Proceedings of the 8th International Conference on Computing and Data Science
DOI: 10.54254/2755-2721/2026.37754

Designing and Evaluating a Collaborative Teaching Model for Integrating AI-Assisted Media Art Practice into Secondary STEAM Education

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Abstract. In this paper, the proposed collaboration-based teaching model with incorporation of AI-assisted media arts practice is considered within the scope of secondary STEAM education. Two intact classes of Grade 8 students enrolled at a secondary school conducted the experiment for eight weeks. The experimental class took part in the coordinated instruction in science, technology, and art subjects and performed an assignment called "Urban Environmental Data and Interactive Media Art Project," where they used BBC micro:bit sensors, Adobe Express with Firefly, p5.js Web Editor, Google Classroom, and Padlet. The control class did a traditional STEAM project related to the same subject and period of time. Creativity test, project assessment rubrics, collaboration and engagement questionnaires, observations in classrooms, learning diaries, and interviews were utilized for evidence collection. The experimental class showed greater increase in creative problem solving compared to the control class (14.83 ± 5.21 vs. 5.87 ± 4.69) with statistically significant group effect. Furthermore, their projects had higher marks for data-art integration, interactivity, and justifications of design decisions. The score for collaboration and engagement achieved 4.31 ± 0.36 and 4.24 ± 0.41, respectively.

Keywords: AI-assisted learning, media art, STEAM education, collaborative teaching, project-based learning

1. Introduction

Artificial intelligence is increasingly becoming an applied component of school education. Research shows that effective AI learning depends on age-appropriate interfaces, project-based tasks, teacher scaffolding, authentic assessment, and sufficient programming support [1-3]. Project-based learning has also been shown to provide a practical approach to developing AI literacy among senior secondary students by connecting AI concepts with hands-on learning activities [4]. Generative AI introduces additional challenges because rapid content production may obscure weak reasoning or reduce the visibility of students' thinking. Effective classroom design therefore requires transparent reasoning processes, validation, and continued human judgement [5, 6].

Digital STEAM education further emphasizes embodiment, dialogue, materiality, creative agency, and transdisciplinary collaboration beyond simple tool use [7, 8]. Successful implementation

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also depends on teachers' trust and confidence in AI technologies, while arts-based AI pedagogy can make AI concepts more accessible to non-technical learners [9, 10].

This study examines how art can move beyond a decorative role in secondary STEAM education. It introduces an integrated model combining environmental measurement, data analysis, creative visualization, coding, and media communication, and evaluates its effects on creative thinking, media arts quality, collaboration, and student engagement compared with conventional STEAM teaching.

2. Literature review

2.1. Creative learning via AI in secondary school

Creative tasks enabled by AI technology can lessen the effort put into developing new visuals, layout adjustments, and representation tests. The learning potential of the tool relies on the way students assess the output, document the prompts, exclude unsuitable responses, and connect their output to the field-specific facts [2]. In case the AI is considered a mindless production tool, the final polished product can cover up poor reasoning or lack of certainty in the work's origin. Therefore, meaningful education puts the AI tool in the framework of question-answer-generate-modify-justify loop.

2.2. Media art as a multidisciplinary STEAM approach

The combination of data, images, sounds, codes, interactivity, and reception by the audience is all contained in one artwork through media art. Observations of science could become the basis for visual parameters, mathematical principles might dictate movement or size, and coding could produce interactive qualities. In other words, the artist's choices will control the way evidence is understood and represented [3-8]. An effective project should include correct use of data, effective interaction, proper composition, and the justification of the connection between form and meaning. In other words, media art is a way to research through interdisciplinary approaches.

2.3. Collaborative teaching in the STEAM context

Complicated STEAM assignments require knowledge that one individual teacher alone cannot provide. Cooperative teaching splits duties but retains common project goals. The science teachers ensure validity of the measurements; technology teachers help with artificial intelligence and coding; art teachers assist with composition, symbolism, rhythm, and communication with the audience. Coordination of such effort is possible through a common language, consistent assessment milestones, and the same rubric. Without these tools, the students can see the assignment as a sequence of disconnected discipline-specific tasks [8-10]. Hence, repetitive feedback from all parties involved is crucial for integration of their efforts into the artifact.

3. Experimental methodology

3.1. Research design and participants

A quasi-experimental design involving non-equivalent pretest-posttest research method was carried out in one urban public secondary school. The sample comprised sixty eighth grade students aged between thirteen and fourteen years old from two intact classes based on the school's schedule. One

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of the classes acted as an experimental group, and the other as a control group, each comprising thirty students. Both groups were taught for sixteen forty-five minutes periods during eight weeks on the same environmental topic.

The baseline equality was established with regard to the prior performance in science, digital literacy test, and a pretest for creative problem solving. Participation included taking the pretest and attending at least fourteen classes; all sixty students fulfilled these requirements. The treatment was conducted in regular STEAM classes to ensure the ecological validity of the design. Throughout the study, informed consent from parents, assent from participants, anonymous identification and limited storage of AI prompts were ensured. No additional learning outside of regular classes on media art, environmental sensing, or p5.js was provided to any group.

3.2. Teaching model and digital technologies

Four interlinked phases were involved in the model that was used in the experiment, including the formulation of the environmental problem, the use of sensors for investigating the problem, media creation aided by AI, and explanation to the public. The students made use of the BBC micro:bit V2 boards along with the DHT22 sensors to measure temperatures and humidities in five different locations in the college, with one-minute data sampling interval. The obtained readings were analyzed for missing time stamps and any abnormal changes before being exported in the form of CSV files.

Visual ideation was possible through Adobe Express with Firefly, whereas the p5.js Web Editor created interactive behaviors. The generated visuals had to be saved if students wrote down the initial prompt, found out about manual changes and described how the asset represented environmental measurements. It made it possible to distinguish machine-generated output from the work of students. Google Classroom saved datasets, code versions, prompt history and assessments. The Padlet recorded rationale for design each week, peer review, and decision on revision.

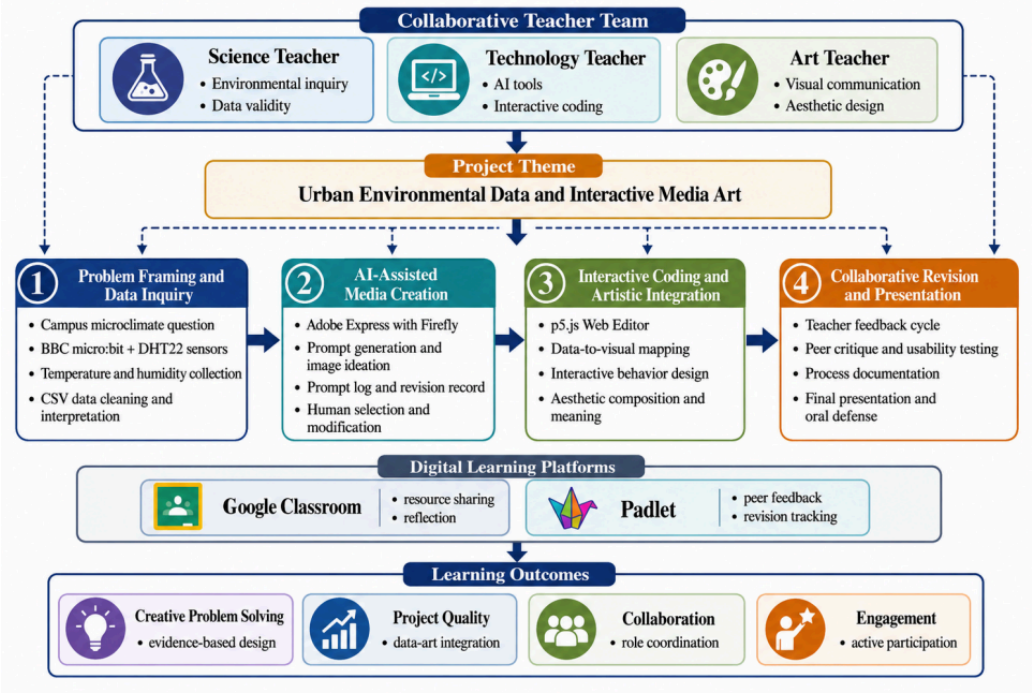

Figure 1. Collaborative AI-assisted media art teaching model for secondary STEAM education

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The comparison group explored the same environmental topic but got the same amount of instruction. Students used charts in spreadsheets and regular digital drawing software to create posters about the environment. They did not use Firefly, interactive functions of p5.js or the collaboration between teachers. This design kept the same subject content while distinguishing the suggested one through AI-based ideation, construction of interactive media, and collaborative instruction. Figure 1 illustrates the whole model of collaborative AI-assisted media art education.

3.3. Data collection and evaluation instruments

Creative problem solving was measured through a twenty-four-item assessment covering problem framing, divergent ideation, evidence integration, and iterative improvement. Two pilot-tested parallel forms were administered before and after the intervention. Each response was rated through a four-level analytic scheme, producing a maximum total score of ninety-six. Project quality was judged independently by three trained raters using five twenty-point dimensions: scientific accuracy, data-to-visual mapping, interactive functionality, aesthetic coherence, and AI-process transparency.

Collaboration was assessed weekly through role coordination, explanation quality, equitable contribution, and conflict resolution. A twelve-item five-point scale measured behavioral, cognitive, and emotional engagement. Internal consistency coefficients ranged from 0.82 to 0.91. Project-rubric agreement reached an intraclass correlation of 0.88 after raters completed calibration with three non-study artifacts.

To prevent high visual polish from compensating for weak evidence or untraceable AI use, the project score combined equal dimension weights with penalties for rater disagreement and incomplete process documentation:

$$Q_g = [\sum_{d=1}^{5} w_d(\frac{1}{R}\sum_{r=1}^{R} s_{grd})][1-\lambda_1 \frac{\sum_{d=1}^{5} SDr(sgrd)}{5S_{max}} - \lambda_2(1-\tau_g)], \quad (1)$$

$$\sum_{d=1}^{5} w_d = 1$$

In Equation (1), s_{grd} represents the score assigned by rater r to group g on dimension d, while τ_g indicates the completeness of the group's prompt, revision, and attribution records. Observation notes, Padlet reflections, and interviews with twelve experimental-group students were coded in NVivo 14 to explain the quantitative patterns.

4. Experimental procedure

4.1. Preparation and teacher collaboration

Before the intervention began, the science, technology, and art teachers held four planning meetings that lasted ninety minutes each. In these meetings, disciplinary goals were aligned with weekly tasks, common vocabulary was agreed upon, the rubric for the project was adjusted, and the process of using sensors to create artwork was tested. The pilot involving six students, who were not part of the intervention groups, found problems associated with importing CSV files, specific wording of prompts in Firefly, and proper variable mapping in p5.js. As a solution to this problem, revised materials were created, including scaffolded code template, prompt recording sheet, data validity checklist, and AI use procedure that required revealing the use of artificial intelligence, checking sources of data, and manual conversion. Feedback procedure for students was agreed upon by all instructors. Scientific validity was checked before the creation of visual elements, functionality of

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code was checked before the aesthetic changes could be made, and evidence of the process was checked before the final submission. Each instructor added comments in the shared feedback form in order not to confuse students with conflicting disciplinary advice.

4.2. Eight-week classroom intervention

The first two weeks covered key concepts relating to microclimates in the urban environment, sensor calibration, data ethics, and the core research question: How can interactive art express environmental differences within the campus? Students completed sensor testing indoors and outdoors, took multiple readings, and then chose their project locations. During Weeks 3-4, students cleaned up data sets, calculated daily extremes and location contrasts, developed potential visual maps before gaining access to Firefly. Such restriction made students develop an evidence-based design concept before exploring interactively.

Weeks 5-6 focused on quick iterations, assessing generated assets, coding in p5.js, and determining whether interaction matched the measurements. Students assessed at least three generated solutions and explained reasons for choosing, modifying, or discarding a particular solution. The weeks 7-8 were dedicated to peer usability testing, debugging, visual polishing, final presentation, and oral presentation. In the comparison class, students worked under a similar time schedule for exploring the environment and presenting, although with teacher-led demos and poster presentations.

Post-intervention outcomes were analyzed through a multivariate covariance model controlling for baseline outcomes, prior science performance, and digital literacy as shown in Equation (2):

$$Y_i^{post} = \beta_0 + \beta_1 G_i + B_2 Y_i^{pre} + \beta_3 D_i + \beta_4 S_i \tag{2}$$

$$+\beta_5 (G_i D_i) + \varepsilon_i,\ \varepsilon_i \sim N_p(0, \Sigma)$$

Here, G_i indicates instructional condition, D_i represents baseline digital literacy, and S_i represents prior science performance. SPSS 29 produced adjusted estimates, while 5,000 bootstrap samples generated confidence intervals. Holm correction controlled familywise error across related outcomes.

4.3. Student grouping and learning tasks

The classes were divided into six teams of five members each. In the experimental condition, students were assigned the roles of data analyst, AI visual designer, coding operator, presentation coordinator, and project manager. Rotation of roles took place after Week 4 so that each student had both a technical role and a communication role. The project manager managed the revision schedule and ensured that all the decisions taken by the group were based on collaborative discussions.

All experimental groups produced a complete set of artifacts, including data sheet validated, storyboard map, Firefly prompt and revision log, p5.js annotated code, an interactive artwork, oral presentation, and personal reflection. Two peer review questions were based on the correctness of data and interpretation of the work. It was necessary to show that at least three variables in the code were linked to the measurements of the environment. Task construction involved having each important artistic decision justified and any AI-based element showing signs of human intervention.

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5. Experimental results

5.1. Changes in students' STEAM creative problem-solving performance

There were no statistical differences between both groups on any aspect of creative problem solving. The experimental group gained 14.83 ± 5.21 points overall, while the comparison group gained 5.87 ± 4.69 points overall. The adjusted difference for total score was 8.61 ± 1.26, with the biggest effects in problem formulation and evidence synthesis.

5.2. Quality of AI-assisted media art projects

Quality ratings for experimental projects came to 86.72 ± 4.08, as compared to 72.94 ± 5.61 for control projects. Group differences have been the largest in data visualization and interactivity. Logs helped distinguish between student transformation of AI-generated content and its direct acceptance by raters.

5.3. Student collaboration, engagement, and learning experience

Collaboration and participation were more pronounced in the experimental group. The classroom observations showed increased instances of cross-role explanation, collaboration during debugging, and revision owing to peer testing. Interviews indicated that the use of generative AI helped in visual exploration, but the teacher had to ask questions to prevent the students from choosing attractive outputs without considering scientific validity (Table 1).

Table 1. Project, collaboration, and engagement outcomes

Outcome	Experimental group	Comparison group	Difference ± SE	Hedges' g
Scientific accuracy	17.42 ± 1.08	15.83 ± 1.47	1.59 ± 0.51*	1.13
Data-to-visual mapping	18.08 ± 0.92	14.67 ± 1.63	3.41 ± 0.54**	2.36
Interactive functionality	17.75 ± 1.21	13.50 ± 1.87	4.25 ± 0.64**	2.47
Aesthetic coherence	17.33 ± 1.03	15.42 ± 1.36	1.91 ± 0.49*	1.45
Process transparency	16.14 ± 1.26	13.52 ± 1.41	2.62 ± 0.55**	1.8
Collaboration score	4.31 ± 0.36	3.68 ± 0.42	0.61 ± 0.10***	1.58
Engagement score	4.24 ± 0.41	3.71 ± 0.47	0.51 ± 0.11***	1.17

**Note. Project dimensions were analyzed at group level through exact permutation tests; collaboration and engagement were analyzed at student level. *p < .05; **p < .01; **p < .001.*

6. Conclusion

The collaborative teaching model improved creative problem solving, project quality, collaboration, and engagement during the eight-week Grade 8 STEAM unit. Its effectiveness resulted from integrating environmental data, traceable AI-assisted ideation, interactive coding, artistic communication, and coordinated teacher feedback. The largest gains appeared when students transformed evidence into visual and interactive design decisions. Generative tools were most effective when supported by prompt records, data verification, manual revision, peer testing, and oral explanation, which preserved student authorship and made reasoning visible. The model is feasible for schools with basic sensors, browser-based tools, and cross-subject teacher coordination.

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However, the use of only two intact classes limits causal interpretation. Future studies should include multiple schools, larger classroom samples, delayed assessments, and comparisons of different levels of AI assistance.

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