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Leveraging Students' Achievement and Attitude towards Science through the Integrating of Inquiry-based Learning and Gamification

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Abstract: This study examines the inquiry-based learning and gamification effect on the science learning achievement and attitude towards the subject of science. Participants were 45 students enrolled in the second semester, 2025 academic year of secondary school at Roi Et Wittayalai School, Roi Et province, Thailand. The instructional intervention included organized inquiry activities with game features like points, badges, and challenges to student engagement based on constructivist learning theory and motivated learning. Students were placed into experimental research by one-group pretest and posttest design, a standardized science achievement exam was given, and attitude towards science was measured after the intervention. Statistics showed that students had considerably greater post-test scores, higher than the criterion of 70%. The results suggest that inquiry-based learning and gamification can enhance students' understanding and performance in science. Students have a positive attitude towards the subject of science with a high. The negative score was at low level. This study shows that these pedagogical methods might make lower secondary science instruction more engaging and effective for school science.

Keyword : attitude, gamification, inquiry-based learning, pedagogy, science education

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Introduction

Science holds a significant importance within the complicated framework of contemporary global society. It extends across several facets of human life (Erickson, 2016; Sulianta, 2024). Many scientific inventions and technology enhancements may be attributed to the fundamental principles and findings of scientific inquiry when integrated with aspects of creativity (Polanyi, 2024; Sawyer & Henriksen, 2024). It enables individuals to engage in various cognitive processes, including logical analysis, inventive thinking, and critical assessment. The empower individuals about scientific inquiry to methodically address intricate challenges, facilitating educated decision-making grounded in thorough knowledge (Kunisch et al., 2023). Science,

supported by solid facts and verifiable witnesses, is regarded as a hallmark of contemporary educational culture.

Science education necessitates the cultivation of students' knowledge and comprehension of science to foster an understanding of nature and human-created technology. Scientific knowledge fosters economic progress, enhancing the capacity to have a fulfilling and prosperous life within the intricate framework of global society (Adeoye, 2025). The objective of science education is to guarantee that students acquire a profound and thorough comprehension of scientific ideas. At the same time, it helps students develop the skills needed for careful research and creating new knowledge by using a structured approach to explore information and effectively solve various complex problems. Students are actively encouraged to engage in all phases of the learning process, fostering a more immersive and engaging educational experience (Fajeriadi et al., 2024).

In fact, the core curriculum of basic education emphasizes the significance of science in contemporary and future global civilizations. The curriculum employed expertise and abilities to address challenges for young students. Students read and work with textbooks for better achievement score. The acquisition of knowledge facilitates decision-making grounded on diverse information and credible evidences should be the authentic science learning (Ponil & Dokmai, 2025). Students utilize digital media and information communication technologies to address real-world challenges (Wangkamhan et al., 2024). They also acquire scientific knowledge that emphasizes the connection between information and processes. In addition, they possess essential abilities in research and information acquisition. That is enabling them to engage in all phases of the educational process. Students possess enduring scientific knowledge and abilities that are crucial for enhancing academic performance.

The management of science education in the country aims to achieve the objectives. However, it is important to recognize that the management of science education primarily emphasizes preparing students for competitive examinations or fulfilling rigorous evaluative criteria. Students should be learned to real science and science competency. This new way of thinking about education shows that many students see learning science as just memorizing facts to get good grades, which makes studying science less about true understanding. Encouraging curiosity and inquiry-based learning, schools can help students develop a deeper connection to scientific concepts and their real-world applications.

Therefore, all individuals engaged in science education must devise methods to promote the understanding of the nature of scientific knowledge, thereby fostering critical thinking among students. Students should be enthusiastic in addressing challenges through scientific methods and have a constructive disposition towards the study of science. Inquiry is an instructional strategy well-suited for scientific

disciplines due to the teacher's preparation (Khonkla et al., 2024). It enables students to fully cultivate their cognitive abilities, conduct independent research, foster a continuous thirst for learning, and acquire skills in organizing their thoughts and seeking knowledge autonomously. It facilitates long-term retention and application in novel contexts. Students are the focal point of education and contribute to the enhancement of positive attitudes toward science.

The classroom evidence from observation in a Grade 7 classroom on scientific topics revealed that a significant issue in learning management is the lack of student engagement in the educational process. Students utilize mobile phones for the multi-purpose of study, including communication via social media. When comparing cooperation skills to individual work capabilities, the capacity for collaboration extends beyond just individual proficiency. Individuals can perform more effectively independently than together. The researchers have selected pedagogical strategies applicable to inquiry-based learning management and innovation, facilitating student engagement in educational activities (Duanphol et al., 2024).

Gamification strategies involve the implementation of fundamental game mechanisms in educational contexts, including points, levels, awards, leaderboards, and contests (Jones et al., 2023; Zourmpakis et al., 2023; Saputra et al., 2025). It allows students to be involved in an enjoyable educational experience. These techniques will enhance the perception of science, thereby influencing the sustainability of long-term scientific success. Research indicates that gamification has been employed to structure learning activities, which enhances academic performance among students. Furthermore, gamification approaches are employed in learning management to enhance academic performance (Bantaokul & Polyiem, 2022).

The rationale and significance of this lie in the researchers' consideration of students' interests through the observation of classroom activity. Consequently, the researchers concur that employing gamification in the management process is suitable. Gamification possesses a significant attribute of crafting activities that align closely with contemporary student learning behaviours. The implementation of gamification in learning management is an intriguing approach that is gaining significant popularity. This fosters a congenial environment among colleagues and teachers, alleviating tension. This study aims to enhance academic achievement and attitude towards the subject of science. The outcomes will efficiently enhance the competencies of students in the 21st century.

Methodology

The study employed an experimental research design by gathering information from Grade 7 students in basic education. The one group post test only design was used for investigating academic achievement and students' attitudes. This design was

chosen for its efficiency in capturing a snapshot of inquiry-based learning with gamification in science classroom. The details can be provided below.

Participants

The population of this study was a total of 135 students, and these students are distributed among three classrooms. The experiment employed cluster random sampling technique as a sampling design, students from the second semester of the 2025 academic year. They were 45 students enrolled in the second semester, 2025 academic year of secondary school at Roi Et Wittayalai School, which is in the Nai Mueang Sub-district of the Mueang District of Roi Et Province, Thailand. They have learned science and specified to learn through this instructional method. Also they were the volunteering classroom to join this program of the study.

Instrumentation

The researchers developed instruments based on effective lesson plans, learning achievement test, and questionnaire about attitude towards science. The research instruments were the inquiry-based learning management plan which constructed based on experts' recommendation. A four-choice multiple-choice exam with 10 questions were created and evaluated by experts. This test will be explained and downgraded. The attitude towards the subject of science is a five-level estimate scale that consists of twenty items. Responses to the attitude items were captured using a five-point Likert-type scale, ranging from Lowest (1) to Highest (5). The rating attitudes transform into numerical data that can be analysed through descriptive analysis.

Data Collection and Analysis

Data were collected and analysed to determine the academic performance of students. The descriptive analysis used the average and standard deviation to summarize the data. Statistics for hypothesis testing was One sample t-test. The students' attitude towards the subject of science were evaluated to assess their overall attitudes about academics. The level of attitude can be calculated and interpreted mean ranges: Lowest (1.00-1.50), Low (1.51-2.50), Fair (2.51-3.50), High (3.51-4.50), Highest (4.51-5.00).

Results and Discussion

Learning Achievement

Students who received inquiry-based learning with gamification had an average score of 7.97 points, or 79.70 percent. It indicated that the learning achievement

of students was statistically significantly higher than the 70% threshold at the level of .05 (Table 1).

Table 1. Learning Achievement Score in the Science Topic Thermal Energy

Test	n	Full score	μ_0	$\bar{x}$	SD	df	t	p
Post-test	45	10	7	7.97	1.28	44	4.35	.001

The comparison of the mean score with the established threshold of 70% revealed a statistically significant difference at the .05 level ($t = 4.35$, $df = 44$, $p = .001$). Students' learning achievement exceeded the predicted level, and this difference is statistically significant. The exceedingly low p-value indicates that the probability of this event arising by chance is negligible, enhancing confidence in the efficacy of the educational intervention. The inquiry-based learning with gamification effectively supported a diverse array of students. It includes those who generally consider abstract scientific ideas.

This method prioritizes active student engagement in the educational process through inquiry, experimentation, and problem-solving. Students are prompted to develop their own comprehension of scientific topics with constructivist learning theory (Othman & Ching, 2024). Inquiry-based activities likely facilitated students' connections between abstract concepts—such as heat transfer and energy transformation—and observable occurrences and real-life experiences, thereby augmenting conceptual comprehension (Phimthong et al., 2024; Safkolam et al., 2024).

Moreover, the use of gamification aspects may have significantly contributed to enhancing students' motivation and engagement. Gamification incorporates elements such as points, challenges, feedback, and awards, fostering a more engaging and intriguing educational atmosphere. These aspects may enhance students' focus, alleviate anxiety over scientific education, and promote perseverance in task completion. Students who are motivated and actively involved are more likely to put in mental effort, which leads to better learning outcomes. The instructional design integrated inquiry-based learning with gamification, effectively targeting both cognitive and emotive aspects of learning (Bhatia & Mushtaq, 2024; Marawar et al., 2024; Zhang et al., 2025). This combination is especially appropriate for scientific subjects necessitating conceptual comprehension and active investigation. It markedly improved students' academic performance in science, as reflected by post-test scores exceeding the 70% threshold at a statistically significant level. This pedagogical

method enhances academic achievement and fosters continuous learning among students (Bantaokul&Polyiem, 2022).

Attitude Towards the Subject of Science

The study needs to understand about positive and negative attitudes toward science subject after students had learned through the integrating of inquiry-based learning and gamification. If found that students have a positive attitude towards the subject of science with a high average overall score. The average value was 4.21, the standard deviation was 0.77, and the attitude towards the subject of science was negative. The average value was 4.31 and the standard deviation was 0.72 (Table 2). Positive attitude scores which is considered "high" interpretively. Students valued and enjoyed science. The moderate standard deviation reflects student consistency.

Table 2. Students' Attitudes towards Science

No.	Item	Score		Interpret
		$\bar{x}$	SD	
Attitude towards science (Positive)				
1	I feel that science is a subject worth studying.	4.17	0.84	High
2	I feel that studying science makes Understand organisms and their processes	4.63	0.49	Highest
3	I feel that science is a useful subject for daily life.	4.47	0.68	High
4	I feel that science can be easily learned and understood.	4.00	0.87	High
5	I have always liked to improve my scientific knowledge.	4.13	0.68	High
6	I will be active when I study science.	4.20	0.68	High
7	I enjoyed and enjoyed studying science more than any other subject.	4.27	0.69	High
8	I always like to participate in science- related activities.	4.03	0.89	High
9	I feel that I like to spend time studying scientific knowledge.	4.07	0.94	High
10	I did my own science homework.	4.10	0.80	High
	Overall	4.21	0.77	High
Attitude towards science (Negative)*				
11	I don't like to study or read about science.	4.33	0.71	Low
12	I would feel very good if I didn' t have to study science.	4.07	0.94	Low
13	I think that the time spent studying science should be reduced and the time spent studying other subjects should be reduced instead.	4.37	0.72	Low
14	I was bored when I had to study science.	4.20	0.71	Low
15	I was uncomfortable studying or doing science-related activities.	4.53	0.63	Lowest
16	I took science classes only to use for exams.	4.17	0.79	Low

17	If I were assigned a job to grasp a science subject, I would try to avoid it.	4.10	0.71	Low
18	I feel that science is a subject that makes Learners are anxious.	4.30	0.79	Low
19	I knew that studying science was a way of It is a waste that learners do not benefit.	4.40	0.67	Low
20	I feel that studying science is not necessary for a practitioner.	4.67	0.48	Lowest
	Overall	4.31	0.72	Low

*Note: Negative questions are reverse items.

This data shows that most participants had good views about science. A closer look at positive attitude items confirms this finding. The item "I feel that studying science makes me understand organisms and their processes" had the highest mean score ($\bar{x}$ = 4.63, SD = 0.49). This shows that students valued science for understanding nature and living systems. This supports scientific education's goals. Students rated science as both practical and inspiring, as evidenced by high mean ratings on issues relating to its utility in daily life ($\bar{x}$ = 4.47) and enjoyment of studying science ($\bar{x}$ = 4.27).

Though the item "I feel that science can be easily learned and understood" had a somewhat lower mean score ($\bar{x}$ = 4.00, SD = 0.87), it still scored highly. This indicates that kids were comfortable learning science. Some subjects may have found scientific concepts difficult. This diversity is expected as science includes abstract reasoning and complicated procedures. The overall favourable review suggests that these hurdles did not dramatically change students' opinions regarding the topic. The mean negative attitude score was 4.31 with a standard deviation of 0.72, indicating a low level.

Negative questions were reverse-coded, high mean scores indicate considerable disagreement with negative science statements. Items like "I was uncomfortable studying or doing science-related activities" ($\bar{x}$ = 4.53, SD = 0.63) and "I feel that studying science is not necessary for a practitioner" ($\bar{x}$ = 4.67, SD = 0.48) displayed high mean scores, indicating students strongly rejected these negative perceptions. It appears that students did not identify scientific study with worry, discomfort, or irrelevance.

Science class instruction is strengthened by low negative attitude scores. Science students are more inclined to participate and solve issues when they are not bored, worried, or pushed (Papadakis et al., 2022). The results suggest that the learning activities were designed to diminish failure dread and promote positive emotions, creating a productive learning environment (Goi, 2024). The instructional strategies influences both attitude variables show that students had a positive science attitude. Strong positive attitudes and low negative attitudes imply that pupils were motivated to learn science and emotionally and cognitively ready to confront it. Such attitudes are important for scientific education because they affect motivation, classroom

involvement, and science proficiency (Ajlouni et al., 2025; da Silva Júnior et al., 2025). Thus, engaging and relevant scientific learning activities can improve student attitudes, learning results, and interest in science-related areas.

Conclusion

The integrating of inquiry-based learning with gamification was effective in enhancing both students' learning achievement and their attitudes toward the subject of science. This instructional approach successfully supported students in achieving the intended learning objectives. The statistically significant results indicate that this improvement was not due to chance and provide strong evidence of the effectiveness of the learning intervention in promoting conceptual understanding of scientific content.

In addition to academic achievement, students exhibited a positive attitude towards the subject of science. The high overall mean score for positive attitudes and the low level of negative attitudes suggest that students valued science, found it useful for understanding the natural world, and enjoyed engaging in science-related learning activities. The strong disagreement with negative statements reflects low levels of anxiety, boredom, and discomfort toward science learning. These results imply that the learning environment fostered confidence, interest, and motivation, which are essential factors for sustained engagement and long-term learning success. Therefore, inquiry-based learning with gamification can be considered a valuable instructional strategy for enhancing students' achievement, motivation, and overall readiness to engage with science in both academic and real-life contexts.

Based on the results, it can be concluded that inquiry-based learning and gamification help students to success their science learning. However, this study had some limitations about design of experiment, the participants should be more expanding. The relationship between academic achievement and attitudes towards science subjects might want to explore in the future.

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