



## Engaging Students in Science Learning Through an Art-Based Approach: A Systematic Review

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### Keywords

*STEAM education, systematic review, Engagement, Art-based approach*

### Abstract

*The purpose of the study was to present a systematic review to explore the student's engagement, and to explain how to develop and promote conceptual understanding, equity, and transformative learning in science education through visual and performing art. For these purposes, seven articles were selected from Google Scholar, Sage Publications, Springer, Frontiers in Education, Science Education International, Institutional repositories (e.g., Scholar Works), and Scopus database which are chosen as per the basis of inclusion and exclusion criteria sets by researcher in method of systematic review approach follow the meta-analysis and meta-synthesis process. The data is analyzed in terms of theme which is generalized through systematic review of web based database includes as research articles. The systematic reviews reflect that art-based learning promotes students' engagement, conceptual understanding, develops creativity, and provides space for equity, lived experiences, and socio-cultural aspects of the learner. Likewise, the study reflect that art-based strategies promote innovation, creativity, and transform the education system. The review suggests that Art integrates STEM plays a crucial role in guiding 21st-century education, making science education more inclusive, imaginative, and transformative. Similarly, art integrated teaching incorporates the glocal knowledge in actual classroom setting that helps to develop the 4Cs skills among students. Therefore, art-based learning is milestone for science education.*

## Introduction

The twenty-first century is the era of innovation, where every individual and society has increasing needs and demands. Sustaining and fulfilling these needs and aspirations requires innovation in education. For that, STEAM education is a new innovative approach for fulfilling this aspiration; it integrates the different facets of education, such as science, technology, engineering, art, and mathematics, in a holistic approach, thus it acts as a transformative approach for the educational field that "opens the door to.... design thinking.....and learner placed at the center of the study"(Hunter-Doniger, 2021). Therefore, STEAM education opens the gateway(s) for diversity of learning, it helps to develop the habits of critical thinking, creativity, collaboration, communication, and problem-solving skills are inculcated to require a global citizen and future sustainable carrier.

In the present time, the global is the hub of learning, where the knowledge and pedagogy of learning are changing day by day, thus the learning style of science is changing and inculcates the habit of creativity, critical thinking, and problem solving that are possible through cultural relevance and emotional engagement of the students in teaching. But, our traditional practices of science teaching is based on the delivery of facts, decontextualized, content delivery-based, focuses on memorization and recalling of scientific phenomena, and is less focused on conceptual understanding, student motivation, equity, and inclusive learning environments in the classroom. In this scenario, the concerned authority person, like a researcher or a teacher, focuses on an alternative method of teaching, which is art-based and narrative pedagogy that promotes science learning as human-centric, incorporate students' motivations, beliefs, identities and

creates a democratic environment in science classroom (Simões & Sousa, 2024; Hunter & Frawley, 2022; Hatzigeorgiou & Schulz, 2022). Therefore, art-based pedagogy is an effective means that incorporates students' experiences as well as the cultural aspects of students, enabling them to achieve the learning goals of teaching.

The term STEM formally began in 2001, coined by the American agency, National Science Foundation (NSF), whose aim is to promote individual careers and focus on science-centered curricula. In 2006, Yakman introduced STEAM for developing creativity and innovation through art. The term is written in the integrated curriculum perspective, as STΣ@M. Yakman (2008) defined STΣ@M as "A" developing educational model of how the traditional academic subjects (silos) of science, technology, engineering, arts, and mathematics can be structured into a framework by which to plan integrative curricula. Now, the integration of art in STEM is not only for aesthetic purposes, but it is also for the engagement of students with natural context. Thus, the art-based learning, visual arts, storytelling, drama, and creative writing tools act as a medium for learners and facilitate learning, where learners connect abstract scientific concepts, facts, and phenomena to their lived experiences, emotions, and sociocultural identities (Rule et al., 2016; Hughes et al., 2022).

Hughes et al. (2022) and Pant et al. (2023) argue that art and narrative-based pedagogy have a significant impact on science, it is because science learning makes it re-humanize, accessible, equitable, and inclusive. The use of art, visual, drama, creative writing, and narratives is crucial for multi-lingual and marginalized communities because learners get an opportunity to explore scientific ideas

through cultural, emotional, and aesthetic lenses (Hughes et al., 2022; Pant et al., 2023). Therefore, an artistic approach increases students' curiosity, imaginative power, and encourages students to see that science is not a banking process, but it is a process of enhancing the capability of learners.

According to Lovejoy et al. (2022), the teachers who adopted arts-integrated pedagogies dance, storytelling, and drawing, apply in science classrooms, teaching learning approach shifted toward student-led driven, reflective, and inclusive classroom, promotes students' engagement, and promotes students' performance in science learning. Moreover, the art-integrated pedagogy develops creativity and measures the cognitive and motivational factors within the STEM approach. Pont-Nicols et al. (2022) study shows that scientific creativity is positively correlated with STEM engagement and aspirations of students. This study reflects an artistic approach, enhancing the creativity and developing the potential of innovative skills. Similarly, art-based storytelling pedagogy in science learning connects the abstract scientific ideas to students' real-life lived experiences. According to Hatzigeorgiou and Schulz (2022), a romantic and narrative pedagogical approach that enhances the emotional resonance and a sense of humor among the students, which develops the insight of curiosity, and motivation toward learning. Similarly, pant et al. (2023) argue that integration of storytelling traditional pedagogy in science education enabled learner to connect their cultural heritage with scientific thinking, promoting cultural and academic inclusion.

From the reflective views of the study, highlight the potentiality of art-based pedagogy in science education, thus, it

is needed for the systematic review that examines how art-integrated pedagogy influences students' engagement, conceptual understanding, creativity, critical thinking, equity, and inclusivity in the classroom. Therefore, the systematic review provides a more holistic understanding of how art-based interdisciplinary pedagogy incorporates students lived experiences and promotes a culturally responsive environment that transforms science learning for conceptual understanding and develops STEAM-based skills.

### **Contribution of the Literature**

The engagement of students in science learning through art-based learning is fruitful and a milestone for the development of STEAM-based abilities and promotes empathy, equality, empowerment, and makes learning culturally relevant and incorporates students lived experiences in learning, but lack of studies that have been done to focus on an art-integrated approach in science studies. Thus, in this research, I systematically examined the previous studies that provide insight about art-based learning and how researchers integrate art in science and what the impacts of learning in science are, that insight contribute to the literature. The findings from the systematic review provide insight into how the integration of art-based pedagogy has a profound impact on students' learning, develops STEAM-based skills, and improves their' learning outcomes of students.

### **The Systematic Reviews Process**

The objectives of the systematic review are to identify the art-based relevant pedagogy and its role in science education for promoting students' engagement, creativity, and conceptual understanding, and to adopt culturally and socially relevant pedagogy

in science learning. The systematic study focuses on the research question of how art-based learning outcomes pedagogy promotes students' engagement, and its impacts on creativity, conceptual understanding, and equity in science learning.

**Methods**

This study follows a systematic review approach, which aims to synthesize the relevant studies of art-integrated pedagogy in science learning. Systematic reviews provide precise and relevant scientific evidence and help to examine specific issues through database sources on the web. The ethics of the research is ensuring through transparency by mentioning the research articles in tabulated form their sources, proper citation, accurate presentation and properly acknowledging the first authors.

**Data Collection Procedures**

The systematic review research on engaging students in science learning through art-based learning. The data was collected from database sources, Google Scholar, Sage Publication, Springer, Frontiers in Education, Science Education International, Institutional repositories (e.g., Scholar Works), and Scopus database. The research data collection is based on inclusion and exclusion criteria, which are mentioned in Table 1, to make the systematic reviews relevant. Accordingly, the data collection procedure was held on those who met the inclusion criteria.

- Studied based on an Art-integrated approach/STEAM
- Studies done from 2016 to 2025
- Only write in the English language
- Focused on visual Art and performing art

In addition to these inclusion criteria, I do not use a data searching process, I exclude those

studies that do not meet the exclusion criteria. First of all, I collected all the documents, as per the inclusion criteria, keywords, like STEAM and Art, I collected 103 research articles, and then excluded all articles that do not focus on visual and performing art-related studies in science studies. Finally, I selected seven articles by applying the lottery method and mentioned in table 3

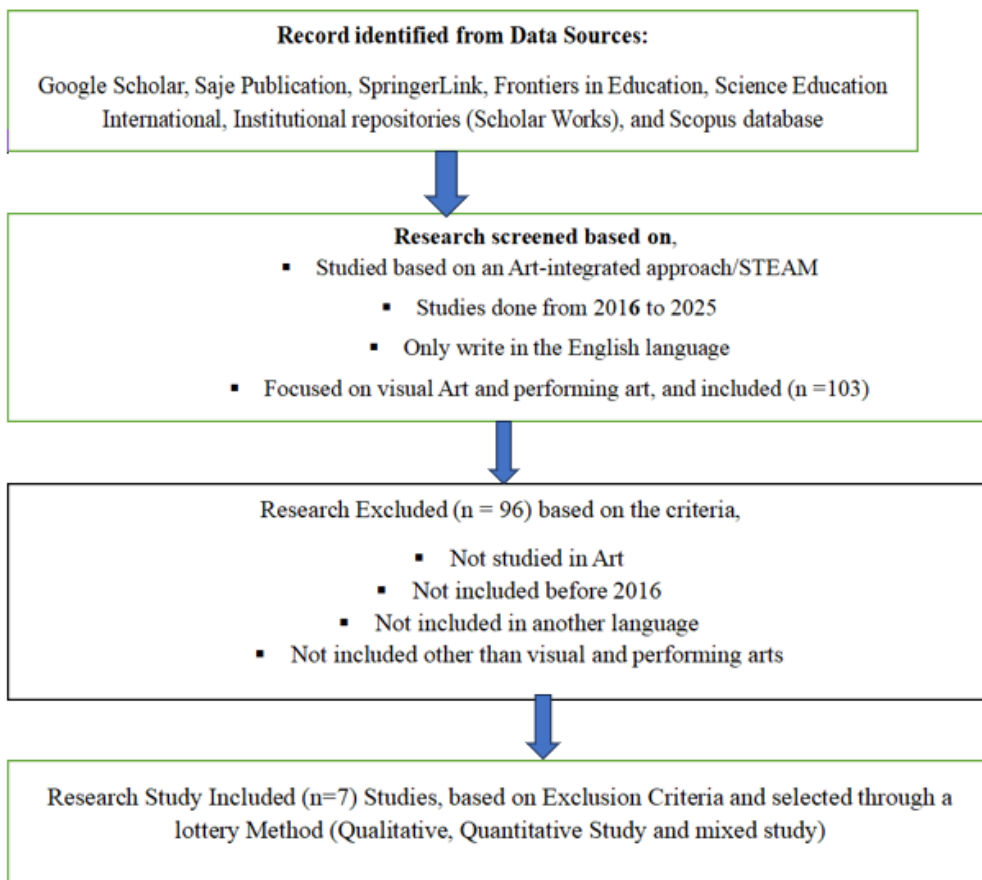
**Table 1.** *Criteria for Inclusion and Exclusion of Research Articles for Systematic Review*

Inclusion criteria:	
Exclusion criteria	
Studied based on an Art-integrated approach	Not studied in Art integrated
Studies done from 2016 to 2025	Not included before 2016
Only write in the English language	Not included in another language
Focused on visual Art and performing arts	Not included other than visual and performing arts

**Table 2.** *Main Keywords*

Main	
words,	Alternative words,
Search place	
STEAM. STEAM: science, technology, engineering, arts, and mathematics; & STEAM education Keywords	
ART: Visual art, storytelling, drawing, modeling, creative writing, romantic narrative,	
Critical reflection, Transformative learning, personal storytelling, Local art forms,	
Keywords	

## Data Analysis Procedure



**Figure:** Systematic Review Follows the Stage-by-Stage for Analysis

**Table 3.** A List of Articles in Systematic Review

Reference	Title	Source Title
Simões & Sousa (2024)	Enhancing Science Education Through Visual Art and Complex Storytelling: The Case of Einstein and Eddington	<i>Science and Education</i> , Springer.
Rule et al. (2016)	Literacy and Arts-Integrated Science Lessons Engage Urban Elementary Students in Exploring Environmental Issues	<i>Science Education International</i> .
Hatzigeorgiou & Schulz (2022)	Engaging Students in Science: The Potential Role of “Narrative Thinking” and “Romantic Understanding	Frontiers in Education

Pant et al. (2023)	Science and Art as Ways of Knowing in School Education in Nepal.	<i>Discover Education</i>
Pont-Niclòs et al. (2024)	Scientific Creativity in Secondary Students and Its Relationship with STEM-Related Attitudes	Frontiers in Education
Hughes et al. (2022)	Integrating Arts with STEM for Equity in the U.S.	International Journal for STEAM Education, Springer
Lovejoy et al. (2022)	What Teachers Learn from Science and Arts Integration in a Design-Based Learning Framework.	Issues in Educational Research

**Table 4.** *The Authors and Aim of Articles*

References	Aim of articles
Simões & Sousa (2024)	This paper delves into the innovative integration of arts in science education, as exemplified by the book Einstein, Eddington, and the Eclipse
Rule et al. (2016)	Examined student attitudes, writing skills, content knowledge, literacy, thinking skills, and art-integrated environmental science of urban 4 <sup>th</sup> and 5th-grade students
Hadzigeorgiou & Schulz (2022)	Discuss the possibility of engagement with science content learning by focusing on the potential of two ideas, namely, “narrative thinking” and “romantic understanding.
Pant et al. (2023)	Explores the need to integrate science and art as pedagogical approaches in school education.
Pont-Niclòs et al. (2022)	The main aim of this study is to Assess the scientific creativity of the Spanish compulsory secondary school students, and their relationship with their attitudes towards science, in terms of perceptions, engagement, and career expectations.
Hughes et al. (2022)	Explore the potential of arts-integrated science as a way to expand these opportunities for EB students.
Lovejoy et al. (2022)	Aimed to integrate science and the arts in a whole-school approach.

**Table 5. Overviews of the Study**

Study	Methodology	Participants	Art	Focus Area	Key Findings
Simões & Sousa (2024)	Qualitative	Secondary level students	Visual art, storytelling	Scientific reasoning, epistemology	Promoted critical thinking, narrative-enhanced scientific understanding
Rule et al. (2016)	Quasi-Experimental	Elementary Students (120)	Drawing, modeling, and creative writing	Environmental science	20% content gain; increased environmental concern
Pant et al. (2023)	Mixed Methods	Secondary level students (72) and teachers (8)	Local art forms, cultural storytelling	Science inclusion	Culturally relevant pedagogy enhances students' participation and understanding
Pont-Niclòs et al. (2022)	Quantitative	Secondary students (450)	Creative problem-solving tasks	Creativity, STEM attitudes	Relation between creativity and STEM interest ( $r = .42$ )
Hughes et al. (2022)	Mixed Methods	Bilingual students (96)	Theater, visual art, music	Equity in science learning	Post-test increases 15–25% score in science and language
Hadzigeorgiou & Schulz (2022)	Theoretical, empirical support	Middle school	Romantic narrative, personal storytelling	Science engagement	Narrative, wonder, and emotional resonance with science
Lovejoy et al. (2022)	Design-Based	Teachers (5), students (100)	Storytelling, dance, drawing	Science pedagogy	Adopted a more inclusive, creative teaching approach

## Discussion and Implications

The overview of the systematic reviews generalizes argumentative facts that provide insight into themes, and that provides a road-map of thematic analysis, which provides analytical evidence through qualitative and quantitative studies. The overview of the study analyzes and focuses on how art-based approaches promote student engagement and impact on science teaching and learning. The reviews of articles provide the evidence to formulate the theme that gets insight to support the implementation of art-based learning in science classrooms, making learning meaningful and promoting conceptual

understanding as well as developing 21st-century STEAM-based skills. Moreover, the systematic reviews of the articles provide generalized evidences that contribute to the field of science learning.

### Students' Engagement and Conceptual Understanding

The review of the study reflects that integration of art, visual, narratives, and performance arts in STEM provides the entry point of abstract content by stimulating multiple ways of knowing and senses, which promotes cognitive and affective engagement of the students. Hatzigeorgiou & Schulz



(2022) reflect that the concept of romantic and narrative-based art teaching emotionally connects the abstract scientific phenomena with their personal stories and events that promote thinking ability, motivation, and learning by doing habits among students. Similarly, Simoes & Sousa (2024) argue that art-based narrative study deepens the students' understanding and scientific knowledge. The study reflects that art-based learning, visual arts, and storytelling connect the abstract scientific phenomena with individual insight and promote empathy, critical reflection, engagement, and conceptual understanding of students. Similarly, Rule et al. (2016) argue that art integrated with drawing, creative writing, and modeling improves the students' understanding scores by 20%, which suggests that a multimodal artistic approach increases the students' retention and conceptual understanding. In addition, Lovejoy et al. (2022) observe that the teachers who apply the arts-integrated pedagogy in the classroom promote flexible and inclusive teaching practice. Moreover, Arts-based design thinking process assists the teacher and students to reflect on their understanding and make science more reflective, conceptual, accessible, and engaging for every learner at their own pace. From these multiple studies suggested that art-based, visual, narrative, and creative art helps the learner to internalize the abstract scientific concept, making learning meaningful, enjoyable, and enhancing the engagement, so art-integrated pedagogy is a blessing for the teaching field. In my reflective views, the study provides insight about how to minimize the traditional hegemonic cultural practices rooted in the classroom through the implementation of art-based innovative pedagogy that promotes students' engagement in science learning, develops STEAM-based skills, and promotes conceptual learning.

As per the review articles and my reflective lens, art promotes learners' engagement, it means increases the level of interest, motivation, and commitment habits during the time of teaching activities. In my reflective insight, art promotes behavioral, emotional, and cognitive engagement of students while learning. As per these arguments, students are actively engaged in learning, creating well-felling values, and a willingness to share their ideas through art-based learning promotes engagement and conceptual understanding among learners. In the context of science education, art connects all these dimensions at the time of learning, makes science learning emotionally interesting in science content, increases active participation in class, and explores and shares their ideas as per their cognition. Thus, all these situations are created through the art-based learning, so that art is the tool for eliminating traditional hegemonic cultural practices in science learning, and act as a means for the improvement of students' engagement and conceptual understanding.

### **Fostering the STEAM-based skills**

STEAM education is a new, innovative approach in the field of education that integrates different facets of education, such as science, technology, engineering, art, and mathematics, in a holistic approach. Thus, STEAM acts as an innovative approach for the educational field that "opens the door to....design thinking... and students are placed at the center of the study"(Hunter-Doniger,2021). Thus, the STEAM approach opens the multiple realities of learning. Furthermore, art-based STEAM education develops creativity, critical thinking, communication, and problem-solving abilities. The reviews of the study reflect that art-based STEM develops creativity, which is the pathway to STEM. According to Pont-Nicols et al. (2022), the art-based approach develops creativity and has a



positive correlation with STEM interest and individual carriers ( $r = 0.42$ ,  $p < 0.01$ ). This study reflects that students who engaged in creative work of problem-solving can think scientifically and innovatively. Furthermore, this study reflects that creative thinking supports identity formation in science. The study reflects that art-based pedagogy promotes engagement of students, which is not for academic performance, but rather for creating interest in long-term motivation for science. Similarly, Hunter-Doniger (2021) state that, when the learner engaging in creativity, autonomy that promotes the ability of imagination and problem-solving skills among learners. In addition, STEAM is the first and foremost approach that promote learning gain for bilingual learner, that facilitates scientific knowledge and promote equitable classroom that facilitate the collaboration and communication (Hughes et al., 2022). Love-joy et al. (2021) mentioned that teacher who adopt the design-based pedagogy in the classroom that develop the habits of critical thinking, creativity, and interdisciplinary skills of pedagogy. In addition to Simoes and Sousa (2024) study reflect that visual arts and storytelling-based pedagogy promotes conceptual understanding, creativity and reflective thinking among students. As per the insight of these studies, I realized that art-based approach fostering the holistic sets of skills such as creativity, critical thinking, reasoning through collaborative and communicative action in equitable environment promotes cultural inclusivity and sustainable learning. Therefore, art is act as a transformative tools for science learning.

As per the conclusive views of these studies, I argue that, art-based pedagogy provides the space for students' engagement and holistic learning experiences, which not only develop creativity but also enhance the students'

interest and motivation toward science teaching and learning. Similarly, art-based pedagogy tackles the challenges of traditional hegemonic cultural practices in the science classroom. Moreover, art-based pedagogy bridges the gap between STEAM-based skills and current practices of the teaching and learning framework. In my reflective lens, art acts as a tool for the improvement of the teaching/learning scenario of the classroom and acts as a means for reforming, re-framing and re-imagining the pedagogical aspects of the classroom environment.

As per the STEAM lens with respect to these studies, I realize that our educational institutions are running a one-size-fits-all policy but do not focus on learners -fits-on-all -sites modality, thus, our educational practices fit a one-size-fits-all modality emphasizing teacher-centered educational practices; thus, in this situation, art plays the crucial role to change our learning scenario, to become more reflective learning, meet the demands of learners, and develop 21st-century skills. Thus, I feel that, STEAM-based artistic approach is an innovative tool for reforming our teaching habits in the classroom and making science learning interactive, joyful, and promoting 21st-century skills among students. I realize that an art-based approach is relevant that promotes empathy in teaching, develops conceptual understanding, criticality, divergent thinking, and creativity among the learners (Taylor, 2019). It promotes the students' participation in science learning productively as well as trains them in problem-solving and developing meta-cognitive skills that help to succeed in solving problems of the 21<sup>st</sup> century through STEAM-based skills, which are developed through art-based teaching. Thus, art acts as a fruitful tool and milestone for reforming science learning.

**Art promotes equity, equality, and empowerment**

Art-based education has a multifaceted impact beyond student engagement; it acts as a vehicle for justice and decolonization of science education, providing a place of equality, equity, and empowerment through art-based instruction. According to Pant et al. (2023), integration of art-based teaching, local arts, and storytelling in the classroom promotes learners' values, cultural identities, supports knowledge inclusiveness, and puts their feelings, beliefs, cultural and community practices, and realities within the science classroom. Thus, the integration of art-based learning in the science classroom decentralizes or decolonizes from teacher-centered to student-centered, and culture-centered by authenticating the multiple ways of knowing. Furthermore, art-based pedagogy promotes indigenous knowledge and empowers marginalized students in the classroom. Similarly, Hughes et al. (2022) studied the main focus on equity, which was undertaken in multilingual and culturally diverse learners participating in theater, song, and visual art-integrated lessons, increasing the 15-20 % science understanding and language skills. Likewise, it focuses on art-integrated pedagogy to mitigate the access barrier of culturally and linguistically diverse learners. According to Lovejoy et al. (2022), Art opens the gateway for inclusive instructional practices in science classrooms. From these studies, it reflects that art-based pedagogy is not only focused on student engagement, but it is a powerful tool for promoting equity, inclusiveness, and empowerment in the classroom. Thus, the visual and performing arts play crucial roles in Cultural, social, as well as educational fields, where students get an opportunity to reflect on them, so increase the engagement, conceptual understanding, and retention of knowledge.

**Art integrates cultural aspects and lived Experiences of the learner**

Art-based pedagogy is a tool, like a metaphor, that connects students lived experiences with a cultural and sociological framework. Now, incorporating this metaphor in the science classroom makes learning enjoyable, fruitful, and promotes conceptual understanding. As per the arguments of Simões & Sousa (2024), science is not culturally and politically free, but embedded with cultural and political aspects; thus, teaching should be carried out as per the knowledge generated from cultural and political aspects. According to Simões and Sousa (2024) argue that science activity is framed as a historically and geopolitical embedded activity, which facilitates the culturally responsive art-based pedagogy that helps to deconstruct the myth of science as objective and culture-free. Furthermore, art is not a decorative tool, but it provides a thinking medium, where students reflect their abstract ideas in visual form. In addition, visual art and reflective writing encourage students to connect their story with their experience and navigate the truth. According to Hatzigeorgiou and Schulz (2022), art-based storytelling pedagogy is a means of rekindling wonder and imagination. Both of these reflective studies emphasize that lived experience is not isolated from science learning, creates a crucial position in science learning, and thus art-based learning connects the students lived experiences. This study reflects that science learning is not a reductionist view, but it is cognitively rigorous, emotionally resonant, and culturally inclusive. Moreover, art in STEAM is not "add-on" but it act as a bridge to connect the disciplinary knowledge to learners cultural aspects and lived experiences into science learning, fostering, creativity, criticality, equitable environment and in-depth conceptual understanding of abstract scientific phenomena(Hunter-Doniger, 2021;Hughes et al., 2022; Lovejoy

et al.,2021; Pant et al.,2023). Thus, all these aspects are incorporated through the art-based approach that makes abstract scientific phenomena more accessible, individualized, culturally responsive, and cognitively rigorous. The review of these articles reflects that students are not empty vessels, but have certain values, experiences, history, cultural beliefs, and emotions. Therefore, teachers should focus on the lived experiences of students while designing instruction. The connection between students' experiences, cultural aspects, with learning content makes science learning meaningful, inclusive, and transformative.

### **Art Integrated Pedagogies Promote Transformative Learning**

The reviews of these studies reflect that art-based pedagogy transforms the traditional culture of teaching and the beliefs, perceptions, and thoughts of teachers and students toward teaching. Lovejoy et al. (2022) studied teachers engaged in design-based learning that integrated arts into science teaching. This study emphasizes that the art-based design thinking process promotes teachers' reflection, flexible curriculum, and transforms lecture-based instruction to student-driven pedagogy, such as collaborative and inquiry-driven. The reviews of the study reflect that art-based pedagogy is not only for students' transformation but also transforms teachers' beliefs, thoughts, and teaching practices adopted in the classroom, making learning more adaptive, reflective, inclusive, and developing STEAM-based skills among students. Thus, Art is an innovative tools that facilitate action and reflection, which promotes transformative learning by reshaping and re-imagining the pedagogical role in learning that focuses on how students and teacher engage with science through bridging the culture and experiences with art, that allow to promote STEAM based skills,

critical conscious through interdisciplinary and learner centered teaching( (Hunter-Doniger, 2021; Hughes et al., 2022; Lovejoy et al.,2021; Pant et al.,2023;Simoes &Sousa,2024) . From this review study, art-based pedagogies act as professional tools that enable teachers to implement more relevant innovative pedagogy, enhance flexibility, reflectivity, and an inclusive classroom, encourage student-driven activity, and address the varied abilities in teaching. These scenarios transform the learning and promote reflective teaching; thus, art-based pedagogy is a milestone for educational transformation.

As a STEAM educator's reflective lens, I saw the pedagogical aspect through the lens of a transformative perspective. I realized that the classroom is a complex place of teaching and learning laboratory, which reflects the image of cultural, pedagogical, personal experience, and intellectual diversity. In this sense, all educators' role is to integrate all aspects in teaching that challenge the conventional practices in the educational field. Now, the reviews of this study are further supported by additional literature, as per Taylor's (2015) argument, art-based pedagogy promotes a constructivist environment in the classroom that facilitates collaboration, dialogic, design thinking, divergent thinking, and provides opportunity for sharing ideas that promote reflection and creativity among learners. According to Taylor (2015), teaching is a cultural and ethical practice, enhances critical self-reflection. Thus, we aim to promote a dialogic process and every activity incorporates the living experiences of the learners, which changes the role of the teacher from expert to facilitator, mentor, guide, and reformer of learning. As an educator, I realize that teaching activities are designed through problem posing (Dahal,2022), which is based on liberty pedagogy, pedagogy of hope, that facilitates critical consciousness, inclusivity,

and empowers the learners (Luitel et al., 2022). As a STEAM educator, I get insight from reviews of this study, teaching pedagogy is based on a learning by doing approach, which facilitates the situation of a disorienting dilemma (Taylor, 2022), that promotes engagement, conceptual understanding, creative, reflective, and imaginative thinking. Thus, we aim to emphasize the practice over perfection, which facilitates the action and reflection-based pedagogy that facilitates transformative learning. From this reflective lens, art-based pedagogy facilitates all these aspects in the classroom, so it acts as a transformative pedagogy for science learning.

As per the reflective lens, the implications of this study is to get insight about how to reforming, re-framing and re-imagining science learning through innovative ways that promotes students' interest, motivation, and enabling teacher to design and implement learner friendly approach that promotes conceptual understanding. Similarly, it provides evidence-based guidance for curriculum and policy developer, how to design curricula, content, objectives, and activities as per the cultural and lived experiences that sustain the goal of equity, empowerment, and sustainability of science education.

## Conclusion

As per the bird eye's views of STEAM lens, our educational system is rooted in hegemonic cultural practices in the classroom that emphasized on "chalk and talk" and "sit and get" system. Now, these cultural practices are reformed through the integration of art-based pedagogies in science teaching/learning, open the door for diversity of learning that is crucial for shifting the modality of learning from "one-size-fit's-all" into learner fit's- on-all-site". Thus ,art-

integrated pedagogies are powerful tools for transforming science teaching and learning. Furthermore, the systematic review provides a deep insight into art-based pedagogy that enhances students' engagement, conceptual understanding, develops creativity, promotes an inclusive and emotional classroom environment, transforms pedagogies, and supports teachers' professional development. This study provide insight about how, and what situation we can integrate the art-based approach in science learning that ensuring the students' engagement, develop conceptual understanding, and legitimacy in developing STEAM-based skills. Likewise, it develops concept of respecting cultural aspects, lived experiences, and promoting innovative thinking that should play a crucial role in guiding 21st-century education, making it more inclusive, imaginative, creative, and transformative science education facilitate to develops 21st-century STEAM -based skills.

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