International Journal on Multidisciplinary and Applied Research
https://doi.org/10.63236/ijmar.2.1.3
Date received: 30/04/26; revised: 13/07/26; accepted: 16/08/26; published: 31/08/26

Confirmatory Factor Analysis of a Teacher Active Learning Competency Model in Primary Schools under the Suphan Buri Primary Educational Service Area Office, Thailand

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Abstract
Although active learning has been widely promoted, there remains a lack of an empirically validated measurement model of teachers' ability in active learning within the context of Thai basic education. This study aimed to examine the confirmatory components of teachers' active learning competency under the Suphan Buri Primary Educational Service Area Office. An exploratory sequential mixed-methods design was employed. The qualitative phase involved in-depth interviews with seven experts, including educational administrators, supervisors, school administrators, and teachers. The quantitative phase involved 258 teachers selected through stratified random sampling. Data were collected using a five-point rating-scale questionnaire. Qualitative data were analyzed through content analysis, while quantitative data were analyzed using confirmatory factor analysis (CFA). The qualitative findings identified four components of teachers' active learning competency: (a) planning and designing active learning, (b) management of active learning, (c) using media to support active learning, and (d) measuring and evaluating active learning. The quantitative findings confirmed that the measurement model was consistent with the empirical data: Chi-square = 54.48, df = 41, p = 0.07743, $\chi^2/df = 1.329$, GFI = 0.97, AGFI = 0.93, CFI = 1.000, SRMR = 0.016, and RMSEA = 0.036. All four components showed high factor loadings, indicating that the model demonstrated construct validity and can be appropriately used as a framework for assessing teachers' active learning competency.

Keywords: confirmatory factor analysis, abilities in active learning, exploratory sequential.

1. Introduction

Amidst the transformative shifts of the 21st century characterized by rapid advancements in information technology that impact every dimension of lifestyle, economy, and society, educational paradigms must evolve to equip individuals with the skills and competencies essential for future life (Schleicher, 2019). However, the quality of Thai education continues to face significant challenges, particularly regarding student achievement in core subjects, which often falls below standard benchmarks in both national (O-NET) and international assessments, such as PISA. This reflects a critical deficiency in students' analytical thinking and their ability to apply knowledge to solve real-world problems (Martínez & Villar, 2020; Secretariat Office of the Education Council, 2020). These issues stem, in part, from instructional models that remain teacher-centered, focusing on content delivery and rote-memory assessment. Consequently, student engagement is limited, hindering the realization of their full potential. Research consistently indicates that without opportunities for meaningful, hands-on practice and reflective thinking, long-term learning quality suffers (Barkley & Major, 2018).

Therefore, education must shift beyond mere content transmission toward developing key competencies—such as critical thinking, problem-solving, communication, collaboration, and lifelong learning—enabling students to adapt to an ever-changing society (Schleicher, 2019; Secretariat Office of the Education Council, 2020). In response, the Ministry of Education has prioritized policies to enhance educational quality through active learning, shifting the teacher's role from a sole lecturer to a facilitator of learning (Barkley & Major, 2018). Developing teachers' competencies in active learning is a vital mechanism for fostering higher-order thinking skills and international competitiveness (Chaimongkhon, 2013; Schleicher, 2019). Active learning engages students physically, intellectually, socially, and emotionally through activities requiring analysis, synthesis, and problem-solving (Himmele & Himmele, 2017). Teachers play a pivotal role in designing activities that stimulate interest and align with students' natural learning processes, consistent with the National Education Act B.E. 2542 (1999) and its amendments, which emphasize learner-centered education (Office of the Basic Education Commission, 2019).

A review of the literature on teachers' active learning competency indicates that numerous scholars have identified key competencies and structural dimensions essential for effective active learning implementation. Drawing upon relevant theoretical perspectives and previous empirical studies (Alam et al., 2017; Auerbach, 2018; Bureau of Teacher and Educational Personnel Development, 2010; Darling-Hammond et al., 2017; Jaiwanglok, 2018; Jehha, 2017; Kaewchote & Wattanathum, 2022; Neves et al., 2021; Nilpat, 2015; Phukongking, 2017; Poonputta & Nuangchalerm, 2022; Office of the Basic Education Commission, 2010; Rodphuang, 2016; Sirirattanachit, 2017), this study synthesized a conceptual framework comprising four major dimensions of teachers' active learning competency. These include: (a) planning and designing active learning, consisting of three subcomponents; (b) management of active learning, comprising five subcomponents; (c) using media to support active learning, with two subcomponents; and (d) measuring and evaluating active learning, consisting of three subcomponents. The synthesis demonstrates that these dimensions

and their associated indicators constitute an integrated and systematically interconnected framework, providing a theoretical foundation for the development and validation of the proposed measurement model.

Although active learning and teacher competency have been extensively investigated, the existing literature reveals several important research gaps. First, most previous studies have focused primarily on examining the effects of active learning on students' academic achievement or on enhancing teachers' competencies in a broad sense. In contrast, relatively few studies have developed and validated a measurement model of teachers' active learning competency using CFA. This limitation is particularly evident in the context of basic education in Thailand, where empirical evidence supporting the structural validity of the underlying dimensions and indicators of teachers' active learning competency remains scarce. Consequently, a well-established measurement model that accurately represents this multidimensional construct has yet to be confirmed.

Although previous studies have proposed various dimensions and competency frameworks for teachers' active learning practices from different theoretical perspectives (Darling-Hammond et al., 2017; Kaewchote & Wattanathum, 2022; Neves et al., 2021; Poonputta & Nuangchalerm, 2022), most have been limited to conceptual syntheses or investigations conducted within specific national contexts. Consequently, the structural validity of these proposed dimensions has not been adequately examined in the context of Thai teachers. Given the differences in educational policies, curriculum implementation, learning environments, and educational resources across countries, it cannot be assumed that competency models developed in other contexts are directly applicable to Thai basic education. Therefore, empirical validation is needed to determine whether these dimensions appropriately represent the active learning competency of teachers in the Thai educational context.

From a methodological perspective, most previous studies have relied exclusively on either quantitative or qualitative approaches. As a result, limited attention has been given to integrating expert perspectives with statistical validation to develop a measurement model that reflects both theoretical constructs and practical educational contexts. To address this limitation, the present study adopted an exploratory sequential mixed-methods design, in which qualitative findings were first used to identify and refine the underlying dimensions of teachers' active learning competency. These dimensions were subsequently validated using CFA with quantitative data. This integrated research design strengthens the credibility and construct validity of the proposed measurement model by combining expert-informed conceptual development with empirical statistical verification (Creswell & Plano Clark, 2018; Suwattanapornkul, 2019).

A further research gap relates to the study population and research context. Most existing studies have been conducted in higher education settings or have examined teachers at the national level without considering the contextual characteristics of specific educational jurisdictions. Comparatively few studies have focused on teachers working in primary education under Thailand's Primary Educational Service

Area Offices, where teaching conditions, resource availability, and instructional contexts differ substantially. This contextual issue is particularly relevant in Suphan Buri Province, which encompasses urban, rural, and remote schools and includes teachers with diverse professional backgrounds and varying levels of teaching experience. These contextual variations may influence the competencies required for implementing active learning effectively. Therefore, empirical validation within this specific educational setting is essential to determine whether the proposed competency model adequately reflects the active learning competencies of primary school teachers in this context.

In response to these research gaps, the present study aimed to develop and validate a confirmatory factor model of teachers' active learning competency by integrating qualitative evidence from expert interviews with quantitative data collected from practicing teachers. This mixed-methods approach was intended to establish a measurement model with both theoretical soundness and empirical validity. The validated model is expected to provide a robust framework for assessing teachers' active learning competency and to serve as a valuable reference for teacher professional development, educational policy formulation, and future research on active learning in basic education.

Research Objective
The objective of this study was to analyze the confirmatory factors of teachers' active learning management abilities under the Suphan Buri Primary Educational Service Area Office.

Research Hypothesis
The developed measurement model for abilities in active learning is consistent with empirical data.

2. Theoretical Framework
A review of the literature indicates a broad consensus among both international and Thai scholars that teachers' active learning competency is a multidimensional construct encompassing the knowledge, skills, and professional capabilities required to design learning experiences systematically, facilitate active learning activities, promote student engagement, and assess learning outcomes. Although the conceptualizations proposed by individual scholars differ in terminology and emphasis, they consistently highlight a fundamental shift in teachers' roles—from knowledge transmitters in teacher-centered classrooms to learning facilitators who actively support students in constructing their own knowledge through meaningful learning experiences (Barkley & Major, 2018; Bonwell & Eison, 1991; Prince, 2004).

According to Bonwell and Eison (1991), active learning is an instructional process that actively engages students in thinking, discussing, applying knowledge, and reflecting on their learning experiences. Building on this foundation, Prince (2004), through a comprehensive review of the literature, concluded that active learning enhances both students' academic achievement and their depth of understanding. Extending this perspective, Barkley and Major (2018) emphasized that effective active learning

requires teachers to design intellectually challenging learning activities that promote higher-order thinking and connect students' prior experiences with authentic real-world situations.

Similarly, Darling-Hammond et al. (2017) and Neves et al. (2021) argued that teachers' active learning competency extends beyond classroom instruction to encompass learning design, the integration of instructional media and technology, assessment practices, and reflective teaching aimed at continuously improving student learning. This perspective is consistent with the findings of Kaewchote and Wattanathum (2022) and Poonputta and Nuangchalerm (2022), who emphasized that the development of teachers' active learning competency should be approached systematically by integrating lesson planning, instructional implementation, the use of instructional media, and assessment into a coherent and interconnected instructional process.

Taken together, the findings from both international and Thai literature suggest that teachers' active learning competency is best conceptualized as an integrated competency comprising multiple interrelated dimensions rather than a single isolated capability. Based on the synthesis of the theoretical and empirical literature (Barkley & Major, 2018; Bonwell & Eison, 1991; Darling-Hammond et al., 2017; Kaewchote & Wattanathum, 2022; Neves et al., 2021; Poonputta & Nuangchalerm, 2022; Prince, 2004), together with the competency framework proposed by the Office of the Basic Education Commission (2010, 2019), the present study developed a conceptual framework consisting of four dimensions: (a) Planning and Designing Active Learning, (b) Management of Active Learning, (c) Using Media to Support Active Learning, and (d) Measuring and Evaluating Active Learning. These four dimensions served as the conceptual foundation for the proposed measurement model, as illustrated in Figure 1:

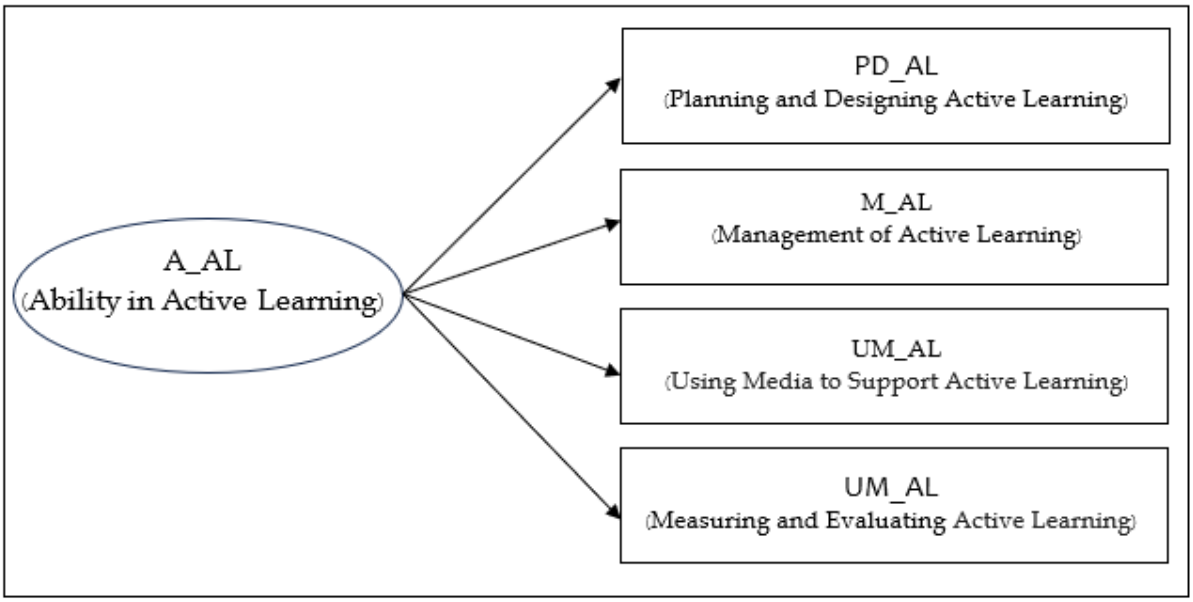

Figure 1: The conceptual framework

3. Methodology

Participants

The qualitative phase involved seven experts selected through purposive sampling. Participants were recruited based on the following criteria: (a) demonstrated expertise in promoting or implementing teachers' active learning competency, (b) holding at least a master's degree, (c) possessing a professional rank of senior professional level or higher, and (d) having received professional recognition or awards related to active learning practices. The expert panel comprised one educational administrator, one educational supervisor, three school administrators, and two classroom teachers.

For the quantitative phase, the target population consisted of 4,821 teachers working under the Suphan Buri Primary Educational Service Area Office. A sample of 258 teachers was selected using stratified random sampling. The sample size was determined based on the recommendation of Hair et al. (2010), who suggested a minimum sample size of 10–20 participants per observed variable in factor analysis. The proposed measurement model comprised four latent dimensions represented by 13 observed variables derived from the qualitative findings and literature synthesis. Accordingly, the recommended sample size ranged from 130 to 260 participants, indicating that the final sample of 258 teachers was adequate for CFA.

Design

This study employed an exploratory sequential mixed-methods design to develop and validate a measurement model of teachers' active learning competency. In the first phase, qualitative data were collected and analyzed to identify the underlying dimensions and indicators of the construct. The findings from this phase informed the development of the quantitative research instrument. In the second phase, quantitative data were collected to examine the construct validity of the proposed measurement model using CFA (Suwattanapornkul, 2019).

Materials

Two research instruments were employed in this study.

The first instrument was a semi-structured in-depth interview protocol used to collect qualitative data. The interview protocol comprised four guiding questions corresponding to the four dimensions of teachers' active learning competency identified through the synthesis of relevant theories, conceptual frameworks, books, academic literature, and previous studies. These dimensions included: (a) planning and designing active learning, (b) management of active learning, (c) using media to support active learning, and (d) measuring and evaluating active learning.

The second instrument was a 64-item questionnaire designed to measure teachers' active learning competency using a five-point Likert scale. The questionnaire was developed based on the qualitative findings and literature review. Content validity was evaluated by experts, yielding item-objective congruence (IOC) indices ranging from 0.80 to 1.00. A pilot study was subsequently conducted with 37 primary school teachers who were not included in the main sample. Item discrimination, assessed using item–total correlation coefficients, ranged from 0.329 to 0.757. Internal

consistency reliability, estimated using Cronbach's alpha coefficient, was 0.963, indicating excellent reliability.

Procedure

The study was conducted in two sequential phases following the exploratory sequential mixed-methods design.

In the first phase, qualitative data were collected through online semi-structured interviews with the selected experts. Prior to each interview, appointments were scheduled, and participants provided informed consent for note-taking and video recording. The interview data were analyzed using content analysis to identify the dimensions and indicators of teachers' active learning competency. The findings from this phase served as the basis for developing the questionnaire used in the subsequent quantitative phase.

In the second phase, a questionnaire was developed based on the synthesized literature and the qualitative findings. The questionnaire was administered online using Google Forms to teachers selected through stratified random sampling. Quantitative data were then analyzed using the LISREL statistical software package to validate the proposed measurement model through CFA.

Before conducting CFA, the suitability of the data for factor analysis was examined using the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. Subsequently, the relationships between the observed variables and the latent constructs were evaluated by examining the model fit indices in accordance with the recommendations of Anan (2018).

4. Results

Qualitative Results

The thematic analysis of the expert interviews identified four major dimensions of teachers' active learning competency. Regarding the planning and designing of active learning, participants emphasized that teachers should possess the ability to design diverse and learner-centered lesson plans that actively engage students in meaningful learning activities. They also highlighted the importance of analyzing students' learning potential and prior achievement before planning instruction, as well as formulating learning objectives that comprehensively address the cognitive, psychomotor, and affective domains of learning. Representative excerpts from the interviews are presented below:

"Effective teachers should be able to analyze the school curriculum, identify students' learning potential and prior achievement, and use this information to develop lesson plans that are appropriate for students' grade levels and learning needs." (Participant 1)

"Teachers should be able to formulate measurable learning objectives that are aligned with the intended learning outcomes and curriculum content." (Participant 3)

"Teachers should be able to design a variety of learner-centered activities that encourage students to actively participate throughout the learning process." (Participant 5)

Regarding the management of active learning, participants emphasized that teachers should possess the competencies required to implement a wide range of active learning strategies that promote meaningful student engagement. They highlighted the importance of using effective questioning techniques to stimulate students' thinking and participation, encouraging students to regulate their own learning, and designing motivating learning experiences that foster active involvement throughout the instructional process. Representative excerpts from the interviews are presented below:

"Teachers should employ a variety of instructional strategies that motivate students to learn and actively participate in classroom activities." (Participant 1)

"Teachers should pay close attention to students who are not yet ready to learn new content by using probing questions to better understand each student's individual learning needs." (Participant 4)

"Teachers should design learning activities that encourage students to express their ideas confidently and actively participate in classroom learning. Effective questioning plays a crucial role in achieving this goal." (Participant 7)

Regarding the use of media for active learning, participants emphasized that teachers should be competent in selecting, developing, and effectively utilizing instructional media that are engaging, innovative, and appropriate for learners' needs. They also highlighted the importance of teachers' proficiency in integrating instructional media into classroom practice and continuously evaluating its effectiveness to improve the quality of teaching and learning. Representative excerpts from the interviews are presented below:

"Teachers should be able to select and develop instructional media that capture students' interest and stimulate their motivation to learn through creative and innovative learning resources." (Participant 1)

"Teachers, particularly those entering the profession, should be capable of developing technology-enhanced instructional media by integrating digital applications and other technological tools to create engaging learning materials." (Participant 4)

"Teachers should be able to develop innovative instructional media, particularly by integrating technology to enrich teaching and learning experiences." (Participant 7)

Regarding the measuring and evaluating of active learning, participants emphasized that teachers should possess the competencies required to develop appropriate assessment instruments and establish clear assessment criteria aligned with learning objectives. They also highlighted the importance of effectively integrating technology into assessment practices and conducting assessment as a continuous and systematic

process to monitor students' learning and support instructional improvement. Representative excerpts from the interviews are presented below:

"Teachers should have a sound understanding of the principles of educational assessment and be able to apply appropriate assessment instruments accurately and effectively." (Participant 1)

"In today's active learning classrooms, teachers should be able to integrate technology effectively into assessment practices to enhance the assessment process." (Participant 3)

"Teachers should conduct assessment continuously throughout the learning process and use the resulting evidence to support and promote students' learning and development." (Participant 5)

"Teachers should be able to develop authentic assessment instruments that accurately reflect students' abilities and learning potential." (Participant 7)

The findings from the literature review and the expert interviews were synthesized to identify the subdimensions and indicators corresponding to each of the four dimensions of teachers' active learning competency. These findings served as the basis for developing the questionnaire used to examine and validate the proposed measurement model through CFA.

Quantitative Results

The results of the CFA for the measurement model of teachers' active learning management abilities under the Suphan Buri Primary Educational Service Area Office are as follows: (a) Data suitability and correlation analysis preliminary checks of the data suitability revealed Pearson correlation coefficients ranging from 0.609 to 0.901, with all observed variables significantly correlated at the .01 level. The correlation matrix was confirmed not to be an identity matrix (Bartlett's test of sphericity = 4248.474, df = 78, $p < .001$). The KMO measure was 0.948, and the measures of sampling adequacy (MSA) for all variables ranged from 0.773 to 0.915. These values, exceeding the 0.50 threshold, indicate that the items are sufficiently interrelated to structural relationship analysis. (b) For descriptive statistics of observed variables, the mean scores ranged from 4.29 to 4.41, indicating a high level of competency overall. When ranked by mean values, the findings are as follows: Rank 1: Establishing learning objectives (PD_AL2) exhibited the highest mean score ($\overline{x} = 4.41, \text{S.D.} = 0.53$). Rank 2: Implementing student motivation activities (M_AL5) followed ($\overline{x} = 4.38, \text{S.D.} = 0.50$). Rank 3: Classroom active learning instructional processes (M_AL1) ($\overline{x} = 4.37, \text{S.D.} = 0.51$). The lowest ranked were designing active learning lesson plans (PD_AL1) ($\overline{x} = 4.29, \text{S.D.} = 0.45$), and classroom instructional processes (M_AL1) ($\overline{x} = 4.29, \text{S.D.} = 0.51$), respectively. Detailed statistics are presented in Table 1:

Table 1: Pearson correlation coefficients of observed variables in teachers' active learning management model

Var.	PD_AL1	PD_AL2	PD_AL3	M_AL1	M_AL1	M_AL1	M_AL4	M_AL5	UM_AL1	UM_AL2	ME_AL1	ME_AL2	ME_AL3
PD_AL1	0.873												
PD_AL2	0.692**	0.773											
PD_AL3	0.791**	0.765**	0.862										
M_AL1	0.798**	0.630**	0.762**	0.875									
M_AL2	0.803**	0.618**	0.753**	0.839**	0.866								
M_AL3	0.781**	0.739**	0.706**	0.790**	0.762**	0.883							
M_AL4	0.764**	0.648**	0.708**	0.760**	0.746**	0.813**	0.885						
M_AL5	0.735**	0.624**	0.688**	0.773**	0.716**	0.798**	0.811**	0.891					
UM_AL1	0.725**	0.606**	0.754**	0.742**	0.772**	0.752**	0.798**	0.827**	0.914				
UM_AL2	0.710**	0.659**	0.722**	0.714**	0.660**	0.751**	0.756**	0.820**	0.854**	0.891			
ME_AL1	0.705**	0.609**	0.686**	0.667**	0.685**	0.692**	0.709**	0.756**	0.813**	0.851	0.858		
ME_AL2	0.714**	0.626**	0.747**	0.773**	0.771**	0.756**	0.796**	0.807**	0.872**	0.819	0.812	0.915	
ME_AL3	0.742**	0.643**	0.756**	0.723**	0.741**	0.727**	0.769**	0.784**	0.869**	0.821	0.785	0.901	0.903
Mean	**4.29**	**4.41**	**4.33**	**4.34**	**4.29**	**4.37**	**4.33**	**4.38**	**4.34**	**4.36**	**4.35**	**4.30**	**4.34**
S.D.	**0.45**	**0.53**	**0.49**	**0.49**	**0.51**	**0.51**	**0.52**	**0.50**	**0.53**	**0.45**	**0.49**	**0.55**	**0.52**

Notes: $n = 258$ $|r| \geq 0.609$, $^{**}p < .01$
Bartlett's Test of Sphericity $\chi^2 = 4248.474$, $df = 78$, $p < .001$
Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy: 0.948
Measure of Sampling Adequacy (MSA): Individual variable values ranged from 0.773 to 0.915.

Second-Order Confirmatory Factor Analysis Results

The second-order CFA of the teachers' active learning management abilities model, following model refinement based on modification indices, indicated that the component with the highest factor loading was measuring and evaluating active learning (ME_AL) (®= 0.98), followed by using media for active learning (UM_AL) (® = 0.97) Both planning and designing active learning (PD_AL) and management of active learning (M_AL) were at ® = 0.95. All latent variables exceeded the 0.50 threshold, satisfying the established statistical criteria. In terms of model quality, convergent validity was confirmed with an average variance extracted (AVE) of 0.927, which exceeds the 0.50 threshold. The construct reliability (CR) was 0.981, exceeding the 0.70 threshold, indicating high internal consistency. Furthermore, all factors for the latent variables were statistically significant at the .01 level. Detailed results are presented in Table 2:

Table 2: Results of the second-order confirmatory factor analysis for the refined teachers' active learning management abilities model

Factor / Observed Variable	b	SE	*t*	R^2	AVE	CR
First-Order Factor Analysis						
1. Planning and Designing Active Learning (PD_AL)					**0.760**	**0.904**
- Designing active learning lesson plans (PD_AL1)	0.85	-	-	0.72		
- Setting learning objectives (PD_AL2)	0.82	0.05	15.46**	0.67		
- Designing active learning activities (PD_AL3)	0.94	0.05	18.83**	0.87		
2. Management of Active Learning (M_AL)					**0.772**	**0.944**
- Classroom instructional processes (M_AL1)	0.86	-	-	0.74		
- Integrating prior knowledge and experiences (M_AL2)	0.83	0.05	15.98**	0.68		
- Facilitating student knowledge construction (M_AL3)	0.91	0.05	18.61**	0.82		
Factor / Observed Variable	**b**	**SE**	***t***	**R^2**	**AVE**	**CR**
- Facilitating student knowledge construction (M_AL3)	0.91	0.05	18.61**	0.82		
- Supporting student self-regulation (M_AL4)	0.90	0.05	18.38**	0.81		
- Enhancing student learning motivation (M_AL5)	0.89	0.05	18.02**	0.79		
3. Using Media to support Active Learning (UM_AL)					**0.793**	**0.884**
- Selecting and developing instructional media (UM_AL1)	0.91	-	-	0.81		
- Utilizing media to enhance active learning (UM_AL2)	0.87	0.05	18.46**	0.74		
4. Measuring and Evaluating Active Learning (ME_AL)					**0.837**	**0.939**
- Developing assessment tools and criteria (ME_AL1)	0.84	-	-	0.71		
- Implementing measurement and evaluation tools (ME_AL2)	0.97	0.05	20.72**	0.93		
- Facilitating learning reflection (ME_AL3)	0.93	0.05	19.53**	0.87		
Second-Order Factor Analysis						
Active Learning Instructional Competency (A_AL)					**0.927**	**0.981**
- Planning and Designing Active Learning (PD_AL)	0.95	-	-	0.91		
- Management of Active Learning (M_AL)	0.95	0.06	15.83**	0.91		
- Using Media to support Active Learning (UM_AL)	0.97	0.05	20.13**	0.98		
- Measuring and Evaluating Active Learning (ME_AL)	0.98	0.06	16.89**	0.97		

*Note: **p < .01; Standard Error (SE) and t-values are not reported for constrained parameters.*

Model Fit and Factor Loading Analysis

The results of the second order CFA for teachers' active learning management abilities, following model refinement, indicated that the measurement model is highly congruent with the empirical data. The chi-square (χ^2) value was 54.48 (df = 41, p = .077), which is statistically non-significant (p > .05), satisfying the criteria. Other goodness-of-fit indices demonstrated superior model quality: Relative chi-square (χ^2/df): 1.329 (< 3.00), goodness of fit index (GFI): 0.97, Adjusted goodness of fit index (AGFI): 0.93, comparative fit index (CFI): 1.000 (> 0.900), standardized root mean square residual (SRMR): 0.016, and root mean square error of approximation

(RMSEA): 0.036 (< 0.06). Analysis of the standardized factor loadings showed consistent values ranging from 0.76 to 0.94, all significant at the .01 level. The indicators with the highest relative weight (Rank 1) were media selection and development (UM_AL1) and implementation of assessment tools (ME_AL2), both with a loading of 0.94. Conversely, setting learning objectives (PD_AL2) exhibited the lowest relative loading at 0.76. These structural relationships are depicted in Figure 2:

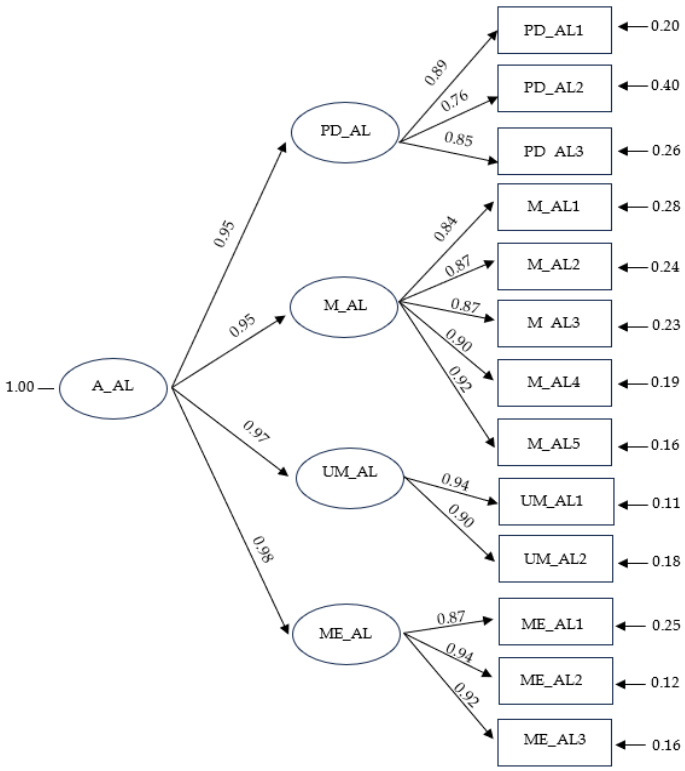

Figure 2: The second-order confirmatory factor analysis model of teachers' active learning management abilities under the Suphan Buri Primary Educational Service Area Office

Discussion

The findings of this study support the proposed four-dimensional measurement model of teachers' active learning competency, comprising (a) planning and designing active learning, (b) management of active learning, (c) using media to support active learning, and (d) measuring and evaluating active learning. These four dimensions were specified as latent constructs and demonstrated a satisfactory fit with the empirical data. The CFA indicated that the proposed measurement model was consistent with the observed data and supported the hypothesized factor structure. The GFIs met the recommended criteria ($\chi^2 = 54.48$, df = 41, $p = .077$, $\chi^2/df = 1.329$, GFI = .97, AGFI = .93, CFI = 1.000, SRMR = .016, and RMSEA = .036), providing strong evidence of the construct validity of the proposed model.

The findings demonstrate a high degree of convergence between the qualitative and quantitative phases, reflecting a key strength of the exploratory sequential mixed-methods design. During the qualitative phase, experts—including educational administrators, educational supervisors, school administrators, and classroom

teachers—consistently identified four essential dimensions of teachers' active learning competency: planning and designing active learning, organizing active learning activities, using instructional media to support active learning, and measuring and evaluating active learning. Participants further emphasized that teachers should be able to analyze curriculum requirements and students' learning characteristics, design learner-centered activities that encourage active participation, integrate diverse instructional media and digital technologies, and conduct continuous assessment to enhance student learning. These qualitative findings provided a theoretically grounded and practice-oriented foundation for identifying the subdimensions and indicators used to develop the questionnaire, which was subsequently validated through CFA.

The quantitative findings further confirmed the qualitative results by demonstrating that the proposed measurement model fit the empirical data well and that all four dimensions exhibited high standardized factor loadings (0.95–0.98). These findings indicate that the competency structure identified through the expert interviews was empirically supported in a large sample of teachers. The convergence of evidence from both qualitative and quantitative phases strengthens the credibility of the proposed model and suggests that the identified dimensions are not merely conceptually derived but are also grounded in practitioners' professional experiences and supported by robust statistical validation.

Furthermore, integrating the interview findings with the CFA results provides additional insights into the key competencies required for effective active learning. During the qualitative phase, experts consistently emphasized the importance of integrating technology and diverse instructional media, fostering students' learning motivation, and using assessment to promote learning. These themes were consistent with the quantitative findings, in which the dimensions using instructional media to support active learning and measuring and evaluating active learning demonstrated the highest factor loadings. This finding suggests that, within the context of the Suphan Buri Primary Educational Service Area Office, teachers regard instructional media, digital technologies, and assessment for learning as fundamental components of effective active learning. This interpretation is consistent with the work of Barkley and Major (2018), Chappuis (2022), and Darling-Hammond et al. (2017), who argued that active learning is most effective when instructional design, learning resources, and assessment are integrated into a coherent instructional process.

Furthermore, the results of this study identified 13 sub-components comprising a total of 64 indicators, all of which function as observed variables for their respective latent variables. The details are as follows:

Planning and designing active learning: This component consists of three sub-components and 15 indicators, namely (a) active learning lesson planning, (b) setting learning objectives, and (c) active learning activity design. These sub-components clearly reflect the teacher's role as a learning designer. The CFA revealed that the active learning planning and design component exhibited high factor loadings, indicating that a teacher's ability to analyze the curriculum and systematically design

lesson plans is the foundational starting point for active learning. This finding aligns with the conceptual framework of Barkley and Major (2018), who state that active learning must commence with clear and structured planning. It is also consistent with Darling-Hammond et al. (2017), who regard instructional design as a core competency of professional educators.

Regarding the indicators for setting learning objectives, a significant relationship was found with the latent variable, demonstrating that establishing clear learning goals focused on developing higher-order thinking skills is the heart of active learning. This corresponds with learner-centered design principles and the research of Hakim (2015), which indicates that appropriate objective setting directly impacts instructional effectiveness. Finally, the indicators for active learning activity design reflect that designing activities which provide opportunities for students to engage, practice, and think critically is the essence of active learning. This is consistent with constructivism and the perspective of Barkley and Major (2018), which emphasize that learning activities must be designed to position students as active participants rather than passive recipients of information.

Management of active learning: This component is divided into five sub-components with 20 indicators, including: (a) in-class active learning processes, (b) integration of prior knowledge or experiences with new learning, (c) facilitation of student-led knowledge construction, (d) promotion of self-regulated learning, and (e) cultivation of student learning motivation. The CFA demonstrated that the active learning implementation component yielded high factor loadings. Upon examining individual indicators, the in-class active learning process reflects the teacher's proficiency in sequencing learning activities to ensure continuous student engagement. This aligns with the concepts of Himmele and Himmele (2017), who emphasize designing instructional processes that stimulate cognitive engagement throughout the entire lesson. The indicator for integrating prior knowledge with new learning also exhibited high factor loadings, highlighting the significance of scaffolding new information onto students' existing cognitive frameworks. This is consistent with constructivism, which posits that learning occurs through the creation of new meaning based on prior knowledge.

Furthermore, the indicator for facilitating student-led knowledge construction—which provides opportunities for students to think, analyze, and discover answers independently—is considered the heart of active learning, correlating with the frameworks of Barkley and Major (2018) and the research of Poonputta and Nuangchalerm (2022). Regarding self-regulated learning, the indicators reflect the teacher's role in encouraging students to plan, monitor, and evaluate their own progress, a concept supported by Himmele and Himmele (2017) as a pathway to sustainable learning. Finally, the factor loadings for cultivating student motivation underscore that motivation is a critical driver of active learning. This resonates with Barkley and Major (2018), who argue that student engagement is a direct result of activities that are both challenging and personally meaningful to the learner.

Using media to support active learning: This component consists of two sub-components and 12 indicators: (a) selection and development of media for active learning, and (b) practical application of media to promote active learning. These indicators align with the concept of media and technology integration, which posits that media should function not merely as a transmission tool but as a catalyst for critical thinking and learner engagement. This perspective resonates with Darling-Hammond et al. (2017), who assert that educators must possess the competency to select and utilize media that align precisely with learning objectives and instructional activities. Furthermore, it corresponds with the policies of the Office of the Basic Education Commission (2010, 2019), which advocate for the use of innovative media and technology as tools to enhance active learning and address individual learner differences.

Measuring and evaluating active learning: This component comprises three sub-components and 17 indicators: (a) development of assessment tools and criteria, (b) implementation of assessment tools, and (c) learning reflection. The analysis revealed that the development of assessment tools and criteria exhibited high factor loadings, indicating that a teacher's ability to design tools aligned with active learning activities is a fundamental cornerstone of educational evaluation. This reflects the paradigm that assessment should not be confined to summative achievement but must remain congruent with the learning goals and processes. These findings are consistent with the assessment for learning (AfL) framework, which suggests that assessment design should support continuous learner development. Himmele and Himmele (2017) note that establishing clear, activity-aligned criteria helps students understand expectations and fosters self-regulation. Similarly, Darling-Hammond et al. (2017) highlight that teachers capable of designing diverse and appropriate assessment tools can accurately reflect authentic student progress.

5. Conclusion

The findings of this study demonstrate that the proposed measurement model of teachers' active learning competency provides a good fit to the empirical data and exhibits satisfactory construct validity and reliability across all four dimensions. The consistency between the qualitative findings obtained from expert interviews and the quantitative results obtained through CFA further strengthens the validity of the proposed model. Together, these findings suggest that the four dimensions adequately represent the competencies required for effective active learning implementation in the context of Thai basic education.

This study contributes to the existing body of knowledge by providing empirical evidence that teachers' active learning competency is a multidimensional construct comprising four interrelated dimensions. Unlike many previous studies that have primarily proposed conceptual frameworks or examined individual aspects of teacher competency, the present study integrated expert-informed qualitative evidence with second-order confirmatory factor analysis to establish a measurement model that is supported by both theoretical foundations and empirical validation. The validated model therefore provides a robust framework for future research on teacher competency and active learning.

6. Recommendations

Recommendations for Policy and Implementation

The findings of this study confirm that teachers' active learning competency comprises four key dimensions: (a) planning and designing active learning, (b) management of active learning, (c) using media to support active learning, and (d) measuring and evaluating active learning. Although the proposed measurement model demonstrated satisfactory validity within the study context, caution should be exercised when applying the model to other educational settings, as contextual factors and po pulation characteristics may influence its applicability. Future research should further validate the model with teachers from different regions, educational jurisdictions, and school contexts across Thailand to examine its generalizability and strengthen its external validity.

Recommendations for Future Research

Future studies should focus on developing and testing specific guidelines or intervention models designed to promote and strengthen teachers' active learning management abilities systematically.

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This paper may be cited as:

Chaitrong, N. (2026). Confirmatory Factor Analysis of a Teacher Active Learning Competency Model in Primary Schools under the Suphan Buri Primary Educational Service Area Office, Thailand. *International Journal on Multidisciplinary and Applied Research, 2*(1), 1-18. https://doi.org/10.63236/ijmar.2.1.3

