensions of active learning behavior, high-order thinking skills, collaborative work skills, teacher's instructional practices, and student engagement were 0.80, 0.81, 0.99, 0.93, and 0.90 respectively. These coefficients exceeded the 0.70 thresholds specified for internal consistency (UCLA: Statistical Consulting Group, 2016), indicating that the items have relatively high internal consistency.

2.3 Data Analysis

1) Analysis of Scores from Teacher Learning Outcome Test. In this case, the analysis involves comparing the scores obtained from the Teacher Learning Outcome Test after the experiment with the 90/90 standard. The first "90" signifies the percentage of the average scores of all teachers in the group that were achieved in the knowledge test. The second "90" indicates the percentage of the number of teachers who were able to pass the test according to all the objectives (Yamkasikorn, 2008). 2) Analysis of pre-test and post-test results using Dependent t-test

3. Results

3.1 Educational Innovation Outcomes

The results of this research have led to an educational innovation known as the "Online Self-Training Program to Empower Teachers' Learning into Action to Enhance Active Learning in the Classroom." This innovation consists of two consecutive projects: *1) Teacher Development Project*: This project utilizes self-training modules for teacher learning, comprising a total of 7 modules as follows: a) definition, b) importance, c) characteristics, d) obstacles and ways to overcome obstacles, e) development guidelines, f) development stage, and g) evaluation, 2) *Teacher Implementation Project:* This project focuses on teachers translating their learning into classroom practice. It features a self-training module designed as a practical guide for teachers as follows: a) instruction, b) summarize the expected characteristics, c) summary of development guidelines, d) summary of the development process, e) assessment form on the level of active learning practice of teachers (google form), f) teachers' self-assessment on the selection of a development process model for implementation (google form), and g) teacher's self-reflection form on practice (google form). Further details and illustrations of these projects are presented in Figure 1.

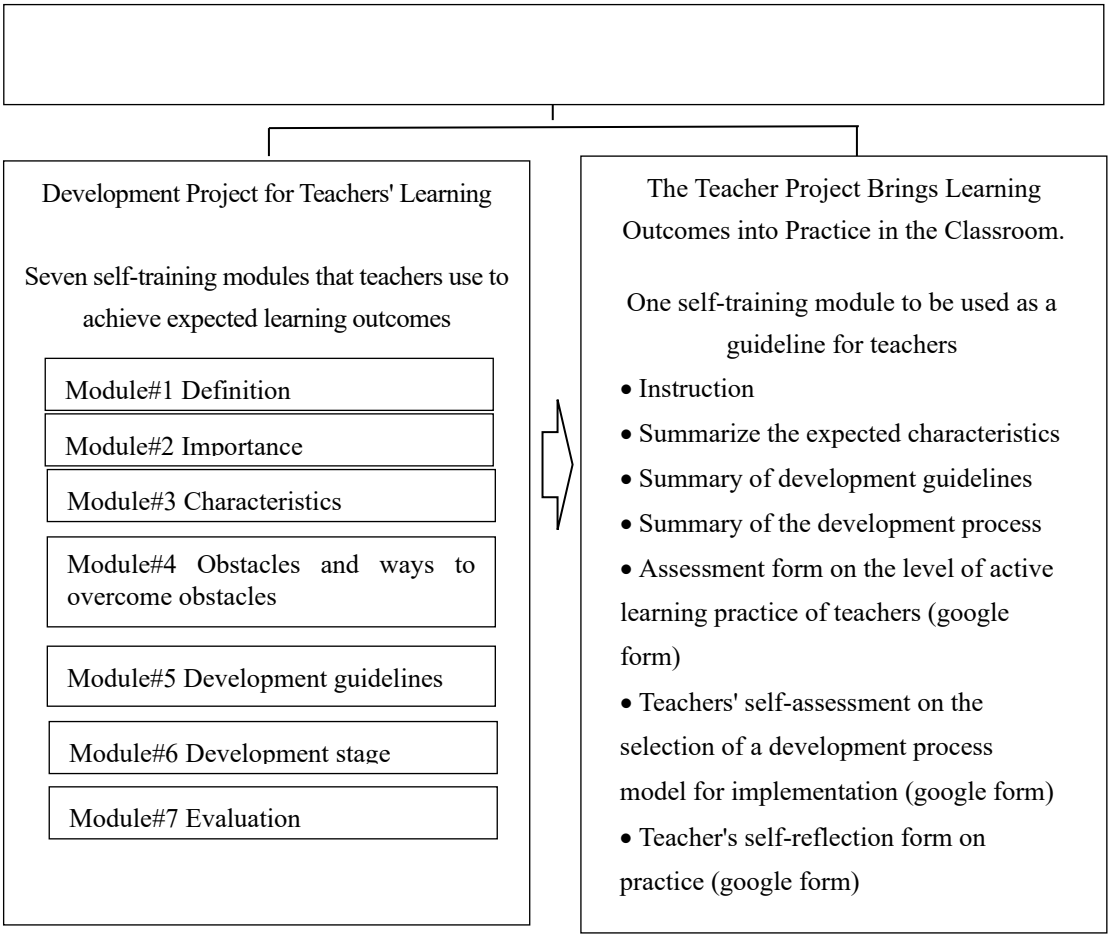

Figure 1. Online Self–Training Program to Empower Teachers' Learning into Action to Enhance Active Learning in the Classroom (See the characteristics of Modules in the original Thai language from https://shorturl.at/dnpBN)

3.2 The Effectiveness of the Online Self-Training Program

3.2.1 Experimental Research Results in the Teacher Development Project

The findings from the experimental research conducted in the Teacher Development Project align with the research hypotheses set forth, which are as follows: 1) teachers in the experimental group achieved an average post-test score of 32.92 out of a total score of 36, which corresponds to 91.44 percent of the maximum score. They also demonstrated learning outcomes meeting 100 percent of the objectives, by the 90/90 standard. There was a statistically significant increase in the average post-test scores compared to the pre-test scores at a significance level of 0.05, as evidenced by the data analysis presented in Table 1.

Table 1. Mean of Teachers' Pre-test and Post-test Scores Using Dependent t-test

Testing	Sample size	Mean	Standard Deviation	t
Pre-test	12	21.08	4.14	16.06*
Post-test	12	32.92	1.68	

* $p < 0.05$

3.2.2 Experimental Research Results in the Teacher Implementation Project

The experimental research conducted in the Teacher Implementation Project yielded findings that align with the research hypotheses set forth. This is evident from the analysis of the mean scores and standard deviations from the

assessment of students' perceptions of teacher-active learning practices before and after the experiment, as presented in Table 2. Furthermore, the results of the comparative analysis using a dependent t-test, as shown in Table 3, also support the research hypotheses.

Table 2. The Average and Standard Deviation from the Assessment of Student's Perceptions of Teacher-Active Learning Practices Before and After the Experiment

Dimension of active learning	Assessment			
	Pre-test		Post-test	
	$\bar{\chi}$	S.D.	$\bar{\chi}$	S.D.
Active learning behavior	3.15	0.29	4.35	0.23
• I dare to criticize things that are not reasonable.	3.10	0.69	4.32	0.59
• I enjoy pretending to be an explorer.	3.17	0.59	4.41	0.63
• I am punctual, such as arriving on time for classes.	3.42	0.62	4.60	0.63
• I am constantly curious and eager to learn and see new things.	3.07	0.73	4.20	0.54
• I feel excited every time I accomplish something and am determined to succeed.	3.12	0.69	4.26	0.54
• I actively participate in work and tasks.	3.20	0.67	4.31	0.57
• I am not afraid to make mistakes because it motivates me to try harder.	2.96	0.64	4.37	0.65
Higher thinking	3.10	0.29	4.36	0.23
• I think passionately and creatively.	3.03	0.62	4.40	0.61
• I can relate the content of my learning to daily life in the world.	3.11	0.55	4.21	0.55
• My teacher encourages me to use both old and new information to solve problems.	3.07	0.58	4.29	0.56
• I often explore my attitudes, beliefs, and values more deeply.	3.15	0.79	4.33	0.62
• I can apply previous ideas and skills.	2.97	0.62	4.38	0.60
• My teacher asks open-ended questions to promote my thinking.	3.35	0.62	4.50	0.61
• I actively participate in critical thinking, synthesis, and assessment.	3.00	0.71	4.41	0.62
Teamworking	3.27	0.27	4.46	0.23
• I enjoy working with others to develop social skills.	3.44	0.60	4.52	0.61
• When there is work to be done, I often discuss with classmates to summarize the assigned tasks.	3.27	0.67	4.56	0.60
• I respect the opinions of my colleagues.	3.32	0.64	4.51	0.61
• I receive feedback directly from friends or teachers.	3.24	0.62	4.25	0.55
• I participate more in interactive communication than just sitting and listening.	3.21	0.71	4.41	0.61
• My teacher lectures less and focuses on developing practical skills.	3.05	0.56	4.37	0.62
• My teacher instructs me to engage in hands-on activities (simulate scenarios or perform hypothetical roles) in what we need to learn.	3.38	0.62	4.57	0.59
Instruction	3.15	0.24	4.40	0.24
• My teacher uses technology effectively.	3.20	0.63	4.50	0.63
• My teacher uses questioning techniques to stimulate my thinking and activities.	3.04	0.55	4.28	0.55
• My teacher encourages me to ask questions when I have doubts or concerns.	3.13	0.50	4.41	0.60
• My teacher creates a fun learning atmosphere during activities.	3.15	0.60	4.34	0.59
• My teacher supports and encourages me to interact with classmates to exchange learning.	3.22	0.47	4.52	0.59
• My teacher actively participates with me in learning activities beyond lecturing.	3.17	0.57	4.36	0.61
• My teacher breaks down the content into subunits to make it easier for me to understand.	3.12	0.48	4.40	0.65
Student actions	2.99	0.26	4.36	0.23
• I'm brave enough to ask questions in class.	3.07	0.77	4.37	0.59
• I only take "days off" for genuine emergencies.	3.01	0.58	4.23	0.57
• I often take notes about vocabulary, content, or lectures that I don't understand.	2.96	0.71	4.36	0.61

Dimension of active learning	Assessment			
	Pre-test		Post-test	
	$\bar{\chi}$	S.D.	$\bar{\chi}$	S.D.
• I'm confident in expressing my thoughts to provide examples related to what the teacher is talking about.	2.95	0.45	4.32	0.61
• I try to find news, information, and answers to questions on my own.	3.10	0.49	4.49	0.60
• I sit close to the front of the classroom to focus better on the topic, the teacher, and the screen/board.	2.92	0.63	4.37	0.62
• If I'm confused about a topic or an example in the textbook or lecture, I search for additional information from other sources (like Google) to see if I can find a better explanation or not.	2.90	0.68	4.39	0.62
Total	**3.13**	**0.16**	**4.39**	**0.11**

Table 2 , it can be observed that the average scores from the assessment of students' perception of teachers' active learning practice after the experiment are higher than before the experiment, that is, the average score after the experiment was 4.39 (standard deviation was 0.11). the average score before the experiment was 3.13 (standard deviation was 0.16). When analyzed and compared using the Dependent t-test, it was found that there is a statistically significant difference at the 0.05 significance level, as shown in Table 3.

Table 3. The Results of Data Analysis Comparing the Mean Scores of the Pre-Test and Post-Test of the Students Using a Dependent t-test

Evaluating	Sample size	Mean	Standard Deviation	t
Pre-test	500	3.13	0.16	136.93*
Post-test	500	4.39	0.11	

* $p < 0.05$

4. Discussion

The results of the research were conducted using R&D methodology, with the final step being an experimental study using the one-group pretest-posttest design in a selected school, where 12 teachers were part of the experimental group and 500 students benefited from the development. The objective was to investigate the effectiveness of "the Online Self-Training Program for Empowering Teachers' Learning and Promoting Active Learning in the Classroom", which was an educational innovation used in this research.

The research results indicate that this educational innovation is effective as hypothesized in both experimental studies. In the teacher development program, the teachers in the experimental group achieved posttest scores that met the standard of 90/90 and were statistically significantly higher than their pretest scores. Additionally, the target group of students also showed statistically significant improvement in posttest scores compared to their pretest scores after teacher training.

This research aligns with findings from various studies that have employed R&D methodology in the study, including "Online Program to Empower Teacher Learning to Develop Students' Digital Literacy Skills" by Promrub and Sanrattana (2022), "Empowering Teachers' Learning to Develop Students' Inspirational Skills" by Kromthamma and Supakicco (2023), and "Enhancing Teachers' Learning to Develop Students to Become Successful Students" by Thammabut and Thacha (2023).

Furthermore, besides aiming to test the effectiveness of educational innovation as the primary objective, the authors also sought to gather additional insights from the teachers in the experimental group, especially knowledge gained through practical activities and the feedback resulting from the implementation. The interesting points are discussed as follows.

The teachers in the experimental group were aware of the importance of transitioning from passive learning to active learning, particularly among younger teachers. Some older teachers, however, were more accustomed to passive teaching methods and needed gradual encouragement and reinforcement. This is because active learning demands more effort from teachers and comes in various forms, both from the teachers themselves and the students. This phenomenon aligns with the perspective of Salsich (2018), who stated that "active learning requires a different kind

of effort. Getting students to shift from sitting and listening to talking to each other, completing multiple iterations of work, and finding effective solutions can be a difficult transition. Passive learning asks kids to perform low-level thinking such as defining, duplicating, listing, memorizing, repeating, or reproducing. Successfully introducing students to activities such as analysis, synthesis, evaluation, construction, and design requires a plan".

Some teachers in the experimental group mentioned a particular challenge with implementing Active Learning, noting that it can be demanding for students. This is because students need to exert more effort. This observation aligns with the perspective of Gardiner (2020), who stated that Active Learning is Hard Work. He referred to a study from 2019 in the Proceedings of the National Academy of Sciences, which explained that "active learning can be a tough approach to sell because it requires students to put in more effort. Active learning necessitates problem-solving, active participation in class discussions, collaboration with peers, or even taking on the role of an instructor. Unlike the relative ease of passive learning through lectures, active learning demands a level of effort that students may neither anticipate nor prefer."

Another issue mentioned by teachers in the experimental group is that even though Active Learning is a more effective approach in catering to students' learning compared to passive learning, the assessment context still heavily emphasizes test scores (Summative Assessment) rather than developmental progress (Formative Assessment). Therefore, the matter of student assessment becomes a barrier to implementing Active Learning in classrooms. This concern aligns with Davidson (2019), who stated, "Now, the reward structure of academia is based on test scores, not learning". It also aligns with Singer (2019), who pointed out that, "Greater test scores often mean less authentic learning". He expressed a perspective that "Student learning is not improved by higher test scores. It is often hindered by them".

Despite some challenges, the research results mentioned above demonstrate that the 'Online Self-Training Program to Empower Teachers' Learning into Action to Enhance Active Learning in the Classroom,' developed through the R&D methodology, is effective as hypothesized. It can be beneficially applied to teachers and students in schools targeted for wider dissemination of research findings in the future.

5. Conclusion

From the results of the research, following the research hypotheses set for both the cases of the *Teacher Development Project* and the *Teacher Implementation Project,* it can be shown that educational innovations developed with R&D methodology with details of operations as mentioned in the research methodology section above. Including the use of the concept of "knowledge and action are power" in designing this research by adopting various perspectives on "Active Learning" in various aspects as a guideline for teacher development to make learning a priority for teachers and then stimulate and encourage teachers to use the learning results to practice in the classroom according to the specified indicators, resulting in effective educational innovations as expected. Therefore, the educational innovations called the "Online Self–Training Program to Empower Teachers' Learning into Action to Enhance Active Learning in the Classroom" (see the characteristics of modules in the original Thai language from https://shorturl.at/dnpBN) obtained from this research can then be disseminated for the benefit of teachers and students in schools that are the target population for this research throughout the country.

6. Recommendations

In applying this program, the research team acknowledges that teachers need to be aware of the challenges and issues mentioned earlier, including the fact that active learning requires a different kind of effort, active learning is hard work, and the reward structure in academia is based on test scores rather than learning.

In addition, to motivate effective and efficient practices, teachers must remain aware of the benefits and importance of Active Learning. This aligns with the synthesized perspectives of Doyle (2019), Gifkins (2015), Shaaruddin and Mohamad (2017), Wasserman (2019), and Whenham (2020), which indicate that active learning strategies are more effective in enhancing students' conceptual understanding, often resulting in double the learning outcomes compared to traditional methods, especially in the fields of science, engineering, mathematics, and technology. Furthermore, students in classrooms that incorporate traditional lecture-based learning are up to 1.5 times more likely to experience failure than students in active learning environments. This is because active learning fosters various characteristics in students, including 1) collaborative skills development, 2) encouragement to take risks, 3) preparation for tasks, 4) increased participation, 5) improved critical thinking, 6) enhanced memory retention, 7) efficient technology usage, 8) sparks of creativity, and 9) encouragement of genuine problem-solving. Active

Learning recognizes that not everyone can answer every question, emphasizing that the search for answers relies on individual student effort.

References

Ahmad, M. B. P., & Keeley, R. G. (2021, January 27). *Five ways to engage students in an online learning environment.* Retrieved from https://t.ly/Ub_3G

Andriotis, N. (2017). *10 Active learning methods for super engaged corporate learners.* Retrieved from https://t.ly/wEIk

Armstrong, P. (2010). *Bloom's Taxonomy.* Retrieved from https://t.ly/iITg

Bonwell, C.C. (n.d.). *Active Learning: Creating excitement in the classroom*. Retrieved from https://t.ly/uHmzf

Brame, C. J. (n.d.). *Active learning.* Retrieved from https://t.ly/uxzCp

Center for Educational Innovation, University of Minnesota. (n.d.). *Active learning.* Retrieved from https://rb.gy/0zaag

Chaichanawirote U., & Vantum, C. (2017). Evaluation of content validity for research instrument. *Journal of Nursing and Health Sciences*, *11*(2), 105-111.

Davidson, C. (2019, August 25). *How to overcome resistance to active learning (your own, your students', your institutions').* Retrieved from https://t.ly/ZFc_

Dhami, H. (2021, July 23). *8 Essential active learning strategies for your next class.* Retrieved from https://t.ly/1k7-

Doyle, L. (2019, October 15). *The benefits of active learning in higher education.* Retrieved from https://t.ly/orvX

Duke Learning Innovation. (2021). *Active learning techniques for the classroom.* Retrieved from https://t.ly/Cs7i

Education Advisory Board. (2019, March 25). *7 Steps to designing an active learning classroom*. Retrieved from https://t.ly/MDTi0

Fulbright, S. (2018, September 27). *Three active learning strategies that push students beyond memorization*. Retrieved from https://t.ly/ZTJ5

Gardiner, E. (2020, February 20). *Overcoming student resistance to active learning*. Retrieved from https://t.ly/UVVL

Gardner, J. N., & Jewler, J. (2005). *Active learning checklist*. Retrieved from https://t.ly/mSUu

Gifkins, J. (2015, October 8). *What is 'active learning' and why is it important*? Retrieved from https://t.ly/C3NlW

Gifkins, J. (2015, October 8). *What is 'active learning' and why is it important?* Retrieved from https://t.ly/94qN

Honeycutt, B. (2018, April 23). *Three active learning strategies you can do in 10 minutes or less.* Retrieved from https://t.ly/fe-H

Knight, R.D. (2004). *Active learning strategies*. Retrieved from https://t.ly/5S3q

Kromthamma, M., & Supakicco, P.S. (2023). Empowering teachers' learning to develop students' inspirational skills. *World Journal of Education*, *13*(2), 31-40. https://doi.org/10.5430/wje.v13n2p31

Nata, N., & Tungsirivat, K. (2017). *Active learning for language skills development.* Retrieved from https://t.ly/Gzbp

Nata, N., & Tungsirivat, K. (2017). *Active learning for language skills development.* Retrieved from https://t.ly/_JxJ2

New York University. (n.d.). *Steps to Creating an Active Learning Environment.* Retrieved from https://t.ly/UEFQ

New York University. (n.d.). *Steps to creating an active learning environment.* Retrieved from https://rb.gy/vz1qu

Open Polytechnic, New Zealand Institute of Skills and Technology. (n.d.). *Active learning.* Retrieved from https://rb.gy/8v1vc

Open Polytechnic. (2020). *Active learning*. Retrieved from https://t.ly/67Mwa

Prince, M. (2004). *Does active learning work? a review of the research.* Retrieved from https://t.ly/cqtsB

Promrub, S., & Sanrattana, W. (2022). Online program to empower teacher learning to develop students' digital literacy skills. *Education Quarterly Reviews, 5*(2), 469-483. DOI: 10.31014/aior.1993.05.02.506

Raudys, J. (2018, April 17). *8 Active learning strategies and examples.* Retrieved from https://t.ly/eZTy

Rovinelli, R.J., & Hambleton, R.K. (1977). On the use of content specialists in the assessment of criterion-referenced test item validity. *Dutch Journal of Educational Research*, *2,* 49-60.

Salsich, J. (2018, August 20). *Moving from passive to active learning: Four ways to overcome student resistance*. Retrieved from https://t.ly/5T2En

Sanrattana, W. (2023). *Research in educational administration: Concepts, practices and case studies* (5th Ed.). Thiphawisut.

Shaaruddin, J., & Mohamad, M. (2017, November 28). *Identifying the effectiveness of active learning strategies and benefits in curriculum and pedagogy courses for undergraduate TESL students*. Retrieved from https://t.ly/XOoE

Silberman, M. (2006). *8 Qualities of an active learning environment*. Retrieved from https://t.ly/QhzH

Singer, S. (2019, October). *Greater test scores often mean less authentic learning*. Retrieved from https://shorturl.at/aeCEF

Surakarn, A., Junprasert, T., Chaiakkarakkan, N., Peungposop, N., & Boonlop, R. (2020). *Active learning and its outcomes: A case study from the education reform project in Thailand.* Retrieved from https://t.ly/-TvP

Thammabut, B., & Thacha, W. (2023). Enhancing teachers' learning to develop students to become successful students. *World Journal of Education*, *13*(3), 13-23. https://doi.org/10.5430/wje.v13n3p13

Twinkl. (n.d.). *Active learning*. Retrieved from https://t.ly/0M0M

UCLA: Statistical Consulting Group. (August 22, 2016). *What Does Cronbach's Alpha Mean?* Retrieved from https://bit.ly/3O1ySxK

University of Ottawa. (n.d.). *Checklist for active learning*. Retrieved from https://t.ly/VSaj

University of Plymouth. (2020). *7 Steps to active learning in online environments.* Retrieved from https://t.ly/Ic62s

Unta, S. (2011, July 4). *Characteristics of active learning in the classroom*. Retrieved from https://t.ly/oMA5

Wasserman, E. (2019, September 5). *A New Harvard study shows the benefits of active learning versus lecture.* Retrieved from https://t.ly/rzaQs

Whenham, T. (2018, October). *9 Benefits of active learning (and why your college should try it).* Retrieved from https://rb.gy/xoe9h

Whenham, T. (2020, April 16). *9 Benefits of active learning (and why your college should try it).* Retrieved from https://t.ly/2km7

Whenham, T. (2020, April 2). *15 Active learning activities to energize your next college class.* Retrieved from https://t.ly/zG3L

Yamkasikorn, M. (2008). How to use efficiency criterion in media research and development: The difference between 90/90 standard and E1/E2. *Education Journal Burapha University, 19*(1), 1-16.

Zheng, M. S. (n.d.). *Active learning checklist*. Retrieved from https://t.ly/XqYU

Acknowledgments

We would like to thank the teachers who participated in the group discussion to review the accuracy and usefulness of the learning modules used in the online self-training program and the teachers and students who were the experimental group to try out the program. We would also like to thank the measurement and evaluation experts who examined the tools used in the research and the teachers and students to try out the

Authors contributions

Chalermchai Pondongnok was responsible for conducting every step of the research. Starting with studying research problems, designing research methods, creating innovations for use in research, conducting field research, summarizing results and reporting research results. Assistant Professor Dr. Phrakhrusutheejariyawattana provided advice and consultation. in the research process. Chalermchai Pondongnok drafted the manuscript and revised it. Assistant Professor Dr. Phrakhrusutheejariyawattana approved the final manuscript.

Funding

Not applicable

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Sciedu Press.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.