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Enhancing Student Engagement and Creativity through STEAM-Based Fine Arts Learning: A Qualitative Case Study in Indonesia

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Abstract
Fine Arts education utilizing the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach serves as a vital bridge between creative expression and logical reasoning in the modern curriculum. This study aims to describe the implementation of STEAM-based learning in Fine Arts education to facilitate students' creativity and learning engagement by integrating artistic imagination with scientific exploration. Employing a descriptive qualitative method, the research involved 72 ninth-grade students at *Sekolah Menengah Pertama (SMP)* Negeri 3 Minas, distributed across three classes, with data collected through intensive classroom observations, documentation of construction processes, and group interviews. During the learning phase, students were challenged to design bridge sketches and realize them by constructing miniature models using Popsicle sticks, which were subsequently tested for structural durability and load-bearing capacity. The findings indicate that student creativity was significantly reflected in the diversity of sketch designs, innovative structural choices, and unique construction solutions devised when facing physical constraints. Furthermore, learning engagement was highly evident through active participation, enthusiasm during group discussions, and persistent effort in completing complex projects. Student collaboration was also clearly identified through effective role distribution and collective decision-making throughout the design and testing stages. This study concludes that STEAM-based Fine Arts learning creates meaningful educational experiences by contextually connecting artistic processes with scientific reasoning, ultimately fostering not only aesthetic skills but also critical thinking and teamwork essential for interdisciplinary competency.

Keywords: STEAM, fine arts, creativity, learning engagement

INTRODUCTION

Art plays an important role in the development of children's creativity, self-expression, and cultural understanding. Through art learning, students can develop visual skills, abstract reasoning, and critical thinking abilities. To achieve these objectives, it is essential to consider effective learning strategies, including appropriate student grouping in the context of art education, in order to support optimal learning processes (Sumarsono, 2023). In line with this, Fine Arts education plays a strategic role in fostering students' creativity, reflective abilities, and higher-order thinking skills. Through artistic activities, students are encouraged to explore ideas, interpret experiences, and make visual decisions that require aesthetic sensitivity, analytical skills, and reflection. The creative process in fine arts learning also enhances problem-solving skills, as students are required to consider media selection, techniques, and visual concepts through continuous evaluation and revision of their work (Indriani et al., 2025).

Furthermore, Fine Arts learning aims to develop drawing skills, increase awareness of local culture, enhance students' ability to appreciate visual arts, provide opportunities for self-actualization, strengthen mastery of visual arts disciplines, and promote multicultural perspectives within the learning process (Rosyidi & Apriliyanti, 2024). Thus, Fine Arts education is not only oriented toward technical skills but also contributes to character development and the cultivation of students' cultural insight. However, the implementation of art education, particularly at the elementary school level, still faces several challenges. Research indicates a gap between teachers' perceptions of the importance of art education and the instructional practices implemented in classrooms. This condition has resulted in art learning not yet being optimally implemented to fully support the development of students' creative potential (Zuhro, 2025).

In an interdisciplinary context, Fine Arts education through the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach serves as a bridge between creative expression and logical reasoning. STEAM-based learning emphasizes processes of exploration, experimentation, and reflection, thereby strengthening students' creativity and critical thinking skills while helping them understand problems in a holistic and contextual manner (Baidho et al., 2025; Sari et al., 2023). The STEAM approach encourages students to actively engage in learning through activities such as observing, identifying, collaborating, and communicating while completing tasks, which positively contributes to the development of innovation and higher-order thinking skills (Rachmah et al., 2022). This approach aligns with the cognitive characteristics of junior secondary school students, who are entering a stage of more complex cognitive development marked by the ability to think abstractly and critically (Jeranah et al., 2024).

In Indonesia, this educational vision aligns with Law Number 20 of 2003 on the National Education System, which emphasizes holistic learning that fosters creativity, autonomy, and scientific curiosity (Ramadansur et al., 2025). The STEAM approach supports this vision by integrating interdisciplinary learning that connects concepts across subjects, enhances scientific understanding, promotes creativity and innovation, encourages collaboration, and facilitates the application of technology in everyday (Dina, 2025). However, despite its potential, the implementation of STEAM-based Fine Arts learning at the secondary school level still faces challenges, particularly in designing balanced interdisciplinary projects and shifting from product-oriented to process-oriented learning. This highlights the need for innovative instructional strategies to optimize

STEAM's role in fostering students' creativity, engagement, and higher-order thinking skills (Annisa et al., 2025)**.**

A similar condition was observed at SMP Negeri 3 Minas, where Fine Arts learning previously focused primarily on technical drawing skills and procedural artwork production, with limited connections to scientific, technological, or real-world contexts. This approach led to low student engagement, minimal interaction, limited collaboration, and a tendency for students to imitate teacher examples rather than express original ideas. Such conditions indicate that Fine Arts learning had not yet optimally supported the development of creativity and innovative thinking.

This long-standing approach, although efficient in delivering content, has limited the development of students' inquiry skills and critical reasoning abilities (Sembiring et al., 2025). In response to these limitations, STEAM-based learning emerges as an innovative and interdisciplinary approach to learning. The STEAM approach was developed to balance logical reasoning with imagination and aesthetic awareness, and it has been proven to enhance students' creativity, motivation, learning engagement, collaboration, and communication through project-based and interdisciplinary learning activities (Annisa et al., 2025)**.** Within this context, STEAM-based learning supports students in understanding problems holistically and fosters the development of innovation through the integration of science, technology, engineering, arts, and mathematics. By combining analytical and creative processes, STEAM encourages learners to engage in meaningful problem-solving and the application of knowledge across disciplines (Herro & Quigley, 2017).

Although STEAM is considered a form of innovative learning, it differs conceptually from innovative learning in general. Innovative learning encompasses various instructional approaches that emphasize active student participation, higher-order thinking, and problem-solving skills, whereas STEAM represents a specific model within innovative learning that focuses on interdisciplinary integration. Therefore, not all innovative learning approaches fall under the STEAM framework. Examples of innovative learning models beyond STEAM include problem solving and reasoning models, inquiry training, problem-based instruction, conceptual change instruction, and the group investigation model (Huda et al., 2024).

Thus, STEAM holds a strategic position within innovative learning by integrating creative, collaborative, and reflective processes through interdisciplinary project-based activities. This approach is particularly relevant for secondary education, as it facilitates the development of students' creativity, learning engagement, and higher-order thinking skills in alignment with the demands of 21st-century education.

METHOD

Research Design

This study employed a descriptive qualitative research design to explore and describe the implementation of STEAM-based Fine Arts learning at SMP Negeri 3 Minas, Riau, Indonesia. A qualitative descriptive approach was selected because the research aimed to understand learning processes, classroom interactions, and students' creative, engagement, and collaborative experiences in their natural instructional context rather than to measure variables quantitatively (Sugiyono, 2022; Creswell & Poth, 2018). This design enabled an in-depth examination of how STEAM principles were enacted in Fine Arts learning activities and how students responded to interdisciplinary, project-based tasks. SMP Negeri 3 Minas was purposively selected as the research site because it has

implemented a STEAM-oriented approach within its Fine Arts curriculum, making it a relevant and information-rich case for examining the practical application of STEAM-based arts education at the secondary school level.

Participants

The study subjects consisted of 72 ninth-grade students divided into three classes of 24 students each. Each class was divided into three collaborative groups to facilitate observation of interactions, creative processes, and group problem-solving. The project was implemented over four weeks six class meetings (Miles et al., 2019). The STEAM-based learning intervention was implemented through an interdisciplinary project consisting of two main stages: sketch design and miniature bridge construction. Each stage was deliberately designed to integrate the core components of STEAM (Science, Technology, Engineering, Arts, and Mathematics) in a coherent and contextual learning experience.

First, sketch design stage (arts, mathematics, and engineering). In the first stage, students were required to design a bridge sketch as an initial planning activity. From the Arts perspective, students explored visual creativity by applying principles of design such as proportion, balance, symmetry, and aesthetic composition. This stage encouraged artistic expression and imagination while emphasizing visual clarity and originality. The Mathematics component was reflected in students' consideration of measurements, scale, geometric forms, and proportional relationships within the bridge design. At the same time, elements of Engineering were introduced as students began to think systematically about structural forms, load distribution, and the functional feasibility of their designs. Through this process, students developed both creative and analytical thinking skills by integrating aesthetic considerations with basic structural logic.

Second, miniature bridge construction and testing stage (science, technology, and engineering). In the second stage, students constructed miniature bridges based on their sketches using popsicle sticks as the primary material. The Engineering component was emphasized through hands-on construction activities that required precision, problem-solving, and collaboration, particularly in translating two-dimensional designs into three-dimensional structures. The Science component was embedded in the testing phase, where students examined the physical strength and durability of the bridges by applying simple concepts related to force, load, and material resistance. Students observed how different structural designs and material arrangements affected the bridge's ability to withstand weight. The Technology component was represented through the use of tools, materials, and construction techniques, as well as through students' procedural planning and iterative refinement of their designs during the building process.

Overall, this STEAM-based project emphasized not only the final product but also the learning process, including exploration, experimentation, collaboration, and reflection. By explicitly integrating all STEAM components within the sketching, construction, and testing activities, the intervention provided students with a meaningful interdisciplinary learning experience that connected artistic creativity with scientific reasoning and engineering practices.

Data Collection

Data were collected using multiple qualitative techniques to ensure credibility through triangulation of sources and methods. The data collection process was conducted throughout the implementation of the STEAM-based learning project over a period of

four learning sessions (each lasting approximately 90 minutes). First, direct classroom observations were conducted during each learning session to capture students' learning behaviors in a natural setting. Observations focused on students' learning engagement, creative expressions, and collaborative interactions at different stages of the project, including sketch design, miniature bridge construction, and structural testing. The observation instrument consisted of an observation guideline containing indicators such as student participation, enthusiasm, interaction patterns within groups, problem-solving behavior, and responsiveness to tasks. Observations were conducted in all four sessions, and field notes were recorded systematically to document recurring patterns and notable events during the learning process.

Second, documentation was used as a supporting data source to strengthen observational findings. The collected documents included photographs of students' sketch designs, construction processes, and completed miniature bridges, as well as brief written notes related to project implementation. This documentation provided visual evidence of the development of students' creative ideas, design variations, and the application of aesthetic and structural principles. Documentation was collected continuously throughout the project, particularly at the end of each major activity stage.

Third, semi-structured group interviews were conducted at the end of the project implementation to explore students' learning experiences in greater depth. The interviews were guided by an interview protocol consisting of open-ended questions related to students' perceptions of the learning activities, challenges encountered during the project, collaborative experiences, and perceived benefits of the STEAM-based approach. Interviews were conducted with selected student groups from each class, with each session lasting approximately 20–30 minutes. Group interviews were chosen to encourage interaction among students and to elicit collective reflections on teamwork and learning processes. All interviews were audio-recorded and transcribed to support systematic qualitative analysis.

Through the combination of observations, documentation, and interviews, this study obtained comprehensive and credible qualitative data that captured both the learning process and students' experiences during the implementation of STEAM-based Fine Arts learning.

Data Analysis

Data analysis was conducted using a thematic analysis approach to systematically interpret qualitative data obtained from observations, documentation, and interviews. The analysis process followed several iterative stages to ensure rigor and credibility. First, all interview recordings were transcribed verbatim, and observation field notes were organized chronologically. An initial open coding process was then applied to the transcripts and observation notes by identifying meaningful units of data related to students' learning engagement, creative behaviors, and collaborative interactions. Codes were generated inductively based on patterns emerging from the data rather than predetermined categories.

Second, the documentation of students' sketches, construction processes, and final miniature bridges was analyzed through visual and content analysis. This stage focused on identifying indicators of creativity, such as variation in design ideas, originality, aesthetic considerations, and problem-solving strategies reflected in the construction outcomes. Findings from the documentation were used to support and triangulate the results of the coding from observations and interviews.

Third, related codes were compared, grouped, and refined to form broader categories**,** which were subsequently developed into key themes representing how STEAM-based learning influenced students' creativity, engagement, and collaboration during the learning process. These themes were continuously reviewed and refined to ensure internal consistency and alignment with the research objectives.

To ensure data credibility and trustworthiness, several strategies were employed. Triangulation was conducted by comparing data from multiple sources (observations, interviews, and documentation). Prolonged engagement during multiple learning sessions allowed the researcher to gain an in-depth understanding of the learning context. In addition, peer debriefing was conducted by discussing emerging codes and themes with fellow researchers or supervisors to reduce subjective bias and strengthen the validity of interpretations.

FINDINGS AND DISCUSSION

Findings

The implementation of STEAM-based Fine Arts learning demonstrates that students are actively and creatively engaged at every stage, from designing sketches to building mini bridges. These activities encourage students to express visual ideas, discuss designs, revise sketches, and work collaboratively by sharing roles, discussing, and solving problems. Intensive group work also facilitates peer learning, developing cognitive, psychomotor, communication, responsibility, and teamwork skills. These social and collaborative competencies strengthen student engagement, making learning more meaningful and contextual.

Increased Engagement

Observations indicate that STEAM-based Fine Arts learning significantly enhances student engagement. Students were actively involved at every stage, from sketch planning and constructing the miniature bridge to the testing phase, showing high enthusiasm in expressing ideas, discussing designs, and translating them into tangible work. Out of 72 students, approximately 58 reported feeling more focused, confident, and enthusiastic compared to previous learning experiences.

> Student 1: *"Usually, we just draw by following examples, but now we have to think for ourselves because the sketches are used to build the bridge".*
> Student 2: *"I take sketching more seriously because if the design is wrong, the bridge could collapse".*
> Student 3: *"I feel compelled to participate because the success of our group depends on everyone's contribution".*
> Student 4: *"The learning process keeps me active from start to finish".*

These findings indicate that student engagement encompasses physical, cognitive, and emotional aspects. Active participation is reinforced through group work, which encourages interaction, role-sharing, negotiation, and responsibility. This result aligns with previous studies showing that STEAM enhances student engagement through contextual and participatory learning experiences. High engagement serves as a foundation for achieving learning objectives and developing 21st-century skills.

Student Creativity

The implementation of STEAM-based Fine Arts learning demonstrated an increase in student creativity, evident in the diversity of initial sketches and the final

miniature bridge. Each group presented different design ideas in terms of form, structure, and construction techniques, reflecting students' ability to explore ideas innovatively. The sketching process was a crucial step, encouraging students to express their visual imagination while considering functional aspects and structural strength. Creativity further developed through hands-on testing, where students not only created aesthetically pleasing works but also reflected on the effectiveness of their designs based on durability tests.

A total of 61 out of 72 students reported that STEAM-based Fine Arts learning provided ample space to create, experiment, and develop ideas independently. Students felt they were not limited by a specific design example but were encouraged to explore various possible shapes, structures, and techniques for arranging popsicle sticks according to their group's ideas.

> Student 5*: "Each group had a different bridge shape, so we feel our design is unique".*
> Student 6*: "If our bridge wasn't strong enough, we discussed it again and changed the shape".*
> Student 7*: "Usually I just follow examples, but now I can try my own designs based on the group's ideas".*
> Student 8*: "We tried different bridge shapes from other groups to make it stronger and more attractive".*
> Student 9*: "We revised the sketch several times until we found the shape that we thought was best and strongest".*
> Student 10*: "Besides being strong, we also considered making the bridge look neat and attractive".*
> Student 11*: "My friends' ideas helped me see the design from a different perspective".*
> Student 12: *"Through discussion, we were able to combine several ideas into a better design".*

These findings indicate that STEAM learning encourages students to think creatively, flexibly, and reflectively. Creativity is reflected not only in the final product but also in the process of developing ideas, testing alternatives, evaluating, and refining designs based on learning experiences. Group interaction enriches the creative process, allowing students to exchange ideas and gain new perspectives, resulting in more innovative final designs. This approach makes Fine Arts learning more meaningful and contextual for students.

Enjoyable Learning Process

STEAM-based Fine Arts learning creates a more meaningful and motivating learning experience than conventional learning. Students are engaged not only physically in creative activities but also emotionally and cognitively through idea exploration, problem-solving, and collaborative work. This fosters curiosity and enthusiasm throughout the learning process. Nearly all students (approximately 65 out of 72) stated that STEAM-based Fine Arts learning was more enjoyable and less boring than conventional learning. They perceived the activity of creating a miniature bridge and testing its structural strength as a new experience rarely encountered in previous Fine Arts lessons.

Students reported that direct involvement in practical activities made the learning process more engaging:

Student 1*: "The learning process wasn't boring because we were directly practicing, not just theory".*
Student 2*: "It was exciting because our work was immediately tested, so it felt like an experiment".*

Several students expressed that the experience was enjoyable because they could see the results of their ideas, from sketches to miniature bridges that could be tested for strength:

Student 3: "I'm happy because the drawings we made were actually used to build the bridge".
Student 4: "I feel proud to see our sketches transformed into a real bridge, even if only in miniature".

Students also indicated that learning became more meaningful as they understood the connection between drawing, design planning, and the actual function of the work. This helped them see that Fine Arts learning focuses not only on visual aesthetics but also on utility and problem-solving.

Student 5: *"I understand that drawings are not just decoration, but also have a function".*
Student 6: *"We learned that good design must consider both beauty and strength".*

Moreover, a pleasant learning atmosphere emerged from group work and discussions. Students felt more comfortable, motivated, and less stressed because they could exchange ideas and solve challenges collaboratively:
Student 7: *"Learning became more relaxed but still serious because we were doing it with friends".*
Student 8: *"If we encountered difficulties, we could immediately discuss them and find solutions together".*

Overall, interview results indicate that STEAM-based Fine Arts learning created a fun and meaningful learning experience. Students not only enjoyed the process but also gained a deeper understanding of the relationship between ideas, design, and function, fostering intrinsic motivation and strengthening their emotional and cognitive engagement in Fine Arts learning. Activity documentation shows ninth-grade students at SMP Negeri 3 Minas working in groups to design bridge sketches. Students were actively engaged in discussions, sharing ideas, and providing feedback on the designs.

Figure 1. Students working in groups

Discussion

The results of this study indicate that STEAM-based Fine Arts learning can enhance student engagement, collaboration, and creativity through direct involvement in design and construction projects. Students play an active role in the planning, exploration, and collaborative problem-solving processes, making learning more meaningful.

Increased Engagement and Creativity

The increase in student engagement was evident in the enthusiasm and active participation demonstrated throughout the design and construction process of the miniature bridge. Students were intensely involved in every stage of the learning process, from sketching, determining the form and structure, to realizing the design into a three-dimensional work. This involvement demonstrates that STEAM-based learning activities can create engaging and meaningful learning experiences for students.

STEAM activities also encourage students to think creatively and innovatively in solving various problems that arise during the learning process. Students are challenged to integrate aspects of art, such as aesthetics and visual composition, with real-world construction principles related to strength, balance, and structural stability. This process requires students to explore ideas, try various design alternatives, and make adjustments based on observations and group discussions. Through this approach, students not only produce works of aesthetic value but also consider the functional aspects, strength, and efficiency of the design simultaneously. The integration of art and science in this learning strengthens students' conceptual understanding and fosters awareness that artworks can have practical functions. Thus, STEAM-based Fine Arts learning has been proven to increase student engagement while developing students' creative and innovative thinking skills in a contextual manner.

These conditions demonstrate that the STEAM approach can create meaningful and challenging learning experiences for students. Through the integration of art into constructive projects, students are not only guided to produce work but also encouraged to explore ideas, experiment with various design alternatives, and reflect on the process and results. This process strengthens students' understanding that art learning can be a means of developing systematic and creative thinking. The results of this study indicate an increase in student creativity through idea exploration, design experiments, and the integration of functional aesthetics into their work. This research aligns with research conducted by Oktaviani et al. (2025) at the elementary school level, which also showed that project-based STEAM learning and arts integration can enhance student creativity, both in the context of dance and applied science activities.

Collaborative Learning

Students build miniature bridges using Popsicle sticks as the primary material, requiring precision, technical skills, and careful planning at every stage of construction. This process encourages students to consider aspects of structure, balance, and strength, while creatively applying design principles. This activity demonstrates that Fine Arts learning is not solely oriented toward visual aesthetics, but also toward function and contextual problem-solving. During the construction phase, collaborative learning plays a crucial role as students work in groups to design, build, and refine the miniature bridges. Students share roles according to their abilities, discuss solutions to determine the best solution, and negotiate ideas when facing technical challenges. This interaction creates a dynamic and participatory learning environment (Syahnia et al., 2024).

Intensive group work also facilitates peer learning, where students share knowledge, experiences, and strategies to complete assigned tasks. Through these interactions, students can clarify understanding, provide feedback, and collectively develop solutions to problems that arise during the miniature bridge construction process (Anwar et al., 2025)**.** Through this peer learning process, students not only develop cognitive and psychomotor skills, but also interpersonal communication skills, a sense of responsibility for group assignments, and the ability to collaborate effectively. These developed social competencies contribute significantly to the success of the project and strengthen students' active engagement in STEAM-based Fine Arts learning, creating a collaborative, meaningful, and contextual learning experience.

This research is in line with the research conducted by Aziz et al. (2025), the results of this study indicate that the implementation of STEAM in mathematics classes has a positive impact on 21st century skills, especially on students' collaboration and critical thinking, which are an integral part of the integrated learning experience across disciplines.

Art and Science Integration

In the final stage of the lesson, the miniature bridges students have created are tested for their physical structural strength. This testing activity provides a concrete context for students to integrate elements of art and science into a cohesive and meaningful learning experience. Through this testing, students not only assess the visual beauty of the work but also evaluate the function and strength of the structure scientifically. Students relate the artistic design to scientific principles, such as balance, load distribution, material strength, and structural stability. This process encourages students to reflect on their design decisions and understand the cause-and-effect relationships between form, materials, and the function of the structure. Thus, students gain an understanding that artwork in a STEAM context does not stand alone but is closely integrated with scientific logic and reasoning.

Through the integration of art and science in STEAM-based learning, students begin to realize that aesthetics and function are two complementary elements in the design process of an engineering project. Students consider not only the visual beauty of the resulting miniature bridge but also the structural strength, balance, and effectiveness of the design in supporting loads. This understanding demonstrates that artistic and scientific processes can occur simultaneously and reinforce each other.

This type of learning strengthens students' critical and creative thinking skills as they are required to analyze problems, evaluate various design alternatives, and make revisions based on the results of testing. Furthermore, this interdisciplinary learning experience emphasizes the role of Fine Arts not only as a subject oriented solely toward aesthetic expression, but also as a contextual learning vehicle relevant to the application of science and technology. Thus, STEAM-based Fine Arts learning provides a meaningful learning experience and supports the development of 21st-century competencies.

This research is in line with the latest literature Malinda et al. (2024) which explains that STEAM creates meaningful and motivating learning experiences through direct student involvement in practical and contextual activities.

Implications

STEAM-based Fine Arts learning demonstrates student engagement and creativity, including in classes with relatively large student populations. This is reflected in students' active participation at every stage of the learning process, ranging from idea planning and the design and construction of artworks to reflection on the outcomes achieved. Such active engagement indicates that the STEAM approach supports the creation of student-centered learning environments.

Through the STEAM approach, Fine Arts learning does not solely emphasize visual aesthetics but also encourages students to understand and apply concepts from science, technology, engineering, and mathematics in an integrated manner. Students are involved in systematic thinking, problem analysis, and the exploration of creative solutions through design and experimentation. In this context, art-making serves as a medium for the development of critical and innovative thinking in a contextualized way. Another observable implication is the development of students' collaborative and communication skills through group work in STEAM projects. Students learn to work together, share roles, and take responsibility for assigned tasks.

These experiences not only support the continuity of project-based learning activities but also equip students with social and 21st-century skills relevant to further learning and everyday life. Pedagogically, the findings suggest that STEAM-based Fine Arts learning can serve as an effective and relevant alternative instructional strategy at the secondary education level. This approach has the potential to enrich arts learning practices, broaden the meaning of arts education, and foster meaningful and collaborative learning experiences oriented toward the development of students' creativity.

Teachers are encouraged to design interdisciplinary learning activities that integrate arts and science in contextual and meaningful ways, for example through problem-based learning or collaborative STEAM-based projects (Syahnia et al., 2024). Designing such activities allows students to connect artistic concepts with scientific and engineering principles, so that Fine Arts learning focuses not only on aesthetic aspects but also on real-life problem-solving. This approach encourages students to work collaboratively in groups, exchange ideas, and negotiate creative solutions to challenges encountered during the learning process.

Thus, learning is oriented not only toward the final product but also toward students' thinking processes, exploration, and innovation. Through the implementation of STEAM-based Fine Arts learning, students have opportunities to develop 21st-century skills such as collaboration, creativity, critical thinking, and problem-solving abilities, which are relevant to the demands of education and life in the global era.

CONCLUSION

The implementation of STEAM-based Fine Arts learning produced several key research results. In the cognitive and affective domains, student engagement was evident through active participation, sustained enthusiasm, and responsibility throughout the learning process. Students were involved not only physically but also cognitively and emotionally in designing, discussing, and reflecting on their work. In the creative domain, students demonstrated creativity through diverse design ideas, flexible problem-solving strategies, and the ability to integrate aesthetic considerations with scientific reasoning. The learning process encouraged students to explore alternatives, evaluate outcomes, and refine their designs, indicating the development of reflective and innovative thinking. In

the social domain, collaboration was observed through group discussions, role distribution, and collective decision-making. Students learned to communicate ideas, respect differing perspectives, and work cooperatively to achieve shared goals, supporting the development of essential 21st-century skills.

The research results indicate that STEAM-based Fine Arts learning provides meaningful and integrated learning experience by connecting artistic expression with scientific and engineering principles. However, this study was limited by its small sample size, single-school context, and reliance on qualitative data, which may restrict the generalizability of the research results. Future research is recommended to involve larger and more diverse samples, employ mixed-method approaches, and examine the implementation of STEAM-based learning across different subjects and educational levels to strengthen empirical evidence and broaden its educational applicability.

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