



Integrating Canva into Discovery Learning to Enhance Critical Thinking and Support Scientific Literacy in Elementary Science Education

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Abstract

Critical thinking and scientific literacy are essential competencies in elementary science education, yet classroom learning often provides limited opportunities for students to explore scientific phenomena, process evidence, and communicate findings. This study aimed to develop and evaluate the integration of Canva into Discovery Learning as a technology-enhanced instructional approach for improving critical thinking and supporting scientific literacy in elementary science education. A Research and Development (R&D) approach adapted from the Borg and Gall model was employed through seven stages: needs analysis, planning, initial development, expert validation, revision and limited trial, main field trial, and final product development. The participants were 40 fifth-grade students, including 10 students in the limited trial and 30 students in the main field trial. The developed product integrated Canva into the six stages of Discovery Learning and included learning materials, student worksheets, and assessment instruments. Validation results indicated high feasibility, with an overall score of 88.40%. Critical thinking increased from a mean pretest score of 52.10 to 81.40 posttest, with a significant paired-sample t-test result ($p < .001$) and an N-Gain of 0,61. Students demonstrated an overall scientific literacy performance of 85%. Implementation challenges involved teacher adaptation, digital readiness, instructional time, infrastructure, and internet connectivity. The findings demonstrate the potential of Canva-integrated Discovery Learning as a feasible technology-enhanced pedagogy for elementary science education.

Keywords: Canva; Critical Thinking; Discovery Learning; Elementary Science Education; Scientific Literacy.

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INTRODUCTION

The development of education in the twenty-first century requires elementary school students to acquire competencies that extend beyond the mastery of factual knowledge. Critical thinking and scientific literacy have become essential because students increasingly encounter scientific, technological, social, and environmental information that requires interpretation, evaluation, and evidence-based reasoning. Critical thinking enables students to identify relevant information, analyze relationships, evaluate evidence, and formulate logical conclusions, while scientific literacy supports their ability to understand scientific phenomena, interpret evidence, and communicate explanations within meaningful contexts. These abilities need to be introduced from the elementary level because

early experiences in observing phenomena, asking questions, collecting information, analyzing evidence, and explaining findings contribute to the development of more advanced scientific reasoning. Research has also shown a close relationship between science process skills, critical thinking, digital literacy, and students' capacity to engage meaningfully with scientific information (Ardianto & Rubini, 2016; Darmaji et al., 2020; Facione, 2015; Kurniawan et al., 2023). However, elementary science learning does not always provide sufficient opportunities for students to develop these competencies. Learning activities may still emphasize the delivery of information, textbook use, memorization, and routine exercises (Syahrial et al., 2022). Such conditions can limit students' opportunities to investigate phenomena, construct explanations, evaluate information, and communicate conclusions based on evidence. Therefore, elementary science education requires instructional approaches that actively involve students in the processes of thinking, investigating, and constructing scientific understanding (Astalini et al., 2023).

Discovery Learning provides a relevant pedagogical framework for addressing these instructional needs because it places students in an active role during the construction of knowledge. The model guides students through a sequence of activities that generally includes stimulation, problem statement, data collection, data processing, verification, and generalization. Through these stages, students are encouraged to examine phenomena, formulate questions, gather information, identify patterns, test ideas, and develop conclusions. These activities are closely related to the cognitive processes required in critical thinking and scientific literacy. Empirical studies have indicated that Discovery Learning can support students' critical thinking skills and science learning outcomes by creating opportunities for exploration, evidence analysis, and independent knowledge construction (Hadi et al., 2020; Hidayat & Widjajanti, 2018; Lieung, 2019; Niswatu Zahro et al., 2018; Prilliza et al., 2020). The model is therefore relevant for elementary science learning, where students need direct and structured experiences to connect scientific concepts with observable phenomena. Nevertheless, the successful implementation of Discovery Learning depends not only on the instructional model itself but also on the quality of the learning resources used to support each stage. Young learners require learning materials that present scientific information clearly, visually, interactively, and in forms that facilitate exploration and communication.

Digital technology can strengthen this pedagogical process when it is integrated according to specific instructional functions. One digital platform with considerable potential for elementary learning is Canva. Canva provides features for designing presentations, infographics, visual worksheets, diagrams, posters, and other forms of digital content that can help students organize and communicate information. Its educational value is not limited to the visual appearance of learning materials. When used appropriately, Canva can help students structure ideas, represent observations, organize information, and communicate scientific findings through visual and verbal forms. Previous research has reported positive uses of Canva in learning activities, particularly in relation to creativity, engagement, science learning, and scientific communication (Indriani, 2024; Priantini, 2021; Saputri & Ardiansyah, 2022; Wulandari & Mudinillah, 2022). These findings indicate that Canva can function as more than a presentation platform when its features are connected with meaningful learning activities. However, the presence of digital media does not automatically improve the quality of learning. Its instructional contribution depends on how the technology is integrated with the learning model, the cognitive activities expected from students, and the learning objectives to be achieved.

The integration of Canva into Discovery Learning offers a specific form of technology and pedagogy integration in which digital features support the cognitive activities of each discovery stage. During stimulation, teachers can use visual content to introduce contextual scientific phenomena and encourage students to identify relevant issues. During problem statement, students can represent questions and initial ideas through structured visual formats. In the data collection and data processing stages, Canva templates can support the organization of observations, evidence, classifications, and relationships among concepts. During verification and generalization, students can present findings through infographics, diagrams, or visual presentations and use these representations to communicate evidence-based conclusions. In this configuration, Canva does not function as a separate digital component. It becomes an instructional support within a structured discovery process. Studies on

technology-supported learning have emphasized that digital tools become more educationally meaningful when their functions are aligned with learning activities, student participation, and intended cognitive processes (Pratiwi et al., 2026; Toma & Reinita, 2023; Wahyudi & Jatun, 2024; Wilson & Cheung, 2019). This perspective places pedagogical design at the center of technology integration. The relevant question is therefore not simply whether Canva can improve student outcomes, but how Canva can support the processes of observation, inquiry, information processing, reasoning, and scientific communication within Discovery Learning.

Despite the increasing use of Discovery Learning and digital media in elementary education, a specific research gap remains in the systematic integration of Canva with the sequential stages of Discovery Learning. Previous research on Discovery Learning has largely examined its influence on critical thinking, scientific literacy, and science learning outcomes, while studies involving Canva have frequently focused on creativity, learning media development, engagement, or specific learning outcomes. Recent studies have also demonstrated growing interest in integrating interactive Canva-based applications with student-centered instructional models to improve higher-order thinking and collaborative skills (Kartini et al., 2026). However, evidence concerning the systematic use of Canva across the stages of Discovery Learning remains limited. Existing findings therefore provide important foundations for the use of both components, but they do not sufficiently explain how the technological affordances of Canva can be operationalized according to the pedagogical functions of stimulation, problem statement, data collection, data processing, verification, and generalization. This limitation becomes more relevant when critical thinking and scientific literacy are treated as simultaneous learning outcomes rather than as separate competencies.

The research gap also concerns the nature of the instructional product itself. The development of digital learning media can produce visually attractive materials, yet visual quality alone does not guarantee that students engage in analysis, evidence evaluation, or scientific reasoning. In the same way, implementing Discovery Learning without adequate instructional resources may restrict students' ability to organize complex information and communicate findings effectively. A stronger instructional design therefore requires an explicit relationship between the pedagogical sequence and the technological functions used during learning. In this study, Canva is positioned as a digital learning environment that supports specific student activities within each stage of Discovery Learning. This approach shifts the emphasis from using Canva as a general visual medium toward integrating its functions with a structured inquiry-oriented learning process. The intended contribution is an instructional design in which students use digital representations as part of the processes of identifying problems, organizing evidence, interpreting information, verifying findings, and communicating scientific conclusions.

This study addresses the identified gap by developing and evaluating an instructional product that systematically integrates Canva into Discovery Learning for elementary science education. The novelty lies in the structured relationship between the technological functions of Canva and the pedagogical functions of each Discovery Learning stage. Canva is not positioned merely as a tool for displaying information or producing attractive learning materials. It is incorporated into the instructional process to facilitate scientific exploration, information organization, evidence-based reasoning, visual representation, and scientific communication. Through this integration, the study seeks to create a technology-supported learning environment that provides students with opportunities to construct scientific understanding while simultaneously developing critical thinking and scientific literacy. The study therefore extends previous research by moving beyond the separate examination of Discovery Learning and Canva toward the design and empirical evaluation of an integrated instructional application.

Accordingly, this study aims to develop and evaluate the integration of Canva into Discovery Learning for elementary science education. Specifically, the study examines the development process of the Canva-integrated Discovery Learning instructional product, evaluates its feasibility in terms of instructional design, learning materials, practicality, and user acceptance, and investigates its effectiveness in enhancing elementary school students' critical thinking and supporting their scientific literacy. The study also examines implementation challenges experienced by teachers and students to

identify practical conditions that may affect the application and sustainability of technology-supported Discovery Learning in elementary classrooms. Through these objectives, the study is expected to provide empirical evidence regarding the integration of digital technology with an established pedagogical model and contribute an instructional alternative for inquiry-oriented and technology-supported elementary science learning.

RESEARCH METHODS

The methodological design was aligned with the study's focus on the relationship between instructional technology and pedagogy, in which Canva was not treated merely as a visual presentation medium but was embedded within the sequence of Discovery Learning activities to support students' exploration, information processing, evidence-based reasoning, and scientific communication. The development process involved needs analysis, instructional planning, product development, expert validation, revision, limited testing, and a main field trial. The evaluation focused on the feasibility of the developed product, its effectiveness in enhancing students' critical thinking, students' scientific literacy during implementation, and the practical challenges experienced by teachers and students when using the technology-supported learning approach.

Research Design

The study used an R&D design adapted from the Borg and Gall development model (Gall et al., 2003). The original development framework was simplified into seven stages according to the research context and characteristics of elementary science learning: (1) needs analysis, (2) product planning, (3) initial product development, (4) expert validation, (5) product revision and limited trial, (6) main field trial, and (7) final product development. The R&D approach was selected because the study aimed not only to examine learning outcomes but also to develop, validate, revise, and empirically evaluate an instructional product integrating digital technology with a pedagogical learning model.

The central design principle was the systematic integration of Canva into the pedagogical sequence of Discovery Learning. The integration connected the affordances of Canva with the six stages of Discovery Learning: stimulation, problem statement, data collection, data processing, verification, and generalization. Canva was used to provide visual and digital support for presenting scientific phenomena, representing problems, organizing information, processing findings, visualizing evidence, and communicating conclusions. Thus, the technology was positioned as an instructional support within the pedagogical process rather than as an independent learning medium. The resulting instructional package consisted of Canva-assisted learning activities, teaching materials, student worksheets (LKPD), and implementation guidance for teachers.

Research Subject

The research was conducted during the odd semester of the 2025/2026 academic year at an elementary school in South Tangerang, Indonesia. The school was selected based on accessibility, availability of technological facilities, teacher readiness to implement digital learning media, and the suitability of the learning context for the objectives of the study. The primary research subjects were fifth-grade elementary school students who participated as users of the developed Canva-integrated Discovery Learning product.

A total of 40 fifth-grade students participated in the development and evaluation process. Ten students participated in the limited trial to examine the initial practicality, readability, clarity of instructions, and students' understanding of the learning activities. Subsequently, 30 students from one class participated in the main field trial to examine the effectiveness of the developed product, particularly its potential to enhance critical thinking and support scientific literacy. The fifth-grade teacher also participated as a practitioner respondent and provided information regarding the feasibility and implementation of the technology-integrated Discovery Learning process.

Table 1. Research subjects and their roles

Participant	Number	Research Stage	Role
Fifth-grade students	10	Limited trial	Evaluated initial clarity, readability, practicality, and usability
Fifth-grade students	30	Main field trial	Participated in the Canva-integrated Discovery Learning implementation and effectiveness evaluation
Fifth-grade teacher	1	Validation and implementation	Assessed feasibility and provided information on implementation challenges
Total students	40	—	Primary users of the developed instructional product

The use of separate limited and main trials was intended to allow the product to be refined before its effectiveness was examined in the main classroom implementation. This arrangement followed the development-oriented nature of the R&D design described in the original study.

Research Procedure

The research procedure was systematically designed to guide the development, validation, testing, and refinement of the Canva-integrated Discovery Learning product. The procedure was adapted from the Borg and Gall development model and organized into seven sequential stages. Each stage was conducted to ensure that the developed product met the identified instructional needs, reflected the principles of Discovery Learning, integrated Canva appropriately within the learning process, and achieved adequate levels of feasibility and practicality. The overall research procedure is presented in Figure 1.

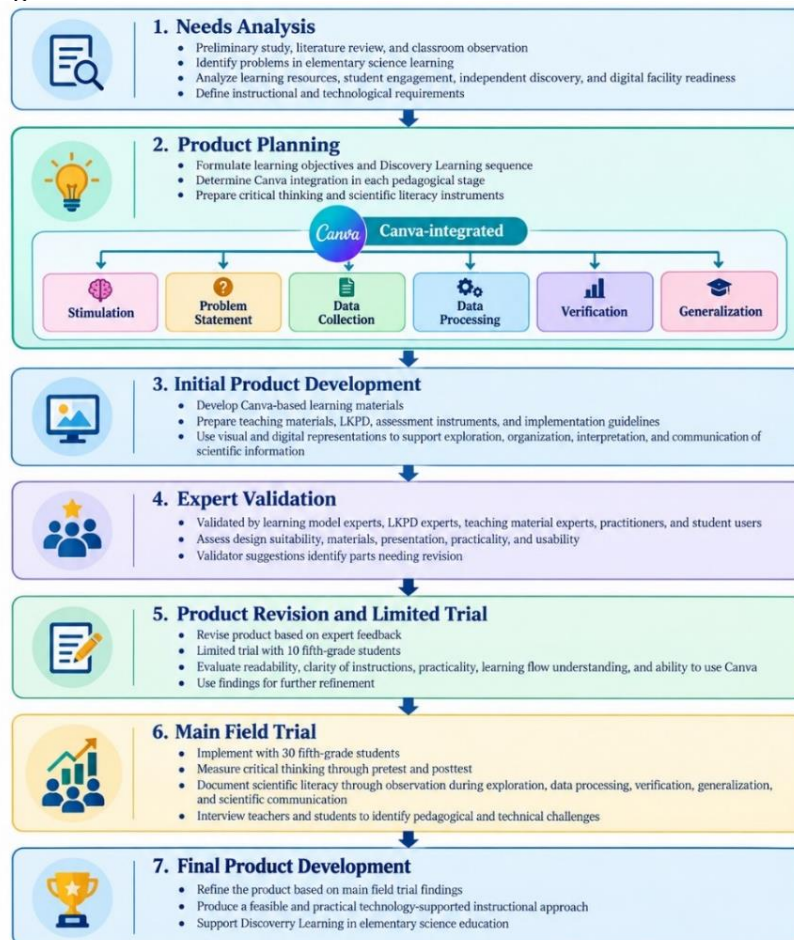


Figure 1. The Research Procedure of the Canva-Integrated Discovery Learning

The relationship between the development stages, data sources, and evaluation purposes is presented in Table 2.

Table 2. Development stages, data sources, and evaluation purposes

Development Stage	Data Source	Main Purpose
Needs analysis	Initial observation, literature review	Identify instructional and technological needs
Product planning	Learning objectives and instructional design	Design Canva integration within Discovery Learning
Initial development	Learning materials, Canva media, LKPD, assessment instruments	Produce the initial instructional product
Expert validation	Experts and practitioner	Evaluate instructional, material, pedagogical, and practical feasibility
Limited trial	10 students	Examine clarity, readability, practicality, and initial usability
Main field trial	30 students	Examine critical thinking and scientific literacy during implementation
Interviews	Teacher and students	Identify pedagogical, technical, and user-related implementation challenges
Final development	Trial and validation findings	Refine the final instructional product

Instruments, and Data Collection Techniques

Data were collected using expert validation sheets, student questionnaires, critical thinking tests, scientific literacy observation sheets, and semi-structured interviews with the teacher and students. The instruments were designed to correspond to the development and evaluation objectives of the study. Expert validation instruments were used to assess the quality and feasibility of the learning model, LKPD, and teaching materials. Teacher and student questionnaires were used to obtain information concerning product appeal, ease of use, practicality, and perceived usefulness.

The critical thinking instrument was administered as a pretest and posttest to the 30 students participating in the main field trial. The instrument addressed critical thinking indicators including analysis, interpretation, evaluation of evidence, and drawing logical conclusions. These indicators were aligned with the cognitive activities promoted through the Discovery Learning process and supported by Canva-based visual and information-processing activities.

Scientific literacy was assessed through observation during the implementation of the Canva-integrated Discovery Learning activities. The observation focused on students' ability to identify scientific problems, explain scientific phenomena, use scientific data and evidence, draw conclusions based on evidence, and communicate findings scientifically. These observations were conducted during the exploration, data processing, verification, and generalization activities.

Interviews were conducted with the fifth-grade teacher and participating students following the implementation to obtain qualitative information that could complement the quantitative findings. Teacher interviews focused on digital media mastery, time management, differences in student abilities, technological facilities, and learning preparation. Student interviews examined their experiences using Canva, understanding of learning instructions, group work, confidence in expressing ideas, and internet connectivity. The instruments and their corresponding data sources are summarized in Table 3.

Table 3. Instruments, data sources, and data obtained

Instrument	Data Source	Data Collected	Purpose
Expert validation sheet	Learning model, LKPD, teaching material, and practitioner experts	Feasibility scores and suggestions	Evaluate product feasibility
Teacher questionnaire/assessment	Fifth-grade teacher	Practicality and usability assessment	Evaluate classroom applicability
Student questionnaire	Fifth-grade students	Appeal, ease of use, and perceived usefulness	Evaluate user acceptance
Critical thinking test	30 students	Pretest and posttest scores	Measure changes in critical thinking
Scientific literacy observation sheet	30 students	Performance scores during learning	Assess scientific literacy performance
Teacher interview	Fifth-grade teacher	Qualitative implementation experiences	Identify pedagogical and technical challenges
Student interview	Fifth-grade students	User experiences and difficulties	Identify usability and adaptation challenges

Data collection was conducted sequentially according to the R&D procedure. Expert and practitioner assessments were obtained during the validation stage, student responses were collected during the limited and main trials, critical thinking pretests and posttests were administered during the main field trial, scientific literacy was observed during the learning implementation, and interviews were conducted to obtain supporting explanations concerning implementation challenges.

Data Analysis Technique

The data analysis was conducted according to the characteristics of the data and the research objectives. Quantitative data from expert and user assessments were analyzed using descriptive percentage analysis to determine the feasibility and practicality of the developed product. The resulting percentages were interpreted according to the feasibility categories used in the study. The validation analysis covered the learning model, LKPD, teaching materials, practitioner assessment, and student user responses. For the effectiveness analysis, descriptive statistics were first used to summarize the critical thinking pretest and posttest scores, including the number of students, minimum and maximum scores, mean, and standard deviation. Because the main field trial involved 30 students, the Shapiro–Wilk test was used to examine the normality of the pretest and posttest data. The normality results were used to determine the appropriateness of subsequent parametric analysis.

Following the normality test, a paired-sample t-test was employed to examine whether there was a statistically significant difference between students' critical thinking scores before and after participation in the Canva-integrated Discovery Learning activities. The significance level was set at 0.05. In addition, normalized gain (N-Gain) analysis was used to determine the magnitude of improvement in critical thinking scores from pretest to posttest. The N-Gain result was interpreted according to the criteria reported by Hake (1998).

Scientific literacy data were analyzed descriptively based on observation scores obtained during the learning implementation. The analysis covered five observed aspects: identifying scientific problems, explaining scientific phenomena, using scientific data and evidence, drawing conclusions based on evidence, and communicating scientific findings. The resulting scores were presented as percentages and interpreted according to the categories used in the study. Importantly, because scientific literacy was measured through classroom observation rather than a pretest-posttest design, the analysis describes students' demonstrated scientific literacy performance rather than claiming a statistically measured increase in scientific literacy.

Qualitative data from observations, expert suggestions, and teacher and student interviews were analyzed descriptively using the stages of data reduction, data presentation, and conclusion drawing proposed by Miles, Huberman, and Saldaña (2014). The qualitative analysis was used to identify aspects requiring product revision and to explain the practical, pedagogical, and technical challenges encountered during implementation. The overall analytical framework is summarized in Table 4.

Table 4. Data analysis framework

Research Focus	Data	Analysis Technique	Output
Product feasibility	Expert, teacher, and student assessments	Descriptive percentage analysis	Feasibility/practicality category
Critical thinking	Pretest and posttest scores	Descriptive statistics	Mean, SD, minimum, maximum
Distribution of critical thinking scores	Pretest and posttest	Shapiro–Wilk test	Normality information
Difference in critical thinking	Pretest and posttest	Paired-sample t-test	Statistical significance
Magnitude of critical thinking improvement	Pretest and posttest	N-Gain analysis	Gain score and category
Scientific literacy	Observation scores	Descriptive percentage analysis	Performance by literacy aspect
Implementation challenges	Teacher and student interviews	Qualitative descriptive analysis	Themes concerning pedagogical and technical challenges
Product refinement	Expert suggestions and qualitative findings	Data reduction, presentation, conclusion drawing	Revision recommendations

RESULTS AND DISCUSSION

RESULTS

The development process produced a technology-enhanced instructional product that integrated Canva into the pedagogical sequence of Discovery Learning for fifth-grade elementary science education. The product was developed through seven stages: needs analysis, product planning, initial product development, expert validation, product revision and limited trial, main field trial, and final product development. The results are presented in terms of the development of the instructional product, product feasibility, students' critical thinking performance, scientific literacy performance, and implementation challenges identified during the main field trial.

The needs analysis identified several instructional and technological conditions that informed the development of the product. Initial classroom observations indicated that science learning was predominantly supported by lectures and textbooks, while opportunities for students to independently observe phenomena, collect information, process evidence, and formulate conclusions remained limited. The use of digital media was also largely restricted to static presentations. These conditions indicated a need for an instructional design that could combine an active pedagogical model with digital technology to support students' participation throughout the learning process.

Based on these needs, the product was designed by integrating Canva into the six stages of Discovery Learning: stimulation, problem statement, data collection, data processing, verification, and generalization. The integration was designed so that Canva functioned as an instructional technology supporting specific learning activities rather than merely as a tool for displaying information. At the stimulation stage, Canva-based visual materials were used to present scientific phenomena; during problem statement and data collection, visual resources supported students in identifying problems and organizing information; during data processing and verification, Canva-

supported representations were used to organize and visualize findings; and during generalization, students used visual outputs to communicate their conclusions. The resulting instructional package consisted of Canva-assisted learning activities, teaching materials, student worksheets, and assessment instruments for critical thinking and scientific literacy.

Product Feasibility

The initial product was evaluated by learning model experts, LKPD experts, teaching material experts, a practitioner, and student users. The validation results demonstrate that all evaluated components reached the *very feasible* category. The learning model received a score of 88%, LKPD 85%, teaching materials 87%, practitioner assessment 90%, and student user assessment 92%. The overall feasibility score was 88.40%.

Table 5. Feasibility assessment of the canva-integrated discovery learning product

Validator/Respondent	Score (%)	Category
Learning model expert	88	Very feasible
LKPD expert	85	Very feasible
Teaching materials expert	87	Very feasible
Practitioner/teacher	90	Very feasible
Student users	92	Very feasible
Overall average	88.40	Very feasible

The validation results indicate that the product met the required criteria across instructional design, learning materials, practicality, and user acceptance. The learning model component obtained 88%, indicating that the integration of Canva was considered compatible with the Discovery Learning structure. The LKPD score of 85% indicated that the worksheets were considered appropriate for supporting discovery-oriented activities. The teaching material score of 87% reflected the suitability and organization of the science content, while the practitioner score of 90% indicated that the product was considered applicable in classroom implementation. Student users provided the highest score, 92%, indicating positive acceptance in terms of usability and learning experience.

The validation process also generated several revisions before the main field trial. The revisions included simplifying LKPD instructions, reducing unnecessary visual complexity, adjusting the presentation of Canva-based materials to students' cognitive characteristics, and improving the sequence of learning activities. These revisions were incorporated into the product before its implementation in the main field trial.

Limited Trial Results

The limited trial involved 10 fifth-grade students and was conducted after the product had undergone expert validation and revision. The trial focused on the clarity of instructions, readability of learning materials, practicality of the learning flow, and students' initial ability to use Canva within the Discovery Learning activities. The results indicated that some students initially required assistance in understanding the Canva workflow and the sequence of Discovery Learning activities. Students also required guidance when following the instructions during the early stages of implementation.

Following the limited trial, the product was further refined before the main field trial. The refinement focused primarily on instructional clarity and the usability of the technology-supported learning sequence. Thus, the limited trial functioned as a formative stage in which user responses were used to improve the final implementation version.

Main Field Trial and Critical Thinking Results

The main field trial involved 30 fifth-grade students. Students' critical thinking skills were measured using pretest and posttest instruments covering analysis, interpretation, evaluation of evidence, and drawing logical conclusions. Descriptive statistics showed an increase in the average critical thinking score from 52.10 before implementation to 81.40 after implementation. The minimum score increased from 38 to 65, while the maximum score increased from 70 to 95. The standard deviation decreased from 8.45 to 7.62.

Table 6. Descriptive statistics of students' critical thinking scores

Statistic	Pretest	Posttest
Number of students	30	30
Minimum score	38	65
Maximum score	70	95
Mean	52.10	81.40
Standard deviation	8.45	7.62

The descriptive results show that the improvement occurred across the observed score range, with both minimum and maximum scores shifting upward. The reduction in standard deviation from 8.45 to 7.62 also indicates that the distribution of students' scores became somewhat more homogeneous after the learning implementation. These results provide descriptive evidence of improved critical thinking performance following participation in the Canva-integrated Discovery Learning activities. Before conducting the paired-sample t-test, the normality of the pretest and posttest scores was examined using the Shapiro–Wilk test. Both datasets obtained significance values greater than 0.05. The pretest produced a significance value of 0.284, while the posttest produced a significance value of 0.173. Therefore, the pretest and posttest data met the normality assumption for the subsequent paired-sample t-test.

Table 7. Shapiro–Wilk normality test of critical thinking scores

Data	Shapiro–Wilk Statistic	p-value	Interpretation
Pretest	0.961	0.284	Normally distributed
Posttest	0.954	0.173	Normally distributed

The paired-sample t-test showed a mean difference of -29.30 between the pretest and posttest scores, with $t(29) = -18.62$ and $p < .001$. This result indicates a statistically significant difference in students' critical thinking scores before and after participation in the Canva-integrated Discovery Learning activities.

Table 8. Paired-sample t-test results for critical thinking

Comparison	Mean Difference	t	df	p
Pretest – Posttest	-29.30	-18.62	29	$< .001$

The magnitude of improvement was further examined using normalized gain analysis. The mean pretest score of 52.10 increased to 81.40 in the posttest, resulting in an N-Gain score of 0.61, which falls within the high category.

Table 9. Normalized gain of students' critical thinking

Component	Score
Pretest mean	52.10
Posttest mean	81.40
N-Gain	0.61
Category	High

Scientific Literacy Results

Scientific literacy was assessed through classroom observation during the implementation of the Canva-integrated Discovery Learning activities. The observation focused on five aspects: identifying scientific problems, explaining scientific phenomena, using scientific data and evidence, drawing conclusions based on evidence, and communicating scientific findings. The overall scientific literacy score was 85.00%, categorized as very good. Students' scientific literacy performance provide Figure 2.

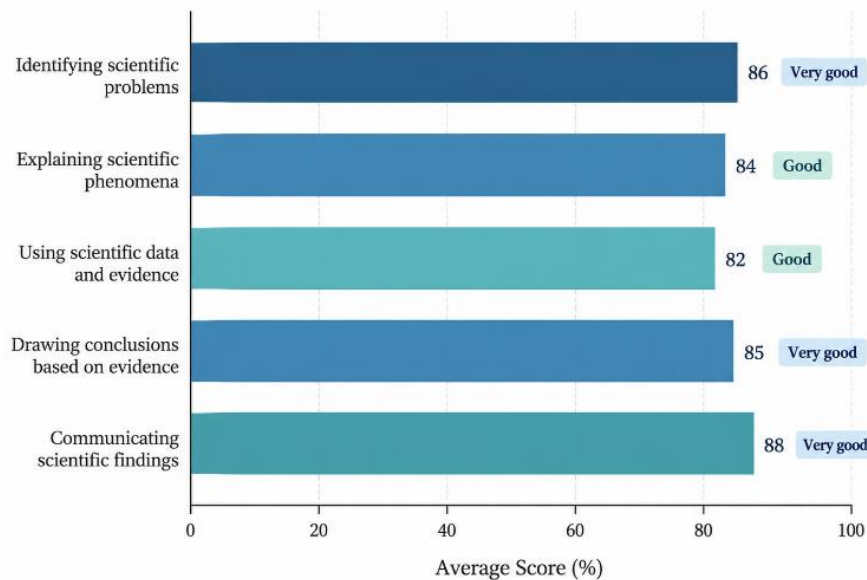


Figure 2. Students' Scientific Literacy Performance by Aspect

The highest observed score was obtained for scientific communication (88%), followed by identifying scientific problems (86%) and drawing conclusions based on evidence (85%). Explaining scientific phenomena obtained 84%, while the use of scientific data and evidence obtained 82%. Thus, all five observed aspects were within the good to very good categories.

Because scientific literacy was assessed through observation during implementation rather than through a pretest-posttest design, the 85% result represents students' demonstrated scientific literacy performance during the intervention, rather than a statistically measured increase from baseline.

Implementation Challenges

Teacher and student interviews provided qualitative information concerning the implementation of the Canva-integrated Discovery Learning activities. The teacher identified five principal areas of challenge: digital media mastery, time management, differences in student abilities, technological facilities, and learning preparation. Teachers required adaptation time to maximize Canva's features and connect them appropriately with the Discovery Learning syntax. Time management was also considered important because the exploration and discussion stages required sufficient classroom time. Differences in students' academic and digital abilities required differentiated guidance, while device availability and internet stability occasionally affected implementation.

Table 10. Teacher-reported implementation challenges

Aspect	Main Finding
Digital media mastery	Teachers required adaptation time to maximize Canva features and integrate them with Discovery Learning
Time management	Exploration and discussion stages required careful time allocation
Student ability differences	Differences in academic and digital abilities required different levels of guidance
Facilities and infrastructure	Device availability and internet stability occasionally created obstacles
Learning planning	Teachers required comprehensive preparation, particularly for LKPD and discovery-based activities

Student interviews revealed several additional implementation challenges. Some students initially experienced difficulty understanding the steps for using Canva, while others found the initial instructions too lengthy. Unequal task distribution during group work and hesitation to express opinions during discussions were also reported. Occasional internet disruptions affected access to the digital learning materials.

Table 11. Student-reported implementation challenges

Aspect	Main Finding
Canva use	Some students initially had difficulty understanding the Canva workflow
Learning instructions	Some students considered the initial instructions too long
Group work	Some group members did not receive equal roles
Confidence	Some students were hesitant to express their opinions
Internet connection	Occasional network disruptions affected access to the media

The qualitative findings indicate that the principal implementation challenges were related to adaptation, instructional management, digital readiness, and technical conditions rather than fundamental incompatibility between Canva and Discovery Learning. The challenges were most evident during the early stages of implementation, particularly when students and teachers were becoming familiar with the technology-supported learning sequence.

DISCUSSION

The findings demonstrate that the integration of Canva into Discovery Learning provides a structured technology-supported approach to elementary science instruction. Its instructional value lies not simply in the use of Canva as a visual medium, but in the alignment of Canva functions with the sequential stages of Discovery Learning. Visual materials were used to stimulate students' attention to scientific phenomena, while digital organizers supported problem formulation, information collection, data processing, verification, and the communication of conclusions. This configuration reflects the broader direction of twenty-first-century education, which emphasizes active knowledge construction, meaningful technology use, and higher-order competencies rather than the transmission of information alone (Hosnan, 2019; UNESCO, 2019). This alignment was particularly relevant to the context identified during the needs analysis, where science instruction remained largely dependent on lectures, textbooks, and static presentations. The developed product therefore addressed an instructional need by positioning technology as support for active scientific learning rather than as an isolated digital addition.

The feasibility findings indicate that this integration was considered appropriate from instructional, material, practical, and user perspectives. The overall validation score reached 88.40%, with individual scores ranging from 85% to 92% across learning model experts, LKPD experts, teaching material experts, practitioners, and student users. The 88% score obtained from the learning model expert is especially relevant because it indicates that the integration of Canva did not replace or disrupt the instructional structure of Discovery Learning. Instead, Canva was incorporated into the existing pedagogical sequence to facilitate selected learning activities. This finding is consistent with research emphasizing that educational technology becomes more meaningful when its functions are intentionally connected with student participation, instructional interaction, and learning objectives rather than merely altering the format of content delivery (Susanti et al., 2026; Zulfa et al., 2023).

The validation and limited trial also showed that technology integration must account for the developmental characteristics and digital readiness of elementary students. Expert feedback led to simpler LKPD instructions, reduced visual complexity, and refinements in the learning sequence. During the limited trial, some students required additional assistance to understand both the Canva workflow and the stages of Discovery Learning. These findings indicate that access to digital features alone does not ensure that learning activities are understandable or pedagogically effective. Elementary students still require clear instructions, appropriate scaffolding, accessible visual

representations, and teacher guidance. Previous research has similarly shown that students' readiness, instructional support, and task structure influence the effectiveness of digital learning environments (Aulia, 2025; Rijal et al., 2025). The revisions made during product development were therefore necessary to reduce unnecessary cognitive and technical demands while maintaining the intended learning processes.

A major finding concerns the change in students' critical thinking performance. The mean score increased from 52.10 on the pretest to 81.40 on the posttest. The paired-sample t-test revealed a statistically significant difference, $t(29) = -18.62$, $p < .001$, while the reported N-Gain indicated substantial improvement. The minimum score also increased from 38 to 65, and the maximum score from 70 to 95, accompanied by a slight reduction in score variability. These findings can be interpreted in relation to the cognitive demands of Discovery Learning. Students were required to identify problems, collect relevant information, examine relationships, evaluate evidence, verify findings, and formulate conclusions. Such activities place students in an active role in knowledge construction, which is consistent with Bruner's conception of discovery-oriented learning (Bruner, 2017). Recent studies have likewise shown that student-centered environments involving exploration, interaction, and problem solving can support critical and creative thinking (Azzahro et al., 2026; Riana et al., 2026).

Canva may have supported these processes by providing visual and organizational tools that helped students represent observations, classify information, construct diagrams, and communicate conclusions. Its contribution in this study therefore extended beyond visual attractiveness. Students used digital representations as part of cognitively demanding activities that required them to transform information into more organized and meaningful forms. Research on digital learning has shown that technology can support higher-order thinking when students use it to organize, analyze, create, and communicate information rather than simply access learning content (Dinia, 2025; Mukminin et al., 2026). Within the present instructional design, Discovery Learning provided the cognitive sequence, while Canva supported information representation and communication within that sequence. The observed critical thinking improvement is therefore better interpreted as an outcome associated with the combined instructional process rather than with Canva as an independent factor.

The scientific literacy results complement the critical thinking findings. Students achieved an overall observed performance score of 85%, including 86% for identifying scientific problems, 84% for explaining scientific phenomena, 82% for using scientific data and evidence, 85% for drawing evidence-based conclusions, and 88% for communicating scientific findings. These results show that students were able to participate in several scientific practices during implementation. The relatively strong performance in problem identification and scientific communication corresponds with learning activities in which students observed visual phenomena, formulated questions, processed information, and communicated their findings through digital representations. Science learning that actively involves students in identifying problems, interpreting information, and constructing explanations can provide opportunities for both scientific understanding and higher-order cognitive development (Evalina et al., 2024; Martir et al., 2024).

The lower score for using scientific data and evidence is also instructive. Students appeared more successful in communicating findings than in evaluating evidence and using it to justify scientific explanations. Working with evidence requires learners to distinguish relevant information, connect data with scientific concepts, and determine whether available evidence adequately supports a conclusion. These processes involve greater cognitive demands than presenting observations in a visual form. Research on students' epistemic development has shown that scientific reasoning depends not only on knowledge acquisition but also on understanding evidence, justification, and the construction of scientific knowledge (Lin et al., 2019). Research on science process skills likewise emphasizes the importance of active scientific experiences in developing reasoning and evidence use (Tanti et al., 2020). This result suggests that future implementation should provide stronger scaffolding during the transition from data collection to evidence interpretation.

Teacher mediation therefore remains essential. Canva can facilitate the organization and presentation of information, but it cannot independently ensure that students critically evaluate evidence or construct scientifically justified conclusions. Teachers need to guide students in questioning observations, comparing information, identifying relationships, and explaining why particular evidence supports a conclusion. Previous research has indicated that beliefs, strategies, and instructional processes remain important components of meaningful science learning even when technology and innovative instructional approaches are introduced (Tanti et al., 2018). Similarly, complex competencies such as problem solving and communication develop more effectively when instructional activities are deliberately aligned with the targeted skills (Winarto et al., 2025). The effectiveness of Canva-integrated Discovery Learning therefore depends on the interaction among digital tools, instructional design, teacher guidance, and students' cognitive engagement.

The qualitative findings reinforce this interpretation. Teachers reported challenges related to Canva mastery, time management, differences in students' academic and digital abilities, infrastructure, and the preparation of discovery-oriented LKPD. Students also reported initial difficulties in using Canva, understanding lengthy instructions, managing unequal participation in group work, expressing opinions confidently, and dealing with occasional internet disruptions. These challenges indicate that digital learning requires adequate preparation and instructional management. Teachers need digital competence, preparation time, appropriate materials, and classroom management strategies, while students require gradual familiarization with digital workflows. Teacher training and instructional scaffolding have been identified as important factors in strengthening the effective use of digital learning media (Rijal et al., 2025). The implementation of innovative instructional models also requires teachers to understand the relationship among learning activities, media, and intended competencies (Yanto, 2017).

These implementation conditions have implications for sustainability and broader application. Schools differ in internet access, device availability, teacher competence, and students' digital readiness. Such contextual differences can influence the quality and consistency of implementation. Research on digital transformation in education similarly identifies opportunities alongside challenges involving access, readiness, pedagogical adaptation, and implementation capacity (Mukminin et al., 2026). Future implementation should therefore include teacher orientation, simplified student guidance, sufficient learning time, and low-bandwidth or offline alternatives where necessary. These provisions can reduce technical barriers while preserving the pedagogical functions of the learning design.

Taken together, the findings support a conception of Canva as technological support within a pedagogically structured environment rather than as an independent determinant of learning outcomes. Discovery Learning organizes students' progression from stimulation and problem formulation to data processing, verification, and generalization, while Canva provides visual, organizational, and communicative affordances that support selected activities within this sequence. This interpretation is consistent with perspectives emphasizing the purposeful integration of technology with instructional objectives and pedagogical strategies (UNESCO, 2019). It also aligns with evidence that digital environments become more meaningful when students actively use technology as part of structured learning experiences (Istiqomah et al., 2024). From an instructional perspective, digital media should therefore be selected according to the cognitive activities required by the learning model, designed at an appropriate level of complexity, and accompanied by active teacher guidance. Similar research has emphasized that opportunities for exploration, idea generation, and higher-order learning depend strongly on how teachers structure classroom activities (Sukardi et al., 2021).

The findings should nevertheless be interpreted within the methodological boundaries of the study. Critical thinking was examined through a one-group pretest-posttest design involving 30 students. Although significant score differences were found after implementation, the absence of a comparison group limits causal inference because other uncontrolled factors may have contributed to the observed change. Scientific literacy was assessed through classroom observation rather than through pretest and posttest measurement. Consequently, the 85% score represents students'

demonstrated performance during the intervention and should not be interpreted as evidence of an increase from baseline. Despite these limitations, evidence from expert validation, critical thinking scores, scientific literacy observations, and qualitative implementation data provides a coherent basis for evaluating the instructional potential of the developed product. The results indicate that Canva-integrated Discovery Learning can support elementary science instruction when digital features are closely aligned with pedagogical objectives, accompanied by appropriate teacher scaffolding, and implemented under adequate technological and instructional conditions.

CONCLUSION

Based on the research findings, it can be concluded that the developed Canva-integrated Discovery Learning instructional design was categorized as very feasible, with validation scores of 88% from learning model experts, 85% from LKPD experts, 87% from learning material experts, 90% from practitioner experts (teachers), and 92% from student users, resulting in an overall feasibility average of 88.40%. The field implementation also showed a statistically significant improvement in students' critical thinking skills, with the mean score increasing from 52.10 on the pretest to 81.40 on the posttest and an N-Gain value of 0.61, categorized as high. However, because the field trial used a single-group design without a comparison group, these results should be interpreted as evidence of improvement following implementation rather than definitive evidence of a causal effect attributable specifically to Canva. The observation of scientific literacy-related learning performance yielded an average score of 85%, indicating that students demonstrated strong performance in identifying scientific problems, explaining phenomena, using data and evidence, drawing evidence-based conclusions, and communicating scientific results during the learning activities. This observation result should not, however, be interpreted as evidence of an increase in scientific literacy over time because no pretest–posttest comparison was conducted for this construct. Implementation challenges included teachers' adaptation to the integrated technology, differences in students' digital readiness, time management, and limitations in technological resources.

The principal contribution of this study lies in the design and empirical evaluation of Canva as a technological component deliberately embedded within the pedagogical structure of Discovery Learning rather than used merely as a presentation or visualization tool. The developed design establishes a stage-specific relationship between Canva affordances, Discovery Learning activities, and targeted cognitive processes, in which visual stimuli support observation and problem statement, visual organizers support data collection and processing, evidence representations support verification and evaluation, and infographics or presentations support the formulation and communication of scientific conclusions. The findings further indicate that successful implementation requires teacher scaffolding, particularly through clear instructions, guided questioning, digital demonstrations, differentiated assistance, and sufficient time for students to interpret evidence rather than focus primarily on visual product creation. Reliable access to devices and connectivity, together with careful alignment among learning objectives, LKPD, Canva activities, and Discovery Learning stages, also represents an important implementation condition. Thus, the study contributes a structured technology–pedagogy–cognition design framework for integrating digital affordances into inquiry-oriented elementary science learning.

For further research, the developed instructional design should be tested across different subjects, educational levels, and larger and more diverse samples to examine its generalizability. Future studies should employ controlled or quasi-experimental designs with comparison groups to strengthen causal evidence regarding its effects on critical thinking. Scientific literacy should also be assessed using validated pretest–posttest instruments so that changes in this construct can be empirically examined rather than inferred from implementation observations. Further research may additionally investigate outcomes such as creativity, digital literacy, and scientific attitudes, as well as explore richer interactive features and integration with complementary digital learning platforms.

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