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Development of Virtual Exchange-Learning Management System Platform Combined with Challenge-Based Learning on the Topic of Education Leadership and Disruption in the Digital Era

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Abstract. The objectives of this research were to 1) design and create, test, use and evaluate a Virtual Exchange (VE) - Learning Management System (LMS) platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era; and 2) propose a VE-LMS platform combined with challenge-based learning management platform developed. This research is research and development. The sample group consisted of 34 graduate students in the master of education program at Rajamangala University of Technology Rattanakosin in the academic year 2024. The target group is ten experts in ICT systems and educational innovations. The research method consisted of four steps: 1) analysis of user requirement, 2) system design and development, 3) usability testing and evaluation, and 4) improving system performance. Quantitative data analysis by using statistical packages to show mean and standard deviation. The qualitative data analysis was used content analysis. The research results were as follows: 1) VE-LMS platform developed uses a DBLC development process. Experimenting with the operational system for graduate learning involves learning alongside digital technology with a simple implementation. Students have a highest level of satisfaction with the platform that is evolving, and 2) This system has a structure that consists of a website, lecturer and student database, knowledge record and exchange, knowledge assessment, discussion board, download documents, related case studies, pictures and videos demonstration of various activities. In addition, the platform will provide students with practical skills in learning Education Leadership and Disruption in the Digital Era. In addition, the platform equips graduate students with practical skills to learn about education leadership in order to improve the quality of education management to be efficient and effective.

Keywords: Virtual Exchange; Learning Management System; Challenge-Based Learning; Digital Era

INTRODUCTION

The Era of Digital Education, Information and Communication Technology or ICT system for education and its implementation to enhance the capacity of education management and the development of teaching and learning management is extremely important for educational institutions at all levels in the midst of the current education disruption (Phakamach, 2023). The Ministry of Higher Education, Science, Research and Innovation met the importance of an ICT in Education by encouraging the use of ICT to develop and apply in order to enable learners to learn and develop to a higher level of knowledge. This is in line with the government's policy according to the 20-year national strategy 2017-2036, and under the ICT Master Plan 3 (ICT Master Plan 3) Higher Education Act B.E. and more educational platforms due to the global connection of information, it is a new avenue for education. People use this main road as a path to intellectual treasures and to develop new learning styles (Lyapina et al., 2019; Phakamach, Senarith, & Wachirawongpaisarn, 2022). Therefore, the Ministry has established policies and standards to encourage educational institutions and agencies to implement the policy to promote the development of ICT for education by providing teachers. Educational personnel and learners have developed the ability to use educational platforms to benefit teaching and learning. Educational institutions at all levels need to have an ICT management system for educational innovation development as a standard system for improving the quality of education at all levels (Panjarattanakorn & Phakamach, 2020; Phakamach, Panjarattanakorn, & Onsampant, 2024).

Teaching in the era of transformational change or under an education disruption has a variety of teaching and learning management models that are used to promote and solve educational management problems in various fields, especially in the situation of the epidemic of Coronavirus (Ismaili, 2021). Teaching and learning management must align with the new learning paradigm. This enables learners to be able to seek knowledge on their own. This is specially true of the ability to fully use innovation and educational technology in pursuing knowledge. Virtual Exchange (VE) is a team "used to refer to the engagement of groups of learners in online intercultural interactions and collaboration project with the partner from other cultural contexts or geographical locations as an integrated part of their educational programmes" (O'Dowd, 2021; Gioiosa & Kinkela, 2022; Evian, Moore, & Hawkridge, 2023). While VEs allow students to interact from a distance and work actively with peers. Challenge-Based Learning (CBL) is a pedagogical approach that engages learners by challenging "challenges" defined as situations or activities that are defined through prompt perception and action. There is competition with oneself to achieve this in a realistic situation that has self-relevance (Nichols, Cator, & Torres, 2016; Inkaew & Napapongs, 2020). Key principles of challenge-based learning are built on the need to stimulate curiosity while creating opportunities for learners to discuss and encourage action. This type of learning provides context for realism by defining challenges and allowing students to take action on their own or help them learn within a group in order to achieve academic outcomes that benefit themselves and their workgroup. In addition, the process of challenge-based learning starts with Big Idea, Essential Question, The Challenge, Guiding Question, Guiding Activities, Guiding Resources, Solution, Action and Assessment (Manaarah Education Development, 2023; Nguyen, Gijlers, & Pisoni, 2023). Therefore, if the challenge-based learning management process is considered for graduate students' teaching and learning, it will also affect the quality of education appropriately.

Education Leadership and Disruption in the Digital Era is a core course in the Master of Education program at the Rajamangala University of Technology Rattanakosin; many institutes provide teaching and learning at the graduate level and are compulsory courses for modern educational administrators. This is because it aims to develop education administrators in the digital era to have high performance for the management of

educational institutions in both Thai and international educational contexts to be of high quality and towards internationalization (Phakamach, Wachirawongpaisarn, & Panjarattanakorn, 2021). Most of the learning takes place in a regular classroom, creating severe obstacles to student learning if there is no good source of support for the use of modern management techniques and operating systems to build an educational platform. It is worthwhile considering using learning materials on web applications, a teaching and learning process management system that connects learners with teachers and learners with learners. It provides digital learning materials and teaching materials with instructors acting as trainers (Adele, Ellinger, McWhorter, & Egan, 2023) and are inspirers by designing experiential proactivity activities that correspond to the course content (Huang & Lai, 2020), which is a self-paced learning model that supports knowledge management in a given course, helping to solve problems and obstacles that arise in students' learning. In particular, graduate teaching and learning focus on creating learning challenges in order to create new knowledge to appear with quality.

Based on this idea, the researcher is interested in developing a virtual exchange learning management system (VE-LMS) platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era and applications for graduate learner. This system will change the learning process by using the learning management system platform to support teaching and learning activities. To be a complete learning organization, this design and development present educational innovations with specific dimensions: 1) electronic learning media; 2) a knowledge management support system, i.e., knowledge repository and exchange, knowledge record, chat board, and a knowledge assessment form; 3) a database of teachers and students as well as academic services; 4) online electronic bulletin boards to exchange learning; and 5) linkage with universities (e-MIS). The education platform will be a model of a learning management system using software and services. as well as assessing the efficiency and satisfaction of the learners. Performance improvements are based on expert feedback. The platform is ideal for serving graduate students. It can be used to respond to student needs and effectively engage in learning about leadership in educational disruption situations.

RESEARCH OBJECTIVES

The study had two research objectives were as follows:

1. To design, create, test, use and evaluate a virtual exchange-learning management system (VE-LMS) platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era.

2. To propose a virtual exchange-learning management system (VE-LMS) platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era.

RESEARCH CONCEPTUAL FRAMEWORK

Research concepts can be formulated from the literature review and related research process design. The goal is to create a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era, as shown in Figure 1.

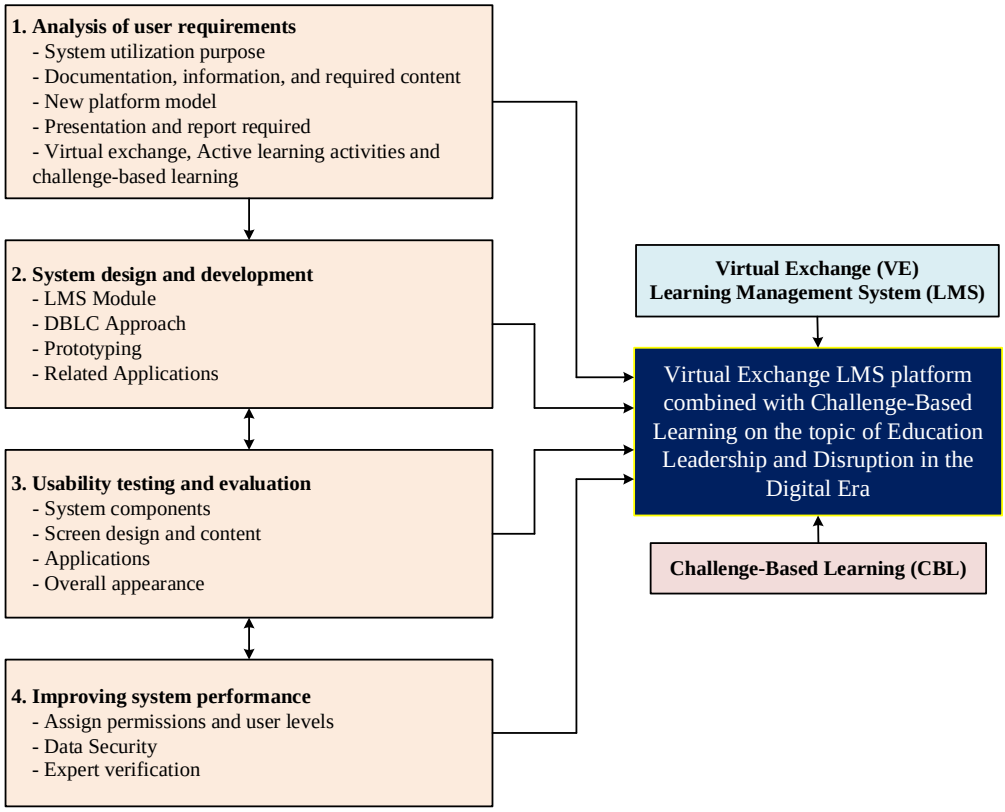

Figure 1: Research Conceptual Framework

METHODOLOGY

This research includes research and development with related details as follows:

Population and Sample

The population used in this research were graduate learners of the Master of Education program, Department of Education Administration and Strategies, Rattanakosin International College of Creative Entrepreneurship, Rajamangala University of Technology Rattanakosin, Enrolled in Education Leadership and Disruption in the Digital Era (EAS 6102) in the first semester of the academic year 2024, there are 34 students because the total study population is small and requires data based on the opinions of all learners. Therefore, the panel used a method of selecting the entire population by defining it as a sample. The target group would be 10 experts in ICT systems and educational innovation.

Research Instruments

The research tools consisted of (1) a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era and (2) the tools used for data collection were:

(1) Quality assessment form (for experts) in ICT systems and educational innovations is a 5-level rating scale that assesses the efficiency of the system in terms of system components, design and development, as well as usability.

(2) The student satisfaction assessment form is a 5-level rating scale that assesses the suitability of the system in terms of system components, screen design and content, as well as usability and attitude.

(3) Structured interview form for interviewing students' use of the system on issues of (1) knowledge exchange and implementation, (2) behavior and response, (3) participation, (4) results of use, and (5) problems and suggestions.

Procedures for Conducting Research

This research is research and development. The research method consisted of four steps:

(1) Analysis of user requirements, which is the study and analysis of user needs for both faculty and students. This establishes the necessary requirements for building a learning management system promotes solving current challenges through a five-step learning process. Starting from 1) Big Idea, 2) Essential Question, 3) The Challenge, 4) Solution and Taking Act, and 5) Assessment, etc.

(2) System design and development, by using learning management system and programs related to the development of online teaching materials. This entails designing a case study related to the course, including a preliminary test.

The process of creating tools used in teaching and learning management includes: 1) Studying the curriculum/course and analyzing the content of the Education Leadership and Disruption in the Digital Era (EAS 6102) course at the graduate level; 2) Defining the learning objectives to determine the scope of content in each unit including challenging learning activities accordingly; 3) Determine the format for presenting content by collaborating academic seminars and virtual exchange in accordance with the learning management approach that promotes the solution of challenging problems in 5 steps. Start with (i) Big Idea, (ii) Essential Question, (iii) The Challenge, (iv) Solution and Taking Act, and (v) Assessment, etc.; 4) Write a flowchart of the learning management platform to define internal communication channels for convenience; 5) Design the storyboard according to a hierarchical structure based on proactive knowledge management techniques and exchanges; 6) Develop the platform layout using LMS tool box and related computer programs; 7) Conduct trial to revise the platform; and 8) Evaluate the quality and satisfaction of the platform.

(3) Usability testing and evaluation, platform quality and suitability checks by 10 experts in ICT systems and educational innovation. This is a 3-month trial phase, and satisfaction is tested by students enrolled in the EAS 6102 course.

(4) Improving system performance, by taking the test and evaluation results obtained from Step 3 for confirmation and improving the performance of the VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era.

Experiment and Data Collection

The experimental model and the data collection were set as follows:

The preparation of the experiment includes:

(1) ask for permission for the data collection and test the system by collecting data and testing the system in the first semester of the academic year 2024.

(2) prepare the developed VE-LMS platform and put it on the LMS Learning Center, send the data to the server, and test its use.

(3) prepare the location and the computer, and schedule the experiment by testing the operating system in the content of educational platform development.

Experiment:

Take a platform that has been evaluated by an expert and test it for performance evaluation according to the following format.

One to One Testing: an experiment with three students who have taken this course before selected on the basis of high, medium and low grades based on their average grades in the past semester. Using a simple random sampling method, test the system to find defects and then use it to improve and fix it with the value $E_1/E_2 = 61.24/62.36$

Small Group: Testing Experiment with nine students who have taken this course before by selecting students with high, medium and low grades based on the average of the course

scores in the past semester as criteria. Using a simple random sampling method, test the system to find bugs and use them to improve E_1/E_2 = 71.56/72.64

Field testing, including:

(1) Bring the system to students for a one-month workshop experiment by selecting a sample group of 34 students and organizing a pretesting knowledge meeting. The meeting is carried out in the following order: (1) Pretest by having students test from the achievement test of 40 items, (2) let learners study by using a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era for the graduate learner, (3) allow learners to do exercises from the system ten items per learning unit, and (4) then post-test by having learners test from the achievement test of 40 items and evaluate the overall efficiency of E_1/E_2 with a value of E_1/E_2 = 81.79/ 83.27

(2) Interview a sample group of students, who use it regularly about their use.

(3) Analyze the results of the interview summarized in an essay manner and improve the system to be suitable and complete.

Data Analysis

The data obtained in the research process were analyzed in the following order:

1) Analysis of user requirements: summarized in an essay to illustrate the details that consist of (a) the purpose of using the system, (b) the required documents, information and content, (c) the format of the new system, (d) presentation and required report (e) the activities of Challenge-Based Learning, and (f) practical activities.

2) System design and development: by ten experts in ICT systems and innovations for education administration, summarized in an essay format to illustrate the details, which consist of (a) LMS Module, (b) DBLC Approach, (c) Prototyping, and (d) related applications.

3) Usability testing and evaluation: Assessment of the efficiency of the platform by experts and based on the satisfaction by 34 students using a 5-level rating scale.

The research at this stage will apply the process in steps 1 and 2 by assessing the effectiveness and satisfaction of use. The information in step 2 can adjust the process as appropriate. There is a practical test. as well as study according to the prescribed format in order to obtain a system that is suitable for VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era for graduate learner.

The study population at this stage can be divided into two groups as follows:

Group 1: the target group is 10 experts in ICT and educational innovations.

Group 2: the sample group consisted of 34 students in Education Leadership and Disruption in the Digital Era (EAS 6102) course at Department of Education Administration and Strategies, Rattanakosin International College of Creative Entrepreneurship, Rajamangala University of Technology Rattanakosin.

The tool used to collect the data is an unstructured interview form to test its effectiveness. Problems and obstacles, as well as corrective guidelines. Data collection can be divided according to the study population as follows:

Group 1: workshops and interviews,

Group 2: was a workshop facilitation and participant observation. The questionnaire consisted of checklist questions, Text form and a 5-level rating scale, with the questionnaire having three parts with details as follows:

Part 1: Information about the respondents.

Part 2: Opinions on using a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era. Will be an analysis to determine the efficiency and satisfaction of the system's users.

The criteria for using the score measurement are as follows:

Strongly Agree; the weight was scored as 5.
Agree; the weight was scored as 4.
Neutral; the weight was scored as 3.
Disagree; the weight was scored as 2.
Strongly Disagree; the weight was scored as 1.

Part 3: Suggestions and guidelines for developing a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era.

Creation and verification of the questionnaire tools draft will be submitted to experts to verify content validity and the appropriateness of language and wording. Then the next step is to test the reliability of the questionnaire using Cronbach's Alpha Coefficient formula. The reliability of the whole questionnaire was .967.

The data were then analyzed by statistical methods using a ready-made computer program. to find the efficiency and satisfaction of using a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era and application for graduate learner and present a statistical model for assessing efficiency and user satisfaction as follows:

Data analysis of group 1:

Bring the data to analyze and synthesize in order to find ways to improve and develop the system. Also, recommend the correct usage according to the prescribed format so that users can use it effectively.

Data analysis of group 2:

Part 1: Information that is the status of the respondents analyzed by frequency distribution and percentage.

Part 2: Information about opinions on using a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era and application for graduate learner. It is approximate scale data and is analyzed by calculating the mean and standard deviation.

Part 3: Information on recommendations and guidelines for developing a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era and application for graduate learner, which is text-based information. Use content analysis to obtain recommendations and development guidelines.

The mean was obtained from the estimation scale questionnaire data from the data analysis in group 2 and was compared with the criteria.

The criteria for interpreting the mean, in summary, are as follows:

4.21 – 5.00 means efficiency and satisfaction are at the highest level.
3.41 – 4.20 means efficiency and satisfaction are at a high level.
2.61 – 3.40 mean efficiency and satisfaction are moderate.
1.81 – 2.60 means that efficiency and satisfaction are at a low level.
1.00 – 1.80 means that efficiency and satisfaction are at the lowest level.

where the spectral range is determined by the formula = (5-1)/5 = 0.8

4) Improving system performance:

The research at this stage will apply the results of the 3rd step to improve a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era and application for graduate learners. Next, conduct interviews with five experts in ICT systems and educational innovations using a non-structured interview, focused interview method verification for opinions and suggestions. Then apply the examination results to improve the system's performance and complete the learning requirements according to the teacher's council of Thailand course criteria.

RESULTS

Developing a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era. The results of the research were as follows:

Research results according to objective 1

Design and create, test, use and evaluate a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era. The findings can be listed as follows:

Results of Analysis user requirements

1) The results of analysis of user requirements in order to use data to design and build a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era. Users have commented on their needs in critical areas, including: (a) it must be a system that can be used to support teaching and learning in a given course; (b) the system must support the process of teaching and learning with complete support functions; (c) the system should provide operating parts consistent with the course content; (d) the system should have relevant practical learning and case studies to enhance knowledge and understanding; and (e) the system designed and create must be able to operate according to the schedule designated classes.

2) Guidelines for developing a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era and recommendations. One should study the information related to academic Education Leadership and Disruption in the Digital Era before teaching management. Then, the system development method should be chosen according to the standard model. DBLC has the proper research and development process to achieve an operational learning system combined with case study learning on Entrepreneurship and Ventures in Education. That responds to the complete knowledge management model in the course.

Results of System design and development

System design and development will use the DBLC standard method to make the system efficient. The key steps are (1) System Analysis, (2) System Design, (3) System Implementation, (4) System Installation, (5) System Operation and Evaluation, and (6) System Maintenance and Evolution, resulting in a learning management system for the course.

Results of Usability testing and evaluation

The results of the test and trial of a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era with students enrolled in Education Leadership and Disruption in the Digital Era (EAS 6102) course in the first semester of the academic year 2024 by quality assessment by experts and the satisfaction assessment by students showed the following:

1) The results of evaluating the effectiveness of a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era and application to graduate learner based on the opinions of 10 experts, as shown in Table 1.

Table 1, shows system performance evaluation by experts in three areas: system components, screen design and content, and usability. It was found that the system's overall quality was at a high level in all aspects ($\bar{x}$=4.15, S.D.=0.55). When considering each aspect, it was found that as for the components of the system, 7 items, the overall picture was at a high level ($\bar{x}$=4.11), arranged in order of averages from highest to lowest in 3 sequences: 1) website, 2) discussion board, and 3) learning activities, respectively, with the highest level, is the website. In terms of screen and content design, 8 items were overall at a high ($\bar{x}$=4.10), arranged in order of averages from highest to lowest in 3 sequences: 1) content and consistency, 2) overall screen, and 3) design process accordingly

sequence, with the highest level on the overall screen as a whole. As for the usability aspect of the 7 items, the overall picture was high ($\bar{x}$=4.25). The mean was sorted from highest to lowest in 3 orders, namely 1) how to use it for the purpose, 2) the membership system, and 3) the interaction section. Respectively, with the highest level in terms of how to use it for the purpose.

Table 1: Results of efficacy assessment by experts

Topics and Assessment Items		$\bar{x}$	S.D.	Interpreting
System components	1. Website	4.25	0.65	Highest
	2. Record knowledge	4.19	0.65	High
	3. Measuring and evaluating knowledge	3.89	0.50	High
	4. Discussion board	4.23	0.55	Highest
	5. Knowledge repository and exchange	4.07	0.55	High
	6. Learning activities	4.21	0.65	Highest
	7. Pictures of various activities	3.99	0.55	High
Design and development	8. Content and Consistency	4.43	0.65	Highest
	9. Format and font size	4.11	0.45	High
	10. Font color and background	4.07	0.65	High
	11. Visual and sound effects	4.17	0.55	High
	12. Multimedia system	3.63	0.55	High
	13. Instructions and Manuals	3.72	0.50	High
	14. Overall screen	4.40	0.55	Highest
	15. Design process	4.34	0.50	Highest
Usability	16. Membership system	4.33	0.65	Highest
	17. Back-end system	4.18	0.45	High
	18. Link section	4.23	0.65	Highest
	19. Interaction section	4.39	0.45	Highest
	20. Search system	3.99	0.45	High
	21. How to use it for the purpose	4.46	0.55	Highest
	22. Practice in the course	4.18	0.55	High
Total		**4.15**	**0.55**	**High**

2) The results of the satisfaction assessment of the use of the model of a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era and application to graduate learner according to the opinions of 34 students are shown as follows: Table 2.

Table 2, shows student satisfaction with using the system in three areas: system components, screen design and content, and usability. It was found that the overall system satisfaction was at a highest level in all aspects ($\bar{x}$=4.22, S.D.=0.66). When considering three aspects, it was found that for 7 items of the system, the overall picture was at a high level ($\bar{x}$=4.22). The averages were sorted from least to most significant in 3 orders: 1) website, 2) learning activities, and 3) pictures of various activities, respectively, with the highest level on the website. In terms of Screen Design and Content, 8 items, the overall picture was at a high level ($\bar{x}$=4.19), arranged in 3 descending orders of average values: 1) content and consistency, 2) instructions and manuals, and 3) overall screen, respectively, with the highest level of content and consistency. As for the usage aspect, 7 items, the overall picture was also high ($\bar{x}$=4.26). The mean was sorted from highest to lowest in 3 orders, namely 1) cognition of learning activities, 2) practice in the course, and 3) implementation for Education Administrators. respectively, with the highest level in terms of cognition of learning activities.

Table 2: Results of the satisfaction assessment by students

Topics and Assessment Items		$\bar{x}$	S.D.	Interpreting
System components	1. Website	4.41	0.67	Highest
	2. Record knowledge	4.23	0.45	Highest
	3. Measuring and evaluating knowledge	4.19	0.74	High
	4. Discussion board	4.25	0.58	Highest
	5. Knowledge repository and exchange	4.08	0.50	High
	6. Learning activities	4.35	0.66	Highest
	7. Pictures of various activities	4.29	0.61	Highest
Screen design and content	8. Content and Consistency	4.40	0.57	Highest
	9. Format and font size	4.27	0.58	Highest
	10. Font color and background	4.20	0.59	High
	11. Visual and sound effects	4.12	0.72	High
	12. Multimedia system	4.18	0.68	High
	13. Instructions and Manuals	4.08	0.63	High
	14. Overall screen	4.37	0.67	Highest
	15. Screen design process	4.32	0.53	Highest
Usability and attitude	16. Membership system	4.01	0.74	High
	17. Back-end and search system	3.92	0.72	High
	18. Link and interaction section	4.26	0.60	Highest
	19. How to use it for the purpose	4.15	0.67	High
	20. Practice in the course	4.40	0.74	Highest
	21. Cognition of learning activities	4.43	0.68	Highest
	22. Implementation for Education Administrators	4.30	0.70	Highest
Total		**4.22**	**0.66**	**Highest**

3) The results of the interviews about student' opinions towards the model of a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era and application to graduate learner included 5 issues, as follows:

3.1 Knowledge exchange and implementation: students have a system suitable for teaching and learning styles at the graduate level for issues related to Education Leadership and Disruption in the Digital Era. As well as the ability to apply knowledge to become an educational administrator in the digital era, including future research design.

3.2 Behavior and response: students use the interaction section with the instructor and between learners together; that they practice this in the course (as group discussion and exchange, One-on-one discussion, brainstorming, doing exercises and presentation of assignments); they can use a search system and link sections related to the course, and record knowledge for exchanging and sharing knowledge. The students can also develop themselves. In addition, learners can also increase their learning capacity to become an educational leader in the digital era.

3.3 Participation: the system can motivate students to use it to create an atmosphere of exchange and transfer knowledge in social media, participatory operations, and challenge-based learning. It also helps students practice design and development skills and strategies for building a modern educational platform.

3.4 Utilization: students were satisfied with the system by applying their knowledge and skills in educational administration a of other members. It also helped build learning skills in effective educational administrator in the digital era.

3.5 Problems and suggestions: students want a system to customize the screen by themselves to be more beautiful, as well as more attractive. When accessing this course,

as with other social networks, practice sessions should be timed appropriately for both learning theory and practice in the course.

Results of Improving system performance

The research team synthesized the results of testing and trials of the system from the expert quality assessment and student satisfaction assessment to improve the system's efficiency. Then, five experts in ICT systems and education innovation were interviewed for a definitive review. An experts commented on the benefits of VE and CBL including: (1) Learning with student centred; (2) Learning takes place in smaller groups (versus traditional classroom); (3) Teachers are coaches and facilitators; (4) Challenges provide the organizational focus and stimulus for learning; and (5) Challenges ensure development of both subject and generic competences. An experts continue to provide feedback and suggestions for further improvements in system performance by developing interactive digital content. Online interactions include other techniques and methods for further improvement of academic achievement.

Research results according to objective 2

Designing and creating, testing, using and evaluating a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era and application to graduate learners found that the system developed according to the methods presented here can be assured of sufficient quality for effective implementation of this system in teaching and learning at the graduate level. An example of a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era and application to graduate learners as shown in Figures 2-4, respectively.

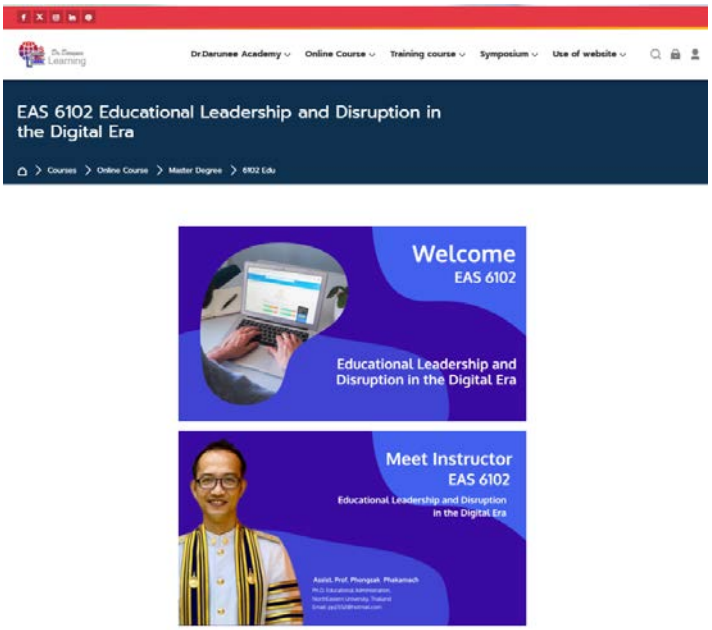

Figure 2: VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era

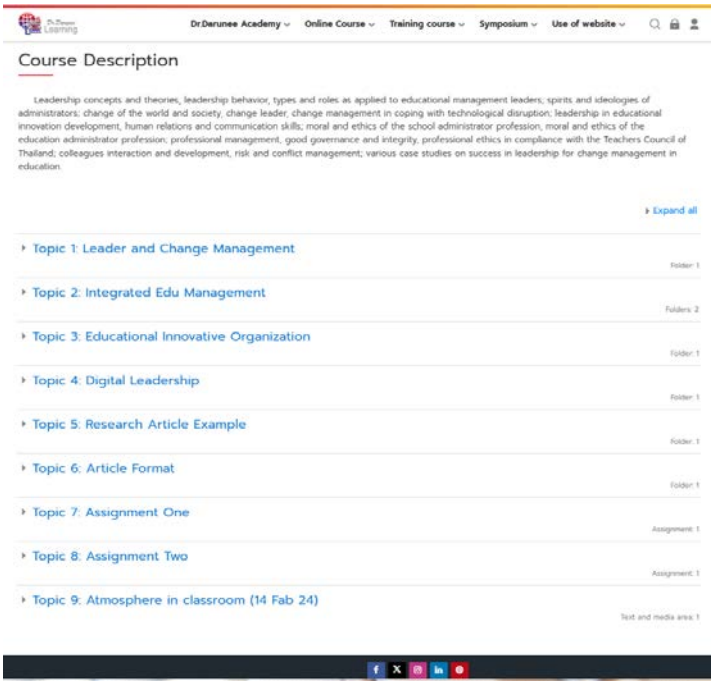

Figure 3: Course Description and Topics

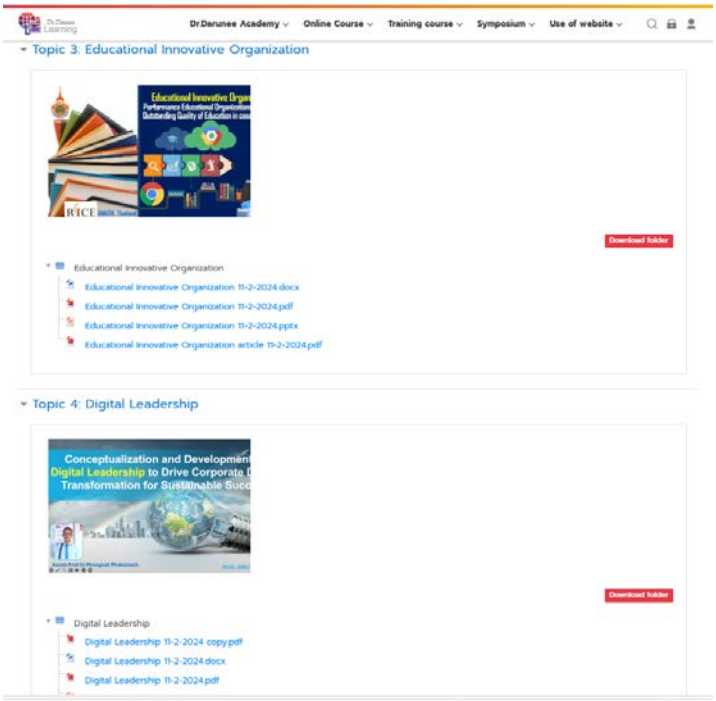

Figure 4: Example of active learning and knowledge exchange

CONCLUSION AND DISCUSSION

The research results can be summarized and discussed in crucial issues according to the objectives and research process as follows:

Conclusion

1) Research and development methods for a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era and application to graduate learner consisted of 4 steps: 1) Analysis of user requirements, 2) Design and development of systems, 3) Usability testing and evaluation,

and 4) Improving system performance. Design and development result in a system with important characteristics, such as a system that can actually be used for teaching and learning in the course. The system must support the teaching and learning process with complete support functions, provide operating sections consistent with the course content, and have practical learning and relevant case studies to enhance knowledge and understanding. In addition, the system must be able to operate according to the specified schedule, and should use a content management system and Virtual Environment Challenges (VEC) to make the system perfect.

2) Design and development of a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era and application to graduate learners. A standard ICT development process should be used to develop a learning system. It determines clear procedures and practices to obtain a system that can fully respond to learning management in a given course or content.

3) An analysis of the efficiency and satisfaction of using a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era and application to graduate learners yield this results:

3.1 The efficiency of using the system from experts' opinions was a high level ($\bar{x}$=4.15, S.D.=0.55), indicating that the developed system could be used as a tool for teaching in the course. This system can be used as effective learning and implementation tool in the EAS 6102 course. It can also support learning about Education Leadership and Disruption in the Digital Era.

3.2 Overall satisfaction from the students' opinions of using the system was a highest level ($\bar{x}$=4.22, S.D.=0.66), indicating that the students who used this system had a satisfactory level of satisfaction because this system can respond well to the management of learning about Education Leadership and Disruption in the Digital Era.

Discussion

Discussion of this research includes, related parts under these headings:

1) Developed platform, the researcher has applied the conceptual framework for research and development from the ideas of Cheng (2016); Adnan and Anwar (2020) and Kant, Prasad, and Anjali (2021) to design the following steps: (1) course content analysis; (2) system design by ordering content, classify subject according to learning principles, assign learning activities, determine the relevant research resources, and creating a virtual learning room and knowledge processing; (3) the development of the system based on the principles of 4Is: Information, Interactive, Individual and Immediate Feedback; (4) the use of the system for teaching and learning based on the communication channels provided; and (5) testing for the efficiency of the system is mainly based on the opinions of students. That is consistent with the research work of Phakamach, Panjarattanakorn, and Onsampant (2024), the research on the development of a platform for graduate education uses the same methodology to create an appropriate and quality platform.

2) The evaluation results by experts found that the developed system is suitable for a high level. It shows that the developed platform has this quality and that it can be used in practice because the researcher develops the lessons systematically from the study and analysis of the data using the (Analysis, Design, Development, Implementation, and Evaluation) or ADDIE process, which experts have reviewed. After that, the data are tested with the sample to evaluate the efficacy and to apply the results for improvement. It is a method of conducting media production according to research and development (R&D) and relying on trials and modifications to be as complete as possible. That is consistent with the research work of Phakamach, Wachirawongpaisarn, and Panjarattanakorn (2021); Demir, Maroof, Sabbah Khan, and Ali (2021) and Trivedi, Patra, and Singh (2022). However, to get a good model and make students understand the subject matter more, some aspects of multimedia and graphics system design should be improved related to the

operation. This is required to make the system more complete and provide more educational options.

3) The satisfaction assessment results by students found that the developed system showed highest satisfaction. It shows that students can learn about Education Leadership and Disruption in the Digital Era. The platform can support learning management and virtual exchange very well. That is consistent with the research by Wang et al. (2021; Singh, Sharma, and Paliwal (2021); Hamdan et al. (2022) and Nguyen, Gijlers, and Pisoni (2023) stated that developing a sound model system requires at least four elements: i, data source and content, ii, support resources; iii, discussion boards; iv, online learning activities; and case studies to help learners understand, which can be used to create a virtual learning model. (Parramore, 2019). In addition, the VE-LMS platform has all the elements that can be used as a system to support learning management in this course.

4) The results of confirmation of the platform used by experts from group interviews found that the VE-LMS platform combined with challenge-based learning can be a support system for teaching and learning at the graduate level. It can enable students to gain theoretical knowledge and practice learning experiences in the study. Therefore, it can be confirmed that the performance of the platform has been developed from the elements and stages of the development of a quality management system and learning exchange (Chapman & Bell, 2020; Kant, Prasad, & Anjali, 2021; Tam, 2022).

In closing, The VE-LMS platform design process based on the above research methods can be applied as a model for designing teaching and learning management in courses related to the development of digital technology for education at all levels. In order to be able to improve the quality of education further.

SUGGESTIONS

The researchers put forward two kinds of feedback as follows:

Suggestions for applying the research results

Implementation and development of this VE-LMS platform combined with challenge-based learning to be more effective consists of

(1) A learning support system requires a qualified development team, such as lecturers, educators, educational psychologists, programmers, and educational innovation and technology designers. Appropriate and efficient.

(2) For the learning management process to be fast and cost-effective, there should be literacy training using browser programs or applications before learning to understand the correct method. And can solve problems that arise during self-study.

(3) Appropriate details should be added to the course, such as the website, related case studies, and the interaction section. To provide in-depth practical training for learners and to promote broader learning.

(4) The development of online learning systems should use appropriate and consistent fonts, graphics, sounds and multimedia. To make situational learning and processing possible effectively and efficiently.

Suggestions for further research

(1) This VE-LMS platform combined with challenge-based learning should be developed to use more elements as standard learning materials. It will provide insights to improve learning styles to be more effective.

(2) There should be research and development of multi-tasking digital platforms based on VE-LMS platform combined with challenge-based learning models that can make online learners feel more positive and imaginative by developing multimedia that attracts online learners' attention.

(3) There should be more research and development of VE-LMS platform combined with challenge-based learning in other subjects to increase modern learning resources for the further development of higher education in Thailand.

According to the design and development methodology, it can be assured of sufficient quality for implementing this VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era for teaching and learning at the graduate level. Therefore, it can be concluded that research and development of a VE-LMS platform combined with challenge-based learning on the topic of Education Leadership and Disruption in the Digital Era produce a desirable performance for graduate learners.

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