

## บทความวิจัย (Research Article)

# การพัฒนากระบวนการจัดการเรียนรู้แบบผสมผสาน สำหรับนิสิตครูระดับปริญญาตรี

## Development of the Blended Learning Management Systems for Bachelor Degree Pre-service Teachers

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### บทคัดย่อ

งานวิจัยนี้มีวัตถุประสงค์หลักเพื่อพัฒนาระบบการจัดการเรียนรู้แบบผสมผสานสำหรับนิสิตครูระดับปริญญาตรี การดำเนินงานแบ่งเป็น 4 ระยะ ดังนี้ ระยะที่ 1 การศึกษาสภาพปัจจุบันและสภาพที่ควรเป็นในการจัดการเรียนรู้แบบผสมผสาน กลุ่มตัวอย่างเป็นนิสิตครูระดับปริญญาตรี จำนวน 113 คน คณะศึกษาศาสตร์ มหาวิทยาลัยของรัฐ 5 แห่งในภาคเหนือของประเทศไทย เครื่องมือวิจัยเป็นแบบสอบถาม วิเคราะห์ข้อมูลด้วยค่าเฉลี่ย ส่วนเบี่ยงเบนมาตรฐาน และความต้องการจำเป็น ระยะที่ 2 การพัฒนาระบบการจัดการเรียนรู้แบบผสมผสาน กลุ่มเป้าหมายเป็นผู้เชี่ยวชาญ 5 ท่าน เครื่องมือวิจัยเป็นแบบสอบถามเกี่ยวกับความเหมาะสมและความเป็นไปได้ของระบบการจัดการเรียนรู้แบบผสมผสาน วิเคราะห์ข้อมูลด้วยค่าเฉลี่ยและส่วนเบี่ยงเบนมาตรฐาน ระยะที่ 3 การปฏิบัติการใช้ระบบการจัดการเรียนรู้แบบผสมผสาน กลุ่มตัวอย่างเป็นนิสิตครูระดับปริญญาตรี จำนวน 65 คน ชั้นปีที่ 2 สาขาวิชาพลศึกษาและวิทยาศาสตร์การออกกำลังกาย คณะศึกษาศาสตร์ มหาวิทยาลัยนเรศวร เครื่องมือวิจัยเป็นแบบวัดความรู้ แบบประเมินทักษะการปฏิบัติ แบบวัดเจตคติ วิเคราะห์ข้อมูลด้วยร้อยละ ค่าเฉลี่ย ส่วนเบี่ยงเบนมาตรฐาน และการทดสอบที ตอนที่ 4 การประเมินรับรองระบบการจัดการเรียนรู้แบบผสมผสาน กลุ่มเป้าหมายเป็นผู้เชี่ยวชาญ 5 ท่าน เครื่องมือวิจัยเป็นแบบประเมินรับรอง วิเคราะห์ข้อมูลด้วยค่าเฉลี่ยและส่วนเบี่ยงเบนมาตรฐาน

ผลการวิจัยพบว่า 1) สภาพปัจจุบันมีค่าเฉลี่ยอยู่ในระดับปานกลาง สภาพที่คาดหวังมีค่าเฉลี่ยอยู่ในระดับมากที่สุด ความต้องการจำเป็นเรียงตามลำดับได้แก่ กิจกรรมการเรียนรู้ การวางแผน สื่อและแหล่งเรียนรู้ การวัดและประเมินผล 2) การพัฒนาระบบการจัดการเรียนรู้แบบผสมผสานมี 6 องค์ประกอบ ได้แก่ การเรียนเต็มรูปแบบออนไลน์ เหตุการณ์ที่เกิดขึ้นในปัจจุบัน การเรียนเนื้อหาแบบออนไลน์ การมีส่วนร่วมในการเรียนรู้ การวัดและประเมินผล และวัตถุประสงค์ประกอบการอ้างอิง ความเหมาะสมและความเป็นไปได้โดยรวมมีค่าเฉลี่ยอยู่ในระดับมากที่สุด 3) นิสิตครูระดับปริญญาตรีมีคะแนนผลการเรียนรู้หลังเรียนมีค่าเฉลี่ย 84.02 (หรือ 84.02%) สูงกว่าเกณฑ์ร้อยละ 80 และสูงกว่าก่อนเรียนที่มีค่าเฉลี่ย 63.11 อย่างมีนัยสำคัญทางสถิติที่ระดับ .01 และ 4) การประเมินรับรองระบบการจัดการเรียนรู้แบบผสมผสาน โดยรวมมีค่าเฉลี่ยอยู่ในระดับมากที่สุดและผ่านการรับรอง

**คำสำคัญ:** ระบบการจัดการเรียนรู้ การจัดการเรียนรู้แบบผสมผสาน นิสิตครู

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## Abstract

The main objective of this research was to develop a blended learning management system for bachelor degree pre-service teachers. This research was conducted in 4 phases as follows: Phase 1: studying the current conditions and the expected conditions of blended learning management. The sample group was 113 pre-service teachers undertaking a bachelor degree pre-service teachers in the Faculty of Education from five Public Universities in the northern region of Thailand. The research instrument used was a questionnaire. The data were analyzed using mean, standard deviation, and priority needs. Phase 2: developing the blended learning management system. The target group was five experts. The research instrument used was the blended learning management system propriety and feasibility assessment form. Mean and standard deviation were used for data analysis. Phase 3: Implementation of the blended learning management system. The sample group was 65 second-year pre-service teachers, majoring in Physical Education and Exercise Science, in the bachelor's degree program in the Faculty of Education, Naresuan University. The research instruments used were as follows: a knowledge test, a practical skill assessment form, and an attitude test. The data were analyzed by percentage, mean, standard deviation, and t-test. Phase 4: evaluated certification of the blended learning management systems. The target group was five experts. The research instrument used was the certification evaluation form. Mean and standard deviation were used for data analysis.

The results revealed that: 1) The current conditions were at a moderate level and the expected conditions were at the highest level. The needs ranking were as follows: learning activities, planning, media and learning resource, measurement and evaluation, respectively. 2) The developed blended learning management system comprised of six components as follows: online driver, live events, online content, collaboration, assessment, and reference materials. The overall mean propriety and mean feasibility were at the highest level. 3) Generally, pre-service teachers had a mean learning outcome post-test of 84.02 (or 84.02%) higher than criteria 80% and higher than post-test of 63.11 with statistically significant at .01 level. 4) Evaluated the certification of the blended learning management system had an overall mean at the highest level and passed the certification.

**Keywords:** Learning management system, Blended learning, Pre-service teacher

## Introduction

Current education management uses teaching styles and techniques to respond to human resource development and the country's competition in technological advancement, adapting to knowledge distribution, and linking knowledge in various fields that are interconnected around the world. The use of information and communication technology in education can take many models. Using computers as teaching equipment, implementing various services in the Internet network system, using the World Wide Web to develop it as a teaching medium for all education levels, and organizing teaching and learning through electronic systems using technology. The Internet is a

medium of communication between students and teachers where students can study without limitations in time and place (anytime anywhere) and creating opportunities and equality in learning for students. With all these, students can quickly exchange knowledge and send news to each other as it creates a learning society through electronic systems (Khlaisang, 2019)

The organization of the learning environment in the past took the form of classroom and out-of-class teaching activities. Computers were used as media with different types of media, teaching methods, and characteristics of different groups of students. Classroom learning was face-to-face, with the teacher supervising and controlling the teaching and learning environment for the group of students. Social interactions between individuals in the classroom involve coordinated activities while organizing a learning environment using computers as media that have the characteristics of distance learning, emphasizing the use of computers to support learning to respond to the learning rates of different students. Nowadays, computer technology is important to use in teaching and learning and affects changes in students' learning environment. Students can access lesson content while outside of class, and contact or interact with classmates and teachers at any time while participating in teaching and learning activities above all, computers and internet networks are a medium for accessing learning beyond the classroom. The Internet supports the creation of learning in the form of virtual society and cooperative learning by interacting and receiving information from many channels, including chatting via the network (chat), sending messages (e-mail), using discussion boards (web board), and group discussions (focus groups), etc.

Another new teaching format is under the trend of computer technology development. It is a model of integrating computer technology into regular teaching to make the process of instruction and learning more advanced, effective, and efficient. This model is called "Blended Learning" which is an educational innovation that combines many types of teaching modules. It is a characteristic of combining distance learning through the online network system with face-to-face learning. Learning is more effective than listening to lectures in a regular classroom. It allows teachers and learners to choose correct and appropriate media according to learning objectives in various ways to increase teaching and learning potential (Khlaisang, 2019). There are four blended learning concepts: 1) combining web-based teaching technology with traditional classroom learning, 2) combining various teaching methods, 3) combining learning technology and all types of teaching with traditional classroom teaching that has face-to-face interactions between students and teachers, and 4) combining teaching and learning technology with real work. Oliver & Trigwell (2005) define the characteristics of blended learning into four types consisting of 1) integration of teaching technology from web-based learning, 2) Combining academic-focused formats or methods to create higher learning output, 3) integration of pedagogical technology methods through specialized curriculum and/or training, and 4) integrating teaching technology into regular work or normal study that is being done. Equally, Horn & Staker (2011) identified six models of blended learning: namely; 1) face-to-face driver which involves one-on-one learning between the student and the teacher in

the classroom. 2) Rotation involving a rotating learning model that follows a curriculum based on a regular teaching schedule in a designated classroom under a variety of circumstances and based on individual learning rates. 3) Flexible learning involves a flexible blended learning model which may be adapted under various circumstances. Here, teachers can provide many learning formats for students including tutoring or small group learning according to interest groups. 4) Online lab involving blended learning that focuses on studying in online classrooms under the conditions of full use of information technology laboratories. 5) self-blended learning by the students themselves learning according to specified topics or curriculum, and 6) online driver where the process of instruction is fully online for both students and teachers. Carman (2002) defines the components of blended learning as having five components: live events, online content, collaboration, assessment, and reference materials. He design the blended teaching method into five steps: step 1. analysis and planning, step 2. design solutions, step 3. development, step 4 implementation, and step 5 evaluation.

Future trends research on appropriate formats for using technology in education continues to evolve according to learning styles, most commonly blended learning systems. Singh et al. (2021) studied online and face-to-face learning through blended learning for COVID-19. It found that it was very important to focus on building the capacity of instructors to be familiar with online instructional approaches, e-learning instruments, and the use of innovative technology to facilitate teaching and learning. A high level of emergency preparedness is required and as such instructors, administrators, and students must quickly adapt to changes beyond their control. With additional training on teaching methods, teachers build relationships and work to promote social presence, teaching presence, and intellectual presence in online teaching materials through the integration of technology in the classroom. A combination of rigorous quality assurance methods and continuous quality improvement helps instructors recognize changes to improve teaching and learning. The model was an appropriate combination of subject content, learner characteristics, and learning activities. The application of network equipment, tools, and computer software and hardware will bring about knowledge and social change. This model allows humans to interact with each other like one-on-one teaching and can learn from various media and unlimited locations. Therefore, developing a blended learning system is important to develop a bachelor degree pre-service teachers to have higher learning outcomes in both knowledge, practical skills, and attitude.

## Research Objectives

This study aimed to develop the blended learning management system for bachelor's degree students. Specifically, this study aimed to:

1. Study the current conditions and the expected conditions of blended learning management for bachelor degree pre-service teachers.
2. Develop the blended learning management system for bachelor degree pre-service teachers.
3. Implement the blended learning management system for bachelor degree pre-

service teachers.

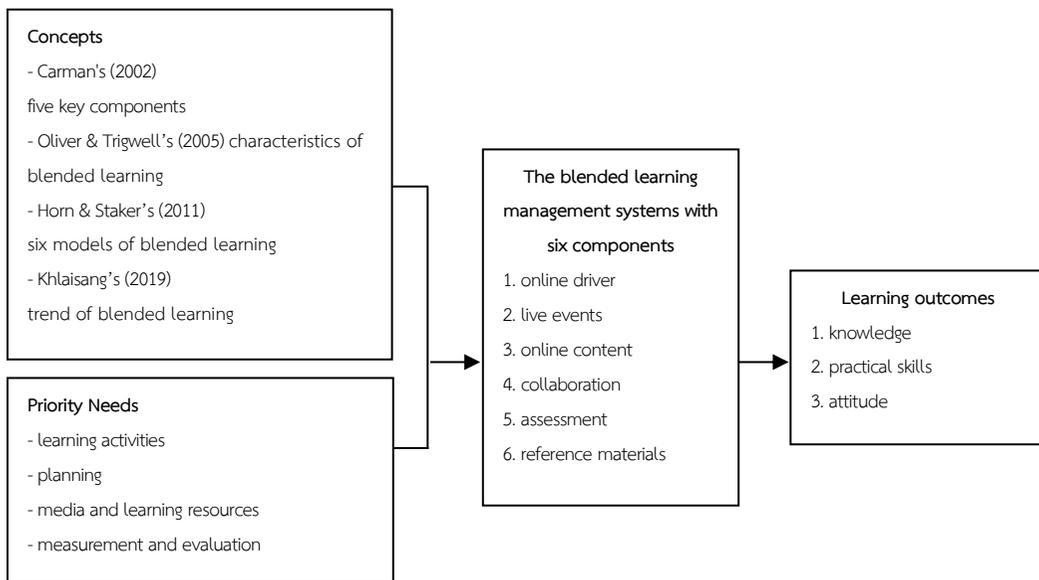
4. Evaluate the certification of the blended learning management systems for bachelor degree pre-service teachers.

### Research Hypothesis

1. The pre-service teachers' learning outcomes after the implementation of the blended learning management systems were higher than the criteria of 80%.

2. The pre-service teachers' learning outcomes after the implementation of a blended learning management system were higher than pre-test.

### Conceptual Frameworks



### Research Methodology

This study was conducted according to the procedures involved in Research and Development (R&D) divided into 4 phases which were consistent with the research objectives as follows:

**Phase 1 Studying the current conditions and the expected conditions of blended learning management for bachelor degree pre-service teachers.**

**Population** comprised 4,850 pre-service teachers, studying bachelor degree pre-service teachers in the Faculty of Education from five Public Universities in the northern region of Thailand, in the 2021 academic year.

**Sample group** comprised 113 pre-service teachers, studying bachelor degree pre-service teachers in the Faculty of Education from five Public Universities in the northern region of Thailand, in the 2021 academic year. The sample size of 98 was calculated using Yamane's formula at a confidence level of 90% (Yamane, 1973). The researcher prevented data loss by increasing 15 samples (15%). The sampling used a multi-stage method was as follows: stage first, the quota

sampling by calculating the proportion for each five Universities; stage second, the lottery sampling using the majoring as the unit of randomization; and stage third, the lottery sampling using the list of pre-service teachers as the unit of randomization.

**Variables** comprised the current conditions and the expected conditions of the blended learning management for a bachelor degree pre-service teachers.

**Contents** comprised the blended learning management that is divided into four areas: planning, learning activities, measurement and evaluation, media and learning resources.

**Research instrument** used was a questionnaire on the current conditions and the expected conditions of the blended learning management for bachelor degree pre-service teachers. The creation and quality analysis of the research instrument was as follows: the research studied concepts and theories from documents and research related to blended learning management. Set definitions of specific terms and developed a 20-item questionnaire divided into four areas: planning with five items, learning activities with seven items, measurement and evaluation with five items, and media and learning resource with three items. The rating scales were 5, 4, 3, 2, 1 level. The criteria meant that the current conditions and the expected conditions of the items were at the highest, high, moderate, low, the lowest levels. The questionnaire was given to three experts: two evaluation experts, and one technology expert. They considered the content validity by checking the consistency between the items and the definitions of specific terms. Analyzed the index of item-objective congruence (IOC) and selected items with an IOC value of .50 or higher. It found that the IOC value was between .67-1.00 with 20 items. It was improved according to the experts' suggestions and then used for data collection.

**Data collection:** the questionnaires were sent to 113 samples. They returned the questionnaires of 100% within one month.

**Data Analysis:** the data was analyzed using the mean and standard deviation of the current conditions and the expected conditions. Analysis of needs using formulas of Priority Needs Index:  $PNI_{modified} = (I-D)/D$ ; I meant important, D meant a degree of success. (Wongwanich, 2007). Then prioritize the needs of components to manage the blended learning for bachelor degree pre-service teachers.

**Phase 2 Development of the blended learning management systems for bachelor degree pre-service teachers.**

**Target group** comprised five experts: three technology experts, and two teaching experts. They had the following qualify: 1) occupation: currently working as an instructor at a University for more than ten years, 2) education: doctoral degree in technology, and teaching, and 3) experience: ever been taught the blended learning management for more than three years.

**Variables** comprised the independent variable was the components of the blended learning management systems with six components: online driver, live events, online content, collaboration, assessment, and reference materials. The dependent variables were propriety and feasibility.

**Contents** comprised the components of a blended learning management system applied according to concepts of Carman (2002) and Horn & Staker (2011) with six components: online driver, live events, online content, collaboration, assessment, and reference materials

**Research Instrument** comprised a questionnaire on the propriety and feasibility of the blended learning management systems for bachelor degree pre-service teachers. The creation and quality assessment of the research instrument was as follows: the research studied concepts and theories from research and documents related to blended learning management systems. Set definitions of specific terms and developed a 17-item questionnaire divided into six components: online drivers with two items, live events with three items, online content with three items, collaboration with three items, assessment with three items, and reference document with three items. The rating scales were 5, 4, 3, 2, 1 level. The criteria meant the propriety and feasibility of the items at the highest, high, moderate, low, the lowest levels. The questionnaire was given to three experts: two evaluation experts, and one technology expert. They considered the content validity by checking the consistency between the items and the definitions of specific terms. Analyzed the index of item-objective congruence (IOC) and selected items with an IOC value of .50 or higher. It found that the IOC value was between .67-1.00 with 17 items. It was improved according to the experts' suggestions. Then it to collect data.

**Operation steps** were as follows: studied of concepts and theories from documents and research related to blended learning. Analyzed and summarized important concepts, then combined the results of the current conditions and the expected conditions in the first phase. Set outline the components of a blended learning management system with six components: online driver, live events, online content, collaboration, assessment, and reference materials. The blended learning management systems for bachelor degree pre-service teachers were given to five experts: three technology experts, and two teaching experts. They considered the propriety and feasibility by checking the questionnaire. It was improved according to the experts' suggestions. Then the blended learning management systems were implemented with the sample group in the third phase.

**Data collection:** the blended learning management system propriety and feasibility assessment form was sent to five experts and responses were obtained within one month.

**Data Analysis:** the data was analyzed using content analysis of a draft of components of the blended learning management system. Analysis of the mean and the standard deviation of the a propriety and feasibility of the blended learning management system. The criteria for passing the propriety and feasibility with an average score of 3.50. (high or the highest level).

**Phase 3 Implementation of the blended learning management system for bachelor degree pre-service teachers.**

**Research design:** a quasi-experimental research design was used with one group pre-test post-test.

**Population** comprised 4,850 bachelor degree pre-service teachers, in the Faculty of Education, from five Public Universities in the northern region of Thailand, in the 2021 academic year.

**Sample group** comprised 65 second-year pre-service teachers (section 11 = 24, section 12 = 23, section 13 = 18), majoring in Physical Education and Exercise Science, in the bachelor's degree program in the Faculty of Education, Naresuan University. The sampling used a purposive sampling method. The sample selection criteria were pre-service teachers studying the course "Learning Measurement and Assessment and Quality Assurance", in the second semester of the 2021 academic year.

**Variables** comprised the independent variable was the blended learning management system. The dependent variables were learning outcomes (knowledge, practical skills, and attitude).

**Contents** utilized in this course was drawn from the course "Learning Measurement and Assessment and Quality Assurance" including principles, concepts, and practices about learning measurement and assessment and education quality assurance, analysis and design about assessment to develop learners, according to learning goals and education quality assurance, practices about learners' learning measurement and assessment, using the assessment results to develop learners and writing the education quality assurance report, using the education quality assurance results to develop educational management, totaling 45 hours in 15 weeks, in the second semester of the 2021 academic year.

**Research instruments** used were as follows: knowledge test, practical skills assessment form, and attitude test. The creation and quality analysis of research instruments were as follows:

1. Knowledge test with 60 multiple choice items, full score of 60 points. The researcher studied concepts and theories from documents and research related to learning measurement, assessment and quality assurance. Set objectives that were consistent with the course description. the test blueprint was created. From there, 80 items with five multiple choices was developed. The test was given to three experts: one measurement experts, one evaluation experts, and one quality assurance expert. They checked the content validity by checking the consistency between the items and objectives. Analyzed the index of item-objective congruence (IOC) and selected items with an IOC value of .50 or higher. It found that the IOC values were between .67-1.00 with 80 items. The test was improved according to the experts' suggestions. After that the test was tried out with 30 third-year pre-service teachers, majoring in Physical Education and Exercise Science in the Faculty of Education, Naresuan University. Checked the answers. The criteria for correct answers to be given 1 point, and incorrect answers to be given 0 points. Then the difficulty was analyzed. The criteria for the difficulty value (p) between .20-.80 with 60 items were selected and 20 items were eliminated. The discrimination was analyzed. The criteria for the discrimination value (r) of .20 or higher with 60 items were selected and 20 items were eliminated. The reliability was analyzed and used Kuder & Richardson's formula (1937). The criteria for the reliability value was close to 1; which meant the test was high reliability, was close to 0; it meant the test was low reliability. It found that the reliability

value ( $r$ ) was 0.91 showing that the knowledge test was high reliability. So it could be used for data collection

2. Practical skills assessment form with 10 items, full score of 20 points. The researcher studied the concepts and theories from documents and research related to practical skill assessment. Set definitions of specific terms. Created 10 items with a rating scale of 2, 1, 0 level. The criteria meant that practice with the items at good, fair, and poor levels. The practical skills assessment form was given to three experts: one measurement experts, one evaluation experts, and one quality assurance expert. They considered the content validity by checking the consistency between the items and the definitions of specific terms. Analyze the index of item-objective congruence (IOC) and select items with an IOC value of .50 or higher. It found that the IOC values were 1.00 with 10 items selected. The practical skill assessment form was improved according to the experts' suggestions and used for data collection.

3. Attitude test with 10 items, full score of 20 points. the research studied concepts and theories from documents and research related to attitude. Set definitions of specific terms and created 10 items with a rating scale 2, 1, 0 level. The criteria meant that agreed with the items at high, and low, and didn't agree with the level. The attitude test form was given to three experts: one measurement experts, one evaluation experts, and one quality assurance expert. They considered the content validity by checking the consistency between the items and the definitions of specific terms. Analyze the index of item-objective congruence (IOC) and select items with the IOC value of .50 or higher. It found that the IOC values were 1.00 with 10 items were selected. The Attitude test was improved according to the experts' suggestions and then implemented for data collection.

**Data collection:** The blended learning management system was implemented using a quasi-experimental and data collected with pre-service teachers in semester 2 in the 2021 academic year.

**Data Analysis:** the data was analyzed using percentage, mean, standard deviation, and t-test of the score of learning outcomes: knowledge, practical skills, and attitude.

**Phase 4 Evaluating the certification of the blended learning management system for bachelor degree pre-service teachers.**

**Target group** comprised five experts: two evaluation experts, two technology experts, and one teaching expert. They had the following qualify: 1) occupation: currently working as a lecturer at a University for more than ten years, 2) education: doctoral degree in evaluation, technology, and teaching, and 3) experience: must have utilized the blended learning instructional approach for at least three years.

**Variables** comprised the independent variable was the components of the blended learning management system with six components: online driver, live events, online content, collaboration, assessment, and reference materials. The dependent variable was the certification consisting of utility, feasibility, propriety, and accuracy.

**Research Instrument** used was a certification evaluation form. The creation and quality analysis of the research instrument were as follows: the researcher studied concepts and theories from documents and research related to evaluating the certification. Set definitions of specific terms and developed a 24-item evaluation form divided into four areas: utility with six items, feasibility with six items, propriety with six items, and accuracy with six items. The rating scales were 5, 4, 3, 2, 1 level. The criteria meant the utility, feasibility, propriety, and accuracy of the items at the highest, high, moderate, low, the lowest levels. The certification evaluation form was given to three experts: two evaluation experts and one technology expert. They considered content validity by checking the consistency between the items and the definitions of specific terms. Analyzed the index of item-objective congruence (IOC) and selected items with an IOC value of .50 or higher. It found that the IOC value was between .67-1.00 with 24 items. It was improved according to the experts' suggestions and then used for data collection.

**Data collection:** all instruments were sent to experts with the certification evaluation and responses were obtained within one month.

**Data Analysis:** the data was analyzed using mean and standard deviation for the certification evaluation. The criteria for passing the certification evaluation with an average score of 3.50 or higher (high or the highest level).

## Results

1. The results of studying the current conditions and the expected conditions of the blended learning management for bachelor degree pre-service teachers revealed an overall  $PNI_{modified}=.26$ . The current conditions were at a moderate level (mean=3.78, SD=.33). The expected conditions were at the highest level (mean=4.80, SD=.32). The needs ranking was as follows: learning activities ( $PNI_{modified}=.28$ ), planning ( $PNI_{modified}=.27$ ), media and learning resources ( $PNI_{modified}=.26$ ), and measurement and evaluation ( $PNI_{modified}=.24$ ), respectively as indicated in the table 1.

**Table 1** shows the needs ranking of the current conditions and the expected conditions of the blended learning management.

Items	The current conditions			The expected conditions			PNI <sub>modified</sub>	The needs ranking
	Mean	SD	Level	Mean	SD	Level		
1. Planning	3.75	.56	moderate	4.76	.42	highest	.27	2
2. Learning activities	3.76	.59	moderate	4.82	.38	highest	.28	1
3. Measurement and evaluation	3.84	.53	moderate	4.76	.42	highest	.24	4
4. Media and learning resource	3.77	.53	moderate	4.82	.37	highest	.26	3
<b>Total</b>	<b>3.78</b>	<b>.33</b>	<b>moderate</b>	<b>4.80</b>	<b>.32</b>	<b>highest</b>	<b>.26</b>	<b>-</b>

## 2. The results of developing the blended learning management systems for bachelor degree pre-service teachers.

In 2020, there was a severe outbreak of Covid-19 situation in Thailand. The government had announced strict measures to prevent the spread of the disease. The University had a policy of providing full online teaching and learning. This was consistent with the idea of the “online driver” model of Horn & Staker (2011) which requires both instructors and students to study online. The researcher studied Carman's (2002) five key components of blended learning comprised of “live events, online content, collaboration, assessment, and reference materials”. Thus, the researcher utilized and integrated Horn & Staker's (2011) one component and Carman's (2002) five components to summarize the important components of developing the blended learning management system. They were combined with the contents of learning activities, planning, media and learning resources, measurement and evaluation because the  $PNI_{modified}$  was between .24-.28 showing that all four areas were almost equally needed as indicated in the table 2.

**Table 2** shows the components of the blended learning management system.

components		The needs ranking (1) – (4)			
		(1) Learning activities	(2) Planning	(3) Media and learning resource	(4) Measurement and evaluation
Horn & Staker (2011)	Online Driver		/		
Carman (2002)	Live events		/		
	Online content	/			
	Collaboration	/			
	Assessment				/
	Reference material			/	

The important components of the developed blended learning management system comprised six components as follows:

Component 1: Online driver: planning for fully online blended learning that was appropriate for students and instructors. Online blended learning was consistent with curriculum or necessary situations in society such as utilizing online applications including Microsoft Teams during the COVID-19 epidemic situation.

Component 2: Live events: synchronous, instructor-led learning events in which all students participate at the same time, such as in a live virtual classroom, traditional lectures, video conferences, synchronous chat sessions, blackboard collaboration, Adobe Connect or YouTube.

Component 3: Online content: learning experiences that students complete individually, at their speed, and on their own time, such as interactive, Internet-based, or Power-point presentation, Video training.

Component 4: Collaboration: environments in which students communicate creatively and continuously with others, for example, e-mail, line, threaded discussions or online chat.

Component 5: Assessment: a measure of students' knowledge. Pre-assessments can come before live or self-paced events, to determine prior knowledge, and post-assessments can occur following live or self-paced learning events, to measure learning transfer. Assessment is not limited to conventional tests, quizzes, and grades. Narrative feedback, evaluations, and importantly, a designer's reflection about the blended learning environment's effectiveness or usefulness are all forms of assessment.

Component 6: Reference materials: designing or creating media and learning resources and building experience through group study and individual study using references from a variety of sources to increase the quality of learning.

The overall mean propriety and mean feasibility were at the highest level (mean=4.92, SD=.12 and mean=4.92, SD=.12), respectively. The mean propriety and mean feasibility of all six components were at the highest level. Components such as online driver, live events, reference materials (mean=5.00, SD=.00 and mean=5.00, SD=.00), online content, collaboration (mean=4.89, SD=.19 and mean=4.89, SD=.19), and assessment (mean=4.78, SD=.38 and mean=4.78, SD=.38), respectively as indicated in the table 3.

**Table 3** shows the propriety and feasibility of the blended learning management system.

Components	propriety			feasibility		
	Mean	SD	Level	Mean	SD	Level
1. Online driver	5.00	.00	highest	5.00	.00	highest
2. Live events	5.00	.00	highest	5.00	.00	highest
3. Online content	4.89	.19	highest	4.89	.19	highest
4. Collaboration	4.89	.19	highest	4.89	.19	highest
5. Assessment	4.78	.38	highest	4.78	.38	highest
6. Reference materials	5.00	.00	highest	5.00	.00	highest
<b>รวม</b>	<b>4.92</b>	<b>.12</b>	<b>highest</b>	<b>4.92</b>	<b>.12</b>	<b>highest</b>

### 3. Results of implementing a blended learning management system for bachelor degree pre-service teachers.

3.1 A comparison of mean learning outcomes between pre-test with 80% found that pre-service teachers generally had mean learning outcomes post-test of 84.02 (or 84.02%, from a full score 100) higher than the stated criteria 80% with statistically significant at the .01 level which was consistent with the research hypothesis. The mean learning outcomes comprised mean practical skills was 17.06 (or 85.30%, from a full score 20), mean attitude was 16.75 (or 83.75%, from a full score 20), mean knowledge was 50.20 (or 83.66%, from a full score 60), respectively as indicated in the table 4.

**Table 4** shows the comparison of mean learning outcomes between post-test with criteria 80%.

Learning outcomes post-test	Full score	%	Mean	SD	MD	t	Sig.
Knowledge	60	83.66	50.20	4.91	2.20	3.60**	.00
Practical skills	20	85.30	17.06	1.65	1.06	5.16**	.00
Attitude	20	83.75	16.75	1.54	0.75	3.94**	.00
<b>Total</b>	<b>100</b>	<b>84.02</b>	<b>84.02</b>	<b>7.55</b>	<b>4.02</b>	<b>4.29**</b>	<b>.00</b>

\*\* significant at the .01 level

3.2 A comparison of mean learning outcomes between the pre-test with post-test found that pre-service teachers had a mean learning outcomes post-test of 84.02 higher than the pre-test of 63.11 with statistically significant at the .01 level which was consistent with the research hypothesis, as indicated in the table 5.

**Table 5** shows the comparison of mean learning outcomes between the pre-test and post-test.

Learning outcomes	Full score	Mean	SD	Paired Differences		
				MD	t	Sig.
Pre-test	100	63.11	6.327	20.91	32.35**	.00
Post-test	100	84.02	7.545			

\*\* significant at the .01 level

**4. The results of Evaluating the certification of the blended learning management system for bachelor degree pre-service teachers** found that all six components were at the highest level of certification with an overall mean score (mean=4.89, SD=.04) and passed the certification. The evaluated certification considered utility (mean= 4.96, SD= .07), feasibility (mean=4.90, SD=.22), accuracy (mean=4.86, SD=.07), and propriety (mean=4.83, SD=.16), respectively as indicated in the table 6.

**Table 6** shows the evaluating the certification of the blended learning management system.

Components	Evaluate the certification											
	Utility			Feasibility			Propriety			Accuracy		
	Mean	SD	Level	Mean	SD	Level	Mean	SD	Level	Mean	SD	Level
1. Online driver	5.00	.00	High-est*	5.00	.00	High-est*	4.80	.44	High-est*	5.00	.00	High-est*
2. Live events	4.80	.44	High-est*	4.80	.44	High-est*	5.00	.00	High-est*	4.80	.44	High-est*
3. Online content	5.00	.00	High-est*	5.00	.00	High-est*	4.80	.44	High-est*	5.00	.00	High-est*
4. Collaboration	5.00	.00	High-est*	4.80	.44	High-est*	4.80	.44	High-est*	4.80	.44	High-est*
5. Assessment	5.00	.00	High-est*	4.80	.44	High-est*	4.80	.44	High-est*	4.60	.05	High-est*

Components	Evaluate the certification											
	Utility			Feasibility			Propriety			Accuracy		
	Mean	SD	Level	Mean	SD	Level	Mean	SD	Level	Mean	SD	Level
6. Reference materials	5.00	.00	High-est*	5.00	.00	High-est*	4.80	.44	High-est*	5.00	.00	High-est*
<b>Total</b>	4.96	.07	High-est*	4.90	.22	High-est*	4.83	.16	High-est*	4.86	.07	High-est*
Mean = 4.89, SD = .04, Highest level*												

\* The criteria for passing the certification evaluation must have an average score of 3.50 or higher

## Discussions

**1. The results of studying the current conditions and the expected conditions of blended learning management for bachelor's degree pre-service teachers.** The needs ranking was as follows: learning activities, planning, media and learning resources, and measurement and evaluation, respectively. This was because pre-service teachers had to learn online by themselves, interact with others via online communication channels, play roles in groups thoroughly, and participate in blended learning activities throughout the learning process which would create a positive learning environment with is related to the present situation. Pre-service teachers and instructors had to participate in blended teaching and learning activities simultaneously, thus, making online learning necessary and important. Also, for the University to deal with the rapid spread of this pandemic, a clear policy regarding online learning was announced requiring all faculties to teach online. The university provided various media and learning resources, prepared and purchased programs for online teaching, and increased the internet network to high speed covering all areas of the university, providing equipment for pre-service teachers to borrow for online study, setting guidelines for measurement and evaluation and providing knowledge and training to instructors and pre-service teachers in preparation for blended instruction. This was consistent with the research of Guzer & Caner (2014) who studied the past, present, and future of blended learning management and found that blended learning was seen as useful, fun, supportive, flexible, and motivating for students. However, these factors according to them are not enough to create a successful learning environment. As such, for instructors to create a positive blended learning environment, they should encourage students to become more involved in the learning process and should find ways to create social interaction activities through more collaboration and a combination of face-to-face and online learning environments should be precisely planned to get more benefit from blended learning management.

**2. The results of developing the blended learning management systems for bachelor degree pre-service teachers.** The important components comprised six components: online driver, live events, online content, collaboration, assessment, and reference materials. The overall mean propriety and mean feasibility were at the highest level. This was because the instructors planned

fully online blended learning for both pre-service teachers and instructors from the specified curriculum or university policies determined due to the COVID-19 outbreak situation. The current phenomenon was planned in a synchronized learning manner from real events or created simulation situations. There was immediate interaction between instructors and pre-service teachers. The pre-service teachers learned online content in lessons by themselves according to their readiness or individual learning rate. They participate in learning and communicating information with others through online media systems. Instructors measure results with quality instruments suitable for pre-service teachers, evaluating learning progress at every stage before, during, and after the learning. The instructors designed or created reference materials that were used as learning media and resources. Pre-service teachers created experiences through peer-reviewed research and individual research with references from a variety of sources to increase the quality of their learning. This was consistent with the research of Kinto et al. (2017) who studied the effectiveness of blended learning by analyzing the relationship between students' characteristics, learning design features, and learning outcomes and the results revealed that Blended learning design features included quality of technology, online tools, and face-to-face support, learner characteristics including attitude, self-control, which were the variables that predict student satisfaction. Students' characteristics and design features were important predictors of student learning outcomes. The findings were also in line with those of Dziuban et al. (2018) who studied the new normal and emerging technologies of blended learning in the post-vaccine and post-pandemic world and found that the outcomes, implications, and possible future directions for blended learning in higher education in an increasingly technologically-informed world where the effectiveness of blended learning was linked to student access, success and perception.

**3. The results of implementing a blended learning management system for bachelor degree pre-service teachers.** Generally, pre-service teachers had mean learning outcomes post-test higher than the stated criteria of 80% and learning outcomes post-test higher than pre-test with a statistically significant level at .01. This was because the blended learning was fully online. Pre-service teachers learned only online at their own pace. They had the opportunity to learn repeatedly which gave them enough time to understand the content under instruction. They could conveniently access learning resources through various channels. They could learn by reading, listening, and watching. The content was presented in the form of letters, pictures, sounds, and animations including creating virtual situations, interaction, and creating a network for them to be able to communicate without boundaries. They were happy and had a positive attitude toward online learning leading to the development of a variety of skills and knowledge. They could practice applying this knowledge in creating quality measurement instruments and creating appropriate evaluation criteria, participating in communicating information during online learning using information technology such as chat, e-mail, line, etc. Therefore, blended learning enabled pre-service teachers to have higher learning outcomes, including knowledge, practical skills, and

attitudes. The findings were consistent with the research of Deechai (2019) who studied the blended learning model to develop critical thinking and academic achievement of students in vocational education institutions and found that vocational education institution students who study with a blended learning model had higher critical thinking and academic achievement than students who studied with a traditional model with statistically significant at .05 level. The results were also in line with that of Leaudnakrob (2018) who found that the critical thinking ability of nursing students after studying was better than before studying with statistical significance at .01 level after developing and implementing a blended learning model by organizing learning for change to promoting critical thinking abilities of nursing students. Also, the results were per khaisri (2017) who developed an instructional model using blended learning and metacognition for Faculty of Education Students in Rajabhat University in the Northeastern region of Thailand and the results found that students' metacognitive ability after studying was higher than before, and was higher than the specified criterion of 75% with students in the experimental group having higher metacognitive abilities than the control group. They had higher information literacy after studying than before, and higher than the criteria of 75% with statistical significance at the .01 level.

**4. Results of evaluating the certification of the blended learning management systems for bachelor degree pre-service teachers.** The overall mean was at the highest level and passed the certification. All six components were at the highest level and passed the certification. The evaluated certifications were utility, feasibility, accuracy, and propriety, respectively. This was because, in this research process, there was a need ranking from the study of current conditions and expected conditions in blended learning management, content analysis and summary of important concepts from many academics which form the important concepts and information used to determine six components of a blended learning management system which were appropriate and accurate according to academic principles. The feasibility of implementing a blended learning management system in the current situation. It was useful to undergraduate students who developed higher learning outcomes, supporting more diverse learning styles that used technology in the modern era in the future. This was consistent with the research of Alammay et al. (2014) who studied blended learning in higher education and found that blended learning had become increasingly popular because it had proven to be an effective way to accommodate increasingly diverse students. The findings were also in line with Guzer & Caner (2014) who studied the past, present, and future of blended learning and the results found that soon it will be dominated by tablets, smartphones, and touchscreen devices which will be the next interest in studying in blended learning when technological innovation spreads new types of integration will emerge and education will be combined with different technologies.

## Conclusions

The blended learning management systems for bachelor degree pre-service teachers comprised six important components: online driver, live events, online content, collaboration,

assessment, and reference materials. There were details covering planning, learning activities, measurement and evaluation, media, and learning resources. The pre-service teachers' learning outcomes: knowledge, practical skills, and attitude after the implementation of a blended learning management system were higher than the pre-test. The learning management system was certified for utility, feasibility, accuracy, and propriety. The university also has prototypes of effective blended learning management systems. Future instruction will be characterized by the utilization of technology which will enable limitless learning in terms of time and place with students having continuous collaboration with instructors and peers. This instructional management system becomes necessary for present and future unitization.

## Suggestions

The research results of the blended learning management system that was fully online learning (Online Driver). The students must be able to learn content by themselves through online learning and be able to communicate and interact with others online. Therefore, they should be provided basic knowledge about using the online system first for students to become familiar with online tools and be able to solve problems in emergencies that may occur while studying online.

Future research should study the factors influencing blended learning management systems, and the development of blended learning management systems for the basic educational basic.

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