

Implementation of Coding-Based Learning as a Digital Learning Culture in Grade V at SD Negeri Ambulu II, Probolinggo Regency

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Abstract. This study aims to describe the implementation of coding learning as part of a digital learning culture in Grade V at SD Negeri Ambulu II, Probolinggo Regency. The study focuses on the planning, implementation, assessment system, interaction patterns between teachers, students, and technology, as well as the challenges encountered during implementation. A qualitative approach with a descriptive research design was employed. Data were collected through observations, interviews, and documentation involving the principal, Grade V teacher, and students. Data analysis followed the Miles and Huberman model, including data reduction, data display, and conclusion drawing. Data validity was ensured through source and technique triangulation. The findings indicate that coding learning was implemented systematically through integrated planning, implementation, and assessment supported by digital technology. Teachers utilized digital learning media and project-based learning to enhance students' creativity, critical thinking, collaboration, and digital literacy. Coding learning also fostered more active, communicative, and collaborative interactions between teachers and students, contributing to the development of a digital learning culture within the school. Furthermore, it promoted students' independent learning, creativity, problem-solving abilities, and adaptability to technological advancements. However, several challenges remained, including limited technological facilities, teachers' readiness to manage digital learning, and differences in students' abilities to understand coding concepts. Overall, coding learning represents an innovative instructional strategy that supports the strengthening of digital learning culture and the development of essential twenty-first-century competencies in elementary school students.

Keywords: Coding Learning; Digital Learning Culture; Digital Literacy; Elementary School; Project-Based Learning.

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1. Introduction

The continuous growth of digital technology has significantly reshaped teaching and learning practices in elementary education, encouraging instructional approaches that are more interactive, learner-centered, and responsive to the competencies required in the twenty-first century. Among these competencies, coding has gained increasing attention because it extends beyond programming skills to promote computational thinking, creativity, collaboration, and systematic problem-solving. In addition, coding instruction contributes to the establishment of a digital learning culture, in which digital technologies are purposefully integrated into classroom practices to support meaningful and engaging learning experiences (Suryanto, 2025).

Developing a digital learning culture requires more than simply introducing technological devices into the classroom. It involves redesigning the interactions among teachers, students, and digital resources to create an environment that encourages

collaboration, active participation, and independent learning. Such an environment is expected to strengthen students' critical thinking, communication, creativity, and problem-solving abilities, all of which are regarded as essential competencies for the digital era (Suryanto & Panuntun, 2025). Furthermore, the incorporation of digital technology into classroom instruction aligns with national educational initiatives aimed at improving digital literacy and introducing coding education from the elementary school level (Happy et al., 2026).

Preliminary observations conducted in a fifth-grade classroom at SD Negeri Ambulu II, Probolinggo Regency, revealed that teaching practices remained largely teacher-centered and relied heavily on conventional instructional methods. Consequently, digital technologies were not fully utilized to support the learning process, resulting in limited student participation and restricting opportunities to cultivate a sustainable digital learning culture. Conversely, coding-based learning offers opportunities for students to engage in structured problem-solving activities that encourage independent learning, collaboration, and reflective thinking (Muhith & Bahri, 2025).

Accordingly, this study investigates the implementation of coding instruction as a component of digital learning culture among fifth-grade students at SD Negeri Ambulu II, Probolinggo Regency. Specifically, the study explores the planning, implementation, and assessment of coding-based learning, examines its influence on teacher–student interactions, analyzes its contribution to the development of a digital learning culture, and identifies the challenges encountered during the integration of technology into classroom instruction (Creswell & Poth, 2018; Jayanti et al., 2021; Yuliandari, 2025). Research addressing the relationship between coding education and digital learning culture in Indonesian elementary schools, particularly in public schools located in regency areas, remains limited, highlighting the significance of this investigation.

The primary objective of this research is to provide a comprehensive description and analysis of the planning, implementation, and evaluation of coding-based instruction as an integral element of digital learning culture in the fifth grade of SD Negeri Ambulu II, Probolinggo Regency. It is expected that the findings will enrich the theoretical literature on coding education and digital learning culture in elementary education while also offering practical guidance for teachers, school administrators, and policymakers seeking to design technology-enhanced learning environments that address the educational demands of the digital age (Faridahtul Jannah et al., 2023; Saifuddin & Putra, 2024).

2. Research Method

This research adopted a qualitative methodology to obtain a comprehensive understanding of how coding-based instruction was implemented as part of a digital learning culture in the fifth grade of SD Negeri Ambulu II, Probolinggo Regency. A qualitative approach was considered appropriate because it facilitates an in-depth exploration of educational phenomena within their natural settings while emphasizing participants' experiences, perspectives, and interactions during the learning process (Annasthasya et al., n.d.; Tantangan, 2025). From a theoretical perspective, the study was grounded in phenomenology, which seeks to interpret the meanings that teachers and students assign to their lived experiences of participating in coding-based learning activities (Inayah et al., 2025).

A qualitative case study design was employed to investigate the implementation of coding instruction within the authentic context of a single elementary school. This design enabled the researcher to examine classroom practices, teacher–student interactions, supporting conditions, and obstacles encountered during the integration of coding into the development of a digital learning culture in a detailed and contextual manner (Assyakurrohim et al., 2023; Alindra et al., 2024).

In accordance with qualitative research principles, the researcher functioned as the primary instrument responsible for collecting and interpreting the data. Supporting instruments included classroom observation sheets, semi-structured interview guides, audio recording equipment, and field notes. Throughout the study, the researcher was directly involved in classroom activities as a participant observer in order to obtain a thorough understanding of the instructional process.

The study was conducted at SD Negeri Ambulu II, Probolinggo Regency, which was intentionally selected because it reflected the characteristics required for investigating coding-based learning within a digital learning culture. Data were obtained from both primary and secondary sources. Primary information was collected from teachers, students, and other key informants through a snowball sampling strategy until no new information emerged and data saturation was achieved (Lenaini et al., 2021). Secondary data consisted of instructional documents, including teaching modules, learning materials, the Learning Objectives Flow

(ATP), Learning Outcomes (CP), school archives, activity reports, and classroom documentation.

Several data collection techniques were applied to strengthen the findings. These included direct classroom observations, semi-structured interviews, Focus Group Discussions (FGDs), document analysis, and a review of relevant literature. Observations were used to capture actual learning practices, interviews explored participants' opinions and experiences, FGDs provided shared insights from multiple participants, while document analysis and literature review served to support data triangulation and reinforce the empirical findings (Susanto et al., 2025; Putri & Murhayati, 2025).

The collected data were processed using an interactive data analysis framework comprising three interconnected stages: data reduction, data display, and conclusion drawing with verification. Analysis was carried out continuously throughout the research process by organizing, interpreting, and synthesizing the collected information until coherent and contextually meaningful conclusions were obtained (Rahmani et al., 2025; Dahlia, 2025).

To establish the trustworthiness of the study, several validation strategies were implemented. These included source triangulation, methodological triangulation, and time triangulation, supported by prolonged engagement in the research setting, persistent observation, member checking, and the examination of documentary evidence. Collectively, these procedures were intended to strengthen the study's credibility, transferability, dependability, and confirmability, thereby ensuring that the research findings are valid, reliable, and academically rigorous (Dahlia, 2025).

3. Results and Discussion

Results

This study was conducted at SD Negeri Ambulu II, Probolinggo Regency, involving the fifth-grade classroom teacher and 32 fifth-grade students as the research participants. The data were collected through classroom observations, semi-structured interviews, and document analysis. Data analysis was carried out through three stages: data reduction, data display, and conclusion drawing.

Table 1. Findings on the Implementation of Coding-Based Learning as a Digital Learning Culture

Aspect	Main Findings
Planning	Preparation of teaching modules, Learning Objectives Flow (ATP), Scratch-based learning media, and assessment instruments aligned with the Merdeka Curriculum.
Implementation	Active, collaborative, creative, and project-based learning using Scratch.
Assessment	Authentic assessment through classroom observation, project evaluation, presentations, and group collaboration.

Planning of Coding-Based Learning as a Digital Learning Culture

The findings showed that the teacher carefully designed the coding-based instructional program before its implementation. The preparation process included developing teaching modules, the Learning Objectives Flow (ATP), student worksheets, digital learning materials, and assessment instruments. All instructional components were developed in accordance with the Merdeka Curriculum while incorporating the principles of the Project-Based Learning (PjBL) model.

Scratch was selected as the primary coding platform because its visual programming environment is suitable for elementary school learners. The teacher considered that block-based programming enables students to understand sequencing, simple algorithms, and computational thinking more easily through practical project activities.

As explained by the teacher:

"I integrate coding into project activities so that students do not only learn the theory but also directly practice creating something." (Interview with Ms. NH, May 26)

The learning design was also adapted to students' developmental levels by introducing coding concepts gradually.

"I started with simple topics, such as arranging command blocks and creating basic animations, because the students are still at the beginner level." (Interview with Ms. NH, May 26)

Despite careful preparation, several limitations affected the planning stage, particularly the lack of formal professional development and instructional resources related to coding education.

"We are still learning independently by looking for examples of coding lessons on the internet because there has not been any specialized training yet." (Interview with AR, Grade V Student)

Implementation of Coding-Based Learning as a Digital Learning Culture

The learning process was implemented through three instructional stages: introduction, core activities, and closing activities. During the introductory stage, the teacher connected the lesson to students' daily experiences by presenting examples of digital games and animations.

"I usually show examples of games or animations that the students are familiar with to attract their interest before we begin the lesson." (Interview with Ms. NH, Grade V Homeroom Teacher, 2026) During the core learning activities, students directly practiced coding using Scratch. Classroom observations showed that students actively explored the application's features, arranged programming blocks, and developed simple digital projects.

One student stated:

"I enjoy it because I can create my own game, even though it is still very simple." (Interview with Student HU, 2026) Students also demonstrated increased confidence in using digital technology. "At first I was confused, but after trying it several times, it became easier." (Interview with Student FI, 2026) Collaboration among students was also evident throughout the learning process.

"If one of our friends has difficulty, we usually help each other so that everyone can complete the assignment." (Interview with Student MD, 2026) Based on the classroom observations, four major instructional patterns were identified during the implementation of coding-based learning:

- a. Exploratory learning
- b. Collaborative learning
- c. Creative learning
- d. Participatory learning

Nevertheless, the implementation process encountered challenges due to the limited availability of digital devices.

"Sometimes the students have to take turns using the laptops because we do not have enough devices." (Interview with Ms. NH, Grade V Homeroom Teacher, 2026)

To address this issue, the teacher organized students into collaborative groups.

"I usually group students with different ability levels so that those who understand the material more quickly can assist their classmates." (Interview with Ms. NH, Grade V Homeroom Teacher, 2026)

Assessment of Coding-Based Learning as a Digital Learning Culture

The findings indicated that coding-based learning was assessed using an authentic assessment approach. Assessment focused not only on the final project outcomes but also on students' learning processes throughout the instructional activities.

The teacher evaluated students through classroom observations, project assessment, attitude assessment, practical coding performance, and project presentations.

"I do not only assess the final product but also observe the students' learning process—whether they are willing to try, ask questions, and collaborate with their peers." (Interview with Ms. NH, Grade V Homeroom Teacher, 2026)

The teacher also provided continuous feedback throughout the learning process.

"If a student's program does not work properly, I guide them step by step so they can identify and correct the errors themselves." (Interview with Ms. NH, Grade V Homeroom Teacher, 2026)

Table 2. Assessment Indicators for Coding-Based Learning.

No.	Indicator
1	Accuracy of program logic
2	Creativity in project design
3	Functionality of the program
4	Organization of programming blocks
5	Ability to explain the completed project

The teacher also assessed students' creativity in developing their digital projects.

"Although the students are given the same assignment, their projects are often different. Some add sounds, colors, or additional animations, and I consider these creative enhancements in the assessment." (Interview with Ms. NH, Grade V Homeroom Teacher, 2026). Students reported feeling more motivated when their work received positive recognition. "I feel happy when my teacher praises my project because it motivates me to create an even better one next time." (Interview with Student AH, 2026).

Discussion

Planning of Coding-Based Learning as a Digital Learning Culture

The findings indicate that the planning of coding-based learning was carried out systematically through the preparation of teaching modules, the Learning Objectives Flow (ATP), digital learning media, and assessment instruments. These findings are consistent with constructivist learning theory, which posits that knowledge is constructed through direct learning experiences. The use of Scratch and the Project-Based Learning (PjBL) model provided students with opportunities to construct their understanding through hands-on learning activities. Furthermore, the use of visual learning media is consistent with Piaget's theory of cognitive development, which states that elementary school students are in the concrete operational stage. At this stage, students are better able to understand concepts through visual representations, animations, and direct practical experiences.

Implementation of Coding-Based Learning as a Digital Learning Culture

The implementation of coding-based learning demonstrated the characteristics of active, collaborative, and creative learning. These findings support the principles of active learning, which position students as the center of the learning process. Rather than merely receiving information, students actively participated in exploring concepts and developing digital projects. The findings are also consistent with Vygotsky's social constructivist theory, which emphasizes the importance of social interaction in learning.

Collaboration among students during project activities indicates that coding-based learning contributes to the development of communication and collaborative skills. Moreover, students' activities in arranging programming blocks and debugging errors demonstrate the development of computational thinking, which is recognized as one of the essential competencies required for the twenty-first century.

Assessment of Coding-Based Learning as a Digital Learning Culture

The assessment of coding-based learning was conducted using an authentic assessment approach that encompassed the cognitive, affective, and psychomotor domains. These findings are consistent with the assessment principles of the Merdeka Curriculum, which emphasize the holistic evaluation of students' competencies.

The provision of continuous feedback throughout the learning process is also aligned with the principles of formative assessment, which suggest that timely feedback enables students to recognize their mistakes and improve their learning outcomes. The assessment of digital projects, including creativity, collaboration, and presentation skills, demonstrates that coding-based learning promotes not only digital literacy but also the development of broader twenty-first-century competencies.

Relationship Between the Findings and Digital Learning Culture

Overall, the findings indicate that the implementation of coding-based learning in the fifth grade of SD Negeri Ambulu II has successfully fostered a digital learning culture. This is reflected in students' increased engagement in classroom activities, enhanced creativity and collaboration, and the growing habit of utilizing digital technology as an integral part of the learning process.

Coding-based learning serves not only as a means of introducing students to digital technology but also as an effective approach to developing logical thinking, problem-solving abilities, communication skills, and creativity. Therefore, coding-based learning can be regarded as an effective instructional strategy for establishing a sustainable digital learning culture in elementary schools.

4. Conclusion and Recommendations

Conclusion

Based on the findings of this study, the implementation of coding-based learning as a digital learning culture in the fifth grade of SD Negeri Ambulu II, Probolinggo Regency, has been successfully carried out through the three main components of instructional practice: planning, implementation, and assessment.

During the planning stage, the teacher systematically prepared teaching modules, the Learning Objectives Flow (ATP), digital learning media, and assessment instruments aligned with the Merdeka Curriculum, utilizing Scratch as the primary project-based learning platform. During the implementation stage, learning activities were conducted in an active, collaborative, creative, and participatory manner, which contributed to improving students' learning motivation, logical thinking, creativity, communication, and collaboration skills. In the assessment stage, the teacher employed authentic assessment through classroom observation, digital project evaluation, attitude assessment, and group collaboration, thereby supporting the development of students' digital literacy and other twenty-first-century competencies.

Overall, coding-based learning serves not only as a means of introducing students to digital technology but also as an effective approach to fostering a digital learning culture characterized by active participation, creativity, collaboration, and innovation. Nevertheless, several challenges remain, including the limited availability of digital devices, insufficient professional training for teachers, and the need to develop more systematic assessment instruments.

Recommendations

Schools should strengthen support for coding-based learning by providing adequate digital infrastructure and enhancing digital literacy programs. Teachers are encouraged to continuously improve their competencies in technology-enhanced instruction while developing more structured instructional materials and assessment instruments.

Future research is recommended to involve a broader range of schools and participants and to investigate the effectiveness of coding-based learning in improving students' digital literacy, creativity, critical thinking, and computational thinking using quantitative or mixed-methods approaches. Such studies are expected to provide more comprehensive evidence regarding the impact of coding-based learning on elementary education.

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