

Development and Evaluation of the KODIKA Framework for Enhancing Information Literacy and Learning Motivation among Fifth-Grade Elementary Students

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Abstract

This study aimed to develop and evaluate the Creative Active Digital Comic (KODIKA) framework, an instructional framework integrating Project-Based Learning, information literacy activities, and Canva-assisted digital comic production in elementary education. The framework embeds information literacy competencies—identifying, locating, evaluating, synthesizing, and communicating information—within each stage of Project-Based Learning. The study employed a Research and Development approach based on the Borg and Gall model, involving design, validation, revision, and field implementation. Participants were 75 fifth-grade students from three classes (5A, 5B, and 5C), involved in limited, main-field, and operational-field trials. Data were collected through expert validation sheets, information literacy tests, and learning motivation questionnaires. Descriptive statistics, normalized gain (N-gain), and paired-sample t-tests were used for data analysis. Validation results showed validity levels of 75%–80%, indicating that the framework was feasible for classroom implementation. Information literacy improved across all implementation stages, with moderate N-gain values ranging from 0.43 to 0.47 and statistically significant pretest–posttest differences ($p < .001$). Learning motivation also increased significantly across all stages ($p < .001$), with large effect sizes. These findings indicate that the KODIKA framework is a practical and promising instructional alternative for enhancing information literacy and supporting learning motivation among fifth-grade elementary students.

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INTRODUCTION

Information literacy and learning motivation are widely acknowledged as key competencies that support students' success in the twenty-first century. In an era characterized by rapid technological advancement and abundant digital information, students are required not only to acquire knowledge but also to develop the ability to access, evaluate, and utilize information

effectively. Information literacy enables learners to interact critically with various information sources and make informed decisions in academic contexts (Trixa & Kaspar, 2024). However, previous studies indicate that elementary school students still encounter difficulties in selecting reliable sources and applying information appropriately during learning activities (Wade et al., 2020). These challenges suggest that information literacy is closely associated with critical thinking, particularly when students are expected to analyze, compare, interpret, and use information to solve learning problems (Prakong, 2024). Consequently, literacy-oriented learning should not merely encourage students to find information but also provide opportunities for them to evaluate, transform, and communicate information through meaningful learning activities.

In addition to information literacy, learning motivation plays a crucial role in determining students' engagement and academic success. Motivation influences students' willingness to participate actively in learning activities, maintain persistence when facing difficulties, and achieve expected learning outcomes (Yeltriana, 2024). Nevertheless, instructional practices in many elementary classrooms still tend to be teacher-centered, limiting students' opportunities to explore ideas independently and participate actively in the learning process. As a result, students may become passive recipients of information and demonstrate lower levels of learning engagement. Previous studies have shown that student-centered learning approaches contribute positively to students' motivation and classroom participation (Pratiwi et al., 2025). Similarly, (Tomaszewski et al., 2020), emphasized that student engagement serves as an important factor influencing academic achievement and long-term learning success. Furthermore, Project-Based Learning has been reported to provide meaningful learning experiences that strengthen students' motivation through active participation and authentic learning tasks (Zaeriyah, 2023). Therefore, fostering learning motivation should become an integral component of instructional practices aimed at enhancing students' cognitive and affective development.

In this study, learning motivation is conceptualized based on Self-Determination Theory (SDT), which emphasizes the importance of autonomy, competence, and relatedness in fostering intrinsic motivation (Ryan & Deci, 2020). Consistent with this framework, students' motivation was examined through four dimensions considered appropriate for elementary-school learners: interest and enjoyment, effort and persistence, confidence (perceived competence), and learning value. These dimensions were selected because they represent students' affective responses to learning activities and align with the design characteristics embedded within the KODIKA framework.

Considering the importance of information literacy and learning motivation, learning environments should provide opportunities for students to engage actively with information and construct knowledge through meaningful experiences. Educational activities that encourage inquiry, collaboration, creativity, and active participation are more likely to support both cognitive and affective development. Therefore, innovative instructional approaches are needed to facilitate meaningful learning experiences capable of strengthening students' literacy competencies while simultaneously enhancing their motivation to learn.

One instructional approach that aligns with these educational needs is Project-Based Learning (PjBL). This approach encourages students to construct knowledge through authentic projects that involve inquiry, collaboration, and problem-solving activities. Through project completion, students are required to seek information, evaluate evidence, and develop meaningful

products based on their understanding. Previous research has demonstrated that Project-Based Learning contributes significantly to improved learning outcomes and higher-order thinking skills (L. Zhang & Ma, 2023). Furthermore, PjBL promotes critical thinking through collaborative investigation and problem-solving processes (Mursid et al., 2023). The implementation of PjBL has also been associated with the development of digital literacy competencies as students actively explore and create digital content during project activities (Maulida et al., 2024). In addition, active participation in project-based learning environments has been shown to enhance student engagement and learning effectiveness (Hasan et al., 2023).

The effectiveness of Project-Based Learning can be further enhanced through the integration of digital technology into classroom instruction. Interactive digital media have been shown to increase student engagement while supporting the development of information literacy skills (Budiarto et al., 2026). In addition, digital technologies provide students with broader opportunities to access information, explore learning resources, and participate actively in meaningful learning activities. Previous studies have reported that the integration of digital technology promotes student engagement and participation, both of which are important foundations for developing information literacy (Benyta & Ningsih, 2023). Furthermore, technology-supported learning environments encourage more interactive learning experiences and facilitate active student involvement throughout the instructional process, (Ali, 2024). Advances in educational technology have also contributed to the development of adaptive learning environments capable of improving learning effectiveness and supporting students' academic achievement (Damioli et al., 2021). In this context, information literacy extends beyond the ability to locate information and involves the capacity to evaluate, interpret, and apply information critically in various learning situations (Secker, 2018). Therefore, the integration of digital technology becomes increasingly relevant for supporting meaningful learning experiences and strengthening students' information literacy skills.

Among various forms of digital learning media, digital comics have attracted considerable attention because they combine visual and textual representations in an engaging format. According to multimedia learning theory, the integration of verbal and visual elements can facilitate students' understanding and improve knowledge retention (Mayer, 2001). Previous studies have shown that digital comics contribute positively to students' literacy development and reading comprehension (Kusmajid et al., 2024). Similarly, (Utami et al., 2025) reported that digital comic media effectively improve elementary students' reading comprehension through meaningful visual storytelling. These findings suggest that digital comics have the potential to function not only as instructional media but also as creative learning products that encourage students to organize, interpret, and communicate information effectively.

Beyond improving reading comprehension, digital learning products can also support broader literacy development when integrated into project-based learning activities. Previous research has demonstrated that the integration of Project-Based Learning supported by audiovisual media contributes to the improvement of students' writing skills, particularly in idea development, vocabulary use, and text organization (Whisnubrata et al., 2025). These findings indicate that combining project-based activities with digital media can strengthen multiple literacy competencies while encouraging students to express their understanding creatively. Therefore,

digital tools that facilitate the creation of creative and interactive learning products become increasingly relevant in supporting the implementation of Project-Based Learning.

To facilitate the creation of digital learning products, Canva has emerged as one of the most widely used educational design platforms. Canva provides accessible design tools that enable students to produce visually attractive learning products while simultaneously developing creativity and communication skills. Previous studies have demonstrated that the use of Canva contributes positively to students' motivation and participation in learning activities (Triwati & Hastini, 2025). Likewise, Mustakim et al. (2024), identified a significant positive relationship between Canva-based learning media and students' learning motivation. In addition, active learning activities supported by digital tools have been found to improve learning outcomes and promote greater student engagement (Hussein & Dzaiy, 2024).

Although previous studies have investigated the effectiveness of Project-Based Learning, digital technology, Canva, and digital comics in educational settings, these components have generally been examined separately. Most existing studies focus either on instructional models or on digital media without providing a structured framework that systematically integrates both pedagogical and technological aspects. Furthermore, research specifically designed to enhance information literacy and learning motivation simultaneously through an integrated and validated instructional framework remains limited, particularly at the elementary school level. Consequently, there is a need for an educational innovation that combines effective instructional strategies and digital learning tools within a coherent learning framework.

To address this gap, this study introduces the Creative Active Digital Comic (KODIKA) framework. In this framework, Project-Based Learning serves as the instructional model, Canva functions as the supporting digital platform, and digital comics become the final products developed by students during the learning process. The KODIKA framework is designed to encourage active participation, collaboration, creativity, independent information exploration, and meaningful learning experiences while supporting the development of information literacy and learning motivation.

The novelty of this study lies in the development of the KODIKA framework as an information-literacy-oriented instructional design that systematically embeds identifying, locating, evaluating, synthesizing, and communicating information into every stage of Project-Based Learning through Canva-assisted digital comic production.

From a motivational perspective, the KODIKA framework was intentionally designed to support autonomy, competence, and relatedness. Students are given opportunities to make creative decisions during comic design (autonomy), experience successful project completion through scaffolded activities (competence), and collaborate with peers throughout information exploration and comic production (relatedness). These features are expected to strengthen students' intrinsic motivation and active participation in learning. Unlike conventional Project-Based Learning practices that primarily focus on project completion, the KODIKA framework explicitly embeds information literacy competencies into every instructional phase and operationalizes these competencies through Canva-assisted digital comic production.

METHOD

Research Design

Explaining research chronologically, including research design, research procedure (in the This study adopted a Research and Development (R&D) approach to develop and evaluate the Creative Active Digital Comic (KODIKA) framework implemented through Project-Based Learning (PjBL). The framework was designed to integrate project-based learning activities, Canva-assisted digital comic creation, information literacy development, and learning motivation enhancement within elementary school learning. The use of the R&D approach was considered appropriate because it enables the systematic development, validation, revision, and evaluation of educational products before wider implementation (Sugiyono, 2019).

The development process followed the Borg and Gall model, which emphasizes continuous improvement through iterative stages of design, evaluation, and revision. The procedure included research and information gathering, planning, preliminary product development, preliminary field testing, product revision, broader field testing, operational testing, final revision, and dissemination activities (Borg & Gall, 1983). Through these stages, the KODIKA framework was gradually refined using feedback from experts and findings obtained during classroom implementation.

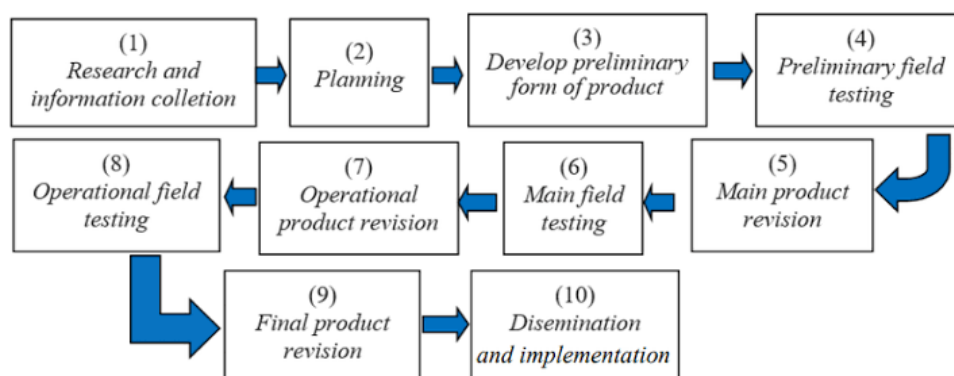


Figure 1. Development Process Steps

Participants

The study was conducted at Bandung City, involving 75 fifth-grade students from three classes: Class 5A ($n = 25$), Class 5B ($n = 25$), and Class 5C ($n = 25$). Different groups of students participated in each implementation stage of the Research and Development process. Class 5A participated in the limited field trial, Class 5B participated in the main field trial (Broad 1), and Class 5C participated in the operational field trial (Broad 2).

The use of different classes across implementation stages enabled the researchers to evaluate the practicality and feasibility of the KODIKA framework under different classroom conditions while minimizing the potential influence of repeated-testing and repeated-exposure effects. In addition, validation was conducted by instructional media experts and subject-matter experts to determine the feasibility of the developed framework before classroom implementation. The participants represented elementary school learners who benefit from interactive and student-centered learning experiences (Q. Zhang & Lin, 2026).

Unlike experimental studies designed to compare treatment effects, the present study followed a Research and Development framework in which each field-testing stage served a distinct function in product refinement. The use of different classes in successive stages enabled the researchers to obtain feedback from different groups of learners while minimizing practice effects that might occur if the same students participated in all stages.

Research Instruments

Data were collected using several complementary instruments to evaluate both product quality and learning effectiveness. Expert validation sheets were employed to assess the feasibility of the KODIKA framework from media and content perspectives. Information literacy achievement was measured using pretest and posttest instruments administered before and after implementation. Learning motivation data were gathered through a questionnaire based on a five-point Likert scale. Prior to implementation, all instruments underwent expert review to ensure content validity. The reliability of the motivation questionnaire was examined using Cronbach's Alpha to ensure internal consistency.

Information Literacy Test

Information literacy was assessed using a researcher-developed test consisting of 15 items, including 10 multiple-choice questions and 5 open-ended questions. The instrument was designed according to information literacy competencies appropriate for fifth-grade elementary school students.

Table 3. Information Literacy Indicators.

Dimension	Indicator	Number of Items
Identifying Information	Identifying important information contained in a text	3
Understanding and Interpreting Information	Explaining causal relationships and interpreting information	7
Evaluating Information	Assessing solutions and supporting arguments	1
Organizing and Communicating Information	Constructing explanatory texts based on available information	4

These indicators were operationalized from the broader information literacy competencies embedded within the KODIKA framework, namely identifying, locating, evaluating, synthesizing, and communicating information. For elementary-school learners, locating and synthesizing information were operationalized through understanding, interpreting, and organizing information. This adaptation was intended to ensure that the assessment tasks were developmentally appropriate while still reflecting the core competencies of information literacy.

Example tasks included identifying relevant information from short texts, comparing information from multiple sources, determining source credibility, selecting evidence to support claims, and constructing short explanatory texts based on collected information. Open-ended responses were evaluated using an analytic rubric assessing accuracy, relevance, organization, and completeness.

Learning Motivation Questionnaire

Students' learning motivation was measured using an eight-item questionnaire administered before and after implementation of the KODIKA framework. The questionnaire was administered before and after each implementation stage (Limited Trial, Broad 1, and Broad 2). Therefore, each trial stage produced a separate pair of pre-implementation and post-implementation motivation scores from different groups of students participating in the respective field-testing stages of the development process.

Table 4. Learning Motivation Indicators

Dimension	Number of Items
Interest and Enjoyment	2
Effort and Persistence	2
Confidence	2
Learning Value	2

Sample questionnaire items included: "I enjoy participating in learning activities using digital comics", "I try to complete project tasks even when they are difficult", "I feel confident presenting my work to classmates", and "The activities help me understand useful information". Prior to implementation, the questionnaire was reviewed by two elementary education experts to ensure age-appropriate language. Several statements were simplified and pilot-tested with students to confirm that the questionnaire items were understood as intended.

Table 5. Reliability of the Learning Motivation Questionnaire

Instrument	Number of Items	Cronbach's Alpha	Interpretation
Learning Motivation Questionnaire	8	0.611	Acceptable Reliability

The learning motivation questionnaire obtained a Cronbach's alpha coefficient of 0.611. Although this value is slightly below the commonly recommended threshold of 0.70, it exceeds the minimum acceptable level of 0.60 frequently adopted in exploratory educational research and newly developed instruments. Therefore, the questionnaire was considered sufficiently reliable for measuring learning motivation among fifth-grade elementary school students. The relatively low alpha coefficient is likely influenced by the small number of items ($n = 8$) and the multidimensional structure of the instrument, which consisted of interest and enjoyment, effort and persistence, confidence, and learning value. However, values above 0.60 are generally considered acceptable for exploratory educational research and early-stage instrument development.

Data Analysis

The collected data were analyzed using descriptive and inferential statistical techniques. Descriptive statistics were applied to summarize expert validation results and determine the feasibility level of the developed framework. Validation scores obtained from experts were converted into percentages and interpreted according to predetermined feasibility categories. To examine learning improvement, students' information literacy scores were analyzed using the

normalized gain (N-gain) formula proposed by (Hake, 1998), The N-gain score was used to determine the magnitude of improvement between pretest and posttest results following implementation of the intervention. Furthermore, structured assessment procedures have been found to contribute to more accurate evaluations of students' academic performance and learning development (Yuan et al., 2021).

To examine whether the observed improvement was statistically significant, a paired sample t-test was performed to compare students' pretest and posttest scores. Prior to the hypothesis testing stage, assumptions of normality and homogeneity were examined to determine the suitability of parametric statistical analysis. When these assumptions were satisfied, the paired sample t-test was applied; otherwise, a non-parametric alternative was considered. This procedure helped ensure the validity of statistical conclusions regarding the effectiveness of the intervention (Eliaumra et al., 2024; Pratiwi et al., 2025).

To examine changes in students' learning motivation, paired-sample t-tests were conducted to compare pre-implementation and post-implementation questionnaire scores. Effect sizes were calculated using Cohen's d for dependent samples ($d = t/\sqrt{n}$), where t represents the paired-sample t statistic and n represents the number of participants in each trial stage. This statistic was used to determine the magnitude of the observed changes. Because Cohen's d was derived from paired-sample t -test statistics, relatively large effect sizes may occur when score improvements are consistent across participants. According to (Cohen, 1988), effect sizes of 0.20, 0.50, and 0.80 indicate small, medium, and large effects, respectively.

Data related to students' learning motivation were analyzed using both descriptive and inferential statistics. Descriptive statistics were used to summarize changes in motivation scores, while paired-sample t -tests and Cohen's d effect size calculations were used to examine the statistical significance and magnitude of the observed changes. Descriptive analysis is commonly applied to summarize and interpret questionnaire-based findings in educational studies (Creswell & Creswell, 2017). In addition to evaluating learning outcomes and motivation, this research focused on the systematic development of an educational product through stages of design, validation, revision, and testing. Therefore, the study fulfills the essential characteristics of Research and Development research, namely product development, validation, and effectiveness evaluation (Sugiyono, 2019; Borg & Gall, 1983).

RESULTS AND DISCUSSION

Results

Feasibility of the Developed Model.

The feasibility of the Canva assisted KODIKA project within the Project Based Learning (PjBL) framework was evaluated through a validation process involving media experts and subject-matter experts. The validation results indicate that the project obtained high scores, suggesting that it is highly feasible for implementation in primary school learning.

Table 6. Expert Validation Results

Aspect	Average Score	Percentage	Category
Media Validation	3.1 - 3.2	77.5% - 80%	Valid
Material Validation	3 - 3.1	75% - 77.5%	Valid

The validation results show that the media aspect achieved scores ranging from 77.5% to 80%, while the material aspect ranged from 75% to 77.5%, both categorized as valid. These findings indicate that the KODIKA project framework meets the feasibility standards and can be implemented with minimal revision.

Effectiveness of the Model on Information Literacy.

The effectiveness of the KODIKA project was analyzed based on the comparison of pretest and posttest scores across three trial stages: Limited, Broad 1, and Broad 2.

Table 7. Pretest and Posttest Results

Trial Stage	Pretest	Posttest	Gain
Limited	49.44	67.68	+18.24
Broad 1	34.56	59.36	+24.80
Broad 2	49.12	67.36	+18.24

Table 7 presents the comparison between students' pretest and posttest information literacy scores across the three implementation stages. The results indicate consistent improvements in students' performance following participation in the KODIKA framework. In the limited trial, the mean score increased from 49.44 to 67.68, representing an improvement of 18.24 points. In Broad 1, the mean score increased from 34.56 to 59.36, showing the largest improvement among the three stages (24.80 points). Similarly, in Broad 2, the mean score increased from 49.12 to 67.36, with a gain of 18.24 points. These findings suggest that participation in the KODIKA framework was associated with positive improvements in students' information literacy across all implementation stages. Further analysis using N-gain and paired-sample t-tests was conducted to determine the magnitude and statistical significance of these improvements..

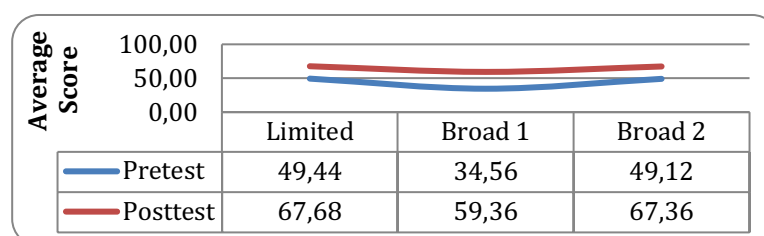


Figure 2. Pretest and Posttest Comparison.

Figure 2 illustrates the increase in pretest and posttest scores across all implementation stages. A consistent upward trend can be observed, indicating improvements following participation in the KODIKA project activities.

N-Gain Analysis

To further examine the effectiveness of the project, an N-gain analysis was conducted for each trial stage.

Table 8. N-Gain Results

Trial Stage	N-Gain	Category
Limited	0.47	Moderate
Broad 1	0.43	Moderate
Broad 2	0.43	Moderate

Table 8 presents the normalized gain (N-gain) scores obtained across the three implementation stages of the KODIKA framework. The limited trial produced the highest N-gain value (0.47), whereas Broad 1 and Broad 2 obtained identical N-gain values of 0.43. All scores were classified as moderate, indicating meaningful improvements in students' information literacy following implementation of the framework. The similarity of the N-gain values across stages suggests that the KODIKA framework consistently supported literacy development despite being implemented with different groups of students. These findings provide preliminary evidence that the framework can facilitate students' engagement with information literacy processes, including identifying, locating, evaluating, synthesizing, and communicating information.

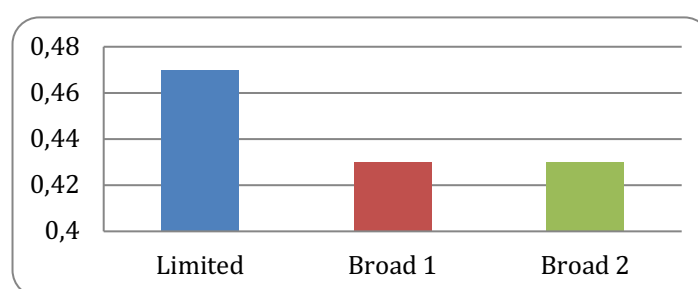


Figure 3. N-Gain Graph

Figure 3 shows a relatively consistent pattern of improvement across all trial stages within the moderate category.

Hypothesis Testing (Paired t-test)

A paired sample t-test was conducted to determine whether there was a statistically significant difference between the pretest and posttest scores across all trial stages.

Table 9. Paired t-test Results

Pretest - posttest	t-count	t-table	Result
Limited	10.45	2.064	Significant
Broad 1	8.92	2.064	Significant
Broad 2	8.23	2.064	Significant

Table 9 presents the results of the paired-sample t-test conducted to compare students' pretest and posttest information literacy scores across the three implementation stages. The calculated t-values in the limited trial (10.45), Broad 1 (8.92), and Broad 2 (8.23) exceeded the critical t-table value of 2.064 at the 0.05 significance level. These findings indicate statistically significant differences between pretest and posttest scores in all implementation stages. Therefore, the results suggest that participation in the KODIKA framework was associated with improvements in students' information literacy. To provide a more comprehensive interpretation of these findings, additional statistical information including confidence intervals and effect sizes is presented in Table 10.

Table 10. Detailed Paired-Sample t-Test Results for Information Literacy

Trial Stage	Mean Difference	t(df)	Sig. (2-tailed)	95% Confidence Interval	Cohen's d
Limited	18.24	10.45 (24)	< .001	14.64-21.84	2.09
Broad 1	24.80	8.92 (24)	< .001	19.06-30.54	1.78
Broad 2	18.24	8.23 (24)	< .001	13.67-22.81	1.65

As shown in Table 10, statistically significant improvements in students' information literacy were observed across all implementation stages. In the limited trial, students demonstrated a significant increase in information literacy scores, $t(24) = 10.45$, $p < .001$, 95% CI [14.64, 21.84], with a very large effect size ($d = 2.09$). Similar significant improvements were found in Broad 1, $t(24) = 8.92$, $p < .001$, 95% CI [19.06, 30.54], $d = 1.78$, and Broad 2, $t(24) = 8.23$, $p < .001$, 95% CI [13.67, 22.81], $d = 1.65$. The confidence intervals did not include zero, indicating consistent positive gains in information literacy following implementation of the KODIKA framework. Furthermore, all effect sizes exceeded (Cohen, 1988) criterion for a large effect, suggesting that the observed improvements were not only statistically significant but also educationally meaningful. These findings indicate that participation in the KODIKA framework was associated with substantial improvements in students' ability to identify, evaluate, organize, and communicate information across all stages of implementation.

Learning Motivation Results

The improvement in students' learning motivation was measured using questionnaire data collected before and after the implementation of the project.

Table 11. Learning Motivation Improvement

Trial Stage	Before	After	Category
Limited	2.63	3.06	Moderate
Broad 1	2.52	3.17	Moderate
Broad 2	2.64	2.98	Moderate

Table 11 presents the changes in students' learning motivation before and after participation in the KODIKA framework across all implementation stages. The results indicate a consistent increase in motivation scores following implementation. In the limited trial, the mean motivation score increased from 2.63 to 3.06. Similarly, the mean score increased from 2.52 to 3.17 in Broad 1 and from 2.64 to 2.98 in Broad 2. These findings suggest a positive trend in students' learning motivation after participating in project-based activities involving digital comic production. Based on the predetermined interpretation criteria, all post-implementation scores remained within the moderate category; however, the observed increases indicate that students demonstrated greater interest, persistence, confidence, and perceived value toward learning activities following implementation of the KODIKA framework.

Table 12. Paired-Sample t-Test Results for Learning Motivation

Trial Stage	Mean Before	Mean After	t(df)	p	95% Confidence Interval	Cohen's d
Limited	2.63	3.06	4.62 (24)	< .001	[0.24, 0.62]	0.93
Broad 1	2.52	3.17	6.65 (24)	< .001	[0.45, 0.86]	1.33
Broad 2	2.64	2.98	7.75 (24)	< .001	[0.28, 0.47]	1.57

As shown in Table 12, statistically significant improvements in students' learning motivation were observed across all implementation stages. In the limited trial, motivation increased significantly, $t(24) = 4.62$, $p < .001$, 95% CI [0.24, 0.62], with a large effect size ($d = 0.93$). Similar results were obtained in Broad 1, $t(24) = 6.65$, $p < .001$, 95% CI [0.45, 0.86], $d = 1.33$, and Broad 2, $t(24) = 7.75$, $p < .001$, 95% CI [0.28, 0.47], $d = 1.57$. The confidence intervals did not include zero, indicating consistent positive changes in students' motivation following participation in the KODIKA framework. Furthermore, all effect sizes exceeded the threshold for a large effect (Cohen, 1988), suggesting that the observed increases were not only statistically significant but also educationally meaningful. These findings indicate that participation in the KODIKA framework was associated with substantial improvements in students' learning motivation across all implementation stages..



Figure 4. Motivation Improvements

Figure 4 shows an upward trend in students' motivation scores across all implementation stages. Although the improvement remained within the moderate category, the results suggest increased learning motivation and willingness to participate in project-based learning activities.

Discussion

Improvement in Students' Information Literacy

The implementation of the KODIKA framework was associated with improvements in students' information literacy across all stages of implementation. The increase in pretest and posttest scores, supported by moderate N-gain values and statistically significant paired sample t-test results, indicates that participation in the framework contributed to meaningful learning experiences that supported students' literacy development. The large effect sizes observed across all implementation stages suggest that the improvements were not only statistically significant but also educationally meaningful. The findings suggest that the KODIKA framework may have contributed to improvements in students' information literacy during implementation.

The improvement in information literacy may be explained by the activities embedded within the KODIKA framework. Through project-based learning activities, students were required to identify information needs, search for information from various resources, evaluate information sources, organize information into meaningful ideas, and communicate their understanding through digital comic products. These activities correspond to the dimensions of information literacy assessed in this study and may explain the observed improvement in students' performance. Through repeated engagement in information-seeking and information-processing activities, students were encouraged to become active users rather than passive recipients of information.

The Contribution of Project-Based Learning

The findings of this study support previous research highlighting the educational benefits of Project-Based Learning. By engaging students in authentic projects, inquiry activities, and collaborative problem solving, Project-Based Learning encourages learners to construct knowledge actively rather than merely receive information from teachers. Students are given opportunities to investigate problems, evaluate information, and develop solutions through project completion. These processes support reflection, critical thinking, and problem-solving abilities that are essential components of meaningful learning.

The present findings are consistent with Zhang & Ma (2023), who reported positive effects of Project-Based Learning on learning achievement and higher-order thinking skills. Similarly, (Mursid et al., 2023) emphasized that collaborative investigation and problem-solving activities contribute significantly to students' critical-thinking development. The moderate N-gain values observed in this study are also comparable with findings reported by Eliaumra et al. (2024), who found that Project-Based Learning integrated with digital literacy activities produced moderate to high levels of learning improvement.

Improvement in Learning Motivation

Another important finding of this study was the improvement in students' learning motivation following participation in the KODIKA framework. Motivation scores increased across all implementation stages, indicating a positive trend in students' willingness to participate and engage in learning activities. Although the post-implementation scores remained within the moderate category, the results suggest that project-based activities helped create more engaging learning experiences for students.

The project-based nature of the framework provided opportunities for students to collaborate with peers, express ideas creatively, make decisions, and develop products that reflected their own understanding. Such experiences may increase students' sense of ownership and responsibility toward learning tasks, thereby encouraging greater participation throughout the learning process. These findings support previous studies indicating that meaningful project experiences contribute positively to students' motivation and classroom participation (Zaeriyah, 2023; Pratiwi et al., 2025). Increased engagement during project implementation may also explain the positive outcomes observed in this study, as student engagement has been identified as a key factor influencing academic achievement and learning persistence (Tomaszewski et al., 2020).

An interesting finding was that the post-implementation motivation score in Broad 2 (2.98) was lower than that observed in Broad 1 (3.17), although it remained higher than the corresponding pre-implementation score. One possible explanation is the reduction of novelty effects as students became increasingly familiar with both Canva and the KODIKA learning activities. Repeated participation in similar project activities may have reduced the initial excitement generated by the innovation. Nevertheless, motivation levels remained above baseline values, suggesting that the framework continued to support students' learning motivation despite a decline in novelty.

It should also be noted that Broad 1 and Broad 2 involved different groups of students. Therefore, differences in post-implementation motivation scores across implementation stages may partly reflect variations in student characteristics, classroom environments, and group dynamics, rather than changes associated with repeated participation alone.

The Role of Canva and Digital Comic Production

The integration of Canva within the KODIKA framework appears to have contributed significantly to student engagement and motivation. Canva enabled students to create visually attractive products while simultaneously developing creativity and communication skills. The opportunity to design digital comics allowed learners to present information in a format that was personally meaningful and enjoyable. Consequently, students became more actively involved in classroom activities and demonstrated higher enthusiasm for completing learning tasks. Similar positive effects of Canva-based learning activities on students' engagement and motivation have been reported by (Triwati & Hastini, 2025). Likewise, Rinja Efendi et al. (2023) found that Canva-supported learning media positively influence both learning motivation and academic achievement.

The role of digital comics in the KODIKA framework should also be highlighted. Through digital comic production, students were encouraged to organize information, construct narratives, and communicate ideas using a combination of visual and textual representations. This process required students not only to understand information but also to reinterpret and communicate it creatively. In addition, digital comic production required students to transform information into visual and textual representations, a process that aligns closely with information literacy competencies related to organizing and communicating information. These findings are consistent with previous studies demonstrating that digital comics contribute positively to literacy development and reading comprehension Utami et al. (2025). Furthermore, project-based digital product creation has been shown to support broader literacy competencies, including idea development, vocabulary use, and communication skills (Whisnubrata et al., 2025).

Educational Implications and Study Limitations

The findings of this study have important implications for elementary education, particularly in efforts to promote information literacy and learning motivation through student-centered instructional approaches. The KODIKA framework provides a structured learning experience that integrates Project-Based Learning, information literacy activities, Canva-assisted digital comic production, and reflective learning practices within a single instructional framework. Through the stages of identifying information needs, locating information, evaluating information sources, synthesizing information, and communicating understanding through digital comics, students were encouraged to engage actively in the learning process and develop essential twenty-first-century competencies.

From a practical perspective, the framework offers teachers an alternative instructional approach that combines technology-supported learning with authentic project activities. The integration of Canva and digital comic creation enabled students to represent information creatively while simultaneously developing communication, collaboration, and critical-thinking skills. In addition, the framework supports the principles of student-centered learning by providing opportunities for students to make decisions, work collaboratively, and construct knowledge through meaningful learning experiences. These characteristics suggest that the KODIKA framework has the potential to contribute positively to classroom learning environments that emphasize active participation and literacy development.

The findings also indicate that learning motivation improved following participation in the KODIKA activities. From the perspective of Self-Determination Theory, this improvement may be associated with learning experiences that support students' sense of autonomy, competence, and relatedness (Ryan & Deci, 2020). Students were given opportunities to make creative decisions during comic development, demonstrate their abilities through project completion, and collaborate with peers throughout the learning process. These experiences may have contributed to increased interest, persistence, confidence, and perceived value of learning activities.

Nevertheless, the findings should be interpreted with caution. Although improvements in information literacy and learning motivation were observed across all implementation stages, this study was conducted within a Research and Development framework rather than an experimental design intended to establish causal relationships. Consequently, the observed improvements cannot be attributed exclusively to the KODIKA framework. Other factors, including teacher guidance, classroom interactions, group dynamics, and contextual learning conditions, may also have contributed to the outcomes obtained during implementation.

Furthermore, different groups of students participated in each field-testing stage. Class 5A participated in the limited trial, Class 5B participated in the main-field trial (Broad 1), and Class 5C participated in the operational-field trial (Broad 2). This approach reduced the possibility of repeated-testing and repeated-exposure effects that may occur when the same students participate in multiple implementation stages. However, differences in student characteristics, classroom environments, and group dynamics across classes may have influenced the variation in outcomes observed between implementation stages.

Another limitation concerns the relatively small sample size and the fact that the study was conducted in a single elementary school. These conditions limit the generalizability of the findings to broader educational contexts. In addition, the duration of implementation was relatively short, making it difficult to determine whether the observed improvements in information literacy and learning motivation can be sustained over longer periods. The absence of a comparison group also restricts the ability to rule out alternative explanations such as maturation, increased familiarity with classroom activities, or other instructional influences unrelated to the KODIKA framework.

Therefore, the positive findings reported in this study should be viewed as preliminary evidence supporting the feasibility, practicality, and potential educational value of the KODIKA framework rather than conclusive evidence of its effectiveness. Future research is recommended to involve larger and more diverse participant populations, include comparison or control groups, examine longer-term implementation periods, and explore the framework's impact on additional competencies such as creativity, collaboration, communication, critical thinking, and digital literacy. Such studies would provide stronger evidence regarding the effectiveness and sustainability of the KODIKA framework in elementary education settings.

CONCLUSION

This study developed and evaluated the Creative Active Digital Comic (KODIKA) framework, which integrates Project-Based Learning, Canva-assisted digital comic creation, and information literacy activities within elementary school learning. The findings indicate that the developed framework met the required feasibility standards based on expert validation results and was appropriate for classroom implementation. The findings suggest that participation in the

KODIKA framework was associated with improvements in students' information literacy, as reflected in the consistent increase in pretest and posttest scores across all testing stages. The moderate N-gain values and significant paired sample t-test results further indicate that the framework supported students' cognitive development and provided meaningful learning experiences.

In addition to information literacy, the KODIKA framework was associated with positive improvements in students' learning motivation. The integration of Project-Based Learning with Canva and digital comic creation encouraged active participation, creativity, collaboration, and independent information exploration. These learning experiences enabled students to become more engaged in classroom activities while promoting the development of both cognitive and affective competencies. Therefore, the KODIKA framework has the potential to serve as an instructional alternative for supporting student-centered learning and strengthening twenty-first-century skills in primary education.

The principal contribution of this study lies in the development of the KODIKA framework as an information-literacy-oriented instructional design. The framework systematically integrates information literacy competencies, including identifying, locating, evaluating, synthesizing, and communicating information, into each stage of Project-Based Learning. By embedding these competencies within digital comic production activities, KODIKA extends the conventional use of Project-Based Learning beyond product creation toward the structured development of information literacy skills in elementary education.

Despite these positive findings, this study has several limitations. The research involved a relatively small number of participants from a single school, which may limit the generalizability of the findings. In addition, the duration of implementation was relatively short, making it difficult to evaluate the long-term effects of the framework on students' literacy development and motivation. Although different groups of fifth-grade students participated in the limited, main-field, and operational-field trials, the study was conducted in a single school and without a comparison group. Therefore, the findings should be interpreted cautiously, and alternative explanations such as classroom context, teacher support, and maturation effects cannot be fully ruled out. Future studies are therefore recommended to involve larger and more diverse participant groups, include comparison groups, extend the implementation period, and examine the impact of the KODIKA framework on additional competencies such as creativity, collaboration, and critical thinking.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Ade Irwan: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Project Administration, Validation, Visualization, Writing – Original Draft, Writing – Review & Editing.

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DECLARATION OF COMPETING INTEREST

The authors declare that there are no competing financial interests, personal relationships, or institutional affiliations that could have influenced the design, implementation, analysis, or reporting of this study. The authors have no conflicts of interest regarding the publication of this manuscript

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy and confidentiality considerations involving student participants

ETHICS STATEMENT

This study did not require formal ethical approval. Participation was voluntary, informed consent was obtained from all participants and school authorities, and no sensitive personal data were collected. All data were analyzed anonymously and used solely for research purposes.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

Not applicable. The author(s) did not use any generative AI or AI-assisted technologies in the preparation of this manuscript.

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