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Research Article

Development of a Situation Problem-Based Learning Model to Promote Grade 8 Students' Learning Achievement and Critical Thinking in a Human Body Systems Unit

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Abstract: This study aimed to develop a Situation Problem-Based Learning (SPBL) model and examine its effects on Grade 8 students' learning achievement and critical thinking in a human body systems unit. The SPBL model was synthesized from situation-based learning and problem-based learning. The study employed a model development process and a one-group pretest-posttest design. The participants were 45 Grade 8 students at Wichianmatu School, Trang Province, Thailand. The research instruments included an SPBL model evaluation form, a learning achievement test, and a critical thinking test. The content validity of the SPBL model was evaluated by a panel of experts using the Index of Item-Objective Congruence (IOC), with IOC values exceeding the acceptable criterion of .60. Students' learning achievement scores before and after learning through the SPBL model were analyzed using a paired-samples t test, whereas students' critical thinking scores after learning were compared with the 70% criterion using a one-sample t test. The results showed that students' post-test learning achievement scores were significantly higher than their pre-test scores, $t(44) = 30.03$, $p < .001$. Students' critical thinking score after learning was slightly higher than the 70% criterion, $t(44) = 2.03$, $p = .049$. These findings suggest that the SPBL model may support science learning and provide opportunities for students to engage in critical thinking processes. Implications for science teaching and instructional model development are discussed.

Keywords: Situation-based learning, problem-based learning, learning achievement, critical thinking, human body systems

Introduction

Thailand's Basic Education Core Curriculum emphasizes learner-centered education, real-life learning experiences, learner participation, thinking processes, and assessment based on students' development and learning behaviors. These principles highlight the need for instructional models that enable students to construct knowledge, solve real-world problems, and develop higher-order thinking skills, particularly critical thinking, in science classrooms (Ministry of Education, 2017).

Science plays an important role in contemporary and future societies because it is closely related to daily life, careers, technology, tools, and innovations. Science education not only helps students understand natural phenomena but also supports the development of rational thinking, creativity, inquiry skills, systematic problem solving, evidence-based decision making, and critical thinking. Therefore, science classrooms should provide opportunities for students to apply scientific knowledge to meaningful situations rather than merely memorize scientific facts.

In line with this policy direction, the Institute for the Promotion of Teaching Science and Technology (IPST, 2018) emphasizes the development of learners' key competencies, including communication, thinking, problem solving, life skills, and technology use. Among these competencies, thinking ability is especially important because it includes analytical, synthetic, creative, critical, and systematic thinking. Developing these thinking skills enables students to construct knowledge, make reasoned decisions, and apply scientific understanding to real-life situations. However, science teaching and assessment in many classrooms still tend to emphasize content transmission and factual recall, which may limit students' opportunities to develop the thinking and problem-solving competencies expected in the curriculum.

Preliminary classroom observations and students' learning records at Wichianmatu School indicated that many Grade 8 students had difficulty explaining relationships among human body systems and applying this knowledge to real-life health situations. These difficulties suggest a need for instructional activities that connect scientific concepts with authentic problems and promote students' critical thinking. The basic education curriculum expects students to recognize the importance of human body systems and understand how to maintain the normal functioning of body organs. This topic is also relevant to students' everyday lives because health-related problems, including non-communicable diseases such as cardiovascular disease, diabetes, and respiratory diseases, remain major public health concerns in Thailand. Therefore, learning about human body systems can help students understand health risks and make informed decisions in daily life.

Critical thinking is an important learning outcome for 21st-century science education. In this study, critical thinking refers to students' ability to analyze situations, identify relevant evidence, evaluate possible explanations, make reasoned decisions, and justify conclusions in relation to human body systems. To promote these abilities, instructional activities should engage students with meaningful situations, authentic problems, and opportunities for idea generation. Situation-based learning (SBL) encourages students to learn through real-life situations that require decision making and problem solving (Khemnani, 2013). Problem-based learning (PBL) uses authentic problems as the starting point for inquiry, enabling students to search for information, construct understanding, collaborate with peers, and propose solutions (Hongprapat, 2004; Thambut, 2002).

Although situation-based learning and problem-based learning have been used to promote active learning and thinking skills, these approaches are often implemented separately. Situation-based learning provides meaningful real-life contexts, whereas problem-based learning engages students in inquiry, knowledge construction, and solution development. Few studies have integrated these two approaches into a coherent instructional model for lower-secondary science learning, particularly in the topic of human body systems. Also, there is no empirical evidence demonstrating the concrete impact on learning outcomes when SBL and PBL are integrated and implemented within science teaching and instructional models", or similar rationale justifying the use of SPBL. Therefore, this study aimed to develop a Situation Problem-Based Learning (SPBL) model and examine its effects on Grade 8 students' learning achievement and critical thinking in a human body systems unit.

Development of the Situation Problem-Based Learning (SPBL) Model

The Situation Problem-Based Learning (SPBL) model was developed through a literature-based synthesis of situation-based learning (SBL) and problem-based learning (PBL). These approaches were selected because they provide complementary instructional functions: SBL situates learning in realistic contexts and PBL engages students in investigating and solving authentic problems. Together, these approaches may support students' scientific understanding and critical thinking. The model-development process involved three stages: 1) identifying instructional steps from relevant literature on SBL and PBL; 2) comparing similar and overlapping steps across the two approaches; and 3) synthesizing these steps into an integrated SPBL instructional sequence. The authors first analyzed relevant literature on SBL to identify common instructional steps (Boonyathorn, 1999; Jingru & Ma, 2017; Seepootorn et al., 2019). The synthesized SBL steps are presented in Table 1.

Table 1 Synthesis of Common Instructional Steps in Situation-Based Learning.

Source	Instructional steps identified	Synthesized SBL step
Boonyathorn (1999)	Set learning objectives; determine the situation; present the situation	**Identify the situation**
Jingru and Ma (2017)	Review prior knowledge; recognition	**Identify the problem in the situation**
Seepootorn et al. (2019)	Identify the situation; identify problems from situations	**Identify the situation; identify the problem in the situation**
Boonyathorn (1999); Jingru and Ma (2017)	Study problems and solutions; understanding	**Study and understand the problem**
Boonyathorn (1999); Seepootorn et al. (2019)	Propose a solution; troubleshooting	**Propose a solution**
Boonyathorn (1999); Jingru and Ma (2017); Seepootorn et al. (2019)	Discussion and conclusion; implementation; application	**Apply the solution**
Jingru and Ma (2017)	Evaluate learning	**Evaluate learning**

Based on the synthesis presented in Table 1, the synthesized SBL process used in this study consisted of six instructional steps: 1) identifying the situation, 2) identifying the problem within the situation, 3) studying and understanding the problem, 4) proposing a solution, 5) applying the solution, and 6) evaluating learning.

The authors then analyzed literature on problem-based learning (PBL) to identify common instructional steps for engaging students in problem identification, inquiry, knowledge construction, application, and evaluation (Kiatjarungphan & Chaiyara, 2016; Cowedrow, 1997; Delisle, 1997; Nuengchalerm, 2014). The synthesized PBL steps are presented in Table 2.

Table 2 Synthesis of common instructional steps in Problem-Based Learning.

Source	Instructional steps identified	Synthesized PBL step
Delisle (1997); Kiatjarungphan and Chaiyara (2016); Nuengchalerm (2014); Cowedrow (1997)	Link to the problem; identify the problem; connect and identify problems; use a problem to stimulate students' thinking and prior knowledge	**Identify the problem**
Delisle (1997); Nuengchalerm (2014); Cowedrow (1997)	Set up an educational framework; understand the problem; identify the problem	**Understand the problem**
Delisle (1997); Kiatjarungphan and Chaiyara (2016); Nuengchalerm (2014); Cowedrow (1997)	Conduct studies; conduct research studies; gather knowledge and decide on a solution; self-study through group investigation	**Study and plan a solution**
Kiatjarungphan and Chaiyara (2016); Nuengchalerm (2014)	Synthesize knowledge; synthesize knowledge and findings	**Synthesize knowledge and findings**
Delisle (1997); Kiatjarungphan and Chaiyara (2016); Nuengchalerm (2014)	Create a portfolio; summarize and evaluate the value of the answer; present knowledge and findings	**Present knowledge and findings**
Cowedrow (1997)	Apply knowledge	**Apply knowledge**
Delisle (1997); Kiatjarungphan and Chaiyara (2016); Nuengchalerm (2014)	Evaluate learning outcomes and problems; presentation and evaluation; evaluate the work	**Evaluate the work**

Based on the synthesis presented in Table 2, the synthesized PBL process used in this study consisted of seven instructional steps: 1) identifying the problem, 2) understanding the problem, 3) studying and planning a solution, 4) synthesizing knowledge and findings, 5) presenting knowledge and findings, 6) applying knowledge, and 7) evaluating the work. These steps emphasize students' active engagement in defining problems, conducting inquiry, constructing knowledge, applying what they have learned, and evaluating their solutions. The authors then integrated the synthesized steps of SBL and PBL to develop the Situation Problem-Based Learning (SPBL) model.

Table 3 Synthesis of the SPBL model.

SPBL step	Contribution from SBL	Contribution from PBL	Critical thinking process supported
1. Introduce an engaging problem situation	Identify the situation	Link to the problem	Curiosity, prior knowledge activation, initial problem awareness
2. Understand and define the problem	Identify the problem in the situation	Identify and understand the problem	Problem identification, analysis
3. Plan problem-solving strategies	Study and understand the problem	Study and plan a solution	Planning, generation of alternatives, reasoning
4. Investigate possible solutions	Propose a solution	Conduct studies and research	Evidence gathering, interpretation
5. Synthesize and construct knowledge	Study and understand the problem	Synthesize knowledge and findings	Inference, explanation, knowledge construction
6. Present solutions and findings	Discussion and conclusion	Present knowledge and findings	Justification, communication
7. Apply knowledge to new or real-life situations	Apply the solution	Apply knowledge	Transfer, decision making, application
8. Evaluate learning and problem-solving processes	Evaluate learning	Evaluate the work	Evaluation, reflection, metacognition

As shown in Table 3, the SPBL model consists of eight instructional steps: 1) introduce an engaging problem situation, 2) understand and define the problem, 3) plan problem-solving strategies, 4) investigate possible solutions, 5) synthesize and construct knowledge, 6) present solutions and findings, 7) apply knowledge to new or real-life situations, and 8) evaluate learning and problem-solving processes. These steps integrate realistic situations and problem-based inquiry to support students' critical thinking throughout the learning process. Each step is described below.

Step 1: Introduce an engaging problem situation

The teacher assesses students' prior knowledge through short quizzes, questioning, games, digital applications, or other appropriate learning activities. The teacher then presents a real-life situation related to human body systems to connect students' prior knowledge and experiences with the target scientific concepts. The situation should be engaging, relevant to students' everyday lives, and designed to stimulate curiosity, activate prior knowledge, and encourage students to recognize a problem that requires investigation.

Step 2: Understand and define the problem

Students analyze the situation by identifying key facts, possible causes, relevant factors, consequences, and questions that require further investigation. They then work in groups to discuss issues of interest, explain why the problem is important, and agree on a specific problem to be addressed. This step helps students clarify the problem and establish a shared focus before developing a problem-solving plan.

Step 3: Plan problem-solving strategies

Each group brainstorms possible solutions to the selected problem. The teacher encourages students to consider relevant scientific concepts, available evidence, possible constraints, and alternative solutions. Each group then develops a problem-solving plan that includes procedures, resources, group roles, expected outcomes, and criteria for judging whether the solution is appropriate.

Step 4: Investigate possible solutions

Each group implements its problem-solving plan by researching relevant information, collecting evidence, conducting activities, and using appropriate media or technology to seek possible solutions. The teacher facilitates the investigation by asking guiding questions, monitoring group progress, and helping students consider whether their proposed methods are appropriate for achieving the learning goals. Students revise their plan when evidence indicates that changes are needed.

Step 5: Synthesize and construct knowledge

Each group synthesizes the knowledge gained through investigation and uses evidence to construct explanations or solutions. Students may organize their understanding through visual representations such as infographics, fishbone diagrams, mind maps, concept maps, spider maps, or Venn diagrams. This step helps students connect evidence, scientific concepts, and problem-solving outcomes.

Step 6: Present solutions and findings

Each group presents its findings, explanations, or proposed solutions using appropriate presentation formats such as infographics, demonstrations, digital media, gallery walks, or carousel activities. The teacher provides opportunities for students to ask questions, exchange ideas, critique evidence, justify claims, and verify the accuracy of information. This step supports communication, collaborative learning, and reflection on scientific understanding.

Step 7: Apply knowledge to new or real-life situations

Students transfer the knowledge and problem-solving processes gained from the lesson to similar situations, new problems, or real-life health contexts. They may formulate solutions, make decisions, create products, or propose guidelines for maintaining healthy body systems in daily life.

Step 8: Evaluate learning and problem-solving processes

The teacher evaluates students' learning outcomes and performance in relation to the learning objectives through both formative and summative assessment. Assessment may focus on problem identification, problem-solving planning, investigation, evidence use, knowledge synthesis, presentation, application of knowledge, and critical thinking. Self-assessment and peer assessment may also be used to encourage reflection on students' learning processes and group collaboration.

Figure 1 illustrates the conceptual framework of the SPBL model, showing how Situation-Based Learning (SBL) and Problem-Based Learning (PBL) are synthesized into eight instructional steps that support critical thinking processes and lead to expected learning outcomes.

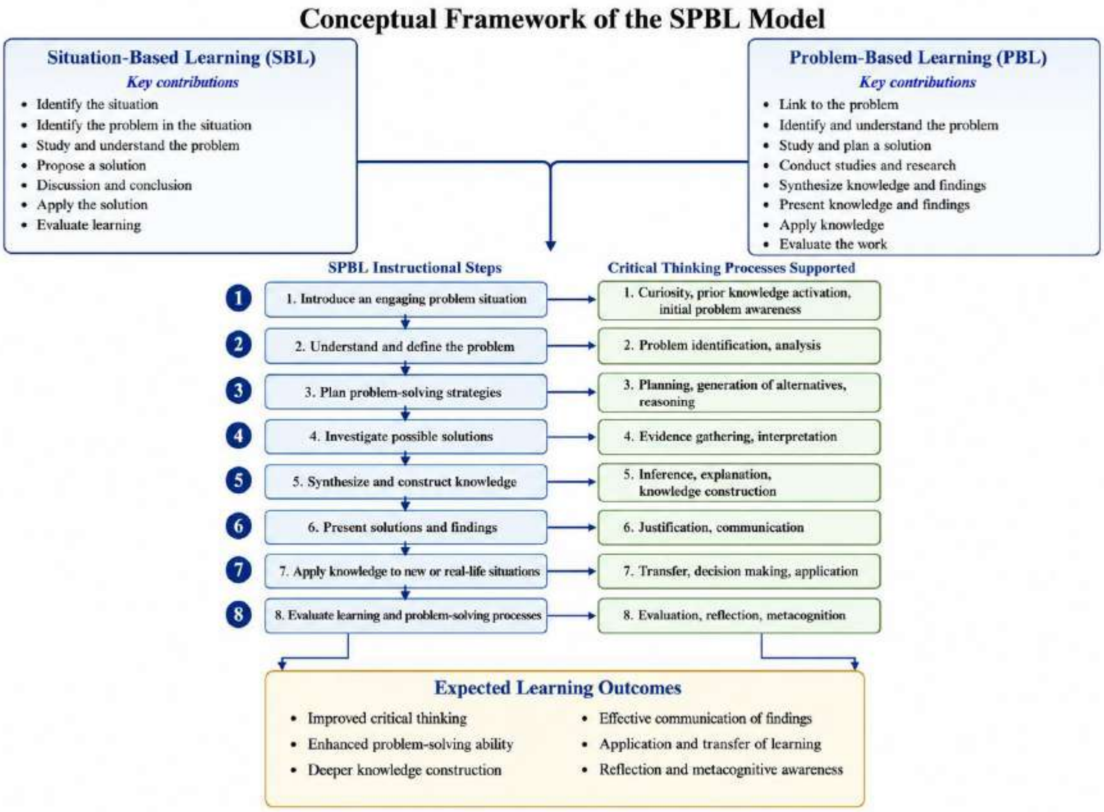

Figure 1 Conceptual Framework of the SPBL Model

Lesson Plan Using the Situation Problem-Based Learning Model

The researcher used the SPBL model to design a five-hour lesson plan on human body systems for Grade 8 students. The lesson aimed to promote students' learning achievement and critical thinking. The following section presents an example of an SPBL lesson plan on the circulatory system. Before the SPBL activities, the teacher introduced the lesson objectives and provided students with online learning materials (https://sites.google.com/wch.ac.th/science-by-kwanjai) on the circulatory system through computer-assisted instruction. Students then completed a 10-item pretest to assess their prior knowledge.

In Step 1: Introduce an engaging problem situation, to introduce an engaging problem situation, the teacher used a bingo activity related to the circulatory system and presented real-life health information to stimulate students' curiosity and prepare them for problem-based inquiry.

Figure 2 Bingo Game on Circulatory System.

The teacher then presented a real-life scenario related to the circulatory system using a video clip (https://www.youtube.com/watch?v=XpLNSkbKE80) about the warning signs of acute myocardial infarction. Students also examined mortality-rate data from Thailand and Trang Province, presented through graphs and PowerPoint slides. These materials were used to help students connect the circulatory system with real-life health issues and recognize the relevance of scientific knowledge to everyday decision making.

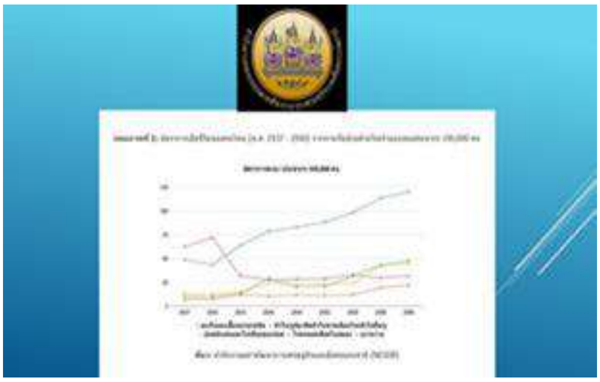

Figure 3 PowerPoint slide showing mortality-rate data in Thailand.

In Step 2: Understand and define the problem, students analyzed mortality-rate graphs from Thailand and Trang Province and discussed how diseases related to the circulatory system affect people's health. They identified possible causes, risk factors, and consequences of circulatory-system problems. Through group discussion, each group selected a specific problem related to hypertension in Trang Province for further investigation.

In Step 3: Plan problem-solving strategies, each group developed a problem-solving plan by identifying possible explanations, relevant scientific concepts, information sources, group roles, and criteria for evaluating proposed solutions. The teacher guided students to consider the relationship between diet, lifestyle, blood pressure, and the functioning of the circulatory system.

In Step 4: Investigate possible solutions, students investigated their selected problem by searching for information from learning materials, videos, and other relevant sources. They studied the structure and function of organs in the circulatory system, blood circulation, blood pressure, dietary factors, and consumption behaviors related to hypertension.

In Step 5: Synthesize and construct knowledge, each group synthesized the information collected during the investigation and constructed explanations or proposed solutions for reducing hypertension risks. Students organized their findings in written reports or visual representations.

In Step 6: Present solutions and findings, each group presented its findings and proposed solutions through a gallery walk. Students asked questions, exchanged ideas, critiqued evidence, and justified their conclusions.

In Step 7: Apply knowledge to new or real-life situations, students applied their knowledge to a new health-related situation through the "Mo Chuan Run" activity, in which they proposed ways to reduce circulatory-system health risks in daily life.

In Step 8: Evaluate learning and problem-solving processes, students completed self-assessment and peer-assessment activities focusing on problem identification, planning, investigation, knowledge synthesis, presentation, application, and critical thinking. The teacher assessed students' work using a mind-map assessment form, a critical thinking assessment form, and a multiple-choice learning achievement test on the circulatory system.

Validation of the SPBL model

Five experts were invited to evaluate the quality of the SPBL model and research instruments. The panel included two university lecturers specializing in science education, one university lecturer specializing in instructional design and learning innovation, one expert in educational measurement and evaluation, and one experienced Grade 8 science teacher. Each expert had at least five years of experience in teaching, curriculum development, instructional design, or assessment. The experts evaluated the model in terms of its theoretical foundation, objectives, instructional steps, learning activities, teacher and student roles, learning materials, assessment methods, feasibility of implementation, and alignment with students' learning achievement and critical thinking.

The experts evaluated the quality of the SPBL model using a five-point rating scale. Each item was scored from 1 to 5, where 5 represented a very good or very appropriate level, 4 represented a good or appropriate level, 3 represented a moderate or fairly appropriate level, 2 represented a low level requiring improvement, and 1 represented a very low level requiring major improvement. The interpretation of mean scores was divided into five levels: 4.51–5.00 = very good, 3.51–4.50 = good, 2.51–3.50 = moderate, 1.51–2.50 = low, and 1.00–1.50 = very low. Using these criteria, the overall quality of the SPBL model was interpreted according to the mean score obtained from the expert evaluation.

The results showed that the SPBL model was rated at a very good level in all aspects, with an overall mean score of 4.51 out of 5.00. This indicates that the model was considered appropriate, coherent, feasible, and suitable for promoting Grade 8 students' science learning and critical thinking in the human body systems unit.

Results from the Preliminary Study

Research Design

The preliminary study employed a one-group pretest-posttest design to examine the effects of the SPBL model on Grade 8 students' learning achievement in the human body systems unit. The participants were 45 Grade 8 students at Wichianmatu School, Trang Province, Thailand. They were selected through purposive sampling because they were students in the class taught by the first author during the study period. The SPBL model was implemented through one lesson plan on the human body systems unit, with a total instructional duration of five hours.

Research Instruments

The research instruments used in the preliminary study consisted of a learning achievement test and a critical thinking assessment. The learning achievement test was designed to measure students' understanding of the human body systems unit before and after learning through the SPBL model. It consisted of 30 multiple-choice items. The item difficulty values ranged from approximately .20 to .80, indicating that the test included items across an acceptable range of difficulty. The item discrimination values were higher than .20, indicating that the items could distinguish between students with higher and lower levels of achievement.

Critical thinking was assessed using a rubric-based performance assessment rather than a multiple-choice test. Students were required to analyze a problem situation related to the human body systems unit, identify the key problem, use relevant scientific evidence, explain possible causes or solutions, and justify their reasoning. The assessment was scored using a five-level analytic rubric with a total score of 20 points. The rubric consisted of four criteria: 1) problem identification and analysis, 2) use of evidence and reasoning, 3) inference and explanation, and 4) evaluation and justification. Each criterion was rated on a five-point scale, ranging from 1 = very low performance to 5 = very high performance, resulting in a possible total score range of 4–20 points. Higher scores indicated stronger critical thinking performance. To ensure scoring consistency, the students' written responses or activity outputs were evaluated according to the rubric descriptors, and the scores from all four criteria were summed to obtain each student's total critical thinking score. Students' critical thinking scores were obtained from the rubric-based performance assessment, with a maximum possible score of 20 points; therefore, the 70% criterion used for comparison was equivalent to 14 out of 20 points.

The quality of both instruments was examined by five experts. The experts reviewed each item to determine whether it was appropriate, clearly written, relevant to the learning objectives, and aligned with the intended constructs. For the learning achievement test, the experts considered the alignment between the test items and the content of the human body systems unit. For the critical thinking assessment, the experts considered the alignment between the assessment criteria and the targeted critical thinking processes, including problem identification, analysis, evidence use, reasoning, explanation, and application.

Content validity was evaluated using the Index of Item-Objective Congruence (IOC). Each expert rated the congruence of each item with the intended objective using three levels: +1 = clearly congruent, 0 = uncertain, and −1 = not congruent. The IOC value for each item was calculated from the experts' ratings. Items with IOC values of .60 or higher were considered acceptable. The IOC values of the learning achievement test and critical thinking assessment ranged from .80 to 1.00, exceeding the acceptable criterion. This indicates that both instruments had acceptable content validity and were appropriate for use in the preliminary study.

In addition, the reliability of the learning achievement test was examined, and the reliability coefficient was .89, indicating an acceptable level of internal consistency. For the critical thinking assessment, the rubric was reviewed by experts for content validity and clarity of scoring criteria. The reliability of the rubric-based critical thinking assessment was also examined, yielding a reliability coefficient of .82, which suggests that the rubric produced consistent scoring results.

Data Collection

Data were collected before, during, and after the implementation of the SPBL lesson. Before the lesson, students completed the learning achievement pre-test. During the lesson, students participated in SPBL activities and completed the critical thinking assessment through learning tasks related to problem situations in the human body systems unit. After the lesson, students completed the learning achievement post-test. The students' scores were then used to examine changes in learning achievement and to compare their critical thinking performance with the predetermined 70% criterion.

Data Analysis

Students' learning achievement scores before and after learning through the SPBL model were analyzed using a paired-samples *t* test to determine whether students' post-test scores were significantly higher than their pre-test scores. In addition, students' critical thinking scores after learning through the SPBL model were compared with the 70% criterion using a one-sample *t* test to determine whether their critical thinking performance exceeded the expected criterion. The results are presented below

Table 4 Comparison of Students' Learning Achievement Scores Before and After Learning Through the SPBL Model.

Test	n	Mean	SD	*t*	*p*
Pre-test	45	11.36	2.497	30.03	< .001
Post-test	45	24.58	1.305		

Note. *df* = 44

As shown in Table 4, students' mean learning achievement score before learning through the SPBL model was 11.36 (SD = 2.497), whereas their mean score after learning was 24.58 (SD = 1.305). The paired-samples *t* test showed that students' post-test score was significantly higher than their pre-test score, $t(44) = 30.03$, $p < .001$. This result indicates that students' learning achievement in the human body systems unit improved after learning through the SPBL model. To determine the magnitude of the learning gain, Cohen's d for the paired-samples t test was calculated using the formula $d = t/\sqrt{n}$. The result showed a very large effect size, Cohen's d = 4.48, indicating that the SPBL model had a strong practical effect on students' learning achievement in the human body systems unit.

Table 5. Comparison of Students' Critical Thinking Score After Learning Through the SPBL Model With the 70% Criterion.

Critical thinking assessment	n	Criterion score	Mean	SD	*t*	*p*
Activity sheet score	45	14.00	14.42	1.390	2.03	.049

Note. Full score = 20; criterion score = 70%. *df* = 44.

As shown in Table 5, students' mean critical thinking score after learning through the SPBL model was 14.42 out of 20, equivalent to 72.10% of the full score. A one-sample *t* test was used to compare students' mean score with the 70% criterion score of 14.00. The result showed that students' critical thinking score was significantly higher than the criterion at the .05 level, $t(44) = 2.03$, $p = .049$. This suggests that students' critical thinking performance after learning through the SPBL model slightly exceeded the expected criterion.

Discussion

The findings from the preliminary study suggest that the Situation Problem-Based Learning (SPBL) model is an appropriate instructional model for promoting Grade 8 students' science learning and critical thinking in the human body systems unit. The expert evaluation showed that the model was rated at a very good level in all aspects, with an overall mean score of 4.51 out of 5.00. This result indicates that the model had a clear conceptual foundation, coherent instructional steps, appropriate learning activities, feasible implementation procedures, and suitable alignment with the intended outcomes. The positive expert evaluation may be explained by the systematic synthesis of situation-based learning and problem-based learning. The model begins with an engaging real-life situation, guides students to define and investigate problems, supports knowledge construction, and ends with application and evaluation. This structure is consistent with the principles of situation-based learning, which emphasizes learning through meaningful contexts and real-life situations (Boonyathorn, 1999; Jingru & Ma, 2017; Seepootorn et al., 2019), and problem-based learning, which positions authentic problems as the starting point for inquiry, collaboration, and solution development (Delisle, 1997; Hmelo-Silver, 2004; Savery, 2006).

The significant improvement in students' learning achievement after learning through the SPBL model indicates that integrating real-life situations with problem-based inquiry can help students develop a better understanding of human body systems. Students' mean score increased from 11.36 before learning to 24.58 after learning, showing a clear improvement in science learning achievement. This result may be attributed to the way the SPBL model connects abstract scientific concepts with familiar health-related situations, such as hypertension, myocardial infarction, mortality-rate data, and daily health behaviors. Such contextualization can make scientific knowledge more meaningful and easier for students to understand. This interpretation is consistent with situated cognition theory, which argues that knowledge is strongly connected to the contexts and activities in which it is learned and used (Brown et al., 1989; Lave & Wenger, 1991). In this study, students did not learn the circulatory system only as isolated content; instead, they used scientific concepts to analyze real-life health problems, investigate causes and risk factors, and propose possible solutions. This may have helped them construct more meaningful and applicable understanding.

The learning achievement result is also consistent with previous discussions of problem-based learning. PBL encourages students to identify problems, search for relevant information, synthesize findings, and apply knowledge to solve authentic problems (Delisle, 1997; Hongprapat, 2004; Thambut, 2002). Hmelo-Silver (2004) argued that PBL can support flexible knowledge, problem-solving skills, self-directed learning, collaboration, and intrinsic motivation. Similarly, Savery (2006) described PBL as a learner-centered approach in which students engage with ill-structured problems and take responsibility for inquiry and knowledge construction. In the present study, the SPBL model adopted these PBL principles by requiring students to analyze health-related situations, plan investigations, gather information, synthesize knowledge, and present their solutions. These activities likely encouraged students to process information more deeply than they would in conventional content-transmission instruction.

The results also showed that students' critical thinking score after learning through the SPBL model slightly exceeded the 70% criterion. Although the result was statistically significant, the mean score was 14.42 out of 20, or 72.10%, which was only modestly above the expected criterion. This finding should therefore be interpreted cautiously. It suggests that the SPBL model has potential to support students' critical thinking, but the level of improvement may still need further strengthening. The SPBL steps were designed to engage students in several critical thinking processes, including problem identification, analysis, evidence gathering, interpretation, inference, explanation, justification, communication, application, evaluation, and reflection. These processes are consistent with common conceptions of critical thinking as purposeful judgment involving interpretation, analysis, evaluation, inference, explanation, and self-regulation (Abrami et al., 2015; Ennis, 1985). The model may have supported critical thinking because students were required to examine evidence, justify their explanations, critique ideas during presentations, and apply knowledge to new health-related situations.

However, the modest critical thinking result may indicate that students need more explicit scaffolding to develop higher-level reasoning. Research on critical thinking instruction suggests that critical thinking is more likely to improve when thinking skills are taught explicitly, practiced repeatedly, and embedded in meaningful disciplinary tasks (Abrami et al., 2015). In the SPBL lesson, students had opportunities to analyze data, investigate causes, and propose solutions, but they may have needed more structured prompts, reasoning rubrics, evidence-evaluation criteria, or teacher questioning strategies to help them move beyond information gathering toward deeper evaluation and argumentation. Therefore, future implementation of the SPBL model should include clearer scaffolds for critical thinking, such as guiding questions for evaluating evidence, comparison of alternative explanations, justification of claims with data, and reflective discussion after group presentations.

The integration of situation-based learning and problem-based learning appears to be a key contribution of this study. Situation-based learning provided realistic contexts that made the human body systems unit relevant to students' lives, while problem-based learning provided an inquiry structure that guided students from problem definition to solution development. This integration responds to the concern that science learning should not focus only on memorizing theories, definitions, and concepts, but should enable students to apply scientific knowledge to real-life problems. The SPBL model is therefore aligned with the Basic Education Core Curriculum's emphasis on learner-centered education, real-life learning experiences, thinking processes, and assessment based on students' development and learning behaviors (Ministry of Education, 2017). It is also consistent with the science curriculum's emphasis on communication, thinking, problem solving, life skills, and technology use (Institute for the Promotion of Teaching Science and Technology, 2018).

Although the findings showed significant improvement in students' learning achievement after learning through the SPBL model and a critical thinking score slightly above the 70% criterion, these results should be interpreted with caution because the study employed a one-group pretest-posttest design without a control group. Therefore, the observed improvements cannot be attributed solely to the SPBL model with full confidence, as other factors such as students' prior learning experiences, maturation, repeated exposure to similar test content, teacher support, or classroom conditions may also have influenced the results. Nevertheless, the findings provide preliminary evidence that the SPBL model may be a promising instructional approach for supporting science learning and critical thinking, which should be further examined using more rigorous experimental or quasi-experimental designs.

Conclusion

This study described the development and preliminary application of the Situation Problem-Based Learning (SPBL) model for teaching human body systems to Grade 8 students. The SPBL model was developed by integrating situation-based learning and problem-based learning to connect science concepts with real-life problem situations and inquiry-based learning processes. The model consists of eight instructional steps: 1) introduce an engaging problem situation, 2) understand and define the problem, 3) plan problem-solving strategies, 4) investigate possible solutions, 5) synthesize and construct knowledge, 6) present solutions and findings, 7) apply knowledge to new or real-life situations, and 8) evaluate learning and problem-solving processes.

The preliminary findings suggest that the SPBL model is a feasible and promising instructional model for Grade 8 science learning. The model was evaluated by experts at a very good level, indicating that its principles, instructional steps, learning activities, assessment methods, and feasibility were appropriate. In addition, students' learning achievement in the human body systems unit improved significantly after learning through the SPBL model. Students' critical thinking performance after learning also slightly exceeded the 70% criterion. These findings suggest that the SPBL model may support students' science learning and help them engage in critical thinking processes, including analyzing problems, gathering evidence, constructing explanations, justifying claims, and applying knowledge to real-life health situations. However, because the study used a preliminary one-group design, the findings should be interpreted cautiously.

Overall, the SPBL model offers a useful approach for designing science lessons that connect scientific knowledge with authentic health-related problems. It may help teachers create learning environments in which students actively analyze situations, investigate problems, construct understanding, and apply scientific knowledge in daily life.

Recommendations

The main contribution of this study is the development of the Situation Problem-Based Learning (SPBL) model as a unified instructional model that integrates the strengths of Situation-Based Learning (SBL) and Problem-Based Learning (PBL) for lower-secondary science learning. While SBL emphasizes meaningful real-life situations that help students connect science concepts with everyday experiences, PBL emphasizes problem analysis, inquiry, evidence-based reasoning, and solution development. By synthesizing these two approaches, the SPBL model provides a structured instructional process that begins with an engaging problem situation and guides students through problem definition, investigation, knowledge construction, presentation, application, and reflection. This integrated model is particularly relevant to the human body systems unit because the content can be meaningfully connected to health-related situations that students may encounter in daily life.

Teachers who wish to apply the SPBL model should select problem situations that are relevant to students' lives and closely aligned with the science concepts being taught. In the human body systems unit, health-related situations such as hypertension, myocardial infarction, nutrition, exercise, and disease prevention can be used to help students recognize the value of scientific knowledge in everyday decision making. Teachers should also provide sufficient scaffolding during problem analysis, investigation, knowledge synthesis, and presentation so that students can use evidence appropriately and justify their reasoning.

The teacher's role is especially important in the SPBL model. Rather than simply delivering scientific content, the teacher should act as a facilitator who presents meaningful situations, guides students' inquiry, asks probing questions, monitors group progress, and supports reflection. This role is consistent with problem-based learning literature, which emphasizes facilitation, student inquiry, collaboration, and self-directed learning (Barrows, 1986; Hmelo-Silver, 2004; Savery, 2006). In classroom implementation, teachers may use digital materials, health-related data, video clips, group investigation, visual representations, gallery walk presentations, and assessment tools to create an active learning environment in which students connect science concepts with real-life issues.

Future studies should examine the SPBL model using a stronger research design, such as a quasi-experimental design with a comparison group. Researchers should also collect both pretest and posttest data for critical thinking and report effect sizes to show the magnitude of learning gains. In addition, future research could investigate how each SPBL step contributes to specific critical thinking processes. For example, Step 2 may support problem identification and analysis, Step 4 may support evidence gathering and interpretation, Step 5 may support inference and explanation, and Step 8 may support evaluation and reflection. Studying these processes in more detail would help clarify how the SPBL model promotes critical thinking and how teachers can improve its implementation.

Limitations

Several limitations should be acknowledged. First, the study used a one-group pretest-posttest design without a control group. Therefore, although students' learning achievement improved after the SPBL intervention, the results cannot conclusively prove that the improvement was caused only by the SPBL model. Other factors, such as repeated testing, teacher support, students' familiarity with the topic, or classroom context, may also have influenced the results. This limitation restricts the strength of causal interpretation and suggests that the findings should be viewed as preliminary evidence of the potential effectiveness of the SPBL model rather than definitive proof of its impact.

Second, the critical thinking result was based on a post-learning comparison with a 70% criterion rather than a pretest-posttest comparison. Therefore, the study provides limited evidence about the extent to which students' critical thinking improved from before to after the intervention. Future studies should measure students' critical thinking both before and after learning through the SPBL model.

Third, the participants were 45 Grade 8 students from one school in Trang Province, Thailand. This limits the generalizability of the findings to other schools, grade levels, science topics, and educational contexts. Further studies with larger and more diverse samples are needed to confirm the effectiveness and applicability of the SPBL model.

Finally, future research should employ a control group, randomized assignment where possible, or a quasi-experimental design to provide stronger evidence regarding the effectiveness of the SPBL model. Such research designs would help distinguish the effects of the SPBL model from other possible influences and allow for more rigorous conclusions about its impact on students' learning achievement and critical thinking.

Declaration of Interest Statement

The authors declare that they have no conflicts of interest.

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