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Effects of Inquiry-Based Learning with Peer-Assisted Technique on Sixth-Grade Students' Learning Achievement in Science

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This study aims to investigate the effects of inquiry-based learning with peer-assisted technique on sixth grade students. Achievement and learning satisfaction towards inquiry-based learning with peer-assisted technique on sixth grade students were investigate. The participants used in this research were 32 sixth grade students from the second semester of the 2023 academic year at the Pinijratbumrung School, Yangtalat District, Kalasin Primary Educational Service Area Office 2, Thailand. The research instruments were learning plans, achievement test, learning satisfaction questionnaires. The data were analyzed by mean, standard deviation, and testing the hypothesis by one sample t-test. The research found that the learning outcomes of science subjects using inquiry learning with peer-assisted techniques exceeded the achievement of 70% criterion. A total of 23 students had score at least 70% of the full score, accounting for 71.87% of the total number of students. The learning satisfaction of students toward inquiry-based learning with peer-assisted technique was at high level. This is findings that can be implied to school science and inquiry-based learning in primary schools.

Keywords: achievement, inquiry-based learning, peer-assisted technique, satisfaction, learning achievement, science, students

INTRODUCTION

The scientific knowledge and its method are important to all of us, it seeks new knowledge and improve our quality of life (Nuangchalerm et al., 2024). This is a study of science assists individuals in the development of abilities such as critical thinking, creativity, analytical thinking, and decision-making. In addition to this, it assists individuals in the development of the abilities necessary to carry out research and to solve issues in a methodical manner. As a knowledge-based society, science is an essential component, and in order to make efficient use of science for better life (Širá et al., 2020). It is necessary for everyone to have a fundamental understanding of science. The process of understanding of science can be driven by inquiry-based learning which is the suitable way of science education (Gillies, 2020; Nunaki et al., 2020; Sotáková et al., 2020; Farhan et al., 2023).

The hallmarks of inquiry-based learning include student-initiated questions, scientific investigations, and explorations that shape the learning process to children (Sukontawaree et al., 2022; Thangjai & Worapun, 2022). Students can participate in creating their own knowledge rather than only absorbing it. They also can develop their critical thinking skills via inquiry-based learning, focused on the

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importance of analysis, critical thinking, and independent conclusion-drawing (Bantaokul & Polyiem, 2022). Students have a better grasp of the materials and methods to science. They create their own questions and find the answers to them. Inquiry-based learning often presents students with authentic challenges that test their ability to synthesize and apply theoretical understanding (Firman et al., 2019). They are better able to solve difficult problems in novel ways. Students are more likely to be enthusiastic about and committed to their studies when they are involved in their own education and may pursue their own areas of interest.

Students also develop their abilities to communicate science to others in both oral and written expression as they learn to articulate their thoughts clearly, listen attentively, and have fruitful discussions. They are given the tools to actively participate in various kinds of learning process. They may feel more invested in their education and more driven to succeed as a result of this sense of ownership. In addition, critical thinking, problem-solving, and effective communication are acquired via inquiry-based learning and are beneficial in both academic and real-life contexts (Khumraksa & Burachat, 2022).

Inquiry-based learning often results in a more familiarity with the materials. Students build a conceptual understanding rather than rote memorization, which enables them to apply what they have learned in different situations. The capacity to self-learn and adapt is vital in today's ever-evolving environment. Students get the mentality and abilities to adapt to a knowledge environment that is always changing through inquiry-based learning. It's worth noting that variables like student preparedness, classroom climate, and instructor facilitation may affect how well inquiry-based learning works (Chu et al., 2021). Safkolam et al (2024) explores inquiry-based learning and understanding of various NOS aspects, such as the tentativeness, empirical basis, and creativity in science. It increased student engagement and motivation, leading to a more profound and meaningful learning experience. The study suggests that it can help students develop better instructional strategies.

In science education, peer-assisted learning help students collaborate in small groups or pairs to clarify and improve their own understanding of complex ideas. This technique has several advantages and may be used in different ways. In group settings, students may work together to find solutions, elaborate on ideas, and demonstrate mastery of scientific concepts and principles. Students learn to work together and pool their expertise when they engage in group projects or experiments. Participants in the activity take turns instructing one another on a chosen subject. By going through this procedure, individuals may solidify what they already know and pinpoint any areas where they can benefit from more explanation.

As a way to test and improve each other's knowledge, students might work in groups to formulate questions that each other must answer. Students work together to find solutions to complicated issues, students may have a more thorough grasp of the material covered in class. Students may be more engaged and have access to more resources when they work together in virtual classrooms using online platforms and interactive technology. The concept of collaborating with classmates may liven up the learning experience (Yıldız-Feyzioğlu & Demirci, 2021). Some students may have interesting points of view that the instructor has overlooked. Students' ability to express themselves and provide explanations is enhanced via the use of peer-assisted learning.

Although students take the lead in peer-assisted learning, teachers still need to be there to make sure everything is running smoothly and appropriately. During peer-assisted exercises, teachers may keep tabs on their students' progress, correct their mistakes, or build on their comprehension via comments. Peer-assisted learning has the potential to be an excellent tool for meeting the requirements of students with a wide range of backgrounds and learning styles (Walkup-Amos, 2020; Jayathilake & Huxham, 2022). By incorporating peer-assisted strategies into science lessons, teachers may make

their classrooms more engaging and participatory, which in turn helps students grasp scientific ideas better.

Nevertheless, it has the potential to favorably influence children's emotional, social, and cognitive development when executed properly. For scientific investigation, the ability to follow the scientific method is crucial. Students can't do their own research or solve issues well if they lack these abilities. Science is a more analytically oriented topic than others, and the researcher was given the task of teaching it. It was discovered that some students were unable to achieve the stipulated requirements by completing the practice activities, worksheets, or assessments. The fact that certain pupils have exceptional talents is the root cause of this issue.

That is, it is impossible for students to properly do research or find solutions to issues if they do not possess. The abilities necessary for the scientific method may be taught and improved through suitable learning environment. The researchers were given the responsibility of teaching science, which is a topic that, in comparison to other courses, demands more critical thinking. It was discovered that several students were unable to finish the practice activities, worksheets, or examinations in order to successfully achieve the requirements that were set. This issue arises as a result of the fact that some students' talents are problematic. In light of this, the researcher looked for a method that would encourage students to take an interest in the subject matter and encourage students to be more enthused.

As a consequence of this, students are prone to becoming bored. Following the completion of the lesson, the teacher assessed the students' performance by giving them worksheets, practice activities, and examinations. This study aims to investigate the effects of inquiry-based learning with peer-assisted technique on sixth grade students' achievement in science, and also study the learning satisfaction towards inquiry-based learning with peer-assisted technique on sixth grade students. They should develop learning achievement in science to passing the 70% criterion of the full score. Also, the study the learning satisfaction of students towards inquiry-based learning with peer-assisted technique. This research has the potential to assist educators in gaining a better knowledge of instructional design in order to better meet the needs of students through inquiry-based learning and interesting strategies.

METHOD

Participants

Grade 6 students from one classroom, the second semester of the 2023 academic year at Pinijrattabooranam School, Yangtalat Subdistrict, Yangtalat District, Kalasin Province. One classroom with 32 students participated in the experimental study. They enrolled in the science subject based on Thai national basic education curriculum. Due to this school has only one class of grade 6 level, they were selected to participated in the program of study. The research aims and procedure announced to all students before implementation.

Data Collection

Research instruments were developed learning plans, inquiry-based learning with peer-assisted technique was created. Then the quality of lesson plans was evaluated by 3 experts in terms of qualitative recommendation, lessons plans were revised after experts commented. Achievement test was created based on the objectives and then 3 experts recommended, it was revised after experts commented. Finally, learning satisfaction questionnaires was created based on the operational definition. and then 3 experts recommended, it was revised after experts commented.

The researchers divided the students into groups. In each group, the students who were responsible and had leadership qualities to be group leaders. The researchers explained the peer-assisted technique

to the students. After that students were taught each lesson, students were assigned to complete practice exercises. They would sit down and work on the exercises, brainstorming together. If any member of the group did not understand a topic, the members who understood would help explain it to the friend until they understood. The researchers observed the group activities, including how the students helped each other solve problems, interest, and commitment to the group. The researchers observed the results of the activity sheets to see if they improved. The researchers assessed the students' learning at the end of the lesson.

Data Analysis

In the data analysis, the researchers analyzed and interpreted the data by analyzing the academic achievement in science using the inquiry-based learning with peer-assisted technique passing the 70% criterion of the full score. The one sample t-test employed data analysis as well. Then analyzing the learning satisfaction of 6th grade students toward inquiry-based learning with peer-assisted technique. The mean and standard deviation were used for data analysis and interpretation.

FINDINGS AND DISCUSSION

From the study of science achievement using the scientific inquiry learning with peer assisted learning techniques of 6th grade students on the topic of separating mixtures, the results showed that students had a science achievement that passed the 70% criterion with an average of 7.93, accounting for 79.30% of the full score and a standard deviation of 1.61. There were 23 students in the 6th grade sample group who scored at least 70% of the full score, accounting for 71.87% of the total number of students. There were 9 students who did not meet the 70% criterion, accounting for 28.13% of all students (Table 1).

Table 1
Academic achievement score of students

N	Full score	Mean	S.D.	percentage of the full score
32	10	7.93	1.61	79.30

According to Table 1, 6th grade students had a science achievement that passed the 70% criterion after participating in inquiry-based learning activity with peer-assisted learning technique. The average score was 7.93, accounting for 79.30% of the full score, and the standard deviation was 1.61. There were 23 students who scored at least 70% of the full score, accounting for 71.87% of the total number of students.

The art of teaching and learning should exist; students should have science, which should encourage participation, critical thinking, and teamwork (Warsah et al., 2021). Inquiry-based learning actively engages students in answering questions, conducting experiments, and analyzing empirical data. Wyatt (2005) highlights that students can expand inquiry-based learning to include original experimentation, allowing them to formulate their own questions and design and conduct their own experiments. This strategy not only improves teaching, but also helps students have a better grasp of information acquisition and data assessment. The importance of inquiry-based learning in teaching critical thinking by encouraging students to ask questions and conduct experiments to discover answers, thereby cultivating a scientific mentality. It encourages students to inquire independently and use self-directed strategies to solve their problems.

Inquiry-based learning involves students actively participating in the cognitive process by searching, querying, and posing questions (Sypsas et al., 2021). This educational approach involves the learner formulating hypotheses for research, which they then test through experimentation and observation of the experimental results. Spies (2019) stresses the peer-to-peer concept in inquiry-based learning, which may boost motivation and professionalism. Belcadhi (2014) backs up this claim, discussing the use of ontologies to promote peer evaluation in inquiry-based learning settings, particularly in

learning situations. Lower-Hoppe (2021) presents a thorough review of inquiry-based learning theory and practice, emphasizing its ability to increase material comprehension and integration. Various studies have validated the educational usefulness of the inquiry learning technique, demonstrating that using the inquiry learning approach led to more effective learning compared to conventional teacher-centered approaches.

The satisfaction of sixth-grade students with the science and technology course on separating mixtures using inquiry-based learning with peer-assisted learning techniques was found to be high, with an average score of 2.50. Of the 10 items, 7 were rated as high and 3 were rated as medium. The item with the highest average score was item 10, which states that the learning approach helps students to construct knowledge and understanding on their own, with an average score of 2.59. The items with the lowest average scores were items 6 and 7, which state that the learning activities are enjoyable, students are involved in expressing themselves and practicing teamwork, and the learning activities allow them to work with others (Table 2).

Table 2
Students' satisfaction towards learning activities

Item	Mean	SD	Satisfaction level
1. Learning objectives are introduced to students before classroom activities begin	2.53	0.50	High
2. Learning activities meet students' requirements	3.53	0.56	High
3. Learning activities allowed students with fun classroom	2.50	0.54	High
4. Peer-assisted learning helps students learn to think and do in effectively	2.51	0.70	High
5. Peer-assisted learning helps students to create learning task	2.59	0.55	High
6. Students participated in collaboration and group learning	2.43	0.61	Moderate
7. Learning activities allowed students learn with others	2.43	0.56	Moderate
8. Learning activities help students to construct their knowledge	2.46	0.62	Moderate
9. Learning management help students get new knowledge from group discussion	2.50	0.50	High
10. Learning management helps students construct understandings and new knowledge	2.59	0.70	High
Overall	2.50	0.58	High

This may be due to the fact that students enhance their learning achievement through inquiry-based learning process. This is a student-centered learning activity, they can learn by themselves. They gain knowledge from their peers and have more confident to ask questions. The results of a study on the learning satisfaction of students towards inquiry-based learning with peer assisted learning technique. The overall satisfaction level was high, when considering each item, the item with the highest mean was item 10: learning management helps students construct understandings and new knowledge (M = 2.59, SD = 0.70), followed by item 5: peer-assisted learning helps students to create learning task (M = 2.59, SD = 0.55), item 1: learning objectives are introduced to students before classroom activities begin (M = 2.53, SD = 0.50), and item 2: learning activities meet students' requirements (M = 2.53, SD = 0.56). The items with the lowest mean were item 6: students participated in collaboration and group learning (M = 2.43, SD = 0.61) and item 7: learning activities allowed students learn with others (M = 2.43, SD = 0.56). These findings may be due to the fact that students have the opportunity to work together with different abilities, engage in hands-on activities, interact with each other in groups, have fun and feel comfortable, not feel pressured, feel free to think and ask questions when they have problems or doubts. Therefore, when students are satisfied or enjoy learning, it can lead to improved learning behavior and academic achievement after learning.

The main finding is that inquiry-based learning combined with peer-assisted learning techniques significantly enhances students' learning achievement and satisfaction. The student-centered nature of

inquiry-based learning allows students to learn independently and collaboratively, gaining knowledge from peers and increasing their confidence to ask questions. High levels of satisfaction were reported, particularly in learning management and peer-assisted learning, suggesting that these methods effectively help students construct new understandings and knowledge. Furthermore, students' enjoyment and comfort in collaborative, hands-on activities contribute to improved learning behavior and academic achievement.

Gunawan et al. (2020) investigates the effectiveness of combining the inquiry learning model with advance organizers to enhance students' problem-solving skills. The study was conducted with a group of students, employing a quasi-experimental design. The experimental group received instruction using the inquiry learning model combined with advance organizers, while the control group received traditional instruction. Results showed a significant improvement in the problem-solving skills of students in the experimental group compared to the control group. The combination of inquiry learning and advance organizers helped students better organize and process information, leading to enhanced cognitive and metacognitive abilities. The approach increased student engagement and motivation, making the learning process more interactive and student-centered. The paper concludes that integrating inquiry learning with advance organizers is an effective instructional strategy to improve problem-solving skills and recommends its implementation in various educational settings.

Research has demonstrated that inquiry-based learning enhances student satisfaction and enhances learning outcomes. Lee & Ke (2013) and Fook et al. (2016) discovered that inquiry-based learning may improve students' self-regulated learning processes and situational interest, resulting in greater satisfaction levels. Yasar et al. (2023) students demonstrated a basic awareness of 21st-century skills such as critical thinking, creativity, collaboration, communication, and digital literacy. They perceived these skills as important for their future success. The positive perceptions, students identified challenges such as limited access to technology, insufficient teacher support in using new methods, and a lack of understanding of how these practices connect to real-world applications. They should have more experiences on inquiry-based learning and educators should receive more training in 21st-century teaching methods. Sasanti et al. (2024) proved the efficacy of this strategy in increasing students' critical thinking abilities, receiving high satisfaction ratings. The importance of instructional presence, cognitive presence, and social presence in e-learning, which inquiry-based learning can support to enhance student satisfaction and improve learning outcomes. The study provides insights on designing authentic and inquiry learning supporting social and individual aspects of self-regulation processes.

CONCLUSION

Learning achievement of participants passed the 70% criterion of the full score, and the satisfaction of students were at high level. subject of separating mixtures is important because it will help to improve the learning outcomes of science for 6th grade students. Based on the findings of the study, the use of the inquiry-based learning with peer-assisted learning techniques can lead to science learning achievement that meets the 70% passing score. Therefore, in the teaching and learning process, it is recommended to appropriately apply peer-assisted learning technique in order to focus on the learner and improve student learning achievement. However, further research should be conducted on the effects of the inquiry-based learning with peer-assisted learning techniques.

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