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Integrating Scratch and Canva to Foster Digital Literacy in Junior-Secondary Science: A Feasibility Study in Indonesia

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Abstract
This study investigated the feasibility of integrating Scratch (block-based programming) and Canva (visual design) to cultivate digital literacy within a junior-secondary science lesson on the human circulatory system in Indonesia. Using a descriptive, cross-sectional design, one intact Grade VIII class (n = 12) at an MTs participated in a single-period implementation that combined brief teacher input with a make-and-explain sequence: students authored a simple Scratch mini-project to externalize mechanism and then produced a concise Canva infographic to communicate key ideas. Data were collected via structured classroom observations, a brief post-lesson teacher interview, and a four-item student questionnaire (binary Yes/No) capturing satisfaction, perceived difficulty, prior exposure to similar media, and perceived improvement in digital literacy; analysis focused on counts and percentages. Results showed high acceptability and usability: 11/12 students (91.7%) reported satisfaction, none reported difficulty (0/12), 8/12 (66.7%) indicated prior exposure, and 11/12 (91.7%) perceived improved digital literacy; observations corroborated sustained on-task behavior, successful navigation of core interface actions, and productive peer support. These patterns suggest that a low-threshold, creation-centered workflow is implementable under ordinary school conditions and pedagogically consistent with active, student-generated learning. The study concludes that explicitly coupling executable modeling (Scratch) with audience-ready visual explanation (Canva) is a promising approach for classroom-level digital-literacy development, while noting limitations of a small, single-class sample and reliance on brief self-reports. Teachers can package lessons as short inputs → templated production → micro-publication to strengthen digital literacy without heavy infrastructure; future research should adopt larger, pre–post or quasi-experimental designs with validated multi-item scales, content assessments, fidelity checks, and comparisons of integrated versus single-tool conditions.

Keywords: Active Learning Pedagogy; Block-Based Programming Activities; Canva Infographic Design; Computational Thinking Development.

INTRODUCTION

Preparing learners for data-saturated, technology-rich societies requires more than routine tool use; it demands digital literacy understood as a multidimensional competence that integrates information seeking and evaluation, production/creation, communication, and responsible participation across platforms. Beyond operational skills, digitally literate learners can locate relevant information efficiently, interrogate its provenance and quality, and recognize bias and uncertainty. They can transform evidence into clear, audience-appropriate artifacts texts, visuals, data displays, and interactive media through iterative drafting, design judgment, and principled citation. They participate in networked communication ethically and effectively, adapting tone and modality to purpose and community norms while safeguarding privacy, security, and intellectual property. They also exercise civic and interpersonal responsibility online by engaging respectfully, resisting mis/disinformation, and reflecting on the social consequences of digital actions. Taken together, these capacities constitute a transferable, practice-based literacy that enables students not only to consume digital content, but to curate, create, and contribute meaningfully across learning, work, and civic contexts (Garad et al., 2021; Le et al., 2022; Zamista & Azmi, 2023). In STEM learning contexts, students' digital literacy is positively associated with engagement patterns in blended environments and academic performance, but also reveals uneven profiles that call for

explicit instruction and scaffolded practice (Garad et al., 2021; Le et al., 2022; Zamista & Azmi, 2023). These findings converge with Indonesian evidence that institutions' e-learning readiness and learners' cognitive competencies shape the effectiveness of distance or technology-enhanced learning, reinforcing the urgency of pedagogy that cultivates authentic digital practices rather than mere platform navigation (Garad et al., 2021; Le et al., 2022; Zamista & Azmi, 2023).

Active and student-generated learning designs are among the most reliable approaches for building such competencies. Across rigorous field experiments and meta-analyses, active learning robustly improves conceptual understanding and course achievement, and can narrow equity gaps in STEM when implemented with sufficient intensity and inclusive design. In practice, these approaches shift classroom time from transmission to sense-making: students analyze problems, generate explanations, construct artifacts, and receive rapid feedback. Structured techniques such as problem-based tasks, guided inquiry, peer instruction, and think-pair-share prompt learners to retrieve prior knowledge, articulate reasoning, and revise misconceptions, thereby strengthening durable understanding. Student-generated products (e.g., code, models, infographics, short videos) further catalyze learning by requiring selection, organization, and integration of ideas for a real audience. To ensure broad benefit, activities are scaffolded with clear goals, worked examples, and checkpoints; participation structures (random calling, rotating roles, small-group norms) distribute opportunities to contribute; and formative assessment makes progress visible while normalizing error as part of learning. When coupled with accessibility and universal design principles—multiple modes of representation, flexible pacing, and low-floor/high-ceiling tasks active learning supports diverse learners and mitigates performance gaps. The result is a classroom ecology in which students do the cognitive work of the discipline and, in doing so, build the transferable competencies demanded by digital, data-rich contexts (Deslauriers et al., 2019; Theobald et al., 2020; Wang et al., 2022). Importantly, students may misperceive active classrooms as less effective because effortful cognitive work "feels" harder, a bias instructors should pre-empt by making learning mechanisms explicit (Deslauriers et al., 2019; Theobald et al., 2020; Wang et al., 2022).

Two complementary strands of research point to design choices likely to strengthen digital literacy in science learning. First, computational thinking (CT) pedagogy especially through block-based, visual programming has consistently yielded gains in problem solving and algorithmic reasoning for school-age learners, with positive effects reported across interventions and contexts. Block-based tools such as Scratch lower entry barriers, enabling novices to externalize models and build executable artifacts that connect domain ideas with CT practices (Braun & Huwer, 2022; Fagerlund et al., 2021; Lu et al., 2023).

Second, research on multimedia learning and generative activity underscores that students benefit when they transform content into new representations e.g., through visual explanation, signaling, and contiguity because such designs reduce extraneous cognitive load and deepen sense making (Çeken & Taşkın, 2022; Fiorella, 2023; Noetel et al., 2022). Within this space, infographic creation has emerged as a particularly effective vehicle for learning-by-design: it requires concise synthesis, audience-aware communication, and principled visual decisions using accessible tools (e.g., Canva), with reviews and guidance articles documenting how these artifacts enhance comprehension and knowledge translation (Fiorella, 2023; Jaleniauskiene & Kasperiuniene, 2023; Traboco et al., 2022).

Integrating these strands suggests a promising, but under-examined, design pattern: coupling block-based programming (e.g., Scratch) for interactive modeling with infographic authoring (e.g., Canva) for audience-facing explanation. Theoretically, such a pairing unites CT practices (decomposition, iteration, debugging) with generative visual communication (selecting, structuring, signaling), thereby exercising multiple dimensions of digital literacy information curation, multimodal content production, and ethical sharing within authentic tasks (Noetel et al., 2022; Fiorella, 2023; Le et al., 2022). Moreover, in science topics that benefit from dynamic representations, learners can first encode mechanisms as simple simulations and then translate their understanding into concise, credible visuals that foreground evidence and uncertainty (Fiorella, 2023; Le et al., 2022; Noetel et al., 2022).

Despite the extensive body of literature, significant gaps remain in research that explicitly Despite robust evidence for each component individually CT with block-based programming and student-created infographics the literature reveals few classroom studies that deliberately integrate Scratch-based modeling and Canva-based visual design in a single, coherent learning sequence with digital-literacy outcomes as primary endpoints, particularly in lower-secondary science in emerging contexts (Braun & Huwer, 2022; Fagerlund et al., 2021; Jaleniauskiene & Kasperiuniene, 2023). Indonesian studies report both opportunities and uneven digital-literacy profiles among secondary students, reinforcing the need for designs that develop creation and communication not just access skills (Fitriani et al., 2022; Garad et al., 2021; Zamista & Azmi, 2023). This gap limited evidence on integrated, student-generated interactive media that intentionally link CT practices with visual communication to cultivate digital literacy in junior-secondary science motivates the present study. Accordingly, the purpose of this research is to design, implement, and evaluate an interactive learning sequence that combines Scratch-based modeling with Canva-based infographic authoring, and to examine its effects on students' digital-literacy dimensions (information evaluation, content creation, communication/participation), as well as its perceived usability and learning value in a science topic relevant to the curriculum.

METHODS

This study adopted a descriptive, cross-sectional design to examine the feasibility and learner reception of an interactive media package that integrates Scratch (block-based programming) and Canva (visual design) within a Grade VIII science lesson on the human circulatory system at an Indonesian *madrasah tsanawiyah* (MTs) in Bengkulu City. The focus on a single scheduled lesson reflects the exploratory aim of documenting usability and perceived value in a routine classroom context rather than estimating causal effects on achievement.

Participants were drawn from one intact class; all students present on the implementation day were invited to participate, yielding 12 learners (six girls and six boys, approximately 12–14 years old). Because the implementation leveraged an existing class roster and timetable, no random assignment or control group was used. The intact-group approach was selected to preserve ecological validity and minimize disruption to school operations.

The instructional sequence comprised two components orchestrated within a single period. First, the teacher delivered concise, guided explanations of core circulatory concepts (blood, heart, blood vessels, and systemic circulation) using brief visuals to activate prior knowledge. Second, students completed two production tasks designed to promote active processing: (a) a Scratch mini-project in which learners labeled and animated simple elements of circulation to externalize mechanistic understanding, and (b) a Canva micro-design in which learners distilled key ideas into a succinct infographic aimed at a peer audience. The teacher circulated to offer prompts and just-in-time support, and students were encouraged to collaborate informally.

Data were collected from three sources to triangulate feasibility and reception. Structured classroom observations captured on-task behavior, successful navigation of media (e.g., running projects, editing blocks/templates), and instances of peer collaboration using a brief a priori checklist. Immediately after the lesson, a semi-structured interview with the science teacher elicited perceptions of practicality, fit with curriculum, and any implementation challenges. Finally, students completed a four-item post-lesson questionnaire with binary response options (Yes/No) covering satisfaction with the media, perceived difficulty, prior exposure to similar media, and self-reported improvement in digital literacy. The items were intentionally concise to fit the period length and reduce respondent burden; the questionnaire is reproduced in Appendix A for replication.

Given the exploratory scope and small sample, analysis was limited to descriptive statistics. For each indicator, counts and percentages were computed from the number of "Yes" responses out of the class total, and percentages were reported to one decimal place. Observational notes and interview comments were reviewed to identify convergent patterns related to usability (e.g., ease of navigation, need for technical assistance) and engagement (e.g., on-task collaboration), which were then summarized narratively to complement the questionnaire results.

Ethical and quality-assurance procedures were aligned with school practice. Administrative permission was obtained from the principal, informed agreement was provided by the class teacher,

and parents/guardians were notified through standard co-curricular channels. No names or unique identifiers were collected; only aggregate results are reported. As a feasibility study, internal-consistency coefficients were not estimated for the four binary items, and no pre–post achievement testing was conducted. The present methods are intended to establish acceptability and practical viability and to inform subsequent, larger trials that will incorporate validated multi-item scales for digital-literacy outcomes, pre–post learning measures, and formal reliability/validity checks.

RESULTS AND DISCUSSION

The class comprised 12 Grade VIII students (six boys and six girls; ages 12–14). As shown in Table 1, the sample was balanced by sex, with a slightly larger share in the 13–14 age band. The post-lesson questionnaire in Table 2 indicates strong feasibility and positive reception: satisfaction with the Scratch–Canva media reached 11/12 students (91.7%); none reported difficulty operating the media (0/12; 0%); two-thirds had prior exposure to similar media (8/12; 66.7%); and 11/12 (91.7%) perceived that the activity supported or improved their digital literacy. Classroom observations corroborated these patterns most learners stayed on task, executed basic interface actions (running/editing Scratch projects, modifying Canva templates), and provided informal peer support during production tasks.

Table 1. Participant characteristics (n = 12)

No	Indicator	Aspect	Count
1	Gender	Boys	6
		Girls	6
2	Age	12–13 years	5
		13–14 years	7

Table 2. Post-lesson questionnaire (binary indicators)

No	Assessment indicator	Yes	No
1	Students' satisfaction with the learning media used	11	1
2	Difficulty learning to use the media	0	12
3	Prior experience using similar media with previous teachers	8	4
4	Students' digital literacy supported/improved by using this learning media	11	1

First, the combination of very high satisfaction and zero-difficulty reports signals strong usability and acceptance key preconditions for scaling technology-enhanced pedagogy. This pattern aligns with evidence that when instruction is organized into short, well-signposted segments and adheres to established multimedia/video principles signaling, segmenting, coherence, and spatial/temporal contiguity learners experience lower extraneous cognitive load and higher perceived usefulness. In our lesson, concise teacher inputs, consistent visual cues, and templated production steps likely operationalized these principles: students could locate essential information quickly, avoid split-attention costs, and progress through tasks with minimal friction. The result is a user experience that feels straightforward, supports accurate mental organization of content, and builds the confidence and willingness required for broader classroom adoption (Fyfield et al., 2022; Mayer, 2021; Mayer et al., 2020). In our implementation, concise teacher explanations, tightly edited visuals, and templated production steps operationalized core multimedia design principles segmenting (breaking the lesson into small, self-contained chunks), signaling (clear headings, icons, and arrows that highlight what to attend to), coherence (removing decorative elements that do not serve the goal), and spatial/temporal contiguity (placing brief instructions immediately beside the Scratch blocks or Canva controls they refer to). The templates doubled as worked examples and progressive prompts, minimizing search and choice overload, while a consistent layout and labeling scheme reduced interface surprises and supported smooth pacing. Collectively, these choices lowered split-attention and other forms of extraneous cognitive load, enabling students to enter productive work quickly and sustain focus an account that is congruent with the uniformly positive ease-of-use pattern in Table 2 (high satisfaction, zero reported difficulty) and with classroom observations of steady on-task collaboration and only minimal requests for technical assistance.

Second, the make-and-explain sequence constructing a Scratch mini-project followed by a Canva infographic accords with flipped/active-learning logic in which scarce contact time is redirected from passive reception to generative activity. In our lesson, brief front end explanations "primed" essential concepts, after which students made an executable

representation (Scratch) that required decomposition, iterative refinement, and self-explanation, and then explained their understanding by curating and structuring key ideas for an audience-ready visual (Canva). This progression engages high-yield mechanisms retrieval, elaboration, organization, dual coding, and immediate feedback while making thinking visible through tangible artifacts that can be quickly checked and discussed. The workflow also supports equitable participation: roles can be rotated (driver/navigator; designer/reviewer), templates provide low-floor entry with high-ceiling extension, and short checkpoints (run the script; apply a layout rule; add a caption) create frequent opportunities for success. Because evidence of learning accumulates in small, inspectable products, instructors can deliver just-in-time guidance, address misconceptions early, and maintain momentum without reverting to lecture. Taken together, this make-and-explain design turns class time into structured practice with the cognitive work of the discipline, which is precisely the condition under which active/flipped formats tend to yield superior performance compared with information-delivery alone (Bredow et al., 2021; Strelan et al., 2020; Sun et al., 2023). These syntheses emphasize the value of structured student production. The high "Yes" rates for satisfaction and perceived literacy gains, together with on-task collaboration observed in class, are compatible with those mechanisms.

Third, the Scratch component targets computational thinking (CT) practices. Systematic reviews consistently show that block-based programming in K–12 reliably strengthens problem solving, algorithmic reasoning, and core CT indicators across contexts. In our sequence, Scratch provides a *low-floor, high-ceiling* environment that minimizes syntactic burden and surfaces the conceptual structure of programs, allowing learners to allocate cognitive resources to disciplinary thinking rather than error-handling. Concretely, students practice decomposition (breaking the circulatory system into sprites such as heart, vessels, and blood cells), abstraction (representing features with variables, messages, and custom blocks), and algorithm design (sequencing beats, flows, and interactions via events, loops, and conditionals). They engage in debugging and iteration as they refine timing, collisions, or message passing, receiving immediate visual feedback that makes misconceptions observable and correctable. Because control flow is embodied in manipulable blocks and behaviors are rendered on screen, Scratch also supports metacognitive monitoring: learners can predict, run, inspect, and revise in short cycles, which aligns with formative assessment and pair-programming routines. These affordances promote equitable entry for diverse learners (including those with limited prior coding experience) while still offering extension through modularization and parameterization. In sum, the Scratch task operationalizes CT not as abstract talk but as *doing*: designing and testing executable models that encode cause–effect relationships precisely the kind of structured reasoning that underpins both programming proficiency and scientific modeling. (Stewart & Baek, 2023; Zhang & Nouri, 2019). In our setting, labeling and animating circulation elements encouraged learners to externalize mechanism and iterate behaviors aligned with the CT outcomes synthesized in these reviews. Fourth, the Canva component provides a venue for knowledge translation through visual communication. Experimental work on infographic design shows benefits for visual thinking and achievement, underscoring why audience-ready explanation tasks can consolidate understanding (Alemdag, 2022; Shemy, 2022; Z. Xu et al., 2019). This aligns with the strong endorsement of digital-literacy support in Table 2, where students reported that the activity helped them communicate ideas effectively.

Fifth, Indonesian feasibility matters. Mapping studies indicate heterogeneous junior-secondary digital-literacy profiles, implying that interventions should be low-threshold yet meaningful (Merino-Armero et al., 2022; Mursidi et al., 2022; E. Xu et al., 2023). Our design simple interfaces, ready-to-use templates, and just-in-time teacher support appears well matched to these constraints, reflected in the 0% difficulty and predominance of positive responses. Finally, our classroom-level results resonate with evidence of widespread reliance on lecture-dominant practices in STEM (Chen et al., 2023; Hillmayr et al., 2020; Li et al., 2023; Sailer & Homner, 2020; Stains et al., 2018). Although that survey concerns higher education, the underlying message is similar: shift from passive consumption toward active production. The Scratch→Canva sequence provides a practical route to integrate executable modeling and scientific communication within a single routine lesson.

This study documents, within a junior-secondary science lesson, the integrated use of Scratch for executable modeling and Canva for audience-ready explanation, with digital-literacy indicators and feasibility as primary outcomes. Unlike studies evaluating either tool in isolation, we operationalize a make-and-explain workflow that couples CT practices (decomposition, iteration) with visual communication (selection, structure, signaling). Practically, teachers can package instruction as short inputs → templated production → micro-publication (infographic), minimizing setup costs while maximizing generative activity. For schools, the workflow is compatible with ordinary infrastructure, offering a feasible path to strengthen digital literacy in regular lessons.

Evidence here is descriptive (small, single-class sample), relies on four binary self-report items, and includes no pre–post achievement or performance-based digital-literacy measures; internal-consistency estimates were not computed for the brief questionnaire. Future research should adopt quasi-experimental designs with validated multi-item scales, content assessments, fidelity checks, and process data (e.g., learning-analytics traces), and should compare the integrated Scratch→Canva condition with single-tool variants (Scratch-only or infographic-only) to identify added value.

CONCLUSION

This feasibility study demonstrates that integrating Scratch for executable modeling with Canva for audience-ready explanation is usable, acceptable, and pedagogically promising for cultivating digital literacy within a junior-secondary science lesson in Indonesia. Across a class of 12 Grade VIII students, satisfaction with the media was high (11/12), no difficulties were reported, two-thirds had some prior exposure, and most perceived that their digital literacy improved, with classroom observations corroborating sustained on-task behavior and productive peer support. Taken together, these patterns indicate that a low-threshold "make-and-explain" sequence brief teacher input followed by templated creation and micro-publication can be implemented under ordinary school conditions while aligning with active, student-generated learning. The contribution of this work lies in explicitly coupling block-based programming and visual communication within a single lesson and orienting outcomes to digital-literacy indicators rather than solely to subject achievement. Nevertheless, conclusions are bounded by the small, single-class sample and reliance on four binary self-report items without pre–post or performance-based measures. Future research should employ larger samples and quasi-experimental designs, validated multi-item scales for digital literacy, content assessments, fidelity checks, and process analytics, and should compare the integrated Scratch→Canva sequence against single-tool conditions to establish added value and characterize for whom and under what conditions the approach is most effective.

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