
Research Articles

The Integration of Learning Approach Based on STEAM Education Using Inquiry Method to Develop Research Skills of Buditpatanasilpa Institute of Fine Arts's Undergraduate Students

Sarisa Prateepchuang^{1*}, Suchada Sowat², Watcharamon Aranyanak³

1. The College of Dramatic Arts, Buditpatanasilpa Institute of Fine Arts, Thailand. E-mail: risasa975@hotmail.com

2. Faculty of Art Education, Buditpatanasilpa Institute of Fine Arts, Thailand. E-mail: suchada_so@gmail.com

3. The College of Dramatic Arts, Buditpatanasilpa Institute of Fine Arts, Thailand. E-mail: watcharamon_ara@gmail.com

*Corresponding Author E-mail: risasa975@hotmail.com

Received: November 28, 2025; Revised: January 01, 2026; Accepted: March 10, 2026

Abstract

The aims of this research are 1) to cultivate research skills via integrated STEAM learning experiences employing inquiry-based learning, and 2) to evaluate students' academic performance by comparing pre- and post-test scores through integrated STEAM learning experiences utilizing inquiry-based learning. The sample group comprises eight third-year undergraduates enrolled in the Bachelor of Fine Arts program in Thai Music at the Faculty of Fine and Applied Arts, Bunditpatanasilpa Institute of Fine Arts, during the first semester of the 2022 academic year. The research results are as follows: The efficacy of the STEAM learning management strategy, which employs inquiry-based learning to cultivate research skills, is 75.16/75.63, falling short of the established standard of 80/80. The efficacy index is 0.59, above the established standard of 0.5. 2) Academic performance prior to and subsequent to the implementation of STEAM learning management through inquiry-based learning aimed at enhancing research abilities revealed an average pre-test score of 8.25 ($M = 8.25$, $SD = 1.20$) and an average post-test score of 15.13 ($M = 15.13$, $SD = 1.45$). The post-test score exceeded the pre-test score by 6.88. The t-value for the pre-test and post-test scores of the sample group indicated that post-test achievement exceeded pre-test achievement by 11.84, which was statistically significant at the .05 level. Research indicates that integrating inquiry-based

methodologies into STEAM educational experiences can promote academic performance, expedite growth, and improve children's educational development.

Keywords: STEAM, Inquiry Method, Research Skills, Undergraduate Student, Bunditpatanasilpa Institute of Fine Arts

Introduction

The 21st-century learning management process serves as a framework for overseeing education, emphasizing collaborative models and practice development to enhance learning management efficacy. It prioritizes the knowledge, skills, expertise, and competencies cultivated in learners, equipping them to thrive in a dynamic society. This approach aligns with the revised National Education Plan (B.E. 2560 - 2564), which asserts that to advance Thailand towards stability, prosperity, and sustainability, it is essential to focus on reinforcing the nation's existing capital and ensuring adequate resources to propel medium- and long-term development, particularly in "human development" to adapt to 21st-century global changes, with a primary emphasis on learning skills and fostering an environment conducive to human quality enhancement.

The organization of STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning activities is a compelling and appropriate pedagogical approach to fostering creativity in students. This strategy is a pedagogical method that amalgamates the five fundamental disciplines: science (S), technology (T), engineering (E), arts (A), and mathematics (M). This method highlights the advantages of nature and the pedagogical techniques of each discipline, integrating them cohesively. Inquiry-based learning is a pedagogical approach rooted in constructivist theory, wherein learners engage in searching, exploring, investigating, and researching through diverse methods. This process fosters understanding and facilitates meaningful knowledge acquisition, empowering learners to construct and retain their knowledge for prolonged application in various contexts. When educators integrate these approaches and processes into their instruction, it will inevitably enhance learners' knowledge and comprehension.

The research process is deemed a crucial component of thesis completion for graduation at the Bunditpatanasilpa Institute throughout undergraduate study. It showcases studies or

research in the domains of arts and culture, dance, music, and visual arts at the undergraduate level, which students of the Bunditpatanasilpa Institute have been undertaking consistently. This dissertation provides a comprehensive, methodical analysis of problem statements and corresponding solutions. A successful thesis must be academically precise and practical, articulated in a clear, sequential manner, employing sophisticated and grammatically sound language, providing comprehensive insights on the subject, and promoting the potential for future research or study Aranyanak, C. (2016) This thesis necessitates research skills as a foundational requirement, and students must possess a comprehensive comprehension of the research process. Research of student theses and my involvement as a committee member in Bachelor of Education thesis examinations revealed that some students remain unaware of the diverse processes involved in thesis writing and lack practical skills in thesis preparation. These flaws led to subpar thesis quality. Moreover, these circumstances exerted a persistent influence on the thesis document's creation. To rectify the highlighted deficiencies, the researcher implemented a cohesive learning experience in STEAM education through inquiry-based learning to enhance students' research skills, equipping them to formulate a thesis. Furthermore, it fosters students' curiosity and promotes methodical planning, logical thinking, analysis and synthesis, as well as effective problem-solving.

Research of Objective

1. To develop and determine the effectiveness of integrating STEAM learning experiences using an inquiry-based process
2. To compare the academic achievement of students between pre-test and post-test scores through the integration of STEAM learning experiences using inquiry-based learning

Literature Review

STEAM Education and Integrated Learning

STEAM education—an acronym for Science, Technology, Engineering, Arts, and Mathematics—represents a paradigm shift from traditional disciplinary instruction toward a more integrative and holistic pedagogical framework. This approach extends beyond the conventional

STEM model by incorporating the arts, thereby fostering not only technical proficiency but also creativity, aesthetic awareness, and innovation. As originally conceptualized by Georgette Yakman (2008), STEAM education emphasizes the interconnectedness of knowledge domains and advocates for a transdisciplinary model in which learners actively synthesize concepts across subject boundaries. Such integration is particularly significant in the 21st-century educational landscape, where complex global challenges demand adaptive thinking, creativity, and collaborative problem-solving skills. In the context of Thai education, integrated learning approaches resonate strongly with national reform agendas aimed at enhancing learners' competencies for the knowledge-based economy. Scholars such as Vicharn Panich (2012) and Wicharn Wongyai (2017) argue that interdisciplinary pedagogies align with Thailand's strategic emphasis on learner-centered education and the cultivation of 21st-century skills, including critical thinking, communication, and innovation. These reforms are embedded within broader policy frameworks that seek to transition from rote memorization toward active and experiential learning models. Empirical studies further substantiate the effectiveness of STEAM-based instruction in the Thai context. For instance, Surasak Srisawasdi (2016) demonstrates that integrated STEM/STEAM approaches significantly enhance students' conceptual understanding, particularly when combined with active learning strategies such as problem-based learning and collaborative inquiry. Similarly, reports that interdisciplinary learning environments contribute to improved analytical thinking and academic achievement among Thai learners. These findings underscore the potential of STEAM education to bridge theoretical knowledge and practical application, thereby fostering deeper cognitive engagement and research-oriented thinking.

Inquiry-Based Learning (IBL)

Inquiry-Based Learning (IBL) is grounded in constructivist epistemology, which posits that knowledge is actively constructed by learners through interaction with their environment rather than passively received. Foundational theorists such as Jerome Bruner (1961) and John Dewey (1938) emphasize the centrality of experience, curiosity, and exploration in the learning process. Within this framework, IBL encourages students to formulate questions, design investigations, analyze data, and construct evidence-based conclusions, thereby mirroring the processes inherent in scientific and scholarly inquiry. In the Thai educational context, IBL has been

increasingly adopted as a means of promoting higher-order thinking and learner autonomy. Research conducted by Sangthong (2019) indicates that IBL significantly enhances students' research skills, critical thinking abilities, and self-directed learning competencies. These outcomes are particularly relevant in higher education, where students are expected to engage in independent inquiry and contribute to knowledge production.

A comprehensive conceptualization of inquiry learning is provided by Margus Pedaste et al. (2015), who propose a cyclical model comprising five phases: orientation, conceptualization, investigation, conclusion, and discussion. This model aligns closely with the research process, thereby reinforcing the suitability of IBL as a pedagogical strategy for developing research competencies. By engaging learners in iterative cycles of questioning and reflection, IBL fosters not only cognitive development but also metacognitive awareness, which is essential for effective research practice.

Academic Achievement and Instructional Innovation

Academic achievement remains a central indicator of educational effectiveness and is commonly assessed through quantitative measures such as pre-test and post-test comparisons. Theoretical frameworks, including those proposed by Benjamin Bloom (1976), suggest that well-designed instructional interventions can produce substantial improvements in learning outcomes by aligning objectives, instructional strategies, and assessment methods. In recent years, there has been growing interest in the role of instructional innovation in enhancing academic performance. Within the Thai educational context, studies demonstrate that active learning approaches—characterized by student engagement, collaboration, and experiential activities—lead to statistically significant gains in academic achievement. Complementing these findings, reports that STEAM-based instructional models positively influence student performance in higher education settings. These innovations not only improve measurable outcomes but also contribute to the development of transferable skills, such as critical thinking, creativity, and problem-solving.

Research Methodology

Population and sample

The population comprises 300 undergraduates from the 2022 academic year at the Bunditpatanasilpa Institute. The sample group comprises third-year undergraduates enrolled in the Bachelor of Fine Arts degree, majoring in Thai Music, at the Faculty of Fine and Performing Arts, Bunditpatanasilpa Institute, for the academic year 2022. Eight individuals were chosen by purposive sampling, as the researcher was designated to instruct that class.

Research Tools

The research tools include two main components: "The Development and Efficiency of a STEAM Education Learning Management Plan Utilizing Inquiry-Based Learning to Augment Research Skills" and "The Creation and Quality Assurance of Achievement Tests."

Data Collection

The sample was acquired by purposive sampling, as the researcher was designated to instruct this subject in this class. Conduct a pre-test utilizing an achievement assessment for the sample group, allocating 30 minutes. The instruction utilized a STEM education lesson plan, implementing inquiry-based learning to enhance research abilities. Execute the exercises for each subject throughout the STEAM education session, employing inquiry-based learning to cultivate research skills and assess efficacy according to the 75/75 criteria and efficiency metrics. Subsequent assessment: A post-test utilizing the post-learning accomplishment test (posttest) was conducted. The assessment included the identical set of questions as the pre-test and was grounded in the STEM education lesson plan, which utilizes inquiry-based learning to cultivate research skills. The examination was conducted within 30 minutes. The assessment outcomes

from the pre- and post-learning achievement tests, which used the STEAM education lesson plan based on inquiry-based learning to enhance research skills, underwent statistical analysis.

Statistics used for data analysis

By calculating the index of item content validity (IOC), it assesses the content validity of the STEAM learning management plan through inquiry-based learning to enhance research skills, the achievement test, and students' perceptions of the integrated STEAM learning experience. This procedure involves determining the difficulty (p), discrimination index (r), and reliability of the assessment. The Test Item Analysis Program evaluates test items utilizing Excel and the KR-20 method. Determining the efficiency value of the STEM education lesson plan using inquiry-based learning to enhance research skills in accordance with the 75/75 criterion, utilizing the formula $E1/E2$. Evaluating the academic advancement of students engaged in integrated STEM learning experiences through inquiry-based learning methodologies to enhance research competencies by computing the effectiveness index (E.I.). Fundamental statistics are used to calculate the average academic performance scores based on a STEAM learning management strategy that is grounded in an inquiry-based methodology to enhance research competencies. The formula is employed to compute the standard deviation of academic achievement scores. It uses the t-test formula for dependent samples to compare the differences in scores before and after learning.

Research Results

Analysis of Data to Assess the Efficiency and Effectiveness of STEM Learning Management Using Inquiry-Based Methods is for the Development of Research Skills.

Table 1 Outcomes of Data Analysis on the Efficiency and Effectiveness of STEM Learning Management Utilizing Inquiry-Based Learning to Cultivate Research Skills

Number of students (N=8)	Score before learning (20 Marks)	Score after learning (20 Marks)	Progress score (D)	Activities Scores (40 Marks)	Efficiency index value (E.I)
Total Score Average	66	121	55	240.50	0.59
Score Percentage	8.25	15.13	6.88	30.06	
	41.25	$E_2 = 75.63$	34.38	$E_1 = 75.16$	

The analysis results in Table 1 indicate that the eight individuals who participated in in-class activities achieved scores of 75.16% (E1) and 75.63% on the post-test (E2). The efficacy of the supplemental reading material developed by the researcher is 75.16/75.63, surpassing the stated benchmark of 75/75. The efficiency index (E.I.) is 0.59, above the set criterion of 0.5. The findings demonstrate that the implementation of inquiry-based methods in STEAM education effectively enhances students' research skills, corroborating Hypothesis 1. The results explore the academic performance pre- and post-implementation of STEM education management utilizing an inquiry-based approach to enhance research competencies.

Table 2 Presents a comparison of pre- and post-learning outcomes from STEM education using inquiry-based learning methodologies to enhance research skills.

Testing	Number of students (N)	Total score	$\bar{X}$	SD	ΣD	ΣD^2	t-test
Average Score After Learning	8	20	8.25	1.20	55	397	11.84*
	8	20	15.13	1.45			

* $P < .05$ t-value from the table (.05, df 7 = 1.89)

Table 2 presents the comparative results of pre-test and post-test academic performance following STREAM education, utilizing inquiry-based learning to enhance research abilities among a sample of 8 students. The mean pre-test score was 8.25, and the mean post-test score was 15.13, indicating a difference of 6.88 between the post-test and pre-test scores. The t-value for the pre-test and post-test scores of the sample group, signifying superior post-test performance, was 11.84. In comparison to the t-value of 1.89 from the table at df 7 for a statistical significance level of .05, the elevated t-value signifies that the sample group of students exhibited markedly higher academic achievement following STREAM education through inquiry-based learning aimed at enhancing research skills at the .05 level, aligning with hypothesis 2

Research Discussion

This study aimed to (1) develop and determine the effectiveness of integrating STEAM learning experiences using an inquiry-based process, and (2) compare students' academic achievement between pre-test and post-test scores following the implementation of such learning experiences.

Effectiveness of STEAM Learning Experiences Using Inquiry-Based Learning

The findings revealed that the integration of STEAM learning experiences through inquiry-based learning significantly enhanced undergraduates' research skills, with efficiency scores of 75.16/75.63 and an effectiveness index of 0.59, exceeding the established benchmark. This indicates that the developed instructional approach was effective in fostering students' research competencies. This success can be attributed to the systematic design of the learning activities. The researcher synthesized course content related to the thesis process in the Bachelor of Fine Arts (Thai Music program), alongside principles of STEAM education and inquiry-based learning. The instructional design emphasized four key components: (1) literature review, (2) conceptual framework development, (3) participant selection, and (4) data collection. These components were embedded within inquiry-based activities that encouraged students to actively engage in questioning, exploration, and knowledge construction. The use of inquiry-based learning strategies played a crucial role in promoting deeper learning. Through guided questioning and problem-solving tasks, students were encouraged to investigate, analyze, and synthesize information independently. This aligns with the concept proposed by Chatree Kerdtham (1999) and Phop Laohapairoon (1999), who emphasized that inquiry-based learning enhances critical thinking by prompting learners to seek knowledge through structured questioning processes. Similarly, Wanna Khunpheng (2010) highlighted that such approaches enable learners to construct knowledge systematically and apply it in real-life contexts.

Moreover, the findings are consistent with prior empirical studies. For example, Napaporn Piangduangjai (2015) reported that integrating inquiry techniques with project-based learning improved students' innovative thinking, achieving efficiency scores of 80.00/80.21. Likewise, Mintra Krapatong (2018) found that STEM learning activity sets significantly enhanced students' achievement and creativity, with an effectiveness index of 0.70. Jenjira Santipaiboon (2018) also demonstrated that STEAM-based activities improved students' process skills and creative abilities, with high levels of student satisfaction. Importantly, the development process of the instructional model contributed to its effectiveness. The researcher conducted a thorough analysis of curriculum content, learning materials, and student needs, followed by expert evaluation using the Index of Item-Objective Congruence (IOC). The activities were revised and

pilot-tested before actual implementation. This rigorous development process ensured both content validity and instructional quality, leading to improved learning outcomes.

Comparison of Pre-Test and Post-Test Academic Achievement

The results indicated that students' post-test scores were significantly higher than their pre-test scores at the .05 level of significance, confirming the effectiveness of the intervention. The mean pre-test score was 8.25, while the post-test mean increased to 15.13, with a mean difference of 6.88. The calculated t-value (11.84) exceeded the critical value (1.89, $df = 7$), demonstrating statistically significant improvement. These findings suggest that integrating STEAM learning experiences with inquiry-based learning processes substantially enhances students' academic achievement. The improvement can be explained by the active learning environment created through inquiry-based activities, which encouraged students to engage in higher-order thinking, problem-solving, and independent research. The results are consistent with previous studies. Darunee Pengnoi (2020) found that STEAM-based learning significantly improved students' academic performance and creative problem-solving skills. Similarly, Sunaree Sriboon (2018) reported that STEAM learning integrated with problem-based approaches enhanced students' mathematical achievement and thinking processes. Athiwat Nawaratch (2016) also demonstrated that inquiry-based learning (5E model) significantly improved both academic achievement and cognitive skills beyond the 70% criterion. In addition, the role of the instructor was a critical factor in the success of the intervention. The instructor acted as a facilitator, guiding students in accessing learning resources such as ThaiLis, ThaiJO, and online academic databases. This approach is consistent with Laddawan Kanhasuwan (2003), who emphasized that instructors in inquiry-based learning environments should support rather than direct learning, encouraging student autonomy and collaboration. Furthermore, inquiry-based learning promotes student-centered learning, as noted This approach allows students to actively construct knowledge, develop critical thinking skills, and apply learning in practical contexts. As a result, students not only achieved higher academic scores but also developed transferable research skills essential for their thesis work.

Conclusion

This study demonstrates that integrating STEAM education with structured inquiry-based learning effectively enhances students' research competencies and academic performance. By engaging learners in systematic processes such as problem identification, hypothesis development, data analysis, and evidence-based reasoning, this approach deepens conceptual understanding while fostering critical thinking, creativity, and methodological rigor. Beyond immediate academic gains, the findings reveal lasting benefits, including greater learner autonomy, improved problem-solving skills, and the ability to integrate knowledge across disciplines. These outcomes highlight the value of experiential, student-centered learning environments in promoting sustained engagement, motivation, and intellectual growth.

Overall, the research underscores the importance of shifting toward inquiry-driven, interdisciplinary pedagogies in higher education. Such approaches not only strengthen technical and cognitive abilities but also cultivate adaptability, collaboration, and lifelong learning skills—essential qualities for success in academic research and an increasingly complex global landscape.

Suggestions

Recommendations for Educational Practice

1. In structuring an integrated learning experience in STEM education through inquiry-based learning to cultivate research skills, educators can devise innovative teaching aids to enhance student engagement, which may also be applicable to learning advancement in other disciplines.
2. It is advisable to examine and contrast learning outcomes of STEAM education combined with inquiry-based learning processes against alternative pedagogical approaches, such as comparing these outcomes with those of traditional teaching methods.

Suggestions for Future Research

1. Investigating the long-term impact of inquiry-based STEM/STEAM learning on students' academic and career trajectories.
2. Examining the effectiveness of these approaches across different educational levels, cultural contexts, and subject areas.
3. Developing and validating assessment tools specifically designed to measure research skills and inquiry competencies.

Reference

- Aranyanak, C. (2016). *Research processes for undergraduate thesis development in arts education*. Bunditpatanasilpa Institute.
- Athiwat, N. (2016). *The development of inquiry-based learning activities using the 5E model to enhance academic achievement and cognitive skills*.
- Bloom, B. S. (1976). *Human characteristics and school learning*. New York, NY: McGraw-Hill.
- Bruner, J. S. (1961). The act of discovery. *Harvard Educational Review*, 31(1), 21–32.
- Chatree, K. (1999). Inquiry-based learning and critical thinking development.
- Darunee, P. (2020). *The effects of STEAM-based learning on academic achievement and creative problem-solving skills*.
- Dewey, J. (1938). *Experience and education*. New York, NY: Macmillan.
- Jenjira, S. (2018). Development of STEAM-based learning activities to enhance process skills and creativity.
- Kanhasuwan, L. (2003). *Roles of instructors in student-centered and inquiry-based learning environments*.
- Kerdtham, C. (1999). Learning through inquiry: Principles and practices.
- Krapatong, M. (2018). The development of STEM learning activity sets to improve student achievement and creativity.
- Napaporn, P. (2015). The integration of inquiry techniques and project-based learning to enhance innovative thinking.

- Office of the Education Council. (2017). *National Education Plan B.E. 2560–2564 (2017–2021)*. Bangkok: Office of the Prime Minister, Thailand.
- Panich, V. (2012). *Ways of learning for students in the 21st century*. Bangkok: Sodsri-Saritwong Foundation.
- Pedaste, M., Mäeots, M., Siiman, L. A., De Jong, T., Van Riesen, S. A., Kamp, E. T., ... Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational Research Review*, 14, 47–61. <https://doi.org/10.1016/j.edurev.2015.02.003>
- Santipaiboon, J. (2018). Effects of STEAM learning activities on students' skills and satisfaction.
- Sriboon, S. (2018). The development of STEAM learning integrated with problem-based learning in mathematics.
- Srisa-ard, B. (2013). *Basic research* (9th ed.). Bangkok: Suwiriyan.
- Wongyai, W. (2017). *Curriculum development and instruction in the 21st century*. Bangkok: Ratchabhat University Press.
- Yakman, G. (2008). STEAM education: An overview of creating a model of integrative education. In *PATT-19 Proceedings*.