JAPRA
Jurnal Pendidikan Raudhatul Athfal
P-ISSN. 2527-4325 E-ISSN. 2580-7412

The Implementation of Arts in STEAM Learning for Children

Wulandari[1], Dyah Ageng Pramesty Koenarso[2]
[1, 2]UIN Antasari Banjarmasin
Jl. Pandarapan Km. 1 Banjarbaru, Kalimantan Selatan, Indonesia 70721
Email: wulandarilande@gmail.com[1], dyah-ageng@uin-antasari.ac.id[2]

Received: November 10, 2025, Revised: December 17, 2025, Approved: December 30, 2025

Abstrak

Artikel ini bertujuan mendeskripsikan implementasi aspek seni dalam pembelajaran Science, Technology, Engineering, Arts, and Mathematics (STEAM) pada 22 anak kelompok B1 di RA Ulumul Qur'an Al Madani, Kota Banjarbaru. Penelitian lapangan ini menggunakan desain deskriptif kualitatif. Data dikumpulkan melalui empat observasi kelas, wawancara semiterstruktur dengan dua guru kelas dan kepala sekolah, serta dokumentasi pembelajaran. Data dianalisis secara siklik melalui kondensasi, pengodean, penyajian, dan verifikasi; kredibilitas diperkuat melalui triangulasi sumber, teknik, dan waktu. Hasil menunjukkan empat kelompok kegiatan pembelajaran: bermain peran profesi dan jual beli; kegiatan mewarnai–menggunting–menempel bertema nelayan; aktivitas sentra berupa balok, playdough, dakon, dan kaligrafi; serta menggambar bulan, meronce, menyusun huruf dengan batu, dan congklak. Keempat kelompok tersebut merangkum kegiatan seni yang diamati dalam pembelajaran yang disebut sekolah sebagai STEAM, bukan capaian perkembangan yang diukur. Kegiatan ini dikaji untuk menelusuri keterkaitan seni dengan bidang STEAM lainnya. Seni berfungsi sebagai medium ekspresi, representasi, konstruksi, dan komunikasi yang membuka peluang bagi eksplorasi alat, desain, pola, jumlah, bahasa, kerja sama, dan motorik halus. Namun, keterpaduan STEAM belum konsisten karena sains, teknologi, rekayasa, dan matematika sering hadir sebagai potensi implisit, bukan proses penyelidikan yang sengaja dipantik. Temuan ini menjadi dasar rekomendasi penguatan dukungan guru yang menghubungkan proses artistik dengan observasi, pertanyaan terbuka, perancangan, pengujian, revisi, dan penjelasan anak.

***Kata kunci**: anak usia dini, pendidikan seni, pembelajaran terpadu, scaffolding, STEAM*

Abstract

This article describes how the arts were implemented within Science, Technology, Engineering, Arts, and Mathematics (STEAM) learning among 22 Group B1 children at RA Ulumul Qur'an Al Madani, Banjarbaru. A qualitative descriptive field design was employed. Data were generated through four classroom observations, semi-structured interviews with two classroom teachers and the principal, and learning documents. Analysis proceeded cyclically through data condensation, coding, display, and verification; credibility was strengthened through source, method, and time triangulation. Four groups of learning activities were identified: occupation and buying–selling role-play; fisherman-themed coloring, cutting, and pasting; center activities involving blocks, playdough, dakon, and calligraphy; and moon drawing, beading, stone-letter construction, and congklak. These groups summarize observed arts activities in lessons identified by the school as STEAM, rather than measured developmental outcomes. They were examined to trace connections between the arts and other STEAM domains. The arts operated as media for expression, representation, construction, and communication, creating opportunities for tool use, design, patterns, number concepts, language, cooperation, and fine-motor coordination. Nevertheless, STEAM integration was inconsistent because science, technology, engineering, and mathematics frequently remained implicit possibilities rather than intentionally elicited inquiry processes. The findings inform a recommendation to strengthen teacher scaffolding that connects artistic processes with observation, open-ended questioning, designing, testing, revising, and children's explanations.

Keywords: arts education, early childhood, integrated learning, scaffolding, STEAM

Introduction

STEAM education integrates science, technology, engineering, the arts, and mathematics around meaningful questions and practices rather than presenting them as isolated subjects. In early childhood education, this integration is developmentally appropriate when it is grounded in play, sensory exploration, conversation, design, and representation. Young children do not need formal disciplinary labels; they need opportunities to notice phenomena, ask questions, select and manipulate tools and materials, construct and revise ideas, compare quantities and forms, and communicate what they have learned (DeJarnette, 2018; Hunter-Doniger, 2021; Su et al., 2025).

The arts are not simply an attractive addition to STEM. Visual art, dramatic play, movement, sound, and symbolic construction can function as modes of inquiry and

communication. When children draw, model, arrange, dramatize, or redesign, they externalize emerging ideas that may not yet be available in conventional language. Arts-integrated learning can therefore support imagination, embodied understanding, spatial reasoning, and problem framing (Halverson & Sawyer, 2022; Henriksen, 2017; Liao, 2016). Perignat and Katz-Buonincontro's (2019) review similarly shows that STEAM is conceptually strongest when artistic practices help connect disciplines rather than merely decorate a finished STEM product.

A recurring implementation problem is that an activity may be labeled STEAM even when only one domain is substantively enacted. Coloring, cutting, or collage can be valuable art experiences, but they do not automatically constitute integrated STEAM. Technology becomes educationally meaningful when children consider what a tool enables; engineering appears when they define a practical problem, plan, test, and improve; mathematics is enacted when they count, compare, order, classify, measure, or justify; and science requires observation, prediction, evidence, or explanation. Integration should therefore be inferred from children's and teachers' observable epistemic actions, not from the mere presence of materials (Kwan & Wong, 2021; Perales & Aróstegui, 2024).

Teachers are central to making these connections visible. Their beliefs, pedagogical content knowledge, choice of prompts, and ability to balance structure with child agency shape the quality of STEAM experiences (Alghamdi, 2023; Jamil et al., 2018; Leung, 2023). Open-ended prompts can turn a product-oriented task into inquiry: children may compare alternative materials, predict which structure will remain stable, decide how many objects fit within a space, or explain why a design changed. At the same time, overly prescriptive modeling may narrow children's choices and produce uniform work. Playful STEAM therefore requires intentional scaffolding without displacing autonomy (Hunter-Doniger, 2021; Ollonen & Kangas, 2025).

In Indonesia, STEAM has gained relevance within child-centered and contextual learning promoted in early-childhood curriculum reform. Studies report its use through cooking, loose parts, creative art, and center-based activities (Agusniatih & Muliana, 2022; Motimona & Maryatun, 2023; Muawanah & Harjani, 2024). However, much of the literature emphasizes activity descriptions or developmental benefits, while fewer classroom-based accounts distinguish between enacted interdisciplinary integration and

integration that remains only potential. This distinction matters for avoiding inflated claims and for identifying concrete improvements in teacher practice.

RA Ulumul Qur'an Al Madani in Banjarbaru provides a useful case because Group B children participated in varied artistic experiences, including role-play, drawing, coloring, cutting, pasting, block construction, playdough modeling, calligraphy, beading, and arranging stones into letters. The study focuses specifically on implementation: the sequence of classroom activity, teacher mediation, children's participation, and the observable relationship between the arts and other STEAM domains. It does not evaluate program planning, measure learning gains, or claim causal developmental effects.

Accordingly, the research question was: How were the arts implemented and connected with other STEAM domains in Group B learning at RA Ulumul Qur'an Al Madani? The study aimed to identify activity patterns, teacher scaffolding, child agency, and the degree to which interdisciplinary connections were explicitly enacted. Its contribution is an evidence-based distinction between doing art during a STEAM-labeled lesson and learning through the arts as an integrative STEAM process.

Methodology

This study used a qualitative descriptive field design to examine naturally occurring classroom implementation. The site was RA Ulumul Qur'an Al Madani, Guntung Manggis, Landasan Ulin District, Banjarbaru, South Kalimantan, Indonesia. Classroom observations were conducted on 18 and 19 February, 10 March, and 14 April 2025. The bounded case was selected because the class routinely used thematic, center-based, and arts-oriented activities identified by the school as STEAM learning.

Participants comprised 22 children in Group B1, two classroom teachers, and the principal. The teachers were the primary respondents because they directly facilitated the observed activities; the principal served as a contextual informant. Children's names are not reported. Data sources included classroom field notes, semi-structured interviews, photographs, weekly and daily lesson plans (RPPM/RPPH), assessment sheets, and learning artifacts. Institutional permission was obtained, children's identities were protected, and observation prioritized their comfort and safety.

Observation documented preparation of materials, activity sequences, grouping, teacher prompts, peer interaction, children's use of tools and materials, and closure

routines. Interviews explored the forms and purposes of art activities, thematic content, teacher assistance, and participants' understanding of STEAM. Audio recording was used to support review of the interviews. Documentation was used to corroborate the activity context and chronology. The use of several sources enabled methodological and source triangulation Analysis followed the interactive logic of data condensation, data display, conclusion drawing, and verification (Miles et al., 2020), supported by first- and second-cycle coding (Saldaña, 2021). First, the original source identifiers were retained: CLP1-CLP4 for field notes, CWGK.1-CWGK.4 for teacher interviews, CWKS.1 for the principal interview, and CDFPA for photographic documentation. Second, descriptive and process codes captured the activity, artistic mode, teacher action, child action, tool/material use, and enacted STEAM practice. Third, related codes were grouped into categories and four implementation patterns. Finally, matrices were used to compare observation, interview, and documentary evidence and to classify each interdisciplinary connection as explicit/enacted or implicit/potential. Negative or limiting evidence such as a missing inquiry prompt was retained rather than forced into a positive STEAM claim.

Table 1. Analytic codebook used to examine arts–STEAM implementation

Code	Operational meaning	Indicative evidence
ART-MODE	Observed mode of artistic meaning-making	Role-play, color choice, composition, modeling, calligraphic line
T-SCAF	Teacher scaffolding	Explaining rules, modeling safe procedures, prompting, grouping, assisting
C-AGENCY	Child agency	Choosing, negotiating roles, positioning, reshaping, explaining
TOOL-USE	Purposeful use of tools/materials	Scissors, adhesive, play money, blocks, playdough, beads, stones
SCI-INQ	Science inquiry	Observing a phenomenon, predicting, comparing evidence, explaining change
ENG-DES	Engineering/design process	Planning, constructing, testing stability or fit, revising
MATH-ACT	Mathematical action	Counting, matching, ordering, patterning, grouping, comparing size/position
INT-LEVEL	Strength of integration	Explicit/enacted when prompted or performed; implicit/potential when only afforded by materials

Table 1 makes the analytic criteria transparent. The analysis uses qualitative descriptions, not a numerical rubric or validated rating scale. A connection is explicit/enacted when a relevant action or prompt is documented, and implicit/potential when it is suggested by the materials or theme without a recorded action. Overall labels such as “emerging” and “moderate” are not used because the study did not establish scoring thresholds. An activity was not coded as engineering merely because children

assembled materials, nor as mathematics merely because countable objects were present. The code required an observable action or prompt. This criterion strengthened analytic restraint and enabled the results to distinguish enacted learning from unrealized opportunity.

Credibility was supported through triangulation across participants, techniques, and observation dates; an audit trail connected source identifiers, codes, categories, and claims. Findings are presented with coded observational excerpts and verbatim interview excerpts. Indonesian excerpts were translated into English by the author and lightly edited only for readability without changing meaning. Photographic documentation (CDFPA) was used as corroborating evidence; images were not reproduced in this article to protect children's privacy, but their codes are reported so that an editor or reviewer may trace the evidentiary chain

Result and Discussion

Result

Arts-related STEAM learning generally occurred after opening routines and early literacy. Teachers prepared materials before the children arrived, introduced a task or scenario, organized small groups when required, assisted participation, and asked children to return materials. Coding across the four observation dates produced four groups of learning activities. Table 2 summarizes the evidence and documented or potential connections; the subsections then interpret each pattern.

Table 2. Cross-case display of coded activities and observed STEAM integration

Activity pattern	Role of the arts	Other STEAM affordances/ actions	Analytic assessment	Evidence code
Occupations and buying–selling role-play	Dramatic role, dialogue, expression	Play money and role positions documented; quantity reasoning not recorded	Arts and social communication explicit; mathematics potential	CLP1; CWGK.3.2; CDFPA-SDMS1
Fisherman coloring–cutting–pasting	Color, collage, composition	Tool use; placement, size, position, number	Tool use documented; inquiry and mathematics not established	CLP2; CWGK.1.3; CDFPA-SDMS2
Blocks, playdough, dakon, calligraphy	3-D form, line/pattern, Islamic aesthetics	Construction and symbols; possible balance, sequence, and counting	Construction and tracing documented; counting and testing not recorded	CLP3; CWGK.2.8; CDFPA-SDMS3
Moon drawing, beading, stone letters, congklak	Representation , pattern, composition	Natural forms and materials; possible pattern, counting, and	Moon forms introduced; counting and patterning not	CLP4; CWKS.1.13; CDFPA-SDMS4

	strategy	recorded

As Table 2 indicates, the arts consistently organized children's participation, but the strength of connections with the other domains varied. Role-play and center activities offered the broadest range of connections, whereas the fisherman and moon activities contained substantial possibilities that were not always converted into explicit inquiry through teacher prompts.

Occupation and Buying–Selling Role-Play

Two teachers divided the class into six groups representing carrot sellers, carrot farmers, chocolate-cake sellers, carrot-cake sellers, doughnut sellers, and buyers. Teachers explained the rules, checked role understanding, and provided play money. A simple Islamic sales agreement was incorporated into the dialogue. Roles were rotated after one round so that sellers and farmers could become buyers.

> *Field-note excerpt [CLP1, P2, K4; ART-MODE, T-SCAF, C-AGENCY]: "The children who acted as buyers were given play money for the transaction.... The children were also taught Islamic values: in a sales transaction there should be an agreement, such as saying 'sell and exchange.'"*

Dramatic art was explicitly enacted through characterization, dialogue, gesture, and an improvised social plot. The field note documents play money and assigned positions, but not a process of designing the stalls. The play-money transactions (CLP1, P2, K4) offered opportunities for mathematics, but no prices, counts, calculated totals, or equal distributions were recorded. Teacher D explained, "In role-play, we prepare media such as simple costumes, hand puppets, and props made from recycled materials.... We use this method because the arts in STEAM can encourage children to imagine and express their ideas and feelings" (CWGK.3.2, author translation). Thus, the arts and social-language dimensions were explicit, whereas mathematics remained a potential connection.

Fisherman-Themed Coloring, Cutting, and Pasting

Each child received a fisherman outline to color, separately colored fish, cut them out, and pasted them into the fisherman's net. Teachers gave procedural guidance while leaving some freedom in color and visual arrangement. The activity linked visual composition with eye–hand coordination and safe tool use.

Field-note excerpt [CLP2, P2, K5-K8; TOOL-USE, ART-MODE]: "The children were asked to color the picture according to their own creativity.... They then colored, cut out, and pasted separate fish onto the net, forming a visual composition of a fisherman catching fish."

Scissors and adhesive functioned as simple technologies because children used them to transform and join materials. Positioning the fish resembled elementary design, but no documented cycle of testing and revision was evident. The theme offered links to aquatic environments, position, size, and number, yet explicit science and mathematics questions were limited. Teacher K stated, "We first look at the learning objective. In visual-art material, children may draw, color, or make work using finger prints.... This trains fine-motor skills while helping children express themselves through color and form" (CWKG.1.3, author translation). Tool use was documented, whereas science, engineering, and mathematics connections remained potential rather than fully demonstrated.

Center Activities and Islamic Calligraphy

On 10 March 2025, children rotated among dakon, building a mosque with blocks, modeling chocolate-based foods with playdough, and tracing Islamic calligraphy. All children were given an opportunity to trace a kalimah tayyibah. Teachers directed children to form Latin letters first and then trace the Arabic script slowly.

Field-note excerpt [CLP3, P2; ART-MODE]: "The children were divided into four activity groups: playing dakon, constructing a mosque with blocks, making chocolate-food forms with playdough, and tracing calligraphy. Each child took a turn tracing the kalimah tayyibah."

Blocks and playdough enabled construction, balance, spatial reasoning, and material transformation. Dakon offered opportunities for one-to-one correspondence, sequence, and quantity, but CLP3, P2, K2 does not record specific counting actions, while calligraphy connected visual line, fine-motor control, literacy, and Islamic meaning. Nevertheless, the centers were not documented as parts of one shared investigation. Their integration lay mainly in the simultaneous skills and representational practices they afforded, not in a unifying problem or project. The field note records group activities but does not establish that every child rotated through all centers (CLP3, P2, K2).

Moon Drawing, Beading, Stone Letters, and *Congklak*

On 14 April 2025, the teacher introduced crescent, half, and full-moon forms. In small groups, children drew a moon from imagination, beaded an animal-head image, arranged small stones into letters, or played congklak. Individual literacy support accompanied the activities.

> *Field-note excerpt [CLP4, P2; ART-MODE]: "The teacher explained crescent, half, and full-moon forms. The children then joined small-group activities: beading, drawing a moon, arranging their names with small stones, and playing congklak."*

Moon drawing connected a natural object with visual representation, while beading and congklak offered opportunities for pattern, sequence, counting, and strategy, although specific examples of these actions were not recorded (CLP4, P2, K8). Stone letters transformed concrete material into symbols. The principal explained that selected media can be related to science, technology, engineering, and mathematics, giving clay forms and musical patterns as examples (CWKS.1.13). Scientific engagement in the observed moon task, however, remained limited to recognition of visible form; the record does not show observation across time, prediction, or explanation of lunar phases. The evidence therefore supports visual representation more clearly than mathematical reasoning or science inquiry.

Discussion

The Arts as Inquiry and Representation, Not Merely Product

The findings show four artistic modes: dramatic, visual, constructive, and patterned-symbolic. Children did more than produce drawings or calligraphy; they chose, positioned, modeled, arranged, enacted, and negotiated. These processes matter because early-childhood arts education should not be reduced to uniform products. Autonomy and modification allow children to make thinking visible and to experience creativity as purposeful decision-making (Hunter-Doniger, 2021; Leggett, 2017). The observed role-play and open color choices most clearly supported agency, whereas tracing and template-based work offered less room unless followed by modification.

The findings also reinforce the distinction between arts enhancement and arts integration. An attractive product does not itself demonstrate STEAM. Integration

becomes stronger when art is a mode for investigating and communicating a phenomenon or solving a design problem (Halverson & Sawyer, 2022; Liao, 2016).

Degrees of STEAM Integration in Classroom Practice

Across the four patterns, integration was uneven and often distributed across parallel activities. Role-play combined arts, language, social knowledge, tools, space, and exchange. Block and playdough activity linked aesthetics with construction and material change. Beading, dakon, and congklak offered potential connections with pattern, number, and sequence; the available field notes do not establish these as observed mathematical actions. These findings align with research positioning play and authentic tasks as productive contexts for integrated STEAM (Agusniatih & Muliana, 2022; DeJarnette, 2018; Su et al., 2025).

However, the codebook's action-based threshold shows why several links should be treated as potential rather than accomplished integration. Scissors are a technology only when their function and alternatives matter to the learning problem; assembly becomes engineering when children plan, test, encounter constraints, and revise; countable objects become mathematics when children actually quantify, compare, order, or justify. This analytic restraint responds to the conceptual ambiguity identified in STEAM reviews (Kwan & Wong, 2021; Perignat & Katz-Buonincontro, 2019) and offers a practical criterion for classroom observation.

Teacher Scaffolding and Child Agency

Teachers structured the environment, explained safe procedures and rules, organized groups, supported individual literacy, and established responsibility for materials. These practices enabled participation and classroom manageability. Yet high-quality STEAM also requires generative prompts and responsive follow-up. Evidence from early-childhood research shows that teacher beliefs and pedagogical knowledge influence whether integrated activities become inquiry-oriented (Alghamdi, 2023; Jamil et al., 2018; Leung, 2023).

The central pedagogical challenge is to balance structure and agency. Detailed models are useful for safety and initial technique, but they can narrow problem solving if children are expected to reproduce one answer. Conversely, unguided freedom may not reveal

disciplinary connections. This balance is consistent with motivational scaffolding in playful early learning (Ollonen & Kangas, 2025).

Developmental Opportunities and Limits of Inference

The activities provided simultaneous opportunities for fine-motor coordination, spatial thinking, language, negotiation, confidence, patterning, quantity, and responsibility. Indonesian studies similarly associate loose-parts and STEAM activities with critical thinking, creativity, mathematics, and kinesthetic engagement (Atikah & Biru, 2024; Muawanah & Harjani, 2024; Pegia et al., 2024). These convergences support the developmental relevance of the observed practices.

Nevertheless, the present design was descriptive. It did not employ pre–post measures, comparison groups, or standardized developmental assessment. The findings therefore establish opportunities and enacted processes, not causal improvement or effect size. The findings are limited to the observed class and four observation dates. This distinction should be maintained in reporting, and future research should combine process evidence with systematic assessment where claims of effectiveness are intended.

Practical Implications

The main implication is a shift from an activity checklist to the trajectory of children's thinking. A single art activity can become integrated STEAM when it moves through observing, questioning, selecting tools, planning, making, testing, revising, comparing, and communicating. Multiple activities offered on the same day are not necessarily integrated when they lack conceptual connection. Teachers can strengthen integration with one thematic driving question, documentation of process rather than product alone, and short reflection conversations in which children explain choices and changes. These are recommendations, not activities or effects established by this study. In the fisherman activity, for example, children could have compared habitats, designed different nets, tested adhesives, classified catches, and narrated evidence through the collage. Such extensions preserve artistic freedom while making disciplinary thinking explicit. Questions such as ‘How could you keep the block mosque from falling?’, ‘How many fish fit in this net, and how do you know?’, or ‘What changes when you use larger beads?’ would invite prediction, design, comparison, evidence, and explanation while retaining playfulness.

Conclusion

The arts were implemented through occupation and buying–selling role-play; fisherman-themed coloring, cutting, and pasting; blocks, playdough, dakon, and Islamic calligraphy; and moon drawing, beading, stone-letter construction, and congklak. Across these activities, the arts served as media for expression, representation, construction, and communication. Children used simple tools, arranged forms, participated in activities offering opportunities to explore patterns and quantities, explored thematic knowledge, cooperated, exchanged roles, and cared for materials.

The implementation pointed toward integrated STEAM, but integration was not consistent. Science, technology, engineering, and mathematics sometimes remained implicit affordances, while the arts dominated the visible activity. To strengthen implementation in this setting, the study recommends open-ended prompts, simple design challenges, opportunities to test and revise, and reflective dialogue that makes interdisciplinary relationships both experienced and articulated by children. This case suggests that observable inquiry and design actions provide a clearer basis for interpreting STEAM integration than the number of art products or the nominal presence of five domains.

The study was limited to one class, four observation dates, and descriptive evidence. It did not measure developmental change. Future studies should extend observation duration, include children's explanations as data, and examine how targeted teacher prompts change the depth of arts–STEAM integration.

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