Development of a learning management model for science teachers

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Article Info	ABSTRACT
	The goal of this study was to create a learning management model for primary science teachers that considers the factors affecting the learning management strategies of science instructors in the Province of Roi Et. The sample consisted of 300 basic science teachers in the Province of Roi Et and was created via a straightforward random selection of 20 schools. Among the study tools are science learning management manuals, assessments, and surveys. The following statistics were used in the data analysis: mean and standard deviation. The results showed that the science learning management model consists of five steps: i) involvement, ii) survey, iii) justification, iv) detailed description, and v) evaluation. Therefore, it is clear that the elements of learning management and innovation creation are significant factors in this context. The inspiration of having a public mind has a direct impact on the learning management strategies of primary science instructors at the 0.01 level, with an influence value of 0.58. *This is an open access article under the [CC BY-SA](#) license.*

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1. INTRODUCTION

In the current era, science and technology are constantly evolving. This is because scientific knowledge is being applied to make people's lives better. The ability to apply scientific knowledge in various ways and to address real-world challenges is referred to as scientific intelligence. This concept encompasses knowledge, understanding, and the application of science and technology, and it is an essential tool for ensuring that young people are prepared to function effectively in today's highly scientific and technological society. Scientific intelligence also involves the ability to recognize and evaluate social challenges arising from scientific and technological advancements with understanding and expertise. Developing scientific intelligence in every student is a primary goal of science education [1].

Scientific intelligence is essential for national development, economic competitiveness, and lifelong learning. According to the Programme for International Student Assessment (PISA), knowledge refers to a student's capacity to apply their knowledge and abilities in the main topics they have acquired in real-world situations rather than the knowledge they possess. The ability to think critically, reason, and communicate clearly involves recognizing essential ideas, interpreting, assessing, and resolving issues in a variety of contexts [2]. A key element of students' scientific growth is scientific intelligence. This helps students to think clearly and scientifically, which has crucial components: i) the phenomenon's scientific explanation; ii) assessing and planning the scientific inquiry procedure; and iii) analyzing information and using scientific evidence [3].

An analysis of national basic education test results in science subjects indicates that students' scores remain below the benchmark level of 50% and show a declining trend. It was found that the average did not meet the required percentage of 50 [4]. These findings demonstrate that students' academic performance in scientific courses is still below acceptable levels. Many educational institutions emphasize memorization and examination performance at the expense of critical thinking skills. The proper scientific principles are not presented to learners by observation. Teachers overemphasize the quantity of material and do not routinely evaluate students, despite the fact that asking questions is seen as a crucial ability in science learning. As a result, students are unable to think like scientists [5].

Furthermore, findings from teacher meetings within school-based scientific learning communities indicate that lecturing remains the dominant instructional approach. Students can take part in many activities. Students are given a worksheet to complete in order to assess their understanding of what they have read. Students have evaluated the idea map that is presented to the class in the textbook, but they have not been able to apply it. Students are not encouraged to demonstrate their own skills. Pupils are not taught how to independently assess and plan the learning process. Students cannot comprehend the content of the phenomena or circumstance that occurs because they do not examine what actually occurs in everyday life. Students are consequently unable to make connections between facts or scientific knowledge in order to produce scientific explanations [6].

The quality of human resources is the primary aspect that promotes the nation's empowerment and is crucial in addressing the social development, as outlined in the national education plan. The National Scheme of Education B.E. 2560-2579 (2017-2036) create regulations that will allow children to grow to their greatest potential. To effectively support learners, teachers must possess both knowledge and professional skills and be able to manage learning in ways that are developmentally appropriate and aligned with holistic child development principles. In accordance with national policies, particularly the objectives of the socio-economic development plan, educational institutions are required to design activities that align with curriculum standards and student competencies related to quality assurance [7]. Raising the educational standards encourages educational institutions to manage learning toward competency-based outcomes in accordance with the core curriculum. The Buddhist curriculum from 2007, which was amended by the professor in 2017, aims to help pupils acquire the skills they will need in the future. Create the classes with the development of the pupils' multiple intelligences in mind. The primary focus is on practical learning management, in order to improve educational standards and promote lifelong learning [8]. Primary school teachers play a critical role in the development and progress of children's learning. In order to prepare children to learn as much as possible at the basic education level, it is necessary to address the diverse talents and abilities of teachers. Curriculum development and learning management design are other important topics that are relevant to the production of educational content and may offer learning management experiences that are in accordance with the demands of students in the 21st century [9], [10]. Effective learning management, often referred to as experiential learning, is a key component of high-quality teacher education and initial teacher preparation programs [11]. The fact that someone willingly chooses to become a teacher is obvious; they have a strong sense of personal accountability and adapt to their profession. Teachers must possess the skills required to apply knowledge effectively in the 21st century, enabling successful classroom management, instructional material development, and the monitoring and evaluation of student progress [12].

Nowadays, science learning management is regarded as a crucial strategy and an essential learning process for students by emphasizing involvement, knowing the nature of science as well as its principles and procedures. The abilities required in the 21th century are also covered, such as critical thinking abilities, creativity, ingenuity, and problem-solving [13], [14]. During teacher education, a significant role in advancing teachers' professional growth is deemed crucial. Direct scientific experience should give teachers firsthand knowledge as learners, and they should be encouraged to use this knowledge in future practical experiences with students [14]. The majority of students observed that another element that influences scientific process abilities is scientific preference, which is primarily influenced by knowledge acquisition and action-oriented activities [15]. This is due to the fact that comprehending the issues and challenges that kids can encounter might aid in the development of coping mechanisms [16]. While most studies on flexible learning focus on student outcomes and teacher perspectives [17], fewer address parental viewpoints and challenges [18]. It has been demonstrated that these strategies can raise student involvement and academic accomplishment [19]–[22]. Professional competence of teachers, the noble truth's foundational elements four, in the spirit of teaching; Growth of innovative learning teachers of primary science are inspired to have a public spirit, which leads to learning management behavior (BhvTT). The findings of the study will be compiled in the Roi Et Province as guidelines to help primary science instructors improve their learning management abilities.

2.   METHOD

The research employed a research and development (R&D) strategy. R&D is a method of study used to develop particular products and assess their effectiveness [22]. The outcome of this study is the learning management model. The R&D of learning management is carried out in line with a model that places a high value on practicality and involvement in teaching and learning activities in order to achieve fundamental learning efficiency. That is the idea behind developing a framework for learning resources [23].

2.1. Sample

The sample of this study consisted of primary school science teachers affiliated with the Office of the Basic Education Commission in Roi Et Province, Thailand. The population comprised 300 teachers. The sample size was determined using the Krejcie and Morgan sampling table, and a total of 20 schools were selected through simple random sampling [24]. Participants were chosen based on their eligibility and voluntary participation, with the key criterion being that they were actively teaching science at elementary school.

2.2. Research tools

The research tool was a 151-question survey on the management of science education in the 21st century [25]. The creation of a learning management model for scientific instructors consists of six essential elements. From 1 (strongly disagree) to 5 (strongly agree), the scale calculates the values of the 5 Likert scale levels: 5=strongly agree/most generally used, and 1=strongly disagree/least utilized. Six essential elements: i) teacher professional competency (CmptT); ii) the four noble truths (NoblT); iii) teacher spirit (SprtT); iv) using innovative learning (InvML); v) inspiration for public mind (PblcM), and vi) BhvTT. The research instruments, which have undergone several stages of development and testing to ensure their accuracy and dependability, have been designed and verified by the research team. Based on the literature review and the objectives of the study, researchers would first create, develop, or select appropriate instruments. Pilot tests are then conducted to assess clarity. Program knowledge and applicability will help identify any ambiguous regions or issues with the tool, which may then be suitably corrected or enhanced. A group of five experts (two in curriculum, two in science learning management, and one in measurement and evaluation) assessed the accuracy of the content once the tool was updated. In accordance with expert advice, the IOC was raised from 0.67 to 1.00.

The dependability of the instruments used in this study was evaluated using the widely recognized Cronbach alpha coefficient test to assess the reliability and consistency of the products [26]–[28]. It certifies that the use of well-established measures that have already been tested demonstrates the reliability of the data and can help increase the likelihood that the new data will also be reliable. The data collection Cronbach's alpha coefficient, which ranges from 0.80 to 0.91, shows excellent reliability. It agrees with Cohen *et al.* [29], which explained that very high trust is generally indicated by a score above 0.90, very trusted by a score between 0.80 and 0.90, trusted by a score between 0.70 and 0.79, least trusted by a score between 0.60 and 0.69, and unsatisfactory by a score below 0.60 [30]. A 12-part domain trust evaluation score with a median alpha value of 0.90 suggests that the query has a very high level of trust, as shown in Table 1.

Table 1. Determination of the quality of the tool

Message	Number of variables	Cronbach's alpha coefficient	Result
CmptT	6	0.89	Highly reliable
NoblT	4	0.80	Highly reliable
SprtT	5	0.91	Very highly reliable
InvML	5	0.90	Very highly reliable
PblcM	4	0.91	Very highly reliable
BhvTT	5	0.89	Highly reliable
Overall	29	0.90	Very highly reliable

2.3. Data collection and data analysis

The researcher followed several steps to conduct the R&D procedure 4 techniques an independent investigation (research: R1). This data analysis is straightforward (analysis: A), instructing crucial details for creating learning and teaching styles techniques 2 progress (progress: D1) (D and D stand for development and design). It was created and designed as: the efficacy of teaching and learning strategies has been established and discovered by the researcher. The lesson plan that has been evaluated by five experts and the instruction manual are the instruments that go along with the teaching and learning paradigm. The joint committee on educational evaluation standards. There are four evaluation standards in all [31]. Following the computation of the assessment data's mean and standard deviation, the results are contrasted with the

analytical standards for the evaluation results. Research is the third step (research: R2). The application (implementation: I) is as: the effectiveness of teaching and learning models is evaluated through testing by putting into practice the established paradigm for teaching and learning science. Test using a four-person development sample (development: D2). It is an evaluation (Result: E): evaluation and improvement of teaching and learning strategies.

The research is currently applying the scientific teaching and learning paradigm in the three areas using the outcomes of the trial. This is the outcome of a study on the efficacy of a learning management technique employed by academic researchers. Science instructors improved their science learning management abilities in the twenty-first century both before and after the teaching and learning paradigm was put into place. They also developed new ideas about how to use scientific learning management models to enhance their instruction. Adjust the science learning management model as necessary. Ready to deploy and maintain the improved scientific learning management system in order to increase the utilization of science instructors in schools affiliated with the primary education area office in order to apply the updated scientific learning management model to the students in the extended group in Roi Et Province, data was collected during the first semester of the 2024 academic year, which took place from June to August 2024. Statistics: t-test for independent variables, structural equation modeling (SEM), content analysis, and standard deviation (SD). We also looked at the criteria used to evaluate the practice's usefulness and viability X≥3.50, S.D.≤1.00.

3. RESULTS AND DISCUSSION

3.1. Learning management development to study

The development of a learning management model for scientific instructors consists of six essential components: i) the professional competence of teachers (CmptT); ii) the Four Noble Truths (NoblT); iii) the spirit of teaching (SprtT); iv) learning innovation development (InvML); v) inspiration for public consciousness (PblcM); and vi) the learning management behavior of teachers (BhvTT), as shown in Figure 1.
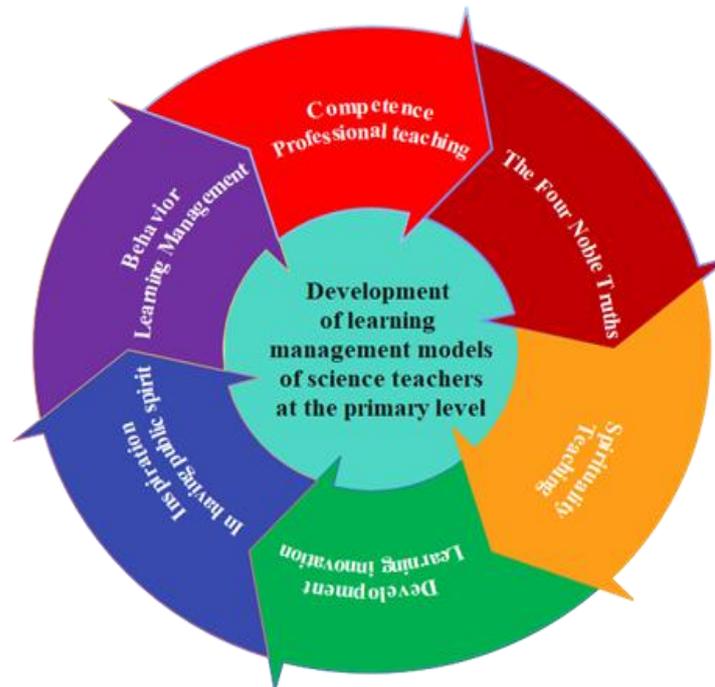

Figure 1. Learning management development model for primary science teachers

The Province of Roi Et's main science teachers is included. There are varying opinions about how scientific instructors ought to oversee their students' education. The average was 4.08, and the standard deviation was 0.70. BhvTT, PblcM and, NoblT are the most important elements of PblcM, as shown in Table 2.

Table 2. Level of opinion on learning management of science teachers

Message	Average	S.D.	Comment level
CmptT	4.01	0.75	Good
NoblT	4.07	0.68	Good
SprtT	4.03	0.75	Good
InvML	4.05	0.48	Good
PblcM	4.10	0.78	Good
BhvTT	4.24	0.73	Good
Overall	4.08	0.70	Good

The results of the evaluation of the learning management systems used by primary science instructors. the results of the assessment of primary science teachers' quality based on the learning management model. It was discovered that the average was generally quite good. When all standards are considered, the accuracy requirements comprise the highest average value. The requirements for appropriateness and utility are then, in that order, based on Table 3.

Table 3. Quality of primary science teachers' learning management models in compliance with the joint committee on standards of educational evaluation

Assessment items	Before the event activity		The level of quality of the model
	$\bar{X}$	S.D.	
1. Feasibility standards	4.34	0.49	Good
2. Utility standards	4.61	0.42	Very good
3. Propriety standards	4.77	0.34	Very good
4. Accuracy standards	4.86	0.34	Very good
Combine	4.64	0.34	Very good

Comparative outcomes of scientific learning activities and skill development by primary science teachers in Roi Et Province. The outcomes of contrasting primary science teachers' science learning practices. In Roi Et Province, it is clear that when science learning activities were implemented, there was a statistically significant difference at level 0.05. The average score was higher after completing the learning exercise than it was before, based on Table 4.

Table 4. Results of comparison of science learning activity skills of primary science teachers

Event organization	N	$\bar{X}$	S.D.	t	Sig.
Before the event	300	43.80	4.07	21.00	0.00*
After the event	300	53.80	1.94		

*Statistical significance at a level of 0.05

3.2. Analysis of linear structural relationship

Influence analysis of teacher professional performance components and relationship analysis of linear structures is the fourth noble truth in the spirit of instructing Both the use of learning management technologies and public sentiment have an impact on the learning management practices of primary science teachers in the Roi Et Province. It was found that there is a linear structural relationship between the inspiring stimuli in the public mind and the InvML that result in BhvTT learning management behavior. Primary science teacher in the Province of Roi Et empirical data is consistent ($x^2/df = 3.4654$), less than or equal to 5 when the Chi-square value is divided by the number of degrees of freedom (x^2/df). This recognizes the harmonious congruence between the empirical findings and the research's conceptual model. One of the other statistical metrics that demonstrate harmony and have support is the harmony level index. Both the modified harmonization index and the quality of fit index (GFI). The corresponding values were 0.90 and 0.92 for the adjustment of the goodness of fit index (AGFI). GFI>0.92 and AGFI>0.90, in addition to the crucial N (CN) value. When the number is 263, which is higher than 200, the model is entirely consistent with the empirical data. The correlation coefficient between factors influencing instructors' performance is the fourth noble truth in the spirit of teaching. New approaches to learning management development all four of the components had statistically significant relationships between them at the 0.01 positive level, with correlation values ranging from 0.462 to 0.953, according to research on how PblcM affects science instructors' learning management techniques in Roi Et province, as shown in Table 5.

Table 5. Correlation coefficient between public attitudes that impact scientific instructors' learning management methods and factors that encourage innovation in learning management

Variable	BhvTT	PblcM	InvML	SprtT	NoblT	CmptT
BhvTT	1.00					
PblcM	0.947**	1.00				
InvML	0.915**	0.802**	1.00			
SprtT	0.946**	0.906**	0.929**	1.00		
NoblT	0.928**	0.953**	0.814**	0.891**	1.00	
CmptT	0.716**	0.507**	0.773**	0.612**	0.462**	1.00

**Statistically significant at the level of 0.01

3.3. Development of learning management model

The results of the linear structure relationship and impact value separation investigations can be used to construct a graphic that shows the effect coefficient. Components of InvML, PblcM has a direct impact on how individuals handle their education. At the 0.01 level, BhvTT is statistically significant with an effect value of 0.58. The structural equation indicates that the components of the model can explain the variation in the InvML development variables. BhvTT is directly impacted by inspiration to have a PblcM. For science teachers, it is a 98.90% and can offer two further explanations for the fluctuation of the internal latent variable. InvML and inspiration to have a PblcM account for 94.50% and 94.10% of the body, respectively. Writing structural equations is feasible as in (1):

$$BhvTT = -0.25 * CmptT + 0.69 * NoblT + 0.15 * SprtT + 1.51 * InvML - 0.05 * PblcM \quad (1)$$
$$R^2 = 0.989$$

BhvTT is influenced by the following factors: the InvML is the most crucial element for scientific teachers. Next are SprtT and NoblT the trend is heading in the correct direction. Five factors account for the diversity of learning management techniques (BhvTT) for science teachers, it is 98.90% writing structural equations is feasible as in (2):

$$InvML = -0.15 * CmptT + 0.23 * NoblT + 0.91 * SprtT + 0.58 * PblcM \quad (2)$$
$$R^2 = 0.945$$

Factors influencing InvML expansion most of them. The first is SprtT which is followed by the inspiration to have a PblcM and the NoblT that there is a positive direction. This component explains the varying nature of InvML development 94.50%. Elements that influence the InvML is shown in (3). The most are CmptT next is the InvML and the spirit of being a teacher (Sprt). There is a positive direction, respectively. The element can explain the variability of inspiration in having a PblcM 94.10%, as shown in Figure 2.

$$PblcM = 0.69 * CmptT - 0.23 * NoblT + 0.23 * SprtT + 0.58 * InvML \quad (3)$$
$$R^2 = 0.941$$

3.4. Discussion

The linear structural relationship between the components of teacher professional performance represents the fourth noble truth in the spirit of teaching. The InvML and public sentiment has led to the BhvTT of primary science teachers in Roi Et Province. It was found that there is a linear structural relationship between the components of PblcM inspiration and the InvML that lead to BhvTT. There is empirical support for primary science teachers in the Province of Roi Et. Consider the Chi-square value divided by degrees of freedom (x^2/df) less than or equal to 5 $(x^2/df) = 3.4654$. This is an acknowledgment that the hypothetical model of the research is harmoniously consistent with the empirical data. In addition, there are other statistical values that indicate harmony that are supported, namely the harmony level index (GFI) and the adjusted harmonized index (AGFI) equal to 0.92 and 0.90 respectively (this research uses the value of GFI>0.92 and the value of AGFI>0.90) and the value of critical N (CN) equal to 263 which is more than 200. This demonstrates that the model and the empirical facts are harmoniously congruent. This leads to the effective development of science instructors' BhvTT.

It is evident that a person who voluntarily decides to become a teacher. They will be proficient in using 19th-century abilities, highly adaptive to their field, and successful in their 21st-century employment. More importantly, it will lead to efficient classroom management, setting up a classroom, creating educational resources, and tracking and assessing students' progress [32]. To provide students with the

chance to develop their skills in the 21st-century. It affects psychological changes that need to be applied initially in the overall setting. The educational system's human capital in schools has grown. Teachers have been trained on learning management strategies. Incorporate schools into community education and increase professional collaboration within schools [33]. Consequently, 21st-century capabilities an individual requires this ability to live a more respectable life. Address issues that are simpler to identify. They should look at events in their community or society from a variety of perspectives in order to achieve greater professional success. New abilities might be acquired in the 21st century, which are classified as learning and rehabilitation. Every educational level, from elementary to university, should focus on information, media, technology, and life and professional skills [34].
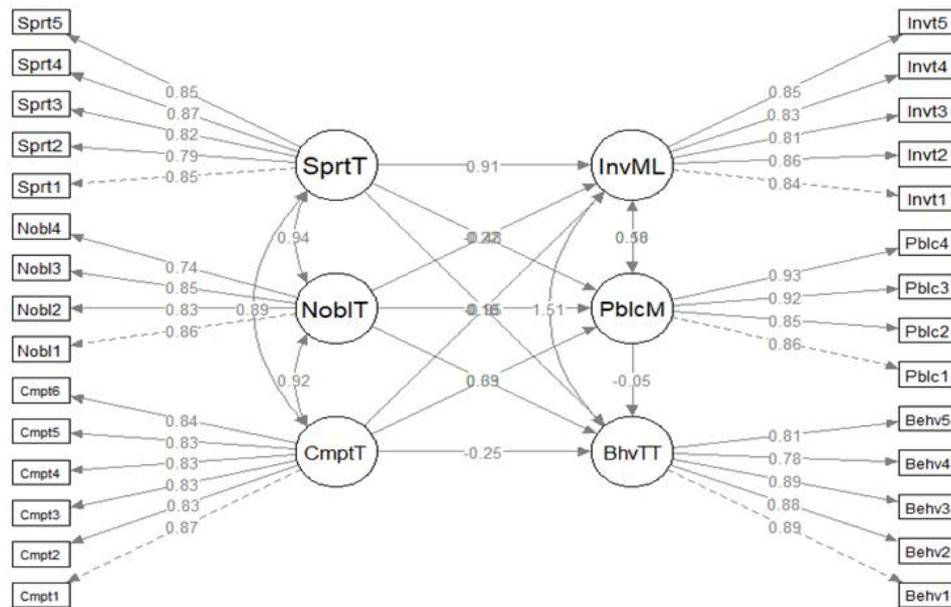

Figure 2. Public attitude and InvML factors affecting science teachers' learning management practices

The learning management paradigm consists of five steps: involvement, survey, justification, explanation, and evaluation. The researcher looked at the model development approach and integrated the elements of the science learning management model, particularly, which has a systematic development model based on Joyce and Calhoun [35], model development concept [35]–[38]. NoblT, the teacher's spirit is the InvML and public awareness, both of which have an impact on the learning management strategies used by primary science instructors in the Roi Et Province. The learning management practices of elementary school science teachers in the Roi Et province are linearly correlated with the motivating factor of public-mindedness. Upon considering the structural equations, it was found that the components of the model could account for the variation in two more internal variables: the InvML at 94.50% and PblcM at 94.10%. Furthermore, primary science teachers' BhvTT was directly impacted by PblcM. Due to the rise of learning management innovations and increased public awareness, science teachers in primary schools are now using. SprtT: NoblT learning management techniques. Studies on the development of managerial skills for science learning in the twenty-first century indicate that it is a process that incorporates theory. Both practicality and involvement in teaching and learning activities are highly valued in the model's concept and guiding principles.

The learning management model was found to consist of five steps: involvement, survey, justification, detailed description, and evaluation. The ability to plan science learning activities is the most common skill among primary science teachers in the Roi Et Province. According to the results of a study on the development of science learning management abilities among primary science teachers in the 21st-century. Naturally, after the organization of learning activities on the development of management abilities, learning science in the twenty-first century was statistically significant at the level of 0.05 when compared to the activities before the activity began [39]. The academic quality of instructors in terms of science content, pedagogical science, and technology also affects their ability to implement learning management innovations that support scientific literacy [34]. It is evident that the creation of a specially created model has a lot of potential. Such a model has been created using thorough R&D approaches, paying close attention to every

little detail. A thorough requirements analysis is part of the modeling process, which aims to handle the difficulties in a complete and context-sensitive manner [40], [41]. Three phases make up the creation of school-wide learning models: inputs, processes, and outcomes. Additionally, minor schools have made use of it. The experiment's findings demonstrate that cooperation is required to guarantee improved inclusive education implementation [42]. In terms of professional development, that may indicate the potential for teacher empowerment. Investigating how performance outcomes affect teacher learning-based teaching methods, especially in the areas of service and design for teacher education [43].

4.   CONCLUSION

The learning management paradigm consists of five steps: participation, survey, justification, detailed description, and assessment. In order to help primary science teachers gain a better understanding of science content and the science learning management process. The researcher has developed a science learning management model that incorporates essential elements such as NoblT, the teacher's spirit, the element of professional competence, and the use of learning innovations and inspiration. Therefore, one strategy to promote student achievement is to develop a learning management system especially for science teachers in elementary schools. Teachers require time to understand and practice this scientific teacher learning management strategy because it is also new to elementary science teachers. Instructors might alter their approaches and concentrate on more tangible material. Upon examining the structural equations, it was discovered that the model's components could account for the variance in the InvML component, the PblcM had a direct effect on the BhvTT of primary science teachers, and the variance in two additional internal variables: the PblcM 94.10% and the InvML 94.50%.

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
Saksri Suebsing	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	
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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

We have obtained informed consent from all individuals included in this study.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [SS], upon reasonable request. The data are not publicly available due to privacy and ethical restrictions, as they contain information that could compromise the privacy of research participants, including personal information of teachers under the Office of the Basic Education Commission.

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