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Phusittananan, P., Deeying, S., & Koolnapadol, A. (2026). Development of The Double P-CE Model Integrated with Context-Based Learning to Enhance Critical Thinking For 11th Grade Students. **International Journal of Industrial Education and Technology**, 8(1), 69-81.

 ABSTRACT

This study aimed to: 1) develop a learning facilitation model to enhance critical thinking integrated with context-based learning, 2) compare the learning achievement and critical thinking of the experimental group and control group after using the learning facilitation model, 3) study the students' satisfaction of the experimental group toward the learning facilitation model. The participants consisted of students in Matthayom 5/3 as the experimental group and students in Matthayom 5/4 as the control group from Watsothonwararamworawiharn School. The research methodology followed a Research and Development. The findings indicated that: 1) The learning facilitation model consisted of four components: the principles of the model, the objectives of the model, the learning facilitation process, which consisted of four steps (Double P-CE model): Step 1: Preparation (P), Step 2: Process (P), Step 3: Conclusion (C), Step 4: Evaluation (E) and the model's measurement and evaluation methods. and the overall appropriateness of the model was rated at the highest level ($\bar{x} = 4.92$, $SD = 0.15$). 2) The findings from the comparison of posttest learning achievement and critical thinking between the experimental and control groups indicated that the post-test learning achievement of the experimental group, which received the Double P-CE model, was significantly higher than that of the control group, which received traditional teaching, at the .05 level. 3) The experimental group students' satisfaction with the Double P-CE model designed to develop critical thinking, was at a high level.

Keywords: Double P-CE model, Critical thinking, Context-based learning, Learning achievement

I. INTRODUCTION

The 21st century is the time of digital revolution and transformation to 4.0 industry. Hence, National Education Plan aims to develop all learners to possess desired characteristics and learning skills of the 21st century (3Rs8Cs). This is particularly on critical thinking that learners should have. At present, most students lack of a critical thinking process and the National Educational Testing indicate that students at Watsothonwararamworawihan School have average science scores below provincial and national benchmarks. This performance gap suggests limitations in students' analytical reasoning and critical thinking processes. To address the evolving demands of 21st century education and the Industry 4.0 era, instructional practices must transition from passive content transmission to active, inquiry-driven, and contextually meaningful learning environments.

As a result, Office of the Basic Education Commission has determined a learning facilitation policy on active learning and collaborative work to enhance critical thinking. The said learning gains the concept of constructivist or self-body of knowledge building which emphasize on self-knowledge creating through actual practice and critical thinking. This conforms to some researchers applying the constructivist theory to learning design. Zandvakili et al. (2019, pp. 1-13) conducted a study on teaching patterns of critical thinking: The 3CA model-concept maps, critical thinking, collaboration, and assessment. It was found that the 3CA model could make learners' critical thinking processes more explicit and concrete, and that these skills could be systematically developed through structured practice. In particular, the use of WH-questions (what, when, where, how, who, and why) was found to stimulate deeper levels of critical thinking. In collaborative learning contexts, students tended to use higher-order analytical and explanatory questions such as "why" and "how" more frequently, whereas students in individual learning settings were more likely to focus on basic level questions such as "what". This conforms to a study of Indah et al. (2023, pp. 218-221) on integrated learning model (GIRQA) to enhance cognition and critical thinking of science students. The integration of GI or group investigation with RQA which consists of reading, questioning and answering called GIRQA. This learning model is designed for Science learning facilitation of students through 10 steps. It comprises: (1) topic indication, (2) investigation planning, (3) reading, (4) questioning, (5) answering, (6) work presenting, (7) investigation, (8) preparing the presentation of the investigation results, (9) presenting the results, and (10) assessment. These activities help the students understand scientific concepts and gain scientific experience with positive attitudes towards learning and critical thinking. The findings indicate that the learning facilitation model developed based on constructivist theory contributed to the enhancement of learners' self-body of knowledge building, which subsequently fostered the development of critical thinking ability.

Context-based learning helps promote students connect acquired knowledge with daily life or current situations (Gilbert 2006, p. 960). It focuses on learning which relies on the integration of scientific context with appropriate situations. This will allow learners to gain knowledge and skills for application at the same time. Actually, learners can learn under actual social or conditions and situations. Dori et al. (2018, p. 1198) conducted a study on context-based learning and metacognitive prompts for enhancing scientific text comprehension. Results of the study revealed that high-intensity CBL combined with metacognitive prompts improved students' chemistry understanding of the adapted scientific articles and the ability to regulate their learning. This conforms to a study of Dehkordi (2021, p. 426) on a comparison of learning by using basic context and normal teaching to investigate intellectual domain (cognitive)/psychomotor domain skills and critical thinking of undergraduate nursing students. It was found that the students using CBL for learning had a higher score of cognitive domains than before. This was in terms of an increase in knowledge, understanding, application, analysis, synthesis, and evaluation. Additionally, they achieved higher scores in both the psychomotor and affective domains. The psychomotor domain reflected improved performance skills, while the affective domain



encompassed respect, awareness, self-assessment, communicative skills, responsibility, critical thinking, and increased learning motivation. The aforementioned studies reflect that context-based learning, in which students learn through authentic experiences, can effectively enhance both knowledge acquisition and critical thinking skills. Thus, the constructivist is used to integrate with context-based learning in physical science course content to develop students' critical thinking skills.

Based on the theoretical foundations and empirical evidence discussed above, this study aimed to develop a constructivist-based learning facilitation model integrated with context-based learning to enhance critical thinking among Matthayomsuksa 5 students. In addition, the study sought to examine the effectiveness of the proposed model by comparing students' learning achievement and critical thinking between the experimental and control groups. Furthermore, the study investigated students' satisfaction with the learning facilitation model in order to determine its overall instructional effectiveness and suitability for implementation in Physical Science subject.

II. LITERATURE REVIEW

Constructivist theory is fundamentally grounded in the cognitive developmental theories of Piaget and Vygotsky (Chand, 2024, p. 276). It can be broadly categorized into two major perspectives: 1) cognitive constructivism and 2) social constructivism. Cognitive constructivism, primarily associated with Piaget, posits that intellectual development progresses through sequential stages as individuals interact with their natural environment. Knowledge is constructed through active engagement, logical-mathematical experiences, social transmission, maturation, and the process of equilibration. Learners build mental structures by assimilating new experiences into existing schemas and accommodating those schemas when confronted with cognitive conflict. In contrast, social constructivism, influenced by Vygotsky, emphasizes the fundamental role of social interaction and cultural context in cognitive development. From birth, individuals are shaped by their social environment, particularly the family as the primary institution influencing early intellectual growth. Language serves as a crucial psychological tool that mediates higher-order thinking and cognitive development. Through social interaction and guided participation, learners internalize knowledge and cognitive strategies. Synthesizing both perspectives, several shared principles emerge: (1) Learners actively construct their own understanding. (2) New learning depends on prior knowledge and existing cognitive structures. (3) Social interaction plays a significant role in knowledge construction. (4) Learning activities should be meaningful and connected to real-life contexts. Therefore, applying constructivist theory in educational practice requires shifting instructional goals from knowledge transmission to facilitating active knowledge construction. Learning should emphasize authentic problem solving, transferable skills, and alignment with students' interests to ensure meaningful understanding. Supporting this perspective, Siregar et al. (2025, pp. 16-17) conducted a study entitled development of constructivism-based learning models to improve student learning outcomes with the aim of developing and evaluating a constructivism-based learning model that emphasizes learners' active construction of knowledge through meaningful experiences and interactions with their environment. The model engaged students in authentic learning activities designed to promote active participation in the learning process. The findings revealed that students achieved higher learning outcomes in terms of knowledge acquisition and demonstrated critical thinking, creativity, and effective problem-solving skills. Similarly, Bunyodom et al. (2023, pp. 489-493) investigated the effect of learning management based on constructivist theory using hand-on activities of grade 6 students' geometrical concepts on triangle. The synthesized instructional model consisted of four stages: (1) Reviewing prior knowledge, (2) Conceptual change, (3) Understanding check, and (4) Knowledge application. The findings revealed that students' geometric conceptual understanding after being taught through constructivist theory using hands-on activities were higher than 60% of the criterion



at the .05 level of significance. Furthermore, the findings are supported by the study conducted by Rullis and Fauzan (2021, pp. 3-4) examined the development of constructivism-based mathematics interactive learning media tools on the material of constructing a flat side space for class VIII junior high school students. This developmental research employed a Problem-Based Learning model (PBL) and was conducted in three phases: preliminary research, prototype development, and evaluation. The results indicated that integrating PBL with constructivist-oriented interactive media was highly appropriate. The developed materials featured clear language and well-designed text, facilitating students' comprehension and enhancing their understanding of mathematical content effectively.

Furthermore, context-based learning (CBL) is an instructional approach that encourages learners to connect newly constructed knowledge with real-life situations or social contexts in relation to scientific content. This approach emphasizes the integration of subject matter with relevant and meaningful situations, thereby fostering learners' independent thinking processes. Various scholars have proposed procedural frameworks for implementing context-based learning; in this study, the researcher adopted the four-stage model proposed by Gilbert (2006, pp. 961-975), which consists of: (1) Situation setting, (2) Investigation or hands-on inquiry, (3) Presentation of findings derived from the inquiry, and (4) Discussion and application of knowledge. Empirical studies have supported the effectiveness of this instructional approach. For example, Rubini and Ardianto (2021, pp. 304-307) conducted a study entitled empowering contextual approach in science learning to enhance critical thinking skills. The findings indicated that the implementation of context-based learning has the potential to enhance students' critical thinking skills, with the improvement observed among students in all three classes being at a moderate level. Some developed critical thinking skills were providing simple explanations, building basic skills, managing strategies and tactics, providing further explanation, and formulating solutions. Similarly, Yulaisa and Desnita (2024, pp. 391-395) examined the effect of using context-based learning videos on fluid materials on students critical thinking ability. The results revealed that students in the experimental group demonstrated significantly higher levels of critical thinking skills than those in the control group. Based on the review of constructivist theory and context-based learning, it can be concluded that the effectiveness of constructivist-oriented instruction depends largely on how individual educators adapt and implement these theoretical principles in their specific teaching contexts. The synthesis indicates that both constructivist theory and context-based learning contribute to learners' ability to construct knowledge independently through hands-on activities, analytical thinking, and social interaction. In addition, linking learning content with contemporary situations or contexts enables learners to approach problem-solving in a systematic and comprehensive manner, thereby fostering the development of critical thinking skills. Previous studies also highlight the development of instructional models designed by educators to address specific learning objectives using a single theoretical framework. Therefore, the researcher proposes integrating both approaches into a structured, clear, and continuous learning process. Each stage of the Double P-CE model is designed to explicitly stimulate critical thinking processes in order to enhance learners' learning development effectively. Accordingly, the Double P-CE model was developed by integrating Gilbert's context-based learning framework (Gilbert, 2006, pp. 961-975).

III. RESEARCH METHODOLOGY

Conceptual Framework

According to the research, concepts and theory as mentioned, the researcher designed the learning facilitation process into four steps: 1) Preparation (P), 2) Process (P), 3) Conclusion (C), and 4) Evaluation (E) as shown in conceptual Framework of this study. (Figure 1)



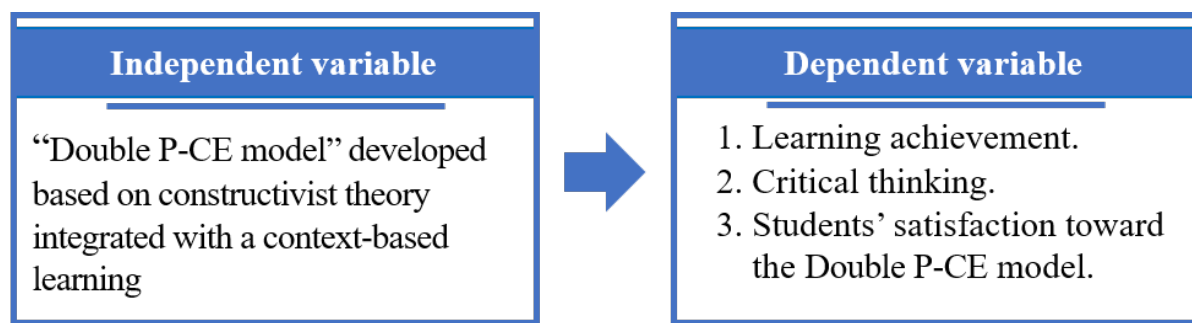


Figure 1: Conceptual framework

Population and samples

1. The population consisted of 200 Mattayomsuksa 5 students at Watsothonwararamworawihan school, Chachoengsao province (5 classrooms), academic year 2025 and 5 chemistry teachers.
2. The sample group consisted of 80 Mattayomsuksa 5 students (2 classrooms), academic year 2025. They were divided into 2 groups: the experimental group and the control group. They were obtained by purposive sampling based on their interest and ability in learning.

Research instrument

The research instruments included:

1. An interview schedule for science teachers.
2. A learning facilitation model and lesson plans based on the Double P-CE model (12 hours).
3. A 30 item multiple choice learning achievement test covering the unit “Food and Packaging” constructed according to Bloom’s revised taxonomy (remember, understand, apply, analyze, evaluate, and create).
4. A critical thinking test consisting of six subjective items assessed using analytic rubric scoring, covering five components derived through synthesis: problem identification, data collection, analysis, conclusion, and evaluation.
5. A satisfaction questionnaire using a five-point Likert scale covering six dimensions: content, model components, objectives, learning activities, assessment, and learner outcomes.

Validity and Reliability of Instruments

All instruments were examined for content validity by five experts using the Index of Item Objective Congruence (IOC), following standard procedures in educational research. The IOC values ranged from 0.60 to 1.00, indicating acceptable content validity.

The learning achievement test demonstrated acceptable item difficulty (0.45-0.75) and discrimination indices (0.20-0.35). The reliability of the learning achievement test was examined using KR-20 coefficient, yielding a value of 0.89, which indicates high internal consistency reliability. The critical thinking test and satisfaction questionnaire also demonstrated acceptable validity and reliability indices.

Research procedure

Phase 1: Research (R1)

Basic data were collected through document analysis and semi-structured interviews with five science teachers. The curriculum analysis was based on the Basic Education Core Curriculum B.E. 2008 (Revised 2017). Interview data were analyzed and synthesized to determine guidelines for model development using a context-based approach.

Phase 2: Development and Design (D1)

The Double P-CE learning model was designed based on constructivist theory, context-based learning, and critical thinking principles. The development process followed systematic R&D procedures including prototype design, expert validation, and refinement. The model comprised four key components: (1) principles, (2) objectives, (3) learning facilitation process, and (4) measurement and evaluation.

The learning facilitation process followed four stages: Preparation (P), Process (P), Conclusion (C), and Evaluation (E). The lesson plans were developed for 12 hours under Unit 3: Food and Packaging. The overall suitability of the model was rated at the highest level ($\bar{x} = 4.93\text{--}5.00$), which followed the learning facilitation process as shown in Figure 2.

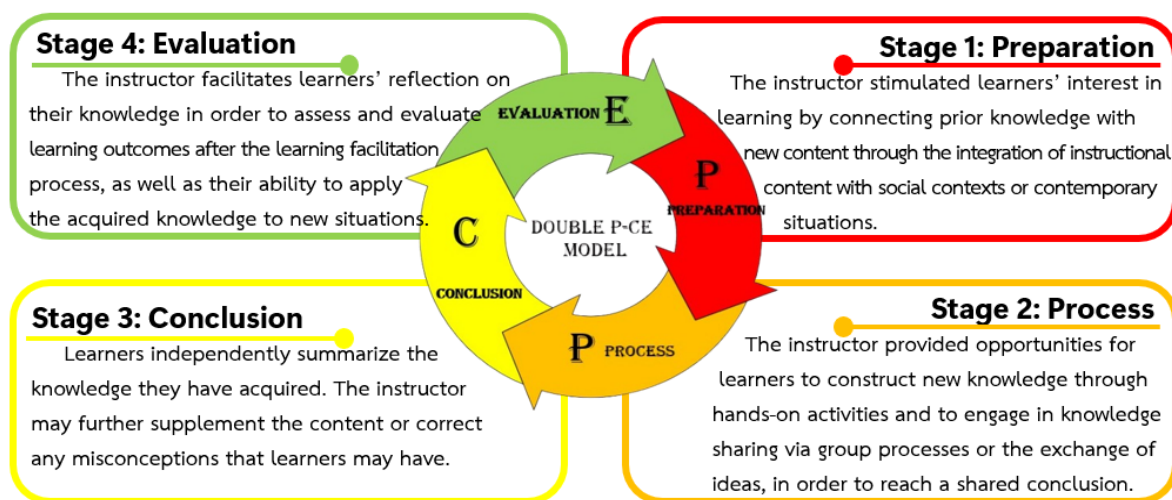


Figure 2: The Double P-CE model

Phase 3: Implementation

The effectiveness of the model was tested using a pretest-posttest control group design (Klockars, 1992, pp. 96-98).

Table 1: Research design

Group	Before	Experiment	After
E	T ₁	X	T ₂
C	T ₁	~X	T ₂

Symbols used in the research format

- E = The experimental group
- C = The control group
- T₁ = Pretest
- T₂ = Posttest
- X = Double P-CE Model
- ~X = Traditional teaching

Both groups completed the learning achievement and critical thinking tests before and after the intervention. The experimental group received the Double P-CE learning model, while the control group received the traditional teaching.

Phase 4: Evaluation (D2)

Quantitative data were analyzed using descriptive and inferential statistics in accordance with educational research principles. Mean ($\bar{x}$) and standard deviation (SD) were used to summarize data. independent samples t-tests were used to compare posttest scores between groups. Students' satisfaction was analyzed using mean and standard deviation. A mean score higher than 3.50 indicated a high level of satisfaction shown in Figure 3.

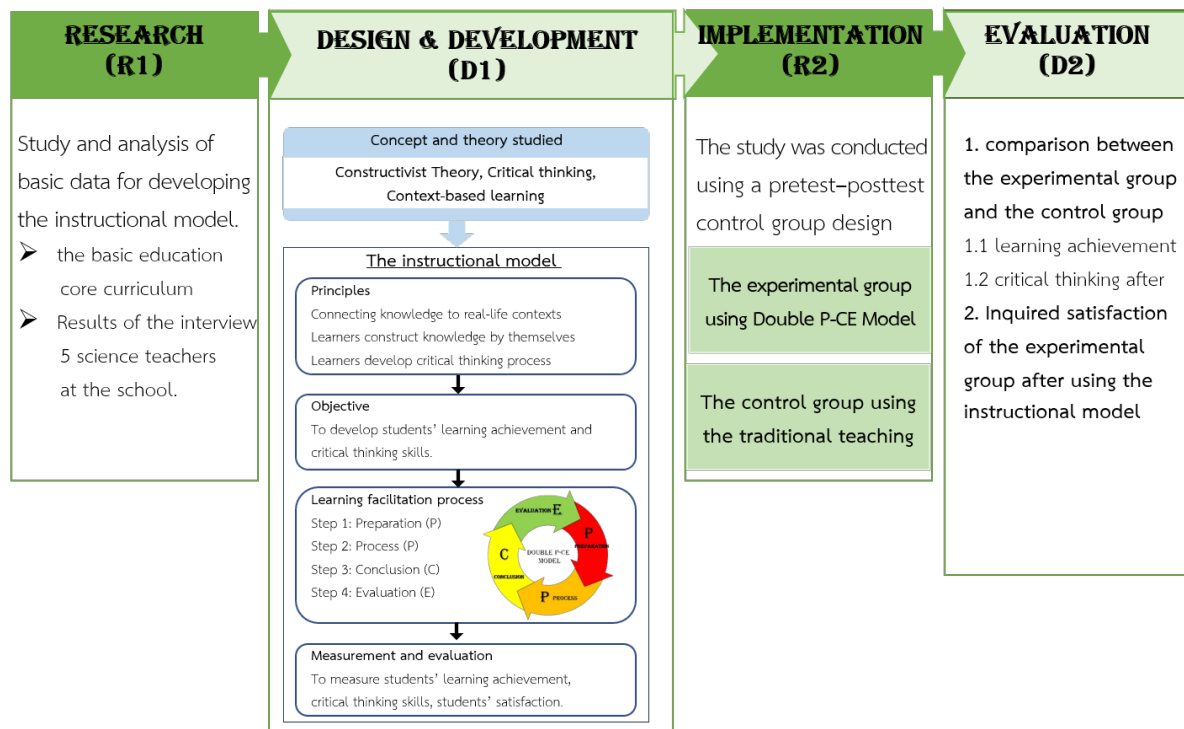


Figure 3: Research procedure

Data Analysis

The researcher analysed various data by using the statistical package as follows: 1) Basic statistics: mean ($\bar{x}$) and standard deviation (SD), 2) Hypothesis testing statistics comparing pretest and posttest learning achievement and critical thinking between the experimental group and the control group by using t-test independent.

IV. RESULTS

Results of the analysis of the development of the Double P-CE model to enhance critical thinking through context-based learning in this study are as follows;

1. Results of the appropriateness assessment of the learning facilitation model was as shown in Table 2.

Table 2: Results of the appropriateness assessment of the learning facilitation model

Items	$\bar{x}$	SD	Description
1. Principles	4.40	0.89	High
2. Objectives	5.00	0.00	Highest
3. Learning facilitation process	5.00	0.00	Highest
4. Measurement and evaluation	4.80	0.20	Highest
Total	4.92	0.15	Highest

Legend: 4.51-5.00 Highest, 3.51-4.50 High, 2.51-3.50 Moderate, 1.51-2.50 Low, 1.00-1.50 Lowest.

As shown in Table 2, the overall suitability of the learning facilitation model was rated at the highest level ($\bar{x} = 4.92$, $SD = 0.15$). The objectives and learning facilitation process received the highest mean scores ($\bar{x} = 5.00$), indicating strong alignment with the intended outcomes. The measurement and evaluation component was also rated at the highest level ($\bar{x} = 4.80$), while the principles component was rated at a high level ($\bar{x} = 4.40$). Overall, the findings indicate that the constructivist context-based learning facilitation model is theoretically sound and practically appropriate for enhancing students' critical thinking in Physical Science.

2. Results of the comparison of the learning achievement and critical thinking of experimental group using the learning facilitation model and the control groups using the traditional teaching in terms of pretest and posttest was as shown in Table 3-6.

Table 3: Comparison of learning achievement between the experimental group before using the learning facilitation model and the control group before using the traditional teaching

Group	Experiment	n	$\bar{x}$	SD	t	df	p
Experimental group	before	40	10.15	2.82	-1.39	78	.17
Control group	before	40	10.90	1.93			

$p > .05$

As shown in Table 3, the learning achievement of the experimental and control groups were not significantly different, indicating that students in both groups had comparable learning abilities. This similarity is attributed to the heterogeneous grouping of students in both classes. The equivalence of the experimental groups is considered an essential condition for ensuring a sound and valid experimental research design.

Table 4: Comparison of critical thinking ability between the experimental group before using the learning facilitation model and the control group before using the traditional teaching

Group	Experiment	n	$\bar{x}$	SD	t	df	p
Experimental group	before	40	59.35	2.78	-1.08	78	.28
Control group	before	40	58.70	2.60			

$p > .05$

As shown in Table 4, the critical thinking ability of the experimental and control groups were not significantly different, indicating that students in both groups had comparable levels of critical thinking. This similarity is attributed to the heterogeneous grouping of students in both classes. The equivalence of the experimental groups is considered an essential condition for ensuring a sound and valid experimental research design.

Table 5: Comparison of learning achievement between the experimental group after using the learning facilitation model and the control group after using the traditional teaching

Group	Experiment	n	$\bar{x}$	SD	t	df	p
Experimental group	After	40	22.83	1.82	5.56*	65.93	.000
Control group	After	40	19.83	2.89			

* $p < .05$

As shown in Table 5, the learning achievement of the experimental group after the intervention ($\bar{x} = 22.83$, $SD = 1.82$) was significantly higher than that of the control group ($\bar{x} = 19.83$, $SD = 2.89$) at the .05 level ($t = 5.56$, $p < .05$). This finding indicates that the learning facilitation model facilitated students' systematic construction of knowledge in connection with real-life contexts, thereby promoting a deeper understanding of the content compared to traditional teaching.

Table 6: Comparison of critical thinking ability between the experimental group after using the learning facilitation model and the control group after using the traditional teaching

Group	Experiment	n	$\bar{x}$	SD	t	df	p
Experimental group	After	40	96.83	4.71	11.17*	78	.000
Control group	After	40	86.23	3.71			

* $p < .05$

As shown in Table 6, the critical thinking ability of the experimental group after the intervention ($\bar{x} = 96.83$, $SD = 4.71$) was significantly higher than that of the control group ($\bar{x} = 86.23$, $SD = 3.71$) at the .05 level ($t = 11.17$, $p < .05$). This finding indicates that the learning facilitation model encouraged students to analyze, discuss, exchange ideas, and systematically connect knowledge with various situations. Consequently, students were able to apply reasoning in making judgments, decisions, and solving problems, thereby enhancing their critical thinking ability more effectively than traditional teaching.

3. Results of the survey on student satisfaction with the learning facilitation model

Table 7: Results of student satisfaction toward the learning facilitation model

Items	$\bar{x}$	SD	Description
Content and learning content			
1. The content is consistent with daily life and social context of the student.	4.49	0.50	High
2. The course content is clear and easy to understand.	4.51	0.50	Highest
3. The content is up-to-date.	4.46	0.53	High
4. The content is consistent with daily life and suitable for critical thinking practice.	4.46	0.53	High
Total	4.48	0.52	High
Components of the learning facilitation model			
5. The principles help the student develop critical thinking and systematic problem solving.	4.55	0.50	Highest
6. The principles involve daily life and context of the student.	4.48	0.66	High
7. The principles are easy to understand.	4.53	0.50	Highest
Total	4.52	0.55	Highest
Objectives of the learning facilitation model			
8. It focuses of enhancing the ability in critical thinking of the student.	4.48	0.59	High
9. It is clear and can be evaluated.	4.48	0.55	High
10. It is clear and can be applied in daily life.	4.45	0.61	High
Total	4.47	0.58	High
Learning activities			
11. It is appropriate and consistent with content in the society	4.44	0.57	High
12. It truly gives an opportunity to practice critical thinking.	4.36	0.56	High
13. It promotes the process of high-level thinking and problem solving.	4.50	0.50	High
14. It promotes the creation of body of knowledge which can be applied.	4.45	0.50	High
15. It gives the student an opportunity to reflect critical thinking through actual practice with suggestions of the teacher.	4.45	0.55	High
16. It is in line with scheduled time.	4.41	0.54	High
Total	4.44	0.57	High

Table 7: (Continued) Results of student satisfaction toward the learning facilitation model

Items	$\bar{x}$	SD	Description
Measurement and evaluation			
17. Having evaluation criteria for appropriate learning facilitation.	4.51	0.53	Highest
18. Measurement and evaluation are clear.	4.48	0.53	High
19. Results of the evaluation can promote the student to improve their learning.	4.39	0.56	High
Total	4.46	0.54	High
Outcomes for the learner			
20. Direct outcomes for the student are clear in accordance with The learning objectives.	4.40	0.54	High
21. Indirect outcomes for the student are clear and can further develop.	4.35	0.60	High
Total	4.38	0.57	High
As a whole	4.46	0.55	High

Legend: 4.51-5.00 Highest, 3.51-4.50 High, 2.51-3.50 Moderate, 1.51-2.50 Low, 1.00-1.50 Lowest.

As shown in Table 7, students' overall satisfaction with the learning facilitation model was at a high level ($\bar{x} = 4.46$, $SD = 0.55$). The highest ratings were found that components of the learning facilitation model ($\bar{x} = 4.52$) which contributes to the development of critical thinking. All other components, including learning activities, objectives, content, measurement/evaluation and learner outcomes, were also rated at a high level. These findings indicate that students perceived the learning facilitation model as appropriate, relevant, and supportive of their critical thinking development.

V. CONCLUSION AND DISCUSSION

In conclusion, the core findings of this research demonstrate that the learning facilitation model developed to enhance critical thinking is called Double P-CE Model, which consists of four steps as follows: Step 1 Preparation (P), Step 2 Process (P), Step 3 Conclusion (C), and Step 4 Evaluation (E). The developed learning facilitation model was evaluated as being appropriate at the highest level ($\bar{x} = 4.92$, $SD = 0.15$). The model was then implemented with the experimental group and compared with a control group using the traditional teaching. The experimental and control groups showed no statistically significant differences in learning achievement and critical thinking in terms of pretest, as students in both groups possessed comparable baseline abilities, the inclusion of pretest data enhanced the reliability and internal validity of the experimental study. Consequently, any differences observed in the posttest outcomes could be more confidently attributed to the instructional innovation rather than to pre-existing differences among the participants (Schochet, 2010, pp. 379-406). The results revealed that the experimental group achieved significantly higher posttest learning achievement than the control group at the .05 level of significance (the posttest mean of the experimental group was 22.83 and the control group was 19.83). In addition, the posttest critical thinking of the experimental group were significantly higher than those of the control group at the .05 level of significance (the posttest mean of the experimental group was 96.83 and the control group was 86.23). Furthermore, an investigation of students' satisfaction with the Double P-CE model indicated that the experimental group reported a high level of satisfaction in all aspects.

The results can be discussed as follows: There are 4 components of the learning facilitation model for developing critical thinking: (1) principles, (2) objectives, (3) learning facilitation process, and (4) measurement and evaluation. Hence, it can be that all of these components are consistent and systematically related. According to this study, the researchers begin with the investigation of related concepts, theories, researches and social context conditions. Also, guidelines for problem solving and content selection are involved to determine the principles, objectives and others which must be consistent and systematically related. The developed learning facilitation



model is based on constructivist theory and critical thinking concept integrated with context-based learning. They are synthesized to obtain the instructional model “Double P-CE Model” with 4 steps as follows: Step 1: Preparation (P). This step creates interest of the student in learning. There is the connection of existing knowledge with new knowledge. Meanwhile, the teacher integrates this step with the content. In addition, this stage corresponds to the situation definition stage and the critical thinking process of problem definition. Step 2: Process (P). This step gives the student an opportunity to truly practice in order to create new knowledge. Then, there is knowledge exchange using group process or opinion presentation to gain the same conclusion. In this regard, it is supported or assisted by the teacher in terms of knowledge enhancement and convenience facilitation. Actually, this step corresponds to the step of actual practice of the student, critical thinking process in data collection and analysis. Step 3: Conclusion (C). The student makes conclusion about what they have learned. The teacher may add knowledge or correct the student’s misunderstandings. This step corresponds to the step of learning key concepts and critical thinking based on conclusion. Step 4: Evaluation (E). This step reflects knowledge of the student to measure and evaluate themselves after learning and are able to apply acquired knowledge to new situations. This step corresponds to the step of the application of knowledge and critical thinking processes in evaluation. According to the learning facilitation process, it can be seen the Double P-CE model demonstrates a significant strength through the systematic synthesis of various concepts, theories, and learning processes. In particular, the integration of constructivist theory, critical thinking concepts, and context-based learning enables the model to effectively promote learners’ self-construction of knowledge, hands-on practice, and in-depth analytical thinking. Learners are not merely passive recipients of knowledge; rather, they play active roles in investigating information, exchanging ideas, analyzing data, drawing conclusions, and conducting self-evaluation. As a result, meaningful learning is fostered, allowing learners to connect acquired knowledge with real-life situations. Furthermore, the four learning facilitation steps are systematically interconnected and sequentially organized. The process begins with stimulating learners’ interest and linking prior knowledge to new experiences, followed by knowledge construction through authentic practice, knowledge summarization, and reflective evaluation. This sequential learning process supports the progressive development of critical thinking among learners. In addition, the model encourages collaborative learning, knowledge sharing, and active classroom participation, which are consistent with student-centered learning approaches and 21st century learning paradigms. Besides, there is an assessment of suitability and quality of the learning facilitation model by the experts. These findings are consistent with the study conducted by Vong & Kaewurai (2017, pp. 90-94), who investigated instructional model development to enhance critical thinking and critical thinking teaching ability of trainee students at regional teaching training center in Takeo province, Cambodia. The findings revealed that trainee students' post critical thinking was much higher than pre-critical thinking implementation, while their abilities in teaching critical thinking were at the exemplary level. Similarly, the study conducted by Khamthanu (2023, pp. 247-264) on development of teaching methods to promote critical thinking skills and scientific concepts of students mathayom 1, found that students’ critical thinking skills and scientific concepts after instruction were significantly higher than before instruction at the .05 level of statistical significance. Both studies, together with the Double P-CE model, emphasize learners’ self-construction of knowledge as a significant factor contributing to the enhancement of critical thinking skills. This supports the suitability and effectiveness of the Double P-CE model in improving both learning achievement and critical thinking skills within contemporary learning contexts. It can be said that the learning facilitation model that focuses on self-knowledge creation, actual practice, thinking training and exchange of knowledge. Meanwhile, the traditional teaching may help increase learning achievement but may be less in critical thinking development. This depends on the difference and ability in thinking of an individual. Regarding student satisfaction, the overall level



was high, indicating that learners perceived the instructional model as relevant and engaging. The integration of real-world contexts enhanced intrinsic motivation and promoted meaningful learning, which aligns with contemporary student-centered learning perspectives. Furthermore, a supportive classroom environment, together with opportunities for collaborative learning and knowledge exchange, further strengthened students' confidence and engagement. These findings are consistent with previous research demonstrating that active learning approaches connected to meaningful contexts contribute to positive learning experiences and higher levels of student satisfaction. Similar results were reported in the studies of Khamthanu (2023, pp. 247-264), who found that students' satisfaction with the learning facilitation model was at a high level.

SUGGESTION

Future studies should investigate the long-term impact of the model through longitudinal designs to examine sustained development in critical thinking. Replication across different subjects, educational levels, or sociocultural contexts is also recommended to enhance external validity. Additionally, future research may explore the integration of this model with other 21st century competencies, such as creativity and problem-solving, to broaden its instructional applicability.

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