

The Effects of STEAM-Based Learning Package for Enhancing the Historical Creative Thinking Ability of Chinese's Undergraduate Students

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Abstract

Background: Chinese martial arts (Guoshu), a vital aspect of China's cultural heritage, faces declining interest among students due to traditional, teacher-centered instruction that limits creativity, motivation, and practical engagement. To address this issue, the present study aimed to develop a STEAM-based learning package that fosters student-centered, interdisciplinary learning experiences, integrates historical perspectives, and enhances creative thinking ability among Chinese undergraduate students in meaningful and sustainable ways.

Methods: Thirty-year martial arts students from Chengdu Sports University were recruited into the experiment using a single-group pretest-posttest design. The simple random sampling involved drawing 30 names from the experimental group. The research instruments included the learning package developed based on NASA's engineering design process. The historical creativity quality and ability assessment form was constructed as a pre- and post-scoring format was evaluated. The tools were assessed by two specialists in curriculum and instruction, one in educational measurement and evaluation, one in sports education, and one in Chinese martial arts history. The research and measurement were evaluated using comprehensive assessment criteria for fluency, flexibility, originality, and refinement. The data were analyzed using means, standard deviations, and paired t-tests.

Results: Expert evaluation confirmed the package's high quality (mean score=4.78/5.00). After implementation, students' scores in all four dimensions—fluency, flexibility, originality, and elaboration—significantly improved ($p < 0.05$). Post-test scores exceeded the 70% benchmark across all learning packages, indicating strong instructional effectiveness.

Conclusions: The STEAM-based learning package effectively enhanced students' historical creative thinking ability, supporting the shift from passive, teacher-centered approaches to active, student-driven learning. The findings advocate for broader integration of STEAM principles in humanities education to promote interdisciplinary engagement, creativity, and historical understanding.

Keywords: STEAM education; historical creative thinking; learning package; Chinese martial arts; undergraduate students

Introduction

Chinese martial arts, historically known as “Guoshu” during the early Republic of China and still referred to by this term in Taiwan, constitute a fundamental component of Chinese cultural heritage (Judkins & Nielson, 2015; Lorge, 2012). This multifaceted tradition encompasses a broad range of elements, including unarmed combat, weapon-based skills, concealed weaponry, fighting theories, tactical strategies, and various practical forms such as health-preserving exercises (Lorge, 2012). The roots of Chinese martial arts extend deep into antiquity, originating from ancient hunting practices and tribal warfare, and evolving systematically through successive dynasties. Along this historical trajectory, practices such as “martial dances” emerged, and significant religious and philosophical syntheses took place, particularly through the influence of Chan Buddhism at the Shaolin Temple (Shahar, 2008). In modern society, Chinese martial arts have not only become subjects of academic inquiry and university programs but have also played important roles in cultural diplomacy and the shaping of contemporary popular culture across China and globally (Judkins & Nielson, 2015).

Despite the profound cultural and philosophical significance of Chinese martial arts, their global popularity remains relatively limited (Shahar, 2008; Lorge, 2012). One notable reason for this constraint is the predominance of a traditional, teacher-centered educational model within martial arts instruction. This conventional approach heavily relies on lectures, explanations, and demonstrations, where students are expected to memorize large volumes of material without sufficient opportunities to apply knowledge practically (Jia et al., 2020; Judkins & Nielson, 2015). In many Chinese martial arts curricula, this manifests in an excessive focus on routine forms (taolu), often at the expense of practical combat skills, physical fitness benefits, and real-world self-defense applications. Such an imbalance tends to foster perceptions among students that martial arts are flashy but impractical, thereby diminishing engagement and motivation (Jia et al., 2020). Instruction commonly follows a repetitive teachers have flexibility and creativity in the use of studentcentered learning approach. In addition to in-class practices, Chinese elementary school teachers

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also design practical activities for their students that are unique to them based on their own creativity, which are often unrelated to the content of the teaching and are spontaneous behaviours of the teachers. They use such practice activities as part of their use of student-centered learning approach (Huang, 2024). Moreover, assessment systems are frequently simplistic, centering primarily on technical precision while neglecting important factors such as individual learner differences, cognitive processes, moral development, and cultural understanding (Adams & Sargent, 2012). Additionally, contemporary teaching methods often fall short in conveying the rich philosophical and ethical foundations inherent in Chinese martial arts, leading to a gradual erosion of spiritual values and over-reliance on outdated learning materials (Shahar, 2008; Jia et al., 2020).

To advance the development of martial arts and adapt it to the digital era, the integration of artificial intelligence has become essential. This involves applying AI in areas such as digital image processing, machine learning, and data-driven analysis to enhance training efficiency, improve the practical value of martial arts techniques, support innovative teaching and learning models, and establish a technological framework for intelligent martial arts training systems (Pang et al., 2025). In this context, STEAM education has emerged as a promising teaching method that integrates Science, Technology, Engineering, Arts, and Mathematics. The strategies and contextual linkages of science teaching were seen as appropriate means for both teachers and students to build critical thinking skills in school science learning. Scientific critical thinking (SCT) model seemed to show some effectiveness in present days connecting science teaching with STEAM education (Koirala, 2025). The emphasizing trends such as interdisciplinary and transdisciplinary learning and the integration of advanced pedagogical technologies, including digital tools and AI-driven platforms. Key highlight the critical role of interdisciplinary approaches in fostering critical thinking, bridging disciplinary divides, and preparing students to solve complex real-world problems (Sokolova et al., 2025).

China's 13th Five-Year Plan (2016–2020) explicitly mandates the exploration of new educational models such as STEAM to develop students' information literacy and innovative capacities, emphasizing interdisciplinary approaches to address complex real-world problems (State Council of the People's Republic of China, 2016). The shifting landscape of STEAM (Science, Technology, Engineering, Arts, and Mathematics) education reveals a transformation into a rhizomatic exploration, uncovering STEAM's potential to challenge and transcend traditional educational paradigms (Mangum, 2024). Applying STEAM to Chinese martial arts education, supported by digital innovation, has expanded the potential for cultural transmission both nationally and globally. The integration of these disciplines is not only beneficial for personal growth but also prepares students to navigate and contribute to a rapidly evolving world. (Khan, 2024).

Recent studies have shown that the teaching of Chinese martial arts history in China remains largely dependent on traditional, teacher-centered pedagogies, with an emphasis on rote memorization and lecture-based instruction. This approach often results in passive student participation, limited engagement, and reduced development of critical and creative thinking skills (Jia et al., 2020). Such traditional educational models are increasingly at odds with China's current educational reforms, which advocate for student-centered learning and the integration of innovative approaches such as STEAM education to foster higher-order thinking and student initiative (Huang, 2024; Xiao & Hu, 2019). Consequently, there is a growing recognition of the need to move away from passive learning formats towards pedagogical practices that actively involve students in the learning process and promote creativity in the study of historical subjects.

Therefore, this study aims to address these critical issues by developing a STEAM-based learning package to enhance the historical creative thinking ability of Chinese undergraduate students. In educational innovation, a learning package is defined as a structured collection of instructional content, resources, and assessments developed to facilitate self-paced, student-centered learning. Its modular nature allows integration of multiple learning strategies and supports higher-order thinking. Thus, STEAM framework (Science, Technology, Engineering, Arts, and Mathematics) education with Problem-Based Learning (PBL) of enhance undergraduates' creative thinking (Bhor & Varghese, 2024). Which the rationale for developing a STEAM-based learning package in this study stems from the need to shift from passive learning environments to dynamic settings that promote creative thinking in history education, particularly among Chinese undergraduate students.

Research Questions

What are the components of a learning package based on STEAM education for enhancing historical creative thinking ability?

What is the level of historical creative thinking ability of undergraduate students when they were treated via a learning package based on STEAM education?

Research Objectives

To design and implement a STEAM-integrated instructional package aimed at promoting students' creative thinking in the context of historical learning.

To study the effectiveness of the learning package based on STEAM education as follows:



To compare the historical creative thinking ability of undergraduate students before and after learning through the learning package based on STEAM education.

The significance of this study lies in its alignment with China's new round of education curriculum reform, which advocates for independent and open learning to promote students' cognitive development and innovative thinking. By applying this educational experiment to university general education Chinese martial arts history courses, it not only fits the new talent training concept but also benefits students' cognitive structures. History, being an event and activity of human beings in the past, requires situations to be created in teaching for students to deeply understand and feel it. Under the STEAM education concept, teaching Chinese martial arts history learning packages encourages students to identify, analyze, and solve problems through relevant historical themes, shifting teachers' roles to guides and promoters of student learning. This research directly addresses the problem of insufficient creativity in martial arts teaching, demonstrating the feasibility of the STEAM concept in enhancing Chinese martial arts history courses and bringing new research into the practice of STEAM approach in the fields of humanities and social sciences education. Ultimately, the results of this research are expected to increase students' creative thinking abilities, make the Chinese martial arts history course more fun and interesting, and lead to higher academic performance.

Literature Review

Chinese Martial Arts

Chinese martial arts, or Guoshu, are deeply rooted in Chinese history and philosophy, integrating physical techniques with moral and cultural values (Judkins & Nielson, 2015; Shahar, 2008). Chinese martial arts (Wushu) possess the potential to enhance both the psychological resilience and physical capacities of learners. Their effective implementation necessitates consideration of spatial and architectural features. This study investigates the impact of spatial-architectural determinants on the psychophysiological adaptation of Wushu practitioners within Chinese and European pedagogical systems (Tu et al., 2025). Coaching support functions as a mediating variable in the relationship between motor skill acquisition and long-term engagement in practice (Jianting, 2025). Traditionally taught through teacher-centered methods focusing on form (taolu), they are often perceived by students as lacking practicality and creativity (Jia et al., 2020; Huang, 2024). The challenge lies in transitioning to student-centered, experiential approaches that maintain cultural depth while enhancing engagement and creativity. The study of Wushu training environments requires an interdisciplinary synthesis: architectural psychology, biomechanics, and pedagogical methodology converge to define optimal spatial conditions (Tu et al., 2025).

Learning Package

Diller et al. (2024) offer a modular framework that enables the creation of customized learning experiences through the seamless integration of pre-built components. In addition, various tools are made available to the user to facilitate the creation of personalized applications, supported by extensive documentation explaining technical aspects and guidelines: Consistency, consistency serves as the backbone of our comprehensive approach, seamlessly linking all elements within our three-part modules. Modularity, modularity is a foundational element in our approach, allowing the creation of independent, self-contained learning units. These units consist of modules encompassing an application, presentation slides, and a quiz. Furthermore, using our framework, multiple development templates can be employed. Yet, combined, they form a rich learning experience. Each module stands on its own and allows students to focus on specific topics. This not only facilitates focused learning but also allows instructors to adapt and expand individual modules to meet the specific needs of their students, promoting flexibility and individualization. Expandability, expandability is an essential part of our intention to create continuous improvement and adaptability. And User Guidance, icons and documentation in the provided templates make it clear where the resources can be used and adapted effectively. Recent research emphasizes its effectiveness in enhancing engagement, particularly when combined with digital tools and personalized learning (Ngabekti et al., 2019; Hardianti, 2024)

STEAM Education

STEAM-based teaching refers to an educational approach that integrates Science, Technology, Engineering, Arts, and Mathematics into the learning process. It focuses on interdisciplinary and hands-on learning experiences to enhance the quality of education. STEAM-based teaching is an innovative approach that equips students with the skills and knowledge they need to thrive in the rapidly evolving world (Bhor & Varghese, 2024). STEAM education represents an interdisciplinary approach that enriches traditional STEM disciplines by incorporating the arts. This integration broadens the educational framework, aiming to boost student engagement, enhance creativity and innovation, improve problem-solving capabilities, and deliver additional cognitive advantages (Hetland & Winner, 2004) Unlike traditional subject silos, STEAM encourages inquiry, hands-on learning, and design thinking. Its application in humanities, such as martial arts education, has shown promise in enhancing student engagement, cultural awareness, and creative capacities (Willmott, 2022).



Creative Thinking Ability

Definition extends Guilford (1967) categorization of creativity into nine constructs: flexibility, fluency, synthesis, novelty, reorganization, analysis, complexity, and elaboration. One explanation is derived from the concept of human insight (Perkins, 2013). Researchers suggest that creative thinkers utilize lateral thinking, a process where thoughts flexibly transition between different aspects rather than adhering strictly to established pathways. Lateral thinking involves the capability to think associatively, leveraging diverse perspectives to think outside the conventional framework and generate innovative ideas. Divergent thinking represents another response to the question of what occurs mentally during creative thinking. In divergent thinking, individuals produce a variety of solutions to problems that lack definitive right or wrong answers (Volle, 2018). Thinking ability refers to the cognitive processes used to solve problems, make decisions, ask questions, plan, organize, and create information. It is a planned and orchestrated process integrating skills, strategies, and content knowledge to produce novel outcomes. Philosophically, thinking encompasses both critical and creative dimensions, involving reason and idea generation for problem-solving or understanding. It is a deliberate exploration of experience for a specific purpose (e.g., understanding, decision-making) and a search for meaning. While spontaneous thinking is innate, conscious thinking is deliberate, evaluative, and purposeful.

Research related to kinds of thinking ability exist: an education through learning plays a crucial role in equipping the 21st-century generation with the necessary skills required by each student in preparation for their successful future both in their careers and personal lives of based on the research Darhim and Juandi (2024) findings, it may be inferred that learning styles exert an influence upon students' computational thinking ability, and learning style model emerging as a focal point of extensive scholarly inquiry into computational thinking ability. The Dual Pathway to Creativity Model theorizes that creative performance arises from cognitive flexibility, persistence, or a combination of the two. Peterson and Pattie (2024) extend the DPCM model by predicting that creative output arises from the generation of response sets containing both highly related (persistence pathway) and unrelated (flexibility) ideas, an idea generation strategy we call Dual Pathway Divergent Thinking (DPDT). The results provide initial evidence that the two pathways may operate simultaneously as a single idea generation strategy, and theoretical and practical implications are discussed. Thus, Creative Thinking is thinking in new, imaginative ways, recognizing innovative ideas, combining ideas originally, and thinking outside the box.

Enhancing students' analytical thinking skills holds great promise for bolstering a nation's economic growth, fostering a dynamic learning culture, and nurturing human capital development, as Anthonysamy et al. (2024) found that metacognitive regulation plays a crucial role in enhancing analytical thinking. Underscore its importance in guiding educators to empower university students to become more self-reliant learners by developing skills in planning, monitoring, and self-assessment. Strengthening metacognitive awareness not only fosters analytical thinking but also contributes to improved academic performance, offering valuable directions for designing more effective instructional strategies and learning activities. Thus, Analytical Thinking is Breaking down complex information, identifying relationships, and using logical, step-by-step processes.

Further study identifies five key dimensions of thinking: critical, strategic, positive, innovative, and systems thinking. Integrating systems thinking with sustainability education emerges as a timely priority, requiring comprehensive frameworks and evaluation criteria. Qudrat-Ullah (2024) proposes a four-dimensional learning model cognitive, affective, behavioral, and systemic supported by criteria emphasizing critical thinking, systems literacy, and ethical decision-making, offering a holistic approach to advance sustainability education. Therefore, creative thinking ability consists of four interrelated aspects: Fluency, Flexibility, Originality, and Elaboraty were measured by providing 5 open-ended essays with the indicators of fluency, flexibility, original thinking, and elaboration thinking (Handayani et al., 2021)

Related Research

Related Research on Learning Packages

Studies show the effectiveness of learning packages in enhancing teaching. Akinbadewa and Sofowora (2020) found that multimedia instructional learning packages (MILPs) significantly improved secondary school students' attitudes toward Biology, fostering engagement and positive behavioral change. Ngabekti et al. (2019) developed a STEM Mobile Learning Package on ecosystems, demonstrating strong validity, legibility, and effectiveness in promoting students' science and technology literacy. Olokooba (2022) found that a cooperative computer-assisted instructional package was more effective than conventional methods in improving performance in Social Studies, recommending its adoption. And personalized learning is an educational approach that adapts instruction to the specific strengths, needs, skills, and interests of each student. By integrating data, adaptive technologies, and flexible instructional models, it provides individualized pathways that foster student ownership and promote deeper engagement with learning. In contrast to traditional one-size-fits-all methods, personalized learning accommodates diverse learning paces, preferences, and goals, enabling students to progress based on mastery rather than age or grade level. Within these environments, students often advance at their own pace through adaptive technologies,

project-based activities, and self-directed tasks. Educators play a pivotal role as facilitators and mentors, designing personalized learning plans, providing feedback, and encouraging reflective practice. This paper examines core models of personalized learning including competency-based education, blended learning, and project-based learning while also addressing the role of data analytics in monitoring progress and refining instruction. Case studies further illustrate the potential of personalized learning to improve academic achievement, enhance student agency, and cultivate essential skills for lifelong learning (Idowu, 2024).

Related Research on STEAM Education

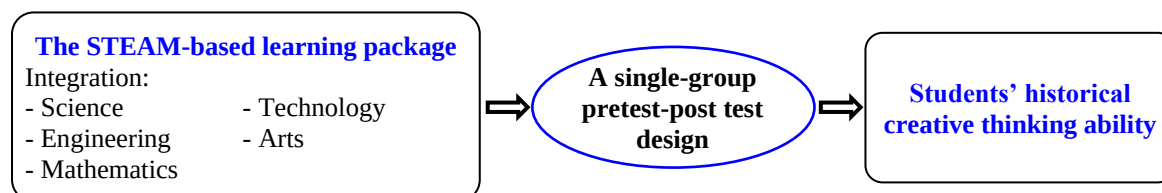
Research highlights common features and essential elements of effective STEM/STEAM curricula. Integrating Computational Thinking Through Design-Based Learning. “Theoretical Framework for Integrating Computational Thinking in Education,” authored by Tuğba Kamalı-Arslantaş (Arslantaş, 2025), addresses effective frameworks for integrating Computational thinking (CT) into education, aligning with design-based learning. The critical function that CT plays in education, emphasizing its necessity, importance, and the challenges of its integration. The begins by exploring the evolution of CT as a fundamental cognitive tool, not just confined to programming but essential for navigating the complexities of the modern world. It underscores the transformative impact of CT on problem-solving, future workforce preparation, critical thinking, and creativity across various disciplines. Anne (2018) identified key characteristics: focus on real-world problems, use of engineering design process, encouragement of exploration and inquiry, active teamwork, integration of math and science, and support for multiple solutions. Ashraf and Tsegay (2024) pointed to the integration of technical and engineering content, promotion of scientific inquiry and engineering design, rigorous teaching of mathematics and science, collaborative learning, a global perspective, project-based learning, and effective technology use. The strategic projects and initiatives designed to enhance interdisciplinary leaning through STEAM education (Kuo, 2024). In order to education serves to cultivate essential skills such as creative thinking, critical thinking, problem solving, communication, innovation, and collaboration (Zhao & Abdullah, 2025). In other fields, Liao and Motter (2020) demonstrated that integrating arts into STEM education (STEAM) enhances creativity and problem-solving, leading to improved student engagement and academic performance in K-12.

Related Research on Chinese Martial Arts

Partikova and Veronika (2019) explored psychological collectivism in martial arts training, arguing that it fosters not only physical skills but also moral codes, rituals, hierarchical roles, and interdependence, contributing to collective identity. Jiang et al. (2025) The findings indicate that Chinese martial arts practitioners emphasize humility and righteousness, reflecting Confucian ideals, while Japanese practitioners value loyalty and perseverance, rooted in Bushidō principles. Both traditions highlight the balance between body and spirit as a core life value, underscoring the universal role of martial arts in fostering holistic development. The study also reveals that training frequency, duration, and proficiency significantly influence value preferences. Overall, martial arts serve as bridges between cultural heritage and modern practice, contributing to personal growth, social cohesion, and cross-cultural dialogue. Future research should explore their evolving roles in global contexts and their impact on mental and social well-being.

Research Conceptual Framework

Figure 1. Research Conceptual Framework.



Note. Created by the researcher to define the independent variables, control variables, and dependent variables.

Variables: This study involved two variables. The independent variable is the STEAM-based learning package. In the first phase, which focuses on creating the package, it serves as the independent variable because the objective is to design and develop it. Here, consistency and suitability act as dependent variables. In the second phase, which involves implementing the package, the independent variable remains the STEAM-based learning package since the objective is to use the developed and validated package. An experimental design is used, specifically a single-group pretest-post-test design. The dependent variable in this stage is students' historical creative thinking ability. This phase aims to examine whether implementing the STEAM-based learning package can effectively enhance students' historical creative thinking ability and to what extent.

Materials and Methods

The research process for developing a learning package based on STEAM education to enhance the historical creative thinking ability of undergraduate students in China includes two main steps.

Step 1: Creating the Chinese Martial Art History Learning Package Based on STEAM Education

Learning packages are initially designed by subject matter of the learning activities are structured around NASA's Engineering Design Process (Hirshorn et al., 2017), which comprises six key stages: Ask (identifying the problem or challenge), Imagine (brainstorming possible solutions), Plan (developing a detailed strategy), Create (constructing and implementing the design), Experiment (testing and refining the product), and Improve (revising based on feedback and outcomes).

First, Studying Information Before Package is the information-gathering process involves several methods:

- Studying Relevant Documents and Sources includes examining integrated cross-disciplinary elements and aligned content with learner-centered approaches.
- Exploring and Analyzing Learner Needs is understanding target group characteristics (age, prior knowledge, interests, learning challenges) is crucial for developing meaningful content and activities, ensuring alignment with cognitive, emotional, and developmental stages.
- Analyzing Successful Examples and Approaches offers practical insights into effective implementation strategies, supporting localized adaptation and pedagogical innovation.
- Consulting Subject Matter Experts instructional designers, and domain specialists allows for expert feedback on content accuracy, pedagogical structure, and assessment strategies, enhancing academic rigor and credibility.
- Pilot Testing and Collecting Learner Feedback with small groups enables early evaluation of usability and instructional effectiveness, with learner feedback providing valuable input for refinement.
- Leveraging Digital Tools and Technologies using online search engines, academic databases, and educational platforms provides access to up-to-date research, instructional resources, and digital tools, supporting technology-enhanced elements
- Synthesizing and Evaluating Collected Data of gathered information identifies key themes, patterns, and pedagogical implications, forming the foundation for planning and designing a learner-responsive and effective instructional package. Adopting a systematic, research-based approach during the initial development phase significantly contributes to creating a high-quality, credible, and student-centered learning package, enhancing instructional relevance and increasing the likelihood of achieving meaningful learning outcomes.

Secondly, Development of Learning Package The researcher developed the learning packages through two steps:

- Learning Package Design are comprised of the following elements:

Table 1. Knowledge and Skills of the STEAM Theme.

Theme	Science	Technology	Engineering (learning process)	Arts	Mathematics
Costume	Properties of natural fiber and chemical synthetic fiber	Software for designing	Engineering design process	Painting	Length measurement
Weapons	metal properties	Software for designing	Engineering design process	Drawing	Measurement and weight
Exhibition of fighting posture	Body and muscle	Equipment to relieve stress	Engineering design process	Posture	Measurement and posture weight
Communica-tion (short film or video about Chinese martial arts)	Light movement, Lens, zoom in and out	Software for presentation	Engineering design process	Visual arts and Communication	Mathematical calculation

Note. Knowledge and skills on STEAM topics are gained through the 6-frame Chinese Martial Arts History Learning Kit.

- Learning Objectives, Learning Activities, Contents, Medias, Equipment, and Materials, Students' Roles, and Evaluation. For Assessment of students' performance using a rubric that measures key aspects of historical creative thinking ability, including fluency, flexibility, originality, and elaboration to four original learning packages were developed:

Learning Package 1: Chinese Martial Arts Traditional Costume.

Learning Package 2: Chinese Martial Arts Weapons.

Learning Package 3: Exhibition of Chinese Martial Arts Fighting Postures.

Learning Package 4: Communication of Chinese Martial Arts Culture.

These packages were designed with specific learning objectives by integrating STEAM principles (fiber properties, design tools, engineering processes, artistic skills, mathematical principles). The learning activities are structured according to NASA's Engineering Design Process, with specific time allocations for each step. Media and equipment, such as video, worksheets, and other materials, consistent with STEAM domains, are used. Evaluation tools include tests and rubric scores measuring creativity, technical skill, and cultural understanding.

Torrance Creative Thinking Test (TCTT) verbal forms is the most cited test among the creative thinking tests. In addition, TCTT has a special importance as it directly measures creativity in terms of content (Kim, 2007). The Creative Thinking Ability Test to test was designed to align with the characteristics to be measured and the target group, based on Paul Torrance's creative thinking theory (Alabbasi et al., 2022), which posits that thinking ability consists of four components: fluency, flexibility, originality, and elaboration. Test questions were formulated accordingly. The test was developed by Torrance in 1966. TCTT consists of four distinct factors: Fluency (idea), Flexibility (change), Originality (original idea), and elaboration (detail) (Kim, 2007; Torrance, 1963). Therefore, the TCTT Verbal Test of Creative Thinking can be applied to all age groups are activities in each form of the test. Which posits that thinking ability consists of four components: fluency, flexibility, originality, and elaboration. Test questions were formulated accordingly.

- The Learning Package and The Creative Thinking Ability Test Improvements were presented to thesis advisors for review of consistency and suitability. The overall quality was evaluated, and the Index of Item-Objective Congruence (IOC) method was used to assess the validity of the Creative Thinking Ability test. Based on expert feedback, were revised and finalized for implementation. The quality of the learning packages was assessed by five experts, including two specialists in curriculum and instruction, one in educational measurement and evaluation, one in sports education, and one in Chinese martial arts history. IOC was applied to evaluate the alignment between the package content and its intended learning objectives. Each item was rated on a scale of -1 (not congruent), 0 (uncertain), and +1 (congruent). Items with IOC values above 0.50 (Rovinelli & Hambleton, 1977) were considered valid and retained. Based on the experts' feedback, only test items with an IOC score between 0.50 and 1.00 were selected, with revisions based on feedback. The evaluation results showed IOC values greater than 0.5 for all selected items, meaning they would be implemented with the target group.

Step 2: Implementing the Chinese Martial Art History Learning Package Based on STEAM Education

Implementing the Chinese Martial Art History Learning Package Based on STEAM Education (Martinez, 2017).

- Population. The population consisted of 95 second-year students majoring in Chinese Martial Arts at Chengdu Sport University.

- Sample Group: The sample group included 30 second-year students selected through simple random sampling from the population. These students were enrolled in the Wushu course and were physically fit. The selection process involved drawing 30 names randomly from 95 students to form the experimental group.

- Variables: This study involved two variables:

Independent Variable: The STEAM-based learning package. In the first phase (creating the package), it serves as the independent variable because the objective is to design and develop it, with consistency and suitability as the dependent variables. In the second phase (implementing the package), it remains the primary independent variable as the objective is to use the developed and validated package.

Dependent Variable: Students' historical creative thinking ability. This stage aims to examine whether the STEAM-based learning package, once implemented, can effectively enhance students' historical creative thinking ability and to what extent.

- Experimental Design: This phase of the research utilized a pre-experimental design, specifically a single-group pretest-post-test design (Fitz-Gibbon, 1987). The design structure is illustrated as:

Table 2. Experimental plan for organizing learning activities using learning activity sets.

Pre test	test	Post test
O1	X	O2
O1 : Evaluation of historical creative thinking ability before using the package. X : Organizing activities using learning packages. O2 : Evaluation of historical creative thinking ability after using the package.		

- Research Instruments: Research instruments are of two types: Experimental tools: The lesson plans of the martial arts history learning package and Data collection tool: The historical creative thinking ability form as a scoring rubric.

- Information Collection: The learning package was implemented in the experimental group participated in centralized learning, with 14 hours of learning time for each package, divided into 7 hours per day for 8 consecutive days. The sample group (30 randomly selected students) completed a pre-test before the experiment and a post-test of historical innovation ability after the experiment. An effective way to achieve educational goals is through interaction and cooperation among students. This focuses on students participating in group tasks that include interaction and exchange of ideas and experiences (Byrge, 2013). Under defines it as "a group of objects, symbols, themes, elements, or special events that are grouped based on their common characteristics that comprise a specific category according to a specific criterion" (Attia, 2013, p. 68).

- Data analysis: Descriptive statistics were used to analyze the learning set, such as mean and standard deviation. The scoring criteria for the test were (Srisa-ard, 2017):

4.51-5.00: highest level

3.51-4.50: high level

2.51-3.50: moderate level

1.51-2.50: low level

1.00-1.50: lowest level

The creativity assessment test was presented to five experts who evaluated its content validity using the Index of Item-Objective Congruence (IOC). Test items with an IOC score between 0.50 and 1.00 were selected, with necessary revisions. The results showed IOC values greater than 0.50 for all selected creative thinking skills test items, confirming their suitability. The researchers set the test scoring criteria at 3 levels as follows:

10-12 points: excellent quality

7-9 points: good quality

4-6 points: fair quality

Table 3. *Creative Thinking Ability Test Item Analysis.*

Evaluation list	Score evaluation criteria		
	10-12	7-9	4-6
Fluency: the ability to generate many historical ideas	- The process of creating historical works to be completed before the specified time	- The process of creating historical works to be completed in the allotted time	- The process of creating historical works to be completed after the specified time.
Flexibility: the ability to move fluidly between different representations	- Designing a variety of methods for creating historical works	- Designing one method for creating historical works	- Designing less than one to creating historical works
Originality: the ability to produce novel and unusual ideas	- Creating historical works that are unique.	- Creating historical works that are unique in some matters	- The creation of historical works is nothing new
Elaboration: the ability to fully develop ideas	- Improving historical works to perfection	- Improving historical works to be complete in some parts	- Improving historical works with little integrity

Note. Creative thinking skills for students using analytical methods to test the researchers' creative thinking abilities.

Hypotheses were tested using inferential statistics, with t-tests to compare the results of the pre- and post-experimental tests. The significance level was set at 0.05.

Results

This research presents findings in two main parts as follows:

A STEAM-Based Learning Package for Chinese Martial Arts History

Six frames, The Chinese Martial Arts History Learning Package Based on STEAM Education. Each learning activity set includes:

Objectives : Clear goals for enhancing historical creative thinking.

Learning Activities : Sequence of instructional steps using the STEAM framework.

Content : Core knowledge aligned with STEAM principles.



Media and Equipment: Teaching aids, digital tools, materials.

Learners' Roles : Student responsibilities and engagement strategies.

Evaluation : Rubric-based assessment measuring fluency, flexibility, originality, and elaboration.

Four learning packages were developed:

Learning Package 1: Chinese Martial Arts Traditional Chinese Costume aims to enhance historical creative thinking through exploring traditional costumes, integrating STEAM principles. Students will explain historical/cultural significance, design costumes blending traditional values with modern requirements, and construct functional, authentic costumes using scientific, technological, engineering, artistic, and mathematical principles.

Learning Package 2: Chinese Martial Arts Weapons focuses on historical and practical dimensions of weapons, integrating historical analysis with hands-on design using STEAM components. Students will analyze historical/cultural significance of weapons and design/construct prototypes using STEAM principles for metal properties, design tools, structural stability, artistic patterns, and precise measurement.

Learning Package 3: Exhibition of Chinese Martial Arts Fighting Postures aims to deepen understanding of historical/cultural relevance of fighting postures, developing ability to design and curate a modern exhibition. Students will explain historical/cultural significance and create an exhibition integrating scientific knowledge (human anatomy), technological tools, engineering principles, artistic techniques, and mathematical principles.

Learning Package 4: Communication of Chinese Martial Arts Culture enhances historical creative thinking by exploring communication of martial arts culture across time, emphasizing short film/video creation with STEAM principles. Students will explain historical/cultural significance of communication methods and create a short film/video effectively communicating key elements of martial arts culture, applying STEAM principles to media tools, technological platforms, video production, artistic expression, and timing/sequencing.

Quality of Learning Package

Table 4. *The Results of the Learning Package 1.*

Evaluation items	$\bar{X}$	S.D.	Meaning
Component 1: Goals			
- Define the goals of the learning activity set that are beneficial for daily life.	4.60	0.92	highest level
- The goals of the learning activity set are clear and can be assessed accurately.	4.80	0.49	highest level
Goals average	4.70	0.70	highest level
Component 2: Content			
- The content is consistent with the goals of the learning activity set.	4.40	0.45	high level
- The content is accurate and covers the concepts of STEAM.	4.60	0.45	highest level
- The content is appropriate for the context of the learners.	4.80	0.49	highest level
Content average	4.60	0.46	highest level
Component 3: Learning activities			
- The learning activities are aligned with the concepts of STEAM.	4.80	0.40	highest level
- The learning activities can develop learners to achieve the goals of the learning activity set.	5.00	0.00	highest level
- The learning activities are appropriate for the context of the learners.	4.80	0.49	highest level
Learning activities average	4.86	0.30	highest level
Component 4 Evaluation:			
- The assessment methods and tools can verify the achievement of the goals of the learning activity set.	4.60	0.45	highest level
- The assessment criteria are clear and specific.	4.60	0.45	highest level
- The assessment tools are appropriate for the context of the learners.	4.60	0.45	highest level
Evaluation average	4.60	0.45	highest level
Average of all 4 Components	4.84	0.20	highest level

Note. The results of the evaluation of the effectiveness of the first learning set by experts were analyzed using descriptive statistics and displayed according to the evaluation criteria.

The results of the evaluation of Learning Package 1's effectiveness, conducted by experts using evaluation criteria, found that all components were at the highest level, demonstrating high quality and suitability for developing students' historical creative thinking abilities. The average scores of the components, from highest to lowest, were as follows: learning activities ($\bar{X}=4.86$), assessment ($\bar{X}=4.84$), goals ($\bar{X}=4.70$), and content ($\bar{X}=4.60$), respectively.

Table 5. *The Results of the Learning Package 2.*

Evaluation items	$\bar{X}$	S.D.	Meaning
Component 1: Goals			
- Define the goals of the learning activity set that are beneficial for daily life.	4.60	0.45	highest level
- The goals of the learning activity set are clear and can be assessed accurately.	4.80	0.49	highest level
Goals average	4.70	0.47	highest level
Component 2: Content			
- The content is consistent with the goals of the learning activity set.	5.00	0.00	highest level
- The content is accurate and covers the concepts of STEAM.	4.80	0.49	highest level
- The content is appropriate for the context of the learners.	4.80	0.49	highest level
Content average	4.87	0.32	highest level
Component 3: Learning activities			
- The learning activities are aligned with the concepts of STEAM.	4.80	0.49	highest level
- The learning activities can develop learners to achieve the goals of the learning activity set.	4.80	0.49	highest level
- The learning activities are appropriate for the context of the learners.	4.80	0.49	highest level
Learning activities average	4.80	0.49	highest level
Component 4 Evaluation:			
- The assessment methods and tools can verify the achievement of the goals of the learning activity set.	4.60	0.45	highest level
- The assessment criteria are clear and specific.	4.60	0.45	highest level
- The assessment tools are appropriate for the context of the learners.	4.40	0.45	high level
Evaluation average	4.53	0.45	highest level
Average of all 4 Components	4.76	0.14	highest level

Note. The results of the second learning set by experts were analyzed using descriptive statistics and displayed according to the evaluation criteria.

The results of the evaluation of Learning Package 2 's effectiveness, conducted by experts using evaluation criteria, found that all components were at the highest level, demonstrating high quality and suitability for developing students' historical creative thinking abilities. The average scores of the components, from highest to lowest, were as follows: content ($\bar{X}$ =4.87), learning activities ($\bar{X}$ =4.80), goals ($\bar{X}$ =4.70), and evaluation ($\bar{X}$ =4.53), respectively.

Table 6. *The Results of the Learning Package 3.*

Evaluation items	$\bar{X}$	S.D.	Meaning
Component 1: Goals			
- Define the goals of the learning activity set that are beneficial for daily life.	4.80	0.49	highest level
- The goals of the learning activity set are clear and can be assessed accurately.	4.60	0.45	highest level
Goals average	4.70	0.47	highest level
Component 2: Content			
- The content is consistent with the goals of the learning activity set.	4.80	0.49	highest level
- The content is accurate and covers the concepts of STEAM.	4.40	0.92	high level
- The content is appropriate for the context of the learners.	4.80	0.49	highest level
Content average	4.67	0.62	highest level
Component 3: Learning activities			
- The learning activities are aligned with the concepts of STEAM.	4.20	0.92	high level
- The learning activities can develop learners to achieve the goals of the learning activity set.	4.60	0.45	highest level
- The learning activities are appropriate for the context of the learners.	4.60	0.45	highest level
Learning activities average	4.47	0.60	high level
Component 4: Evaluation			
- The assessment methods and tools can verify the achievement of the goals of the learning activity set.	4.60	0.45	highest level
- The assessment criteria are clear and specific.	4.80	0.49	highest level
- The assessment tools are appropriate for the context of the learners.	4.80	0.49	highest level
Evaluation average	4.73	0.48	highest level
Average of all 4 Components	4.76	0.18	highest level

Note. The results of the third learning set by experts were analyzed using descriptive statistics and displayed according to the evaluation criteria.

The results of the evaluation of Learning Package 3's effectiveness, conducted by experts using evaluation criteria, found that all components were at the highest level, demonstrating high quality and suitability for developing students' historical creative thinking abilities. The average scores of the components, from highest to lowest, were as follows: evaluation ($\bar{X}=4.73$), goals ($\bar{X}=4.70$), content ($\bar{X}=4.67$), and learning activities ($\bar{X}=4.47$), respectively.

Table 7. *The Results of the Learning Package 4.*

Evaluation items	$\bar{X}$	S.D.	Meaning
Component 1: Goals			
- Define the goals of the learning activity set that are beneficial for daily life.	4.80	0.49	highest level
- The goals of the learning activity set are clear and can be assessed accurately.	4.80	0.49	highest level
Goals average	4.80	0.49	highest level
Component 2: Content			
- The content is consistent with the goals of the learning activity set.	5.00	0.00	highest level
- The content is accurate and covers the concepts of STEAM.	4.60	0.80	highest level
- The content is appropriate for the context of the learners.	4.60	0.45	highest level
Content average	4.73	0.41	highest level
Component 3: Learning activities			
- The learning activities are aligned with the concepts of STEAM.	4.40	0.92	high level
- The learning activities can develop learners to achieve the goals of the learning activity set.	4.80	0.49	highest level
- The learning activities are appropriate for the context of the learners.	5.00	0.00	highest level
Learning activities average	4.73	0.47	highest level
Component 4: Evaluation			
- The assessment methods and tools can verify the achievement of the goals of the learning activity set.	4.80	0.49	highest level
- The assessment criteria are clear and specific.	4.60	0.45	highest level
- The assessment tools are appropriate for the context of the learners.	4.60	4.45	highest level
Evaluation average	4.67	0.46	highest level
Average of all 4 Components	4.76	0.15	highest level

Note. The results of the fourth learning set by experts were analyzed using descriptive statistics and displayed according to the evaluation criteria.

The results of the evaluation of Learning Package 4's effectiveness, conducted by experts using evaluation criteria, found that all components were at the highest level, demonstrating high quality and suitability for developing students' historical creative thinking abilities. The average scores of the components, from highest to lowest, were as follows: goals ($\bar{X}=4.80$), evaluation ($\bar{X}=4.76$), content, and learning activities ($\bar{X}=4.73$), respectively.

Application of a STEAM-Based Learning Package for Chinese Martial Arts History

The results of a comparative analysis of students' historical creative thinking abilities in 1-4 learning packages based on STEAM education.

Table 8. *Comparative Analysis of Students' Historical Creative Thinking Abilities.*

Package	N	$\bar{X}$	S.D.	df	t	p
Package 1 Pretest	30	1.27	0.21	29	-27.72*	0.00
Post test	30	2.75	0.21			
Package 2 Pretest	30	1.20	0.24	29	-21.75*	0.00
Post test	30	2.54	0.24			
Package 3 Pretest	30	1.26	0.19	29	-27.05*	0.00
Post test	30	2.74	0.18			
Package 4 Pretest	30	1.21	0.15	29	-30.08*	0.00
Post test	30	2.80	0.20			

* $p < 0.05$

Comparative analysis of students' historical creative thinking abilities before and after the implementation of the STEAM-based learning packages. The post-test scores across all four dimensions fluency, flexibility, originality, and elaboration show statistically significant improvements ($p=0.00$), indicating the effectiveness of the instructional design in fostering students' creative engagement with historical content.

Discussion

The findings of this study confirm that the STEAM-based learning package significantly improved students' historical creative thinking ability across four key dimensions: fluency, flexibility, originality, and elaboration. Such as those described by Johnson and Johnson (1999) of define the 3 types of goal structures available to teachers during instruction: cooperative, competitive, and individualistic. The traditional competitive structure has dominated American education. The type of goal structure used affects interaction among students and teachers and ultimately affects learning. These improvements are consistent with the theory of creative thinking proposed by Alabbasi et al. (2022) finding, students need to learn several skills, such as creativity, critical thinking, collaboration, and communication (the 4 Cs). Creativity, especially, is an essential skill in a complex and unforeseeable world/era, and an important step in any effort to enhance creativity is to identify students' creative strengths and relative weaknesses.

The development of STEAM-based learning kits to enhance historical creativity among Chinese undergraduate students follows a systematic development process that incorporates NASA's engineering design process and interdisciplinary teaching principles. The entire learning kit was rigorously reviewed by experts in curriculum design, educational assessment, martial arts education, and instructional technology, and passed the content validity test, with an index of item-object congruence that was appropriate for the context and above the acceptable threshold (0.50), indicating significant validity. Therefore, the integration of personalization with STEAM education shows great potential as it naturally resonates with the interdisciplinary essence of STEAM fields. These subjects demand not only critical problem-solving but also imaginative and innovative thinking. By personalizing STEAM learning, students are encouraged to connect their academic exploration with individual passions and real-world contexts. For example, one learner might delve into sustainability through environmental science, while another may investigate the synergy of technology and artistic expression in digital art. When it comes to assessment, this approach introduces both possibilities and complexities. Standardized testing and uniform benchmarks often fail to reflect the true depth of student comprehension or the diversity of their capabilities. In contrast, personalized evaluation methods aim to capture a more detailed and holistic understanding of each learner's progress (Subramanian et al., 2025). For example, the research of Videla et al. (2025) to specify rethinking STEAM education as a catalyst for socio-ecological transformation and provides methodological orientations for sustainable, situated, and inclusive teaching practices.

The dimensions of creativity, namely agility, flexibility, originality, and thoughtfulness, emerged from the evaluation of the effectiveness of a STEAM learning package developed to significantly enhance students' historical creativity. The OECD (2018) report extends this discussion by highlighting the intriguing link between design thinking, digital literacy, and intellectual experience. It emphasizes that these competencies are not only practical tools but also central to the broader intellectual journey, which involves gaining knowledge, building understanding, and developing cognitive abilities. In this regard, design thinking sharpens critical reasoning while fostering creative problem-solving, and digital literacy enhances individuals' capacity to access, analyze, and apply information deepening their comprehension of the surrounding world (Ergin, 2024). Among the two, design thinking stands out as a potent approach for addressing complex challenges, as it encourages innovation, empathy-driven solutions, collaboration, and a willingness to experiment. Ultimately, preparing learners to thrive in a globally interconnected and digitally shaped society depends on strengthening such skills. Both design thinking and digital literacy, as underscored by OECD (2018) and Ergin (2024), are indispensable in navigating the uncertainties and opportunities of this fast-changing era.

Post-test results not only exceeded the standard but also demonstrated that students were able to apply interdisciplinary knowledge to historical situations, promoting a deeper cultural and conceptual understanding. Conform to the results of AlAli (2024), provide compelling evidence that Project-Oriented Problem-Based Learning (PoPBL) proves to be highly effective in strengthening students' skills by engaging them in authentic, real-world problem-solving through project work. The study highlights the significance of this integrated educational approach in cultivating essential abilities such as problem-solving, creative thinking, teamwork, and clear communication. Through hands-on, project-driven tasks, learners are not only able to apply their knowledge but also build the competencies needed to tackle complex challenges in their future careers.

These findings affirm the value of STEAM approaches in humanities education, supporting the broader call for education systems to nurture creativity, critical thinking, and innovation among students. And findings suggest that instructional designers and educators in humanities fields should consider STEAM integration as a viable pathway to foster creativity and interdisciplinary learning, particularly in traditionally content-heavy subjects such as history. Conforming to the findings, Sari (2024) highlighted four key themes: Interdisciplinary Approach, Collaboration and Cooperative Learning, Assessment and Feedback, and Engagement and Motivation. These themes demonstrated that arts integration in STEAM disciplines can be fluid and effective. The findings have implications in three main areas. Firstly, the project provides a framework and practical examples of how art can be integrated into STEM disciplines, offering valuable guidance for art teachers. Secondly, by demonstrating the seamless integration of different subjects, the project helps subject teachers appreciate and adopt an interdisciplinary approach to learning, thereby enhancing the overall educational experience. Lastly, the project's success and collaborative efforts encourage teachers to work together in planning and implementing similar curricula.

Conclusions

In conclusion, this study highlights the potential of STEAM-based education in enhancing students' historical creative thinking ability. By adopting a student-centered approach, the study successfully aimed to improve students' historical creative thinking ability.

Summary of Findings

This study investigated the development and implementation of a STEAM-based learning package to enhance the historical creative thinking ability of Chinese undergraduate students in martial arts history courses. The findings demonstrated that the learning package significantly improved students' performance in four key areas of creative thinking: fluency, flexibility, originality, and elaboration. All post-test scores exceeded the 70% benchmark, confirming the effectiveness of the instructional model.

Contributions

Designed and validated an innovative instructional model that integrates STEAM principles with humanities education.

Demonstrated that interdisciplinary, student-centered learning environments enhance creativity and historical understanding.

Developed assessment tools aligned with creative thinking theory that are adaptable for broader educational contexts.

Limitations

The study focused on a single university and discipline, which may limit the generalizability of the findings.

The intervention period was relatively short, and long-term retention or transfer of skills was not measured.

The cultural specificity of Chinese martial arts may affect the applicability of the model in other settings.

Future Directions

Conduct longitudinal studies to explore the sustained impact of STEAM-based approaches on student learning outcomes.

Replicate the model in diverse academic disciplines and institutions to assess scalability and adaptability.

Investigate teacher readiness and training needs for implementing interdisciplinary instruction in higher education.

Policy and Practical Implications

Universities should promote the integration of STEAM principles into humanities courses to foster creative and interdisciplinary competencies.

Curriculum developers should prioritize student-centered and project-based learning designs supported by frameworks such as the Engineering Design Process.

Educational policy should encourage the development of modular instructional packages that support innovation, creativity, and cultural preservation.

Authors' Contributions

All authors have participated in drafting, reading, and approving the manuscript's final version.

Conflict of Interest

The authors declare that they have no conflicts of interest with any financial organization regarding the content discussed in the manuscript.

Data Availability

The datasets generated, analyzed, and synthesized during the current study can be obtained from the corresponding author upon appropriate request.

Ethical Statement

This article will comply with the principles of research and publication ethics. This study did not involve human subjects requiring additional approval from an in the Classroom.



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