



The development of a curriculum to enhance learning management competency in digital transformation age for pre-service teachers

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Abstract

COVID-19 has accelerated digital transformation, where the traditional curriculum is unable to provide necessary skills to pre-service teachers. This research focuses on curriculum development to equip future teachers with sufficient competencies and aimed to: (1) study learning management competency in the digital transformation age of pre-service teachers; (2) develop a curriculum to enhance learning management competency in the digital transformation age; and (3) assess curriculum quality and effectiveness. The research participants included 16 informants for the interview, 9 experts for the focus group, 12 experts who approved the curriculum and 88 pre-service teachers to assess curriculum effectiveness. The instruments included an interview form, focus group issues, an assessment form, and competency test, subsequently analyzed by means, standard deviations (*SD*), t-test dependent, one sample t-test, and content analysis. The results revealed as follows: (1) Learning management competency in the digital transformation age included; (1.1) pedagogical strategic design; (1.2) using digital in learning management; (1.3) digital communication and collaboration, and (1.4) integrated problem solving. (2) The curriculum are six components; objectives, principles, content structure, the 4-step stairs activities including inquirer, screener, integrator, initiator; instructional media and sources, and evaluation; (3) The quality of curriculum was highest in terms of accuracy, suitability, and benefits; with high feasibility. Pre-service teachers increased their learning management competency after participating, and higher than the 70 percent criteria in all activities, with a significant difference of .01. The findings also showed that pre-service teachers' satisfaction toward the activities was highest, and significantly higher than the 70 percent criteria in all activities.

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Introduction

The COVID-19 outbreak has affected educational management at all levels, resulting in the New Normal of this management in the digital transformation age, the age of integrated technologies with all service platforms for changes and creation of innovations that fulfills different needs of target groups (Wongyai & Phathapon, 2019, pp. 6–7). Educational platform adjustment encouraged UNESCO (2021, pp. 5–6) to set the educational management guidelines in digital transformation age. They encouraged applying digital technologies; student rights for learning; connectivity; access to knowledge and information; media and material preparation; and teacher preparation for new instruction management platforms. In addition, the International Society for Technology in Education (ISTE) introduced ISTE Standards as a plan for curriculum development to create students and to set unambiguous guidelines to develop educators and for professional digital learning management (ISTE, 2021). Thus, the changing situation of learning management may cause insufficient competency of “teachers” and failures to respond to learning management platforms in digital transformation age. This conforms to Basilotta-Gómez-Pablos et al. (2022), who stated that digital competence is necessary in the educational context as one of the core competencies required for teachers. Most teachers still reflect themselves as having low – moderate digital competence and lacking some capabilities to use technologies in their work. Similarly, Chuenjai and Ruangmontri (2021) found that the current conditions of the learning management skills in the digital era of the teachers under investigation were at a moderate level. The needs for skill development were the use of information technology and communication; classroom management; learning management design; and learning measurement. Besides, according to the results of needs for digital competence in pre-service teachers by Wisetsat and Wisetsat (2020, p. 106), it was found that pre-service teacher’s digital competence was highest in terms their needs for teaching and learning. For this reason, it is required for teacher education institutions to prepare guidelines on encouraging pre-service teachers to be capable of efficient learning management in digital transformation age.

Thus, concepts to enhance learning management competency in the digital transformation age for pre-service teachers must encourage students to apply their knowledge obtained from curriculums to teaching practice and solve complex problems under different

phenomena. The concept of phenomenon-based learning (PhBL) focuses on surveying holistic real-world phenomena for students to create bodies of knowledge on their own from problem-solving. Skills and knowledge related to them are studied by crossing the boundaries between subjects, resulting in systematic integration of various sciences; along with the use of guidelines on meaningful learning management (Silander, 2015). Thus, this concept is suitable to be applied for enhancing learning management competency of pre-service teachers who must integrate various contents, skills, and characteristics for applying to teaching practice in professional context. As Moilanen (2015) stated, teachers work in the complex realities of schools, confronting ill-structured phenomena. The traditional content-based curriculum notion of the application of theoretical knowledge to practical problems is too simple and unrealistic. Thus, a phenomenon-based curriculum offers an effective means of linking theory and practice in teacher education. This conforms to Manowaluloua et al. (2022), who found that pre-service teachers who received PhBL had highest learning management competency, and that they could apply PhBL in class, both theoretical and practical phases, by integrating phenomena in the real world. They also had an opportunity to show their holistic perspective to analyze problems about class and to learn from outside that could develop their learning management competency.

However, to follow this concept requires guidelines on field experiences that encourage opportunities for students to learn phenomena and practice their problem-solving skills in real situations in order to achieve learning goals. Work integrated learning (WIL) is a combination between in-class and outside field experiences that can be available in various forms including internship or teaching practice for field experiences (Kramer & Usher, 2011). It also refers to experiential learning that brings opportunities to apply work as well as specialized skills related to their profession and to realize real work life before graduation. These conform to Rusznyak and Bertram (2021), who stated that WIL provides pre-service teachers with opportunities to plan, teach, and reflect on their own lessons and obtain feedback on their own teaching. Working alongside experienced teachers is expected to enable students to learn “the process of acting and thinking wisely in the immediacy of classroom life. Likewise, Bouwer et al., (2021) found that WIL increased practical experiences and shaped future teachers to be ready for taking careers with capabilities and confidence.

Changing situations of the current world in the digital transformation age have brought technology-based learning (TBL) because this concept is a platform to facilitate learning in accordance with goals by focusing on using suitable technologies for student capabilities. The combination of multiple technologies increases attraction and responses to learning goals. This conforms to Parnto (2020), who stated that TBL is an instruction platform using modern media and materials, and transferring to students for their understanding and easier access in the online learning platform. The new platform covers multiple platforms of learning approaches, and supports current as well as future situations. This conforms to the results of a study by Zhang (2022), who found that creative use of technologies developed quality of in-class learning activities and learning in teachers. Thus, it is required to increase roles of technology in teacher profession development programs.

For all of these reasons as stated, this research aimed to: (1) study learning management competency in the digital transformation age of pre-service teachers; (2) develop a curriculum to enhance learning management competency in the digital transformation age for pre-service teachers; and (3) assess curriculum quality and effectiveness.

Literature Review

Learning Management Competency in the Digital Transformation Age

Learning management competency refers to a capability to combine a set of knowledge, skills, beliefs, and characteristics to manage learning in educational institutions. The Common European Framework for Teaching Digital Competence (INTEF, 2017), covers analyzing the main five dimensions: Information, Communication, Content Creation, Safety and Problem Solving. This conforms to Wisetsat and Wisetsat (2020) who studied the need for digital competence of pre-service teachers. It was found their need to enhance digital competence, which included 6 aspects, i.e., search and usage; creativity and innovations; identity and quality of life; teaching and learning; tools and technologies; and communication and coordination, was high. Similarly, Konsanthia (2022) extracted international digital competence frameworks, 7 elements were obtained, i.e., the capability to use technologies to encourage professions; communication and interactions; educational digital resource management; assessment;

teaching and learning; encouraging and facilitating students; and ethics and safety. They also suggested that involved agencies should give precedence to teacher development for their digital competence, which refers to the development of technologies for learning management; good characteristics of using digital media and knowledge transfer to students. For competency assessment, Kanjanawasi (2014) stated that the assessor should define and identify behaviors that indicate competency, and develop measuring instruments with validity and reliability. A variety of tools, including Self-assessment, Peers, Customer assessment, can be used to collect data and set an assessment criteria for further development.

Enrichment Curriculum

Enrichment curriculum is experiential learning masses organized to develop specific knowledge, process skills, or characteristics that align with the learner's problems or needs and the community context. The content is arranged to have additional depth or breadth, more than the normal curriculum. It uses a variety of teaching strategies and assessment methods, emphasizing both theory and practice, to enable learners to learn most effectively (Posner, 2004). There are 3 types of enrichment curriculum; Content-based, process-oriented and productivity-oriented (Colangelo & Davis, 2003). This research uses a process-oriented approach in order to encourages pre-service teachers to integrate knowledge, skills and attributes in the digital transformation classroom effectively through the 4 steps of enrichment curriculum development, which includes: The study of basic information, Curriculum drafting, Curriculum implementation, and Assessment to improve the quality of the curriculum (Gratthorn et al., 2019).

Phenomenon – Based Learning

PhBL is a concept of educational management of Finland that drives suitable curriculums and instruction management for students in the 21st century. This concept is based on constructivism, focusing on driving students to create bodies of knowledge on their own. Knowledge is the outcome from problem-solving. These small findings are like the assembled parts that suit each particular situation at that time. PhBL usually occurs in collaborative environments. It also supports social learning theory and sociocultural theory, which describe that knowledge is not just part of individuals but created by social contexts; thus, students can use knowledge and

learning tools through sociocultural process (Silander, 2015). PhBL includes 5 characteristics; (1) holistic; (2) authenticity; (3) contextuality; (4) problem-based inquiry learning, and (5) learning process. It focused on phenomena that cross boundaries between subjects which are a central role in the development of transversal competences that link different fields of knowledge and skills, and can in turn be applied to real-world situations (Symeonidis & Schwartz, 2016).

Work Integrated Learning (WIL)

WIL is a combination of academic and professional learning under work environments as part of study in curriculum that focuses on specialization or specific fields of study (Stirling et al, 2016). It is a point of agreement and integration of theoretical and practical phases. Students can confront ambiguous problems with no unprecise answers. Theoretical and practical knowledge is required for solutions. WIL includes 4 key characteristics, i.e., (1) combination, point of agreement, and integration of in-class theoretical knowledge and field experiences; (2) part of curriculum; (3) under real work environments; and (4) work under teaching practice must be quality or can develop student efficiency (Yawai & Vongchavalitkul, 2019). These conform to research by Bamrungsin and Khampirat (2022), who found that professional skills of pre-service teachers who participated in the active online WIL training were higher. They also obtained knowledge and skills, and were satisfied with online tools. The training also increased inspiration and confidence; and supported their life, career goals, and self-preparation of pre-service teachers.

Technology-Based Learning (TBL)

TBL is a learning platform that facilitates student learning as per the goals. It focuses on using suitable technologies with student capabilities, a combination of diverse technologies, and responses to learning goals. This conforms to Wathananarong (2009, p. 42), who stated that TBL is to apply technologies and techniques for study so that students can use electronic media during their study and interactions with teachers as well as classmates. Simultaneously, Wongyai and Phathapon (2020, p. 9) stated that using digital technologies for learning design, learning media development and assessment, reflection, and student development using digital technologies is a basic skill of teachers to connect the online world between teachers and students. TBL is to use different technologies in instruction to enhance learning experiences, with 3 key elements, i.e., (1) digital contents, (2) digital equipment for access to contents, and (3) systematic learning process (Cullen, 2018). This conforms to Nilsook (2017), who stated that TBL is to use equipment and techniques to support learning management. Teachers must find suitable approaches to apply technologies for student learning.

Conceptual Framework

The research studied the concepts used for developing the curriculum, i.e., (1) PhBL (Silander, 2015); (2) WIL (Kramer & Usher, 2011) and (3) TBL (Cullen, 2018); (4) Learning management competency in digital transformation age of pre-service teachers (INTEF, 2017; Wisetsat & Wisetsat, 2020). These can be concluded as in Figure 1.

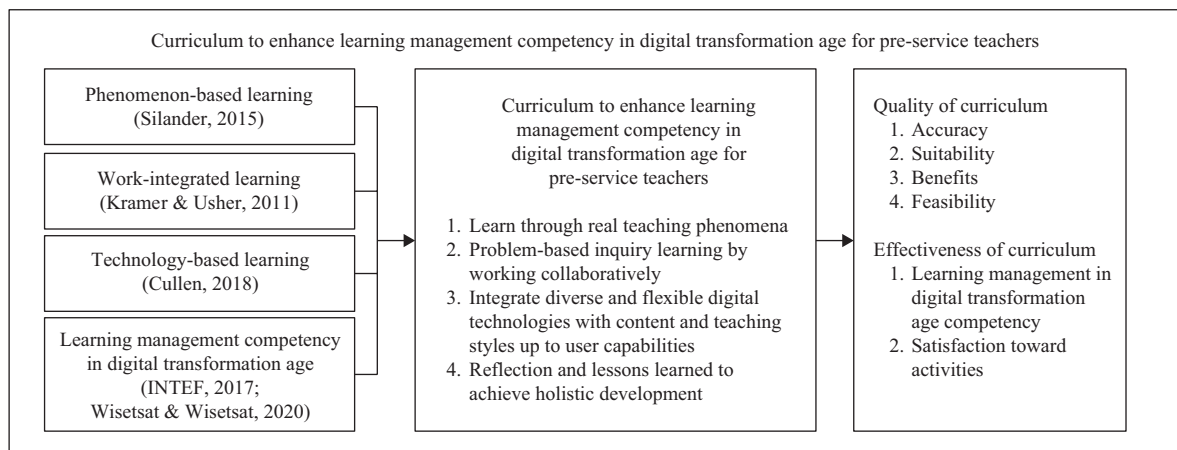


Figure 1 Conceptual framework

The research hypotheses are, i.e., (1) Learning management competency in the digital transformation age of pre-service teachers in the post-participation phase was higher than the pre-participation phase; (2) Learning management competency in the digital transformation age of pre-service teachers in the post-participation phase was higher than the 70 percent criteria; and (3) Pre-service teacher satisfaction toward activities of the curriculum in the post-participation phase was higher than the 70 percent criteria.

Methodology

The methodology of this research study was research and development (R&D), which was divided into three phases, as follows:

Phase I: The Study on Learning Management Competency in the Digital Transformation Age of Pre-Service Teachers

There were 16 informants for the interview, obtained by purposive selection, consisting of; (1) the representatives from teacher education institutions which included field experience administrators, supervisors and lecturers; (2) the representatives from teacher employability agencies, which included school administrators and mentors. The researcher set the selection criteria based on school affiliation with their willingness to provide data. The research instrument was a structured interview form, of which validity was calculated by 5 experts. Index of Item-Objective Congruence (IOC) of the interview form was 1.00 in all questions.

Phase II: The Development of Curriculum included 4 Steps as follows

1. Studying basic data to develop the curriculum by reviewing documents and research papers related to teacher professional standards, education in digital transformation age, learning management competency of pre-service teachers, and related concepts as well as theories.

2. Drafting the curriculum by using the results of phase I and data of step 1 as the essence for further development.

3. Reviewing the draft of the curriculum by setting a focus group discussion from 9 experts, obtained by purposive selection. They were experts at teacher education institutions with training on field experiences, curriculum and instruction, and educational technologies;

and the representatives from schools. The instruments for data collection included the draft of the curriculum and the focus group issues. Instrument validity was calculated by 5 experts. IOC obtained was between 0.80–1.00.

Phase III: Quality and Effectiveness of Curriculum

1. Assessing curriculum quality by 12 assessors, 3 from each region, obtained by purposive selection. They were experts in field experiences, curriculum and instruction, and educational technologies. The assessors also included administrators at teacher education institutions and the representatives from schools. The instrument was a 5 level Likert Scale assessment form in terms of accuracy, suitability, feasibility, and benefits. Instrument validity was calculated by 5 experts. IOC obtained was 1.00.

2. Applying the curriculum to enhance learning management competency in pre-service teachers who were included in the treatment group (Freshmen to juniors who practiced their teaching in schools in 2022). The sample sized was set by G* Power program for comparative analysis of means, with the effect size = 0.70. The samples were obtained by stratified sampling. Their majors were used as the strata. Then, the samples were randomized by simple random sampling based on the proportion of the population to obtain the number as per the effect size (88 samples).

3. The samples participated in a pre-teaching workshop through 5 steps; Teaching phenomenon observation, Lessons value analysis, Problem based inquiry with digital technology, Concept synthesis and Holistic reflection, for preparation before their teaching practice in schools.

4. The samples applied the knowledge and digital technology skills gained from the workshop in teaching practice in schools, reflected on lesson learned with peers and teacher for development.

5. The instruments included a competency test with 5 level Likert Scale, of which IOC was between 0.67–1.00, discrimination power between 0.24–0.76, and reliability between 0.76–0.84. The questionnaire was about satisfaction toward the activities of curriculum. The quality was examined by experts. It was found that IOC was between 0.80–1.00.

The researcher submitted the request for human research ethics. It was approved with the certification no. SWUEC/E-108/2565

Data Analysis

1. Qualitative data were obtained from document study and by the interview. Then, it was analyzed by content analysis.

2. Quantitative data were analyzed by mean and *SD*, t-test dependent, and one sample t-test were used for hypothesis testing.

Results

In this research, the results were as follows.

1. Learning management competency in the digital transformation age included the following competencies: (1) Pedagogical strategic design; (2) Using digital in learning management; (3) Digital communication and collaboration; and (4) Integrated problem solving. These all conform to the results of the interview with the informants from teacher education institutions and graduate users, who found that in the digital transformation age, teachers should realize the principles of learning management in their own fields, with designed activities that met different needs of students through onsite, online, and on-demand platforms. They could select and apply suitable teaching approaches and develop tools, media, digital technologies for learning, and online assessment with the contexts. Moreover, teachers could work with people from different generations by applying digital tools to facilitate their communication and working with others efficiently. They could also analyze and find guidelines on using media and digital tools to prevent and solve problems in and outside class, with suitability for problems and students at each age. Besides, there was a suggestion for teacher education institutions that they should develop curriculums in accordance with the competency of students at each year based on authentic conditions in schools through long-term research and development process. The system should be flexible, with adjustable contents to be in accordance with the changing age.

2. The curriculum included 6 key elements, as per the following details.

2.1 Objectives:

To enhance learning management competency in the digital transformation age for pre-service teachers.

2.2 Principles

1) Using real teaching phenomena that pre-service teachers at each year have to confront, so as to guide and support them to use their knowledge, skills, and characteristics related to their professions and

technologies for “practices” in order to learn or rectify such.

2) Encourage pre-service teachers to learn through problem-based inquiry learning by working collaboratively, reflecting on experiences, developing concept, and putting such into practice.

3) Using and integrating diverse and flexible digital technologies based on contents, teaching styles, learning management platform, and problems in phenomena up to user capabilities in order to enhance their learning experiences.

4) Encourage pre-service teachers reflection, and lesson learned as a result of problem solving so that they can gain holistic perspectives on phenomena leading to student development.

2.3 Content structure and guidelines on activities

There were 4 activities in the curriculum. Activities 1–2 were provided for freshmen. Activity 2 was provided for sophomores and Activity 3 was provided for juniors. Each particular activity was divided into 3 sessions. To clarify, Session 1 included the workshop to enhance learning management competency of pre-service teacher before real practice. Session 2 was to instruct pre-service teachers to apply their knowledge from the workshop to teaching practice in schools. Session 3 included discussion, reflection, and lesson learned all together about the results of applied knowledge for further development. Each session included strategies to support efficient implementation, as in [Figure 2](#).

2.4 Instructional media and sources used in activities included cases, flipchart papers, smartboard, equipment for activities, digital media (classroom video clips), and teaching sites.

2.5 For evaluation of curriculum activities, they considered learning management competency of pre-service teachers was higher than the pre-participation phase, and also higher than the 70 percent criteria. Their satisfaction toward activities was high, and was higher than the 70 percent criteria.

3. The Results of Assessed Quality and Effectiveness of Curriculum Development to Enhance Learning Management Competency in the Digital Transformation Age for Pre-Service Teachers

3.1 The results of overall assessed quality and effectiveness curriculum development to enhance learning management competency in the digital transformation age.

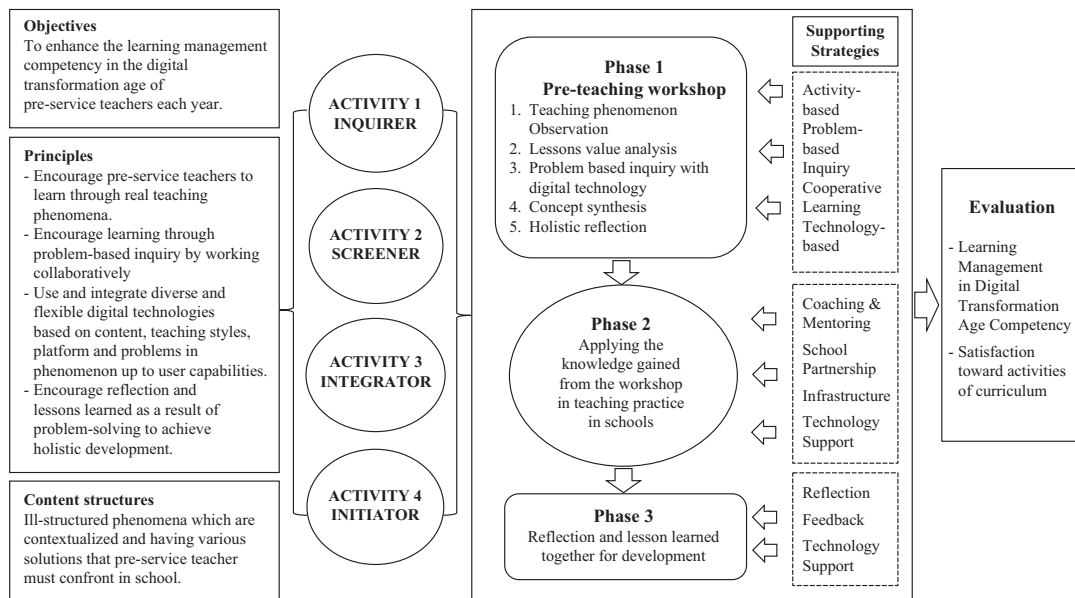


Figure 2 Curriculum to enhance learning management competency in transformation digital age

It was found that the curriculum quality was highest in terms of accuracy, suitability, benefits with high feasibility. The experts found that the curriculum was interesting and necessary in this digital transformation age. The elements of the curriculum were complete and conform to one another. Teaching strategies were clear and practically connected. Selected digital tools were suitable. Setting content structural framework was to respond to qualifications of teachers at each year in the digital age. Problems or phenomena were those occurring in current situations of all schools, and thus it was suitable to develop learning management. Activities included clear steps, each of which revealed added bodies of knowledge, principles, and guidelines on practices. Diverse strategies and digital technologies were used, which helped develop learning management efficiently. Authentic assessment was used, with diversity and suitability. For the results of assessed quality of minor

activities in the developed curriculum to enhance learning management competency in the digital transformation age for pre-service teachers at each year, it was found that the quality in terms of benefits from all activities was highest, followed by high accuracy, suitability and feasibility.

3.2 The results of assessed effectiveness of curriculum development to enhance learning management competency in the digital transformation age for pre-service teachers.

3.2.1 The results of compared learning management competency in the digital transformation age of pre-service teachers between pre- and post-participation (Activity 1–4)

Table 1 indicated that their learning management competency in the post-participation phase was significantly higher than the pre-participation phase ($p < .01$) in all activities.

Table 1 The scores of learning management competency in the digital transformation age of pre-service teachers between pre- and post-participation (Activity 1–4)

Activities	Score of competencies	<i>n</i>	$\bar{x}$	<i>SD</i>	<i>MD</i>	<i>t</i>	<i>p</i>
1 (freshmen)	pre-participation	29	49.10	5.18	27.93	15.38**	.000
	post-participation	29	77.03	7.54			
2 (freshmen)	pre-participation	29	48.93	2.07	28.28	29.75**	.000
	post-participation	29	77.21	4.60			
3 (sophomores)	pre-participation	29	50.52	7.02	22.65	17.52**	.000
	post-participation	29	73.17	1.85			
4 (juniors)	pre-participation	30	52.57	7.39	20.40	14.23**	.000
	post-participation	30	72.97	5.70			

** $p < .01$.

3.2.2 The results of compared learning management competency of pre-service teachers in the post-participation phase between activity 1–4 and the 70 percent criteria.

Table 2 indicated that learning management competency of pre-service teachers in the post-participation phase was significantly higher than the 70 percent criteria in all activities ($p < .01$).

3.2.3 The results of satisfaction toward activities of curriculum to enhance learning management competency of pre-service teachers, compared between Activity 1–4 and the 70 percent criteria.

Table 3 indicated that satisfaction towards activities of curriculum to enhance learning management competency of pre-service teachers after participating was highest, and was significantly higher than the 70 percent criteria in all activities ($p < .01$). To clarify, student teachers reflected that activities with transferred knowledge and fun included contents referred from direct experiences of guest speakers. For this reason, they could apply knowledge obtained to their future teaching. They also learned in-class problems, solution guidelines, and class management to become a quality and happy class. There were diverse patterns of activities, inserted with tactics, techniques, and digital media for individuals' practices and work with their fellow students. This revealed guidelines on selection of digital technologies for learning management and problem-solving with suitability as well as morality.

Discussion

According to the aforementioned results, the researcher discusses three main areas to serve the research objectives as follows.

1. Learning management competency in the digital transformation age included Pedagogical strategic design; Using digital in learning management; Digital communication and collaboration; and Integrated problem solving which covers a capability to combine a set of knowledge, skills, beliefs, and characteristics to manage learning in the digital age. These conform to The Common European Framework for Teaching Digital Competence (INTEF, 2017), analyzing the main five dimensions: Information, Communication, Content Creation, Safety and Problem Solving. Similarly, Konsanthia (2022) extracted international digital competence frameworks, and 7 elements were obtained, i.e., (1) the capability to use technologies to encourage professions; (2) communication and interactions; (3) educational digital resource management; (4) assessment; (5) teaching and learning; (6) encouraging and facilitating students; and (7) ethics and safety. These all conform to the results of the interview with the informants from teacher education institutions and graduate users, who found that learning management competency in digital transformation age included; Curriculum and learning management design, Learning management by digital technology integration, Class management and problem-solving and Communication and collaboration as face-to-face and through online platforms.

Table 2 The results of compared learning management competency of pre-service teachers in the post-participation phase between activity 1–4 and the 70 percent criteria

Score of competencies	<i>n</i>	$\bar{x}$	<i>SD</i>	the 70% criteria	MD	<i>t</i>	<i>p</i>
After participating in activities 1	29	77.03	7.54	56	21.03	21.87**	.000
After participating in activities 2	29	77.21	4.60	56	21.21	24.82**	.000
After participating in activities 3	29	73.17	1.85	56	17.17	49.91**	.000
After participating in activities 4	30	72.97	5.70	56	16.97	16.29**	.000

** $p < .01$.

Table 3 The results of compared satisfaction towards activities of curriculum after participating between activity 1–4 and the 70 percent criteria

Score of satisfaction	<i>n</i>	$\bar{x}$	<i>SD</i>	the 70% criteria	Level	MD	<i>t</i>	<i>p</i>
After participating in activities 1	29	4.87	0.22	3.50	highest	1.37	33.29**	.000
After participating in activities 2	29	4.90	0.19	3.50	highest	1.40	38.48**	.000
After participating in activities 3	29	4.88	0.22	3.50	highest	1.38	33.13**	.000
After participating in activities 4	30	4.89	0.21	3.50	highest	1.39	35.52**	.000

** $p < .01$.

2. The curriculum to enhance learning management competency in the digital transformation age developed by setting the elements was in accordance with the concept of enrichment curriculum development that focused on expected experiences besides a curriculum goal. Due to the short time to apply the curriculum, such focused on enhancing work competency or the development of learning efficiency in specific dimensions (Mahacha & Kositpimanwet, 2022, p. 176; Posner, 2004). As for contents of the curriculum, the researcher used phenomena that pre-service teachers at each year were likely to confront when teaching in schools. They must integrate theoretical knowledge, skills, professional characteristics, and digital technologies with work in real contexts. This conforms to the concept of PhBL, that encourages students to apply phenomena as the foundation for authentic holistic study that can facilitate students to create knowledge on their own (Silander, 2015). Similarly, the research result by Manowaluloua et al. (2022) found that pre-service teachers who received PhBL had highest learning management competency, and that they could apply PhBL in class, both theoretical and practical phases, by integrating phenomena in the real world. They also had an opportunity to show their holistic perspective to analyze problems about class and to learn from outside, that could develop their learning management competency. Furthermore, Setting the activity structure for students at each year included pre-service workshop, teaching practice in schools, reflection, and lesson learned. These facilitated pre-service teachers to practice their connection of theoretical learning for real teaching practice and for reflection to develop at a precise point. This conforms to the concept of WIL that refers to learning management that encourages connection of in-class theoretical knowledge with student experiences of practices in learning sources in authentic conditions systematically designed in curriculums to achieve learning as set (Stirling et al., 2016). For minor activities in the curriculum, the researcher designed the development hierarchy of students at each level in accordance with the concept of process-oriented approach designed with a focus on the development of advanced intellectual process to facilitate consecutive learning by focusing on learning through independent thinking process from contents. Thus, students could apply those skills to situations or problems in their daily life (Colangelo & Davis, 2003, pp. 164–165). This conforms to the results of research by Konsanthia (2022), who found that digital competence of teachers should be developed in accordance with the development hierarchy of digital competence so that

teachers would possess bodies of knowledge, skills, and good characteristics to use digital media for learning management and communication, and safety and code of conduct. As for media and learning sources in each activity, the researcher selected digital tools based on phenomena that pre-service teachers must confront in order to drive learning and problem-solving in each situation and design an environment that supported the use of technologies combined with teaching theories so as to facilitate pre-service teachers to design learning activities that support student efficient learning (Cullen, 2018).

3. The quality and effectiveness of the curriculum are discussed as follows:

3.1 The quality of the curriculum to enhance learning management competency in the digital transformation age was highest in terms of accuracy, suitability, benefits, with high feasibility. This was because this development conforms to enrichment curriculum development process that includes studying basic information from stakeholders, curriculum drafting, curriculum implementation and assessment to improve the quality of the curriculum (Gratthorn et al., 2019). Similarly, Suphakit and Nillapun (2020, p. 391) developed an extra-curriculum as a training to prepare learning competency in a bilingual science class for pre-service teachers in primary schools. The results revealed that the developed extra-curriculum was efficient. Capabilities of learning design and management were excellent. Researcher designed activities based on ill-structured phenomena which are contextualized and having various solutions that pre-service teachers at each year must confront, give them opportunity to solve in various ways depending on how they analyze the problem situation, and how they utilize their knowledge, which enhance their integrated problem solving skill. Such would be suitable and beneficial for their career in the future. As Moilanen (2015) stated, as teachers work in the complex realities of schools, the traditional content-based curriculum of notion, the application of theoretical knowledge to practical problems is too simple and unrealistic. Thus, a phenomenon-based curriculum offers an effective means of linking theory and practice in teacher education. Moreover, pre-service teachers are also encouraged to learn through problem-based inquiry learning by working collaboratively with peers and experienced teachers; thus, they could receive feedback and suggestions through onsite and online platforms for development immediately. This aligns with Rusznyak and Bertram (2021), who stated that WIL provides pre-service teachers with opportunities to plan, teach,

and reflect on their own lessons and obtain feedback. Working alongside experienced teachers is expected to enable students to learn the process of acting and thinking in the immediacy of classroom life. Furthermore, the design focused on digital tools used to drive learning and problem-solving in each situation in accordance with the capability to use technologies among pre-service teachers at each year in order to create beliefs and good attitudes toward the use of technologies, which affected learning management efficiency. As Günbaşı (2022) found, beliefs, skills, and attitudes toward technologies positively affected the use of technologies for learning management among teachers. Similarly, Pilten et al. (2017), mentioned that the successful integration of technology in the learning process should start during the teacher training program in order to encourage that pre-service teachers are familiar with it, which finally affected learning management efficiency in the digital transformation age.

3.2 In the study of the effectiveness of the curriculum to enhance learning management competency in the digital transformation age for pre-service teachers, it was found their learning management competency in the digital transformation age was significantly higher than the 70 percent criteria ($p < .01$) with highest satisfaction. To clarify, student teachers reflected that those activities provided were from real experiences of teachers. Thus, they viewed real class, real behaviors of students, and possible problems. They also viewed teaching principles and tactics to be applied to in-class learning management or problem-solving by diverse platforms, approaches, techniques, digital media. They had an opportunity to try and enjoy activities with teacher and fellow students. Such activities could be applied in their real teaching practice because activities designed for students at each year were based on possible phenomena that they were likely to confront, and student teachers perceived the value and were enthusiastic to find the answers on their own. This conforms to Fields (2020), who stated that using phenomena connected with the real world is to motivate ideas and student curiosity to find different answers. In this research, the pre-service workshop in each particular activity motivated student teachers to learn and practice their search for answers through problem-based inquiry process and collaboration, which helped increase learning efficiency for students. Also, Naik (2019) stated that when students learn to work together to solve problems in real life, they will learn the various perspectives of others and be able to apply those processes to reconstruct knowledge on their own. In the same way, the results of research by Funfuengfu (2022)

revealed that active learning competency of student teachers under PhBL was excellent, higher than the pre-learning phase and, also, higher than the 70 percent criteria. Their opinions towards PhBL were highest. Furthermore, such inquiry process also supported student teachers to use diverse digital tools that were suitable for situations and capabilities of students at each year. This facilitated them to use those tools for problem-solving or enhance their learning efficiency during real in-class teaching practice. It conforms to Boholano et al. (2021, p. 98), who found that using IT for learning management helped work efficiency, increased production skills, increased teacher capability to use technologies, and created knowledge as well as skills of technologies for students in this 21st century.

Furthermore, students have to apply knowledge and skills obtained from the workshop for their real teaching practice in schools after participation phase. Thus, during their participation, they could connect their theoretical knowledge with the real world of practice, and could reflect their learning outcomes all together. This will increase their efficiency and confidence in their teaching. Likewise, according to the research results by Bamrungsin and Khampirat (2022) on the development of an online active learning program using WIL to enhance professional skills of pre-service teachers, it was found that professional skills in the treatment group were higher than those in the control group. The developed program also increased their inspiration and confidence; and supported their life, career goals, and self-preparation. Thus, institutions should give precedence to the development of a program to prepare pre-service teachers for getting ready to be teachers in the digital age.

Conclusion and Recommendation

This research focuses on enrichment curriculum development to equip future teachers with sufficient competencies in the digital transformation age. The curriculum had six components; (1) objectives; (2) principles; (3) content structure based on selected ill-structured phenomena that pre-service teachers were to confront; (4) the 4-step stairs activities that link theory and practice, give opportunity to use digital technology to support student learning, reflect and obtain feedback from experienced teachers immediately; (5) digital instructional media and sources, and (6) evaluation. Thus, teacher education institutions can apply the curriculum for preparation before their teaching practice

in schools. Educational service areas also can apply the curriculum for in-service teacher's development in the form of a short training module or professional learning community (PLC). Phenomenon and digital tools can be adjusted to be suitable for their students, content, learning environment and the changing age.

In future research, researchers could develop curriculum by integrating the virtual reality (VR) or mixed reality (MR) along with the use of guidelines on meaningful learning management as part of the pre-teaching workshop phase so that pre-service teacher could apply their knowledge in classroom simulation before their practice in school. Improving the design to web application platform for everyone can connect content and can involve online simulation to enhance other required competencies in the digital transformation age, e.g., counseling and development, cyber security management for learning and educational digital resource management.

Conflict of Interest

The author declares that there is no conflict of interest.

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