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Creativity Development of Secondary School Students Using Four Thinking Activities Blended Inquiry-Based Learning

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Creative thinking is more than just thinking; it is a practical ability based on knowledge and experience that allows a person to accomplish things better. The objectives of this research were to design science learning activities and promote the creativity of eighth-grade students who received four thinking activities with inquiry-based learning to pass the 70% requirement and to examine the satisfaction of grade 8 students toward blended learning management of four thinking activities with inquiry-based learning. A total of 31 eighth-grade secondary school students at a public school in Northeast Thailand were selected using purposive sampling in the first semester of 2022. The research tools were seven learning management plans using four thinking activities combined with inquiry-based learning on the topic of the human body, a creativity test, and a satisfaction questionnaire. The statistics used were mean, standard deviation, and percentage. The findings revealed that combining learning management with inquiry-based learning resulted in the development of learning activities. The average score for creativity was 16 (80%), from a total of 20 points. The standard deviation was 1.54, which passed the requirement of 70%. Students were satisfied with the four thinking activities and inquiry-based learning, with a mean value of 4.39, representing a high level of satisfaction.

Keywords: four thinking activities, inquiry-based learning, creativity, science learning activities, action research

INTRODUCTION

The Organisation for Economic Co-operation and Development (OECD) seeks to measure the effectiveness of education systems in equipping people with the essential

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potential or abilities required to live in a changing environment. Thailand has participated in the PISA assessment from the first round in 2000 to the current cycle in 2022, which focuses on mathematical intelligence and creative thinking (The Institute for the Promotion of Teaching Science and Technology, 2022).

Creativity is one of the skills that today's youth must master. Individuals must be adaptable and possess 21st-century abilities beyond literacy and computation. Education fostering creativity will enable young people to adapt and build their skills for jobs that machinery cannot replace and address increasingly complicated problems at the local and global levels with solutions that are not constrained by the same framework (Ritter & Mostert, 2017; Ritter et al., 2020).

PISA 2022 defines creativity as the ability to contribute effectively to creating, evaluating, and improving ideas, generating new solutions for tackling new and practical challenges, and fostering the development of knowledge and manifestation of helpful imagination (Vincent-Lancrin et al., 2019).

Such a definition of creativity emphasizes that it occurs in all circumstances and at all educational levels. Pupils must learn to engage in productive conceptualizing. Idea reflection entails appreciating consistency and uniqueness and reworking concepts until problem-solving leads to satisfactory results. The PISA 2022 Creative Assessment focuses on two broad content areas: creative expression and creative knowledge generation and problem-solving (OECD, 2022).

The term "creative expression" refers to an event that demands creative thought to convey one person's inner world to another. This information is classified into "conceptualization through narrative writing" and "visual expression of concepts." It is creative, innovative, and expressive. "Knowledge creation and creative issue solving" refers to the application of creative thinking to the investigation of challenges or open-ended inquiries (OECD, 2022; The Institute for the Promotion of Teaching Science and Technology, 2022).

The test of creative potential used in the OECD project assessed students' divergent exploratory and convergent integration (Lubart et al., 2011). According to Lucas et al. (2013), inquiring, imagining, doing, and reflecting are categorized in the creative process. The creative cognitive process is close to scientific inquiry. Torrance (1966) stated that creativity could not occur without the knowledge of the field or problem being explored; searching for information, locating the problem, and comprehending its various conceivable dimensions are critical components of the creative process. Furthermore, curiosity and unusual linkages between diverse information and challenges are essential in creative inquiry.

Creativity is believed to develop if we train the brain to use it often (Christensen, 2015). Moreover, creativity can be characterized in general terms at the conceptual level; its exercise is domain-specific, which means that it must be experienced in all subjects taught in school rather than being assigned to one or more subjects in the hope that it will subsequently transfer to all subjects. (Vincent-Lancrin et al., 2019). There are

numerous methods for students to develop and improve their creative-thinking skills, particularly in a science subject (Suardana et al., 2019).

According to Zubaidah et al. (2018), scientific learning is demanding and enjoyable, fosters exploration, delivers successful experiences, and develops thinking skills. However, the current learning approach is significantly inversely related to the aim of science education, which is to perform a scientific investigation to build high-level thinking skills in students, including critical- and creative-thinking skills (Muskita et al., 2020). There are several ways to learn science that stimulate creativity, such as problem-based learning (Khoiriyah & Husamah, 2018), STEM-based learning (Sirajudin et al., 2021), project-based learning (Somphol et al., 2022), and inquiry-based learning (which is the most fundamental and common) (Muskita et al., 2020; Supena et al., 2021; Zubaidah et al., 2017).

Numerous studies also reinforce by demonstrating how inquiry-based instruction can foster students' capacity for original thought (Michalopoulou, 2014; Nurhadi et al., 2016). Inquiry-based learning is a student-centered learning strategy emphasizing reflective inquiries and insightful findings in the teaching and learning process (Gholam, 2019; Shanmugavelu et al., 2020). Most research articles use inquiry-based learning to improve academic achievement in science subjects (Bantaokul & Polyiem, 2022; Choowong & Worapun, 2021; Rohimin et al., 2020; Owolade et al., 2022; Thangjai & Worapun, 2022). Inquiry-based learning is commonly used in Thailand for science teaching, especially at the primary and secondary levels. Unfortunately, it has yet to be successful in enhancing learners' learning outcomes and their thinking levels, as the results of the PISA (Sothayapetch et al., 2013; Lounkaew, 2013; Yangjeen et al., 2021) and Ordinary National Educational Test science exams shown.

Currently, teaching and learning activities are still centered on the ability to evaluate students' memory, leaving them unable to think in a pluralistic manner. Instructors should teach children facts and skills for thinking and learning (Mustofa & Hidayah, 2020). Moreover, modern teaching methods should encourage students to be creative, curious, disciplined, collaborative, and persistent across the curriculum. Teachers should modify their practices and lesson plans in high-functioning classrooms so that students face obstacles connected to real-life experiences. Classes must physically, socially, emotionally, and intellectually engage students; they must place students at the center of the learning process by emphasizing their experiences, observations, and questions. This strategy shifts students' educational growth away from a model of acquiring information others know and toward a paradigm in which students have more excellent agency in their learning (Galton, 2007). Indeed, to seek knowledge to practice creative-thinking skills, it is necessary to develop a science learning approach using thought-promoting activities (Keles, 2012).

Despite significant inquiry-based reform efforts nationwide, many educators may need help constructing scientific lessons that foster inquiry-based learning. Additionally, developing creative-thinking skills requires training in lateral thinking, divergent thinking, convergent thinking, and aesthetic thinking. Previously, the inquiry-based learning approach focused on academic achievement and science literacy. This drives

researchers to design science learning management activities through inquiry-based learning and four thinking activities that promote creativity, which has four indicators: fluency, flexibility, originality, and elaboration (Guilford, 1967).

Background

Inquiry-based Learning

The inquiry model is appropriate for learning science in junior high school (Zubaidah et al., 2017) and is widely accepted as the most fundamental and extensively used model for developing creative-thinking skills in science learning (Johnson, 2000; Kind & Kind, 2007; Meador, 2003). Many theoretical approaches have been offered to build this learning environment, including structured inquiry, guided inquiry, open inquiry, and learning cycle (Bianchini & Colburn, 2000). Several researchers agreed that guided inquiry assists students in learning science content, mastering scientific skills, and understanding the nature of scientific knowledge (Sadeh & Zion, 2012), whereas open inquiry "assists students in increasing procedural and epistemological scientific understanding and engaging in higher-order thinking" (Madhuri et al., 2012; Zion et al., 2013). Further, Suardana et al. (2019) claimed that the guided inquiry-based learning paradigm, including orientation, conceptualization, investigation, conclusion, and discussion, effectively enhances creative-thinking skills in science learning. The open inquiry approach is valuable, especially in scientific education, because it has been shown to help students develop their knowledge from their actual learning by using their fundamental abilities to improve their science learning literacy (Tornee et al., 2017). Additionally, Oktavia et al. (2019) discovered that students' creative-thinking skills improved after they were taught using guided inquiry approaches.

Bybee and Landes (1990) claimed that the 5E instructional model supports inquiry-based teaching. The 5E instructional models are engagement, exploration, explanation, expansion, and evaluation (Bybee, 2009). In general, the 5E learning cycle is regarded as a "guided inquiry" in which the teacher supplies resources and problems while students carry out procedures to solve the problem under the supervision of the teacher (Liu et al., 2009; Martin-Hauser, 2002; Windschitl, 2003).

The 5E instructional model is a flexible learning cycle that helps curriculum creators and classroom instructors produce science lessons demonstrating constructivist, reform-based, best teaching practices. The detail of the 5E instructional model is presented as follows (Açõúoõ et al., 2011; Bybee et al., 2006; Duran & Duran, 2004; Stamp & O'Brien, 2005):

Engagement. In this initial phase of the cycle, the teacher's goal is to assess students' prior knowledge or uncover potential misconceptions. This phase should be a motivating period in which students want to learn more about the upcoming topic. This phase is not a time to lecture, define words, provide explanations, or record definitions.

Exploration. Following the engagement phase, which encourages a mental focus on the subject, the exploration phase presents students with a shared, concrete learning experience. Students are encouraged to use process skills with their peers, such as

observing, inquiring, exploring, testing predictions, hypothesizing, and communicating. This stage of the learning cycle typically includes the main inquiry-based activity or experience that encourages students to build skills and concepts. The job of the teacher is that of a facilitator or consultant in this phase. Furthermore, students are encouraged to work in a cooperative learning setting without direct teacher intervention.

Explanation. During the explanation phase, students can convey their comprehension and ask questions regarding the subjects they have been studying. More questions are almost sure to arise. The explanation phase is a critical, hands-on component of the 5E lesson. Before the teacher can explain something, pupils must be allowed to share their explanations and ideas. This step includes clarifying student misconceptions that may have developed during the engagement or exploration phase. After that, students should be able to effectively describe the key concepts to the teacher and their peers.

Elaboration. This phase of the learning cycle's activities should inspire students to apply their new understanding of ideas while reinforcing new skills. This phase's purpose is to assist students in developing a deeper and broader understanding of the concepts. Students may conduct additional research, create products, share information and ideas, or apply their knowledge and talents to other fields.

Evaluation. Assessment in an inquiry-based context differs significantly from assessment in typical science lectures. Both formal and informal assessment methods are acceptable and should be used. Nontraditional modes of assessment, such as portfolios, performance-based evaluations, idea maps, physical models, or journal logs, may provide significant proof of student learning. Assessment should be considered an ongoing process during an inquiry-based session. Teachers should observe their students as they apply new concepts and abilities and seek evidence that students' thinking has changed or been modified. Students may also be given the option of conducting self-assessment or peer assessment. Nonetheless, a summative experience such as a quiz, test, or writing assignment may be included in the evaluation.

Four Thinking Activities

The concepts related to creativity are lateral thinking (De Bono, 2010), divergent and convergent thinking (Guilford, 1967), and aesthetics (Lipman, 2003). Divergent thinking is the process of developing multiple alternative solutions for a problem in a flexible manner (Runco, 2010). In contrast, lateral thinking is a set of recesses regarding systematic and creative thinking that repeatedly produces inventive thinking. Lateral thinking replaces standard vertical thinking, which only uses traditional logic. This thinking may require students' critical and innovative problem-solving abilities (Mustofa & Hidayah, 2020). Applying logic and knowledge to reduce the number of alternative outcomes is defined as convergent thinking (Guilford, 1967). Additionally, interactions with the arts based on an aesthetic style of inquiry enable the development of children's imaginations because children are encouraged to ask questions and embody and associate with the arts (Pavlou, 2013). Creativity will be boosted by using the four thinking to exercise the brain frequently. The four thinking activities can be modified from those in The Creative Challenge book (Christensen, 2015).

Research Objectives

The research aims were to design science learning activities using the four thinking activities, namely lateral, divergent, convergent, and aesthetic thinking, blended with the 5E instructional approach and to encourage grade 8 students to use their creativity to meet the 70% passing requirement. The author also studied how satisfied grade 8 students were after participating in the science learning activities.

METHOD

Research Design

This study was divided into two phases based on the objectives. The first phase used the qualitative method to design science learning activities. The second phase used the quantitative method via action research based on the Kemmis et al. (2014) concept to examine the effectiveness of science learning activities in promoting students' creativity and satisfaction.

Phase I

1.1 Review, analyze, and synthesize the theoretical framework of the four thinking activities and 5E instructional model.

1.2 Apply the theoretical framework of the four thinking activities and the 5E instructional model to encourage students' creativity and generate activities according to the learning plan and to establish instructor roles and tasks.

1.3 Examine the first draft of the science learning activities model.

1.4 Ask five experts to check the correspondence between the items and components of the four thinking activities and the 5E instructional model. These experts graduated in science education, educational measurement and evaluation, educational guidance, and psychology education.

1.5 Revise the science learning activities model based on the experts' opinions and prepare the second draft. Then, have the five experts examine the correspondence between creativity and the four thinking and 5E instructional model designs.

1.6 Have the five experts assess the suitability of the four thinking activities and the 5E instructional model. The result was 4.56.

Phase II

The action research had four steps consisting of two-spiral:

2.1 Plan—Study the school context with the supervising teachers and determine creativity problems by examining the creativity scores of eighth-grade for developing creativity, consisting of a learning management plan using four thinking activities combined with the 5E instructional model. Tools used for data collection include a creativity test and a satisfaction questionnaire with search tool suitability and

consistency values. Then, improve the tools according to the experts' advice and use the tools for data collection.

2.2: Action—Use the revised learning management plan in Step 1 to implement instructional management. Divide the target groups into two cycles of action. The first cycle involves teaching and learning using four thinking activities and the 5E instructional model with learning plans 1–4.

2.3: Observe—Study the target group's behavior while teaching. Then, administer the creativity test at the end of the practical cycle to the target group of students after conducting the teaching and learning activities according to the operational process.

2.4: Reflect—After completing each instructional cycle, collect data by testing creativity, use the data obtained from the test and observations, and summarize the data for further development in the second operational cycle. The second cycle involves learning management plans 5–7.

Target Group

The target group was divided into two phases. The first phase involved five experts, and the second phase involved eighth-grade students at a public school in Kalasin Province. The students were in the first semester of academic year 2022; 31 students were selected using purposive sampling. All students had lower creativity scores than the school's requirement (a predetermined 70%).

Research Tools

The tools used in this research consisted of the following:

1) A learning management plan using four thinking activities together with the 5E instructional model on the topic of the human body. The plan had seven parts: (a) the circulatory system for two hrs., (b) the circulatory system (con.) for two hrs., (c) the respiratory system for two hrs., (d) the excretory system for two hrs., (e) the nervous system for two hrs., (f) the reproductive system for two hrs., and (g) the reproductive system (con.) for one hr. The total learning time was 13 hours. The experts' measurements and evaluations showed a mean value of 4.56 at the most appropriate level with an Item-Objective Congruence (IOC) of 1.

2) A creativity test with an implied rate of 8 items, with the focus on four items, flexibility, originality, efficiency, and elaboration with an IOC of 1, a difficulty (P) ranging from 0.55–0.725, and a discrimination index (R) ranging from 0.2–0.5. The reliability (KR20) value was 0.683.

3) A questionnaire on satisfaction toward learning management using four thinking activities in conjunction with learning management and the 5E instructional model, characterized as a rating scale with five levels according to Likert's (1979) principle. The scale had 10 items with an IOC of 1.

Data Collection

The researcher conducted data collection by

1) Administering the official achievement test to experimental student groups.

2) Organizing learning activities on the human body in class according to four learning management plans. Eight periods of 50 minutes each were conducted, totaling four weeks with the target group. The four thinking activities and the 5E instructional model were used in the first operation cycle.

3) Letting the target students take the creativity test: implicit rate form, eight items, 20 points.

4) Administering creativity test results and then analyzing the data from the first operation cycle.

5) Organizing learning activities on the human body in class according to three learning management plans. Five periods of 50 minutes each were conducted, totaling two weeks with the target group. Four thinking activities were conducted together with the 5E instructional model in the second operation cycle.

6) Letting the target students take the creativity test: implicit rate form, eight items, 20 points.

7) Having the target students complete a ten-item questionnaire on their satisfaction with the learning approach.

8) Administering satisfaction questionnaires and creativity tests and then collecting and analyzing the data.

Data Analysis

The researcher analyzed the data according to the variables as follows.

1) Analyze the data from the creativity test results. After the end of the learning activities in each operational cycle, the mean, standard deviation, and percentage scores are obtained. If the score is less than 70%, students do not pass the requirement and if the score is 70% or more, students pass the criterion.

2) Analyze students' satisfaction with learning management by using the four thinking activities and the 5E instructional model after the end of both cycles to find the mean and standard deviation. Here is a 5-level rating scale according to Likert's principle (1979). The technique for measuring attitudes uses five criteria: 4.50–5.00, very satisfied; 3.50–4.49, satisfied; 2.50–3.49, neutral; 1.50–2.49, dissatisfied; and 1.00–1.49, very dissatisfied.

FINDINGS

Table 1 shows the development of science learning activities in five steps using the four thinking activities and the 5E instructional model.

Table 1
The process of organizing learning activities using four thinking activities together with the 5E instructional model of IBL management

Teaching process	Meaning of each step	Teaching method	Instructor role
1. Engagement (Promote lateral thinking)	The teacher introduces the lesson topic, raising students' interest or encouraging group discussions. The teacher may narrate an exciting story based on a recent event or based on prior lessons, encouraging students to create questions and determine the topic to be studied.	Teachers use thinking activities to create interest in learning. In questioning activities, children have to rapidly come up with answers. The four thinking activities are conducted. Lateral thinking is used for the Q&A activities. Learners practice thinking fluently.	Coach and facilitator
2. Exploration (Promote convergent and divergent thinking)	Students are allowed to study and conduct research independently and summarize their knowledge. The instructor assigns a problem based on the subject students are learning that day. Afterwards, students used what they have observed or studied for role-play.	Teachers use role-playing activities that allow students to describe what they have observed or studied. Without sound, students practice communicating with their peers. This allows them to think about how to apply the knowledge they have obtained. It promotes flexible and original thinking.	Facilitator, co-learner, and coach
3. Explanation (Promote divergent thinking)	The teacher allows learners to express their opinions analytically by using the experience they gained from their exchange of views and the assumptions they made.	The students comment on a role. They ask how students played their roles? Students are encouraged to think of new things. This is an example of initiative development.	Facilitator, co-learner, and coach
4. Expansion (Promote divergent and aesthetic thinking)	The teacher expects learners to use the knowledge and problem-solving skills they have gained to role-play and explain what they have learned. Learners are encouraged to apply what they have learned or expand their knowledge and skills to new situations. Learners are encouraged to make meaningful explanations. Teachers refer to existing information and show evidence and ask the learners what they have learned.	The teacher leads the activity. Children engage in role-play. One of the four thinking activities, extended thinking, is conducted. The teacher assigns a problem to students. Students have to role-play in front of their classmates. When the students complete the role-play and express their opinions in groups, the teacher expands their knowledge and clarifies doubts.	Facilitator and coach
5. Evaluation (Promote aesthetic thinking)	This is an assessment stage to determine whether the teaching has achieved the learning objectives and ensure that no misunderstanding occurred during learning.	The teacher asks students to summarize the knowledge they obtained in class by forming a mind mapping. This leads to the development of meticulous thinking.	Coach and co-learner

The results of the design of science learning activities combining the four thinking activities and the 5E instructional model of inquiry-based learning had a distinctive that combined the main activities of the inquiry-based learning approach with thinking activities. At the same time, such activities must not diverge from their original aim of conducting learning management and encouraging learners to think in the following four ways: Step 1 Engagement-combine activities that stimulate lateral thinking, Step 2 Exploration-combine activities that stimulate convergent thinking and divergent thinking, Step 3 Explanation-combine activities that stimulate divergent thinking, Step 4 Expansion-combine activities that stimulate divergent thinking, and aesthetic thinking and Step 5 Evaluation-combine activities that stimulate aesthetic thinking (Table 1).

Figures 1 and 2 show the results of grade 8 students' creative development through learning management using the four thinking activities and the 5E instructional model of inquiry-based learning management.

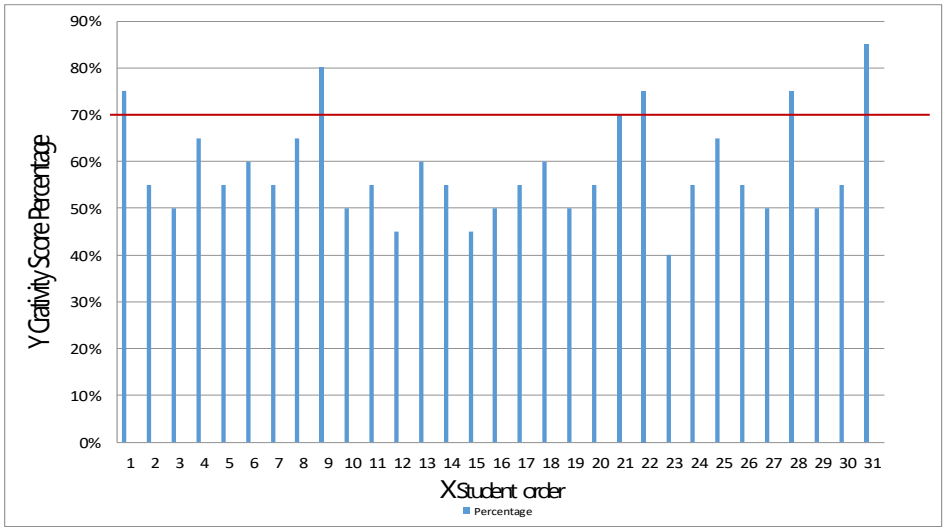

Figure 1
The level of creativity of grade 8 students in the first operational cycle

In operating cycle 1, the learners had a total average score of 11.71, equivalent to 58.54%, and a standard deviation of 2.09. Twenty-five students failed to meet the creativity assessment requirement of 70%, whereas six students succeeded in doing so. The percentage of students who failed was 80.65%, whereas the percentage of students who passed was 19.35% (Figure 1).

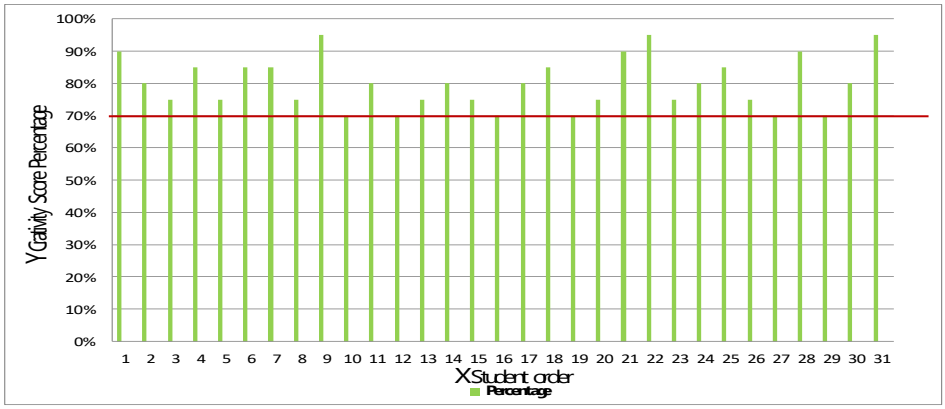

Figure 2
The level of creativity of grade 8 students in the second operating cycle

In the second operating cycle, the students had an average score of creativity equal to 16 (80%) with a standard deviation of 1.54. Thirty-one students passed the 70% requirement (Figure 2).

Table 2 shows the results of students' satisfaction with learning management using the four thinking activities and the 5E instructional model.

Table 2
The results of grade 8 students' satisfaction with learning management using the four thinking activities and the 5e instructional model

List	Average	Standard deviation	Level of satisfaction
1. Students think the duration of the activity is appropriate.	4.70	0.58	Very satisfied
2. Students think that the content of the activity helps them understand their bodies.	4.32	0.89	Satisfied
3. Science learning activities can be used to benefit.	4.00	1.02	Satisfied
4. Students think the activities organized for them are creative.	4.25	0.95	Satisfied
5. Students gain knowledge from learning activities.	4.58	0.55	Very satisfied
6. Teachers have methods they use to make lessons exciting.	4.38	0.75	Satisfied
7. Teachers allow students to express their opinions.	4.38	0.83	Satisfied
8. Activities in the lesson are easy to understand and follow.	4.32	0.86	Satisfied
9. The learning activities are fun and exciting.	4.58	0.55	Very satisfied
10. Teachers have exciting and novel teaching materials.	4.41	0.79	Satisfied
Average	4.39	0.78	Satisfied

Based on Table 2's analysis of assessment item 1, the mean value of 4.70 was the highest. For items 5 and 9, the mean value was the same: 4.58. Meanwhile, item 3's mean value of 4.00 was lower than that of other items. However, the average of all items' means, 4.39, was satisfactory.

DISCUSSION

Learning in class should encourage pupils to think more creatively to grasp an idea. Students should be encouraged to participate in learning, and the instructor should position themselves as a facilitator by developing tactics, approaches, and appropriate learning models (Mustofa & Hidayah, 2020).

Research results on the creative development of grade 8 students using the four thinking activities and the 5E instructional model of inquiry-based learning management are discussed herein. Operational Cycle 1: Students who learned using the four thinking exercises and the 5E instructional model had an average creativity score of 11.71, representing 58.54%. The standard deviation was 2.09. Six students passed the requirement because learning using the four thinking activities and the 5E instructional model of inquiry-based learning helped them develop creative thinking according to Guilford (1967). In the first step, the students practiced fluent thinking through lateral thinking activities, such as sorting games that involved sorting things based on content on the related lesson was used to design the games and the questions. Learners' prior knowledge was used to play the games and answer questions. Further, the lateral thinking activities were designed to stimulate students' interest in the initial objectives of the 5E instructional model. In general, the learners had some basic knowledge and understanding of stories related to the subject being studied. They had some misunderstandings, or they occasionally needed to be corrected. This provided teachers an opportunity to find out what students wanted to learn about the subject being taught.

According to Michalopoulou (2014), children must be encouraged to explore and express their thoughts, ideas, and feelings through art, music, movement, dance, and imaginative and role-playing activities. According to Roof (2012), students should participate in activities they want to design themselves. Students truly seek learning that requires them to use their brains to solve problems using several solutions. Hence, in Step 2, students studied, conducted research, and summarized their knowledge. Problems were assigned based on students' interests. Students brought in what they had discovered, observed, or studied and participated in role-play. Students practiced convergent and divergent thinking by showing their friends, without using sound, what they were talking about. Students gained knowledge by finding evidence, observing and exploring phenomena, and creating stories. Based on Malthouse et al. (2022), convergent thinking is more concentrated because it distills all accessible and relevant material into a single solution. In contrast, divergent thinking is used when building a new product or writing a novel. Divergent thinking practices lead students toward flexible thinking, whereas convergent thinking practices lead them toward originality.

Asmara et al. (2023) claimed that critical- and creative-thinking abilities must be cultivated through student-centered learning, which allows students to think openly and

flexibly, actively participate in debates, and collaborate with peers. Accordingly, in Step 3, the teacher enabled students to express their opinions analytically by bringing the experiences they gained from the exchange of ideas and the assumptions they and their peers made in Step 2. The students were assigned role-play scenarios, and their peers commented on their performance.

Moreover, in Step 4, students were asked to answer questions such as "If you had to play a role on behalf of a friend, how would you perform that role?" "If the student is in that event, how will the student find a way out?" Thus, students were encouraged to think of new things. They were motivated to use what they had learned or to broaden their knowledge and skills in new settings. Students referred to existing information and presented evidence. Teachers asked students what they had learned or what notions they had developed (Açõúoõ et al., 2011; Bybee et al., 2006).

The final evaluation stage involved determining whether students had achieved the learning objectives and ensuring that no misunderstanding occurred during that learning. The teacher evaluated students' summaries of the knowledge they obtained in class. According to Buzan (2002), mind mapping is a technique that stimulates both the left and right parts of the brain and makes thinking visible. It simultaneously provides both the big picture and the details of something. It makes it easy to manage and understand information effectively and systematically, improves the ability to think creatively and innovatively, and improves retention. In Step 5, the instructor evaluated students by asking them to create a mind mapping summarizing the knowledge they had gained in that class. This led to the development of elaboration thinking.

However, 25 students still needed to pass the criteria, representing 80.65% of the sample, after the first operating cycle. The researchers examined the test results and interviewed students who still needed to pass. Most needed help searching for information correctly, summing up their knowledge, and expressing their opinions. Furthermore, most students did not dare to express their opinions for fear of saying something wrong. Therefore, when students could not summarize their ideas in Step 3, they could not answer the questions assigned by the teacher in Step 4. Moreover, only some 25 students could use mapping to connect knowledge. This issue led to the development of the second operation cycle.

The researcher developed narrative events for students to see and analyze. Students were asked questions and asked to respond right away. Asking questions as soon as possible allowed the students to practice using their thinking fluency in the second stage. They learned to think appropriately and obtain a clearer image of the problem. According to Runco and Jaeger (2012), the response process can inspire students to think creatively, to become faster at generating and organizing high-quality ideas, and to be willing to look at problems from several angles.

In the second step, before allowing students to role-play, the instructor first brought up an exciting topic and summed up students' knowledge. Then, the teacher played a role to provide an example to students. Students were asked think critically and use their newfound information for role-playing. After that, students were encouraged to think

flexibly. The third step involved encouraging students to voice their views fully. Thus, group members heard everyone's opinions. This setting boosted their self-esteem and pushed them to learn by sharing their workgroup experiences. Students eventually became more prepared and confident in their thinking abilities.

According to Asmara et al. (2023), students must enhance their thinking abilities by absorbing the essence of an idea and focusing on the thoughts and concepts expressed. As a result, social connection and feedback are essential. Students not asking and answering will be forced to think more deeply and voice more viewpoints, leading to fresh ideas. Students should be encouraged to practice and refine their thinking skills through summarization.

Step 4 involved creating a situation that motivated pupils to practice developing initiative. The researcher integrated visual and divergent thinking activities into learning management to encourage them to engage in thinking and problem-solving. To stimulate aesthetic thinking, children were asked (1) to select one body organ; (2) to consider what happens if we do not have this organ and if a particular organ can be designed, (3) to draw the organ for two minutes, emphasizing thinking. Students were allowed to exchange pictures and explain the purpose of the visual thinking activity. Students practiced thinking more creatively by using flexible thinking and by being more innovative (Christensen, 2015).

Creativity will grow in the fifth step if we teach the brain to use it frequently. Zubaidah et al. (2017) stated that teachers must know how to teach mind map construction and how to use mind maps. Mind mapping is a strategy that relies on images and their relationships with one another. It uses pictures, words, numbers, logic, and colors to create a unique thinking style. Therefore, in the second cycle, teachers trained students to develop a visual connection to the story. Students were trained to use color to identify groups, categories, and functions. The teacher then taught them the vocabulary for various body systems, such as the reproductive system of male humans, and asked students to draw organs related to this system.

According to the findings, the four thinking exercises linked with the 5E learning cycle increased student creativity by more than 70%. Additionally, student satisfaction with science learning activities was investigated. The results indicated that implementing the science learning activities provided more opportunities to practice thinking skills. Moreover, the activities were short, and students learned from the classroom activities. The activities were fun and exciting according to the list of students' satisfaction. Zubaidah et al. (2017) and Michalopoulou (2014) demonstrated that via inquiry, students may express their thoughts and feelings in various ways while still having fun. The ability to articulate ideas in several ways and enjoyable learning environments serve as the foundation for developing components of students' creative-thinking skills: fluency, flexibility, originality, elaboration, and metaphorical thinking. Last, the results resolved students' time management issues in inquiry-based learning (Lai et al., 2015).

CONCLUSION

The 5E instructional model and the four thinking activities allow students to think critically and creatively. Students can practice and improve their thinking skills using the model. To enhance students' interest in learning management in the initial step, the researcher conducted learning management by incorporating four activities, one of which was a questioning activity that asked students to come up with solutions immediately. In the second step, the researcher provided students the opportunity to independently research a topic of interest using the material covered during a certain timeframe and compile their findings. The instructor employed group-thinking exercises in conjunction with learning management in the third step after the students had finished searching for and summarizing information. Role-play was used in the classroom. Students role-played what they had seen or learned about the subject matter without sound. Students practiced explaining the topic to their friends, allowing them to deeply think about the topic. This encouraged flexible thinking. In the third phase, the instructor used extended thinking exercises. The instructor allowed students to express their thoughts analytically by drawing on knowledge gathered from peer discussions. Pupils were encouraged to reinterpret the original thought in fresh ways. In the fourth step, students were asked to visualize themselves in a role-playing scenario the instructor developed. Students used their creative-thinking skills to participate in learning activities and handle life difficulties. The integrated four thinking activities, including lateral, divergent, convergent, and aesthetic thinking, and the 5E instructional model, namely engagement, exploration, explanation, expansion, and evaluation, improved students' creative thinking.

RECOMMENDATIONS

1. Apply the research results before organizing the 5E instructional model and the four thinking activities. Teachers must study the four thinking activities and understand each activity. At what stage should learning management occur? Learning management involves putting things together, merging ideas, and associating activities. For example, the instructor can link "animals" and "words on plates" to create a pre-learning game. Teachers should study their roles to ensure smooth and effective learning management.

2. Future researchers should use the techniques in this paper for organizing additional learning activities, especially problem-solving activities, in conjunction with the 5E instructional model of inquiry-based learning and the four thinking activities.

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