IJECA (International Journal of Education & Curriculum Application)
Journal homepage: http://journal.ummat.ac.id/index.php/IJECA
ISSN 2614-3380 **| Vol. 9, No. 2, August 2026**
https://doi.org/10.31764/ijeca.v9i2.38402

The Influence of Flip Chart Media Use on Elementary School Students' Creativity and Critical Thinking

Didik Herwanto[1], I Wayan Wesa Atmaja[1], Hariyanto[1*]
[1]Postgraduate Program in Learning Technology, Universitas PGRI Argopuro Jember, Indonesia
Author Corresponding: ghost.ary1@gmail.com

ABSTRACT

The development of higher-order thinking skills (HOTS), particularly creativity and critical thinking, has become a central priority in contemporary science education. However, limited access to digital learning resources in many rural elementary schools necessitates the exploration of alternative instructional strategies that remain pedagogically effective. This study aims to examine the effects of non-digital flip-chart media on the creativity and critical thinking skills of sixth-grade students in science learning. The development of creativity and critical thinking skills as part of Higher Order Thinking Skills (HOTS) is an important demand in 21st-century Education. However, limited learning facilities in rural elementary schools still hinder the implementation of innovative technology-based learning. However previous studies predominantly examine digital media interventions or focus on a single higher-order thinking skill, leaving limited empirical evidence regarding the simultaneous development of creativity and critical thinking through non-digital visual media in rural elementary school contexts. This gap highlights the need for contextual and integrative research that explores simple, accessible instructional media to foster Higher Order Thinking Skills (HOTS).This study used a quantitative approach with a one-group pretest–posttest design. Data were collected using validated creativity and critical thinking essay tests consisting of 10 items each, assessed with analytical rubrics. Statistical analyses included normality testing, paired sample t-test, Normalized Gain (N-Gain), and Cohen's d effect size to determine both statistical significance and practical impact. The subjects were 27 sixth-grade students from Elementary School, selected using a total sampling technique. The research instruments were validated through expert judgment and empirically tested using Cronbach's alpha to ensure reliability. Data were analyzed using paired sample t-test, N-Gain, and effect size (Cohen's d). The results showed that the use of flip chart media significantly increased students' creativity and critical thinking skills ($p < 0.05$). The increase in creativity was in the high category (N-Gain = 0.76), while the increase in critical thinking skills was in the medium category (N-Gain = 0.67). The effect size was very large for both variables. These findings indicate that non-digital flip chart media is an effective, practical, and contextually appropriate alternative for developing HOTS in elementary school students, particularly in science learning within technology-limited environments. Theoretically, this study reinforces the role of structured visual media in supporting higher-order cognitive processes, while practically, it offers an accessible instructional strategy for teachers in rural schools to foster creativity and critical thinking without reliance on digital infrastructure.

Keywords: Flip Chart Media; Creativity; Critical Thinking Skills; HOTS; Science Learning.

Article History:
Received: 17-02-2026
Revised : 27-02-2026
Accepted: 26-03-2026
Online : 01-08-2026

How to Cite (APA style):
Herwanto, D., Atmaja, I. W. W., & Hariyanto. (2026). The Influence of Flip Chart Media Use on Elementary School Students' Creativity and Critical Thinking. *IJECA (International Journal of Education and Curriculum Application)*, *9*(2), 622-634. https://doi.org/10.31764/ijeca.v9i2.38402

1. INTRODUCTION

21st-century Education places creativity and critical thinking skills as key competencies that must be developed from elementary school, in line with the demands of a global society that requires individuals to be adaptable, reflective, and produce innovative solutions to complex problems. Creativity enables students to generate diverse, original, and useful ideas, while critical thinking skills help analyze information, evaluate arguments, and make rational, responsible decisions. Creativity is closely related to divergent thinking processes, which include fluency, flexibility, and originality as core dimensions (Runco & Acar, 2012). These two skills do not exist in isolation but complement each other as integral parts of Higher Order Thinking Skills (HOTS), which are prioritized in international and national education policies (Darling-Hammond et al., 2020). The development of higher-order thinking skills also requires appropriate assessment and instructional design to ensure that students engage in analysis, evaluation, and creation processes (Abrami et al., 2015). To maintain conceptual clarity, this study positions creativity and critical thinking specifically within the framework of Higher Order Thinking Skills (HOTS) as operational cognitive outcomes in science learning. Thus, the discussion in this study focuses on their measurable instructional implications rather than expanding broader theoretical debates.

Recent international assessments further emphasize the importance of higher-order thinking skills in elementary education. The Programme for International Student Assessment (PISA) highlights that students' ability to analyze, evaluate, and apply knowledge is more predictive of future academic and professional success than mere content recall (OECD, 2019). This reinforces the urgency of instructional strategies that systematically cultivate higher-order cognitive processes from early schooling. At the elementary school level, strengthening creativity and critical thinking skills is strategic because they lay the foundation for developing a scientific mindset and students' long-term learning readiness. Learning that provides students with opportunities to explore ideas, ask questions, and reflect on their thinking processes has been shown to improve conceptual understanding and transfer knowledge to real-life situations (Voogt & Roblin, 2012). Furthermore, Dwyer et al. (2014) emphasized that early HOTS development contributes to improving the quality of the learning process and to the development of independent learners. Thus, elementary Education serves not only as an initial stage in mastering concepts but also as a vehicle for the continuous development of higher-order thinking skills. In this study, creativity consistently refers to divergent thinking abilities encompassing fluency, flexibility, originality, and elaboration (Runco & Acar, 2012), whereas critical thinking is conceptualized as reflective and reasoned judgment involving analysis, evaluation, and inference (Ennis, 2018). Both constructs are treated as interconnected dimensions within the HOTS framework to ensure conceptual consistency throughout the study.However, empirical evidence suggests that classroom practices in many educational contexts remain insufficiently aligned with the demands of higher-order thinking development. Instruction frequently continues to rely on teacher-centred approaches that prioritize factual recall, procedural completion of tasks, and uniform responses, rather than encouraging analytical reasoning and reflective inquiry. Such practices tend to reduce opportunities for students to engage in divergent thinking, problem exploration, and metacognitive reflection. Recent studies indicate that highly structured, teacher-dominated instruction may limit students' cognitive engagement and restrict the development of complex reasoning processes necessary for critical and creative thinking (Freeman et al., 2014). Furthermore, research in science education demonstrates that the absence of inquiry-oriented and student-active learning environments can constrain the cultivation of higher-order thinking skills from early schooling (Furtak et al., 2012). Consequently, there is a growing concern that

Vol. 9, No. 2, August 2026, pp. 622-634

traditional pedagogical models may not sufficiently prepare elementary students to develop the cognitive flexibility and reflective capacities required in 21st-century learning contexts. Recent conceptual clarifications of inquiry-based learning further elaborate that effective inquiry instruction involves structured phases, including orientation, conceptualization, investigation, conclusion, and discussion, which systematically scaffold students' reasoning processes (Hascher & Waber, 2021). Such structured inquiry cycles provide a coherent pedagogical framework for fostering both analytical and generative thinking in science classrooms.

Active and inquiry-oriented instructional environments have been consistently associated with improved problem-solving and higher-order reasoning skills across educational levels (Hmelo-Silver et al., 2007). Such approaches encourage students to construct knowledge through exploration, questioning, and collaborative meaning-making, which are foundational to both creativity and critical thinking. This problem is even more pronounced in rural elementary schools, which have limited learning facilities and infrastructure. Access to digital technology-based media is often hampered by limited electricity, learning devices, and internet connections, making it difficult for teachers to implement innovative, technology-based learning. However, student cognitive engagement and the development of HOTS are strongly influenced by the quality of the learning experience and the support of learning media that facilitate concept visualization, interaction, and idea exploration (Fiorella & Mayer, 2018). Recent global education frameworks emphasize the need for equitable, context-sensitive learning innovations, particularly in areas with limited technological access (Voogt & Roblin, 2012).

In this context, non-digital visual learning media such as flip charts are a relevant and applicable alternative. Flip charts allow for visual, systematic, and flexible presentation of material, and encourage direct interaction between teachers and students through discussion and collaborative exploration. Several studies have shown that the use of flip charts can increase students' learning engagement and critical thinking skills, especially when integrated with a student-centred learning approach (Schindler et al., 2017). However, most of these studies still focus on a single aspect of cognitive ability and are conducted in school contexts with relatively adequate learning facilities.

To date, empirical studies specifically examining the use of non-digital flip charts to simultaneously develop creativity and critical thinking skills among elementary school students in rural areas remain very limited. Existing research tends to separate the measurement of these two abilities or fails to consider the context of limited infrastructure as a crucial variable in learning design. This situation indicates a research gap that calls for more contextual and integrative studies, particularly on the effectiveness of simple learning media in supporting HOTS development. More specifically, there is still limited empirical research that explicitly examines the simultaneous development of creativity and critical thinking through non-digital visual media in rural elementary school settings with infrastructural limitations. While previous studies acknowledge the importance of HOTS, few have positioned non-digital instructional media as a strategic and context-sensitive alternative. This explicit gap strengthens the academic positioning and novelty of the present research. Therefore, this study offers novelty by focusing on the use of non-digital flip chart media as an alternative learning medium that is feasible, contextual, and appropriate to the conditions of rural elementary schools, and simultaneously testing its influence on students' creativity and critical thinking skills in science learning. This approach is expected not only to provide empirical contributions to the development of HOTS studies but also to offer practical, applicable solutions for teachers to improve the quality of science learning in environments with limited technological facilities.

2. METHODS

This study employed a quantitative, pre-experimental, one-group pretest–posttest design. This design was used to identify changes in students' creativity and critical thinking skills before and after exposure to science learning through non-digital flip charts. Measurements were conducted twice on the same group of subjects, before the treatment (pretest) and after the treatment (posttest), so that the changes could be observed empirically. The research design used in this study is presented in Figure 1.

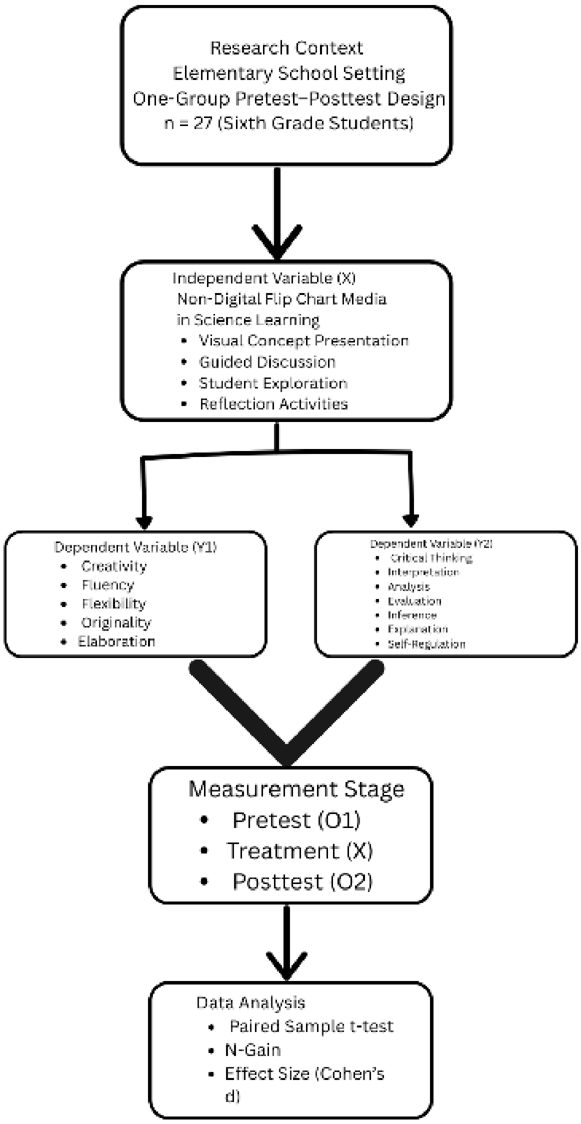

Figure 1. Conceptual and Procedural Framework of the Study

Procedurally, students were given a pretest to measure their creativity and critical thinking skills before treatment. The learning treatment using non-digital flip charts was implemented over four instructional sessions on the topic of Force and Energy. Each session followed a structured sequence: (1) presentation of key concepts through visual flip-chart illustrations, (2) guided questioning to stimulate analytical and reflective thinking, (3) small-group discussion activities, and (4) student presentation and feedback. The flip charts contained sequential visual representations of scientific phenomena designed to facilitate concept visualization and student interaction. This structured implementation was applied consistently across sessions to ensure procedural transparency and enable replicability in similar educational contexts.

They then participated in science learning using non-digital flip charts, followed by a posttest to assess the changes. Although this design did not include a control group, this approach is relevant for contextual research in elementary schools with limited resources. To minimize potential internal validity threats inherent in a one-group pretest–posttest design, several control measures were implemented. The same teacher conducted all instructional sessions to ensure instructional consistency, the learning duration and materials were standardized across meetings, and no additional academic interventions were introduced during the treatment period. Moreover, the use of pretest and posttest measures allowed for within-group comparison to detect changes attributable to the intervention. These procedures were applied to reduce potential biases related to history, maturation, and instructional variability. It provides an initial empirical picture of the treatment's effectiveness (Glaser, 2002).

The study population included all 191 students at Elementary School in the 2025/2026 academic year. The sample was determined using a total sampling technique, involving all 27 sixth-grade students. This sample selection was based on considerations of student characteristics' homogeneity, the relatively small population size, and the effectiveness of implementing learning interventions in one class (Maxwell, 2004). By involving all sixth-grade students, this study is expected to represent the empirical conditions of the subjects fully.

This study used two main instruments: a creativity test and a critical thinking ability test, supplemented by learning documentation. Student creativity was measured using an instrument developed from the Torrance Tests of Creative Thinking (TTCT) that encompassed four main indicators: fluency, flexibility, originality, and elaboration. The instrument consisted of 10 verbal and figural items tailored to the characteristics of elementary school students and the context of science material. Each indicator was assessed using an analytical rubric on a scale of 1–5 to describe the level of student creativity achievement comprehensively.

Critical thinking skills were measured using a structured essay test based on the critical thinking indicators outlined by Ennis (2018), including interpretation, analysis, evaluation, inference, explanation, and self-regulation. The test consisted of 10 contextual questions that required students to analyze science problems, provide logical reasoning, and reflect on their thinking processes. Scoring was conducted using an analytical rubric on a 1–5 scale to ensure the assessment's consistency and validity. Documentation instruments were used to collect supporting data in the form of photographs of learning activities, student work, and teacher notes, thereby strengthening data interpretation and supporting the validity of the research findings (Creswell & Creswell, 2018). The specifications of the research instruments used, including indicators, the number of questions, and the assessment scale, are presented briefly in Table 1.

Table 1. Research Instrument Specifications

Variable	Indicator	Number of Items	Rating Scale
Creativity	Fluency, Flexibility, Originality, Elaboration	15	1-5
Critical Thinking Skills	Interpretation, Analysis, Evaluation, Inference, Explanation, Self-Regulation	15	1-5

The creativity and critical thinking skills test instruments were initially developed with 15 items each. The instrument development process began with blueprint construction based on established theoretical indicators of creativity (fluency, flexibility, originality, elaboration) and critical thinking (interpretation, analysis, evaluation, inference, explanation, and self-regulation). The initial items were reviewed by two experts in science education and educational measurement to assess content relevance, clarity, and alignment with learning objectives. Revisions were made based on expert feedback before pilot testing. Empirical validation was conducted using item-total correlation analysis, and items that did not meet the minimum validity criteria were excluded. Reliability was subsequently confirmed using Cronbach's Alpha to ensure internal consistency.

These instruments were pilot-tested to assess their validity and reliability before use in the main study. Based on the pilot test results, several items that did not meet the validity and reliability criteria were disqualified and not used in the field data collection phase. Therefore, the final instruments used in this study consisted of 10 items each, each of which was found to be valid and reliable. Data analysis was conducted in stages using the Statistical Package for the Social Sciences (SPSS) version 30 software. The initial stage included testing instrument validity and reliability. The validity of the instrument items was tested using product-moment correlations with a significance level of <0.05. At the same time, reliability was assessed using Cronbach's Alpha, with a minimum value of 0.70 indicating good internal consistency (Creswell & Creswell, 2018).

Next, a Shapiro–Wilk test was conducted to assess normality. Hypothesis testing was conducted using a paired sample t-test to compare pretest and posttest scores on students' creativity and critical thinking skills. In addition to the significance test, Cohen's d was used to estimate effect sizes and assess the strength of flip-chart media use's influence on the two research variables. A d value ≥ 0.80 is interpreted as a large effect, 0.50–0.79 as a medium effect, and 0.20–0.49 as a small effect. A summary of the data analysis techniques used in this study is presented in Table 2.

Table 2. Research Data Analysis Techniques

Analysis Objectives	Analysis Techniques	Decision Criteria
Instrument validity test	Pearson Correlation	Sig. < 0,05
Instrument reliability test	Cronbach's Alpha	α ≥ 0,70
Data normality test	Shapiro–Wilk	Sig. > 0,05
Test treatment effect	Paired sample t-test	Sig. < 0,05
Measure of effect strength	Cohen's d	d ≥ 0,80 (big)

3. RESULT AND DISCUSSION

3.1 Research Results

a. Feasibility of Research Instruments

The critical thinking and creativity skills instruments used in this study underwent expert validation and empirical testing. The expert validation results showed that the creativity instrument obtained an average score of 4.67 and the critical thinking skills instrument obtained an average score of 4.40, both of which are in the very valid category. This indicates that the instruments have met the criteria for content suitability, construction, language, and readability, as appropriate for sixth-grade elementary school students.

Vol. 9, No. 2, August 2026, pp. 622-634

The results of the reliability test using Cronbach's Alpha showed that the critical thinking ability instrument had a reliability coefficient of 0.892, and the creativity instrument had a reliability coefficient of 0.915. These values are in the very high reliability category; thus, the instruments are considered consistent and suitable for use in research data collection. The feasibility of the research instruments was tested through expert validation and reliability testing. The test results indicated that the critical thinking ability and creativity instruments met the criteria for validity and reliability. A summary of the instrument feasibility test results is presented in Table 3.

Table 3. Summary of Instrument Eligibility

Instrument	Expert Validity	Cronbach's Alpha	Category
Critical thinking	Very valid	0,892	Reliable
Creativity	Very valid	0,915	Reliable

b. Data Description and Prerequisite Testing

The data for this study were obtained from pre- and posttest measures of critical thinking and creativity skills among sixth-grade students. The pretest was administered before implementing the flip chart media to assess students' initial abilities. In contrast, the posttest was administered after the learning process, using the flip chart, to measure changes in students' abilities following the treatment. This data description provides a general overview of the characteristics of students' scores for each research variable.

A normality test was conducted to determine whether the distributions of pretest and posttest data for each variable were normal. Given that the sample size was less than 50, the normality test was conducted using the Shapiro–Wilk test at the 0.05 significance level. Data were declared normally distributed if the significance value (Sig.) was greater than 0.05. The results of the normality test of the pretest and posttest data on critical thinking and creativity skills are presented in Table 4.

Table 4. Results of Normality Test (Shapiro–Wilk)

Variables	Statistics	df	Sig.
Critical Thinking Pretest	0,927	27	0,059
Creativity Pretest	0,900	27	0,013
Critical Thinking Posttest	0,886	27	0,007
Creativity Posttest	0,901	27	0,014

Based on Table 4, the normality test results indicate that the data generally meet the normality assumption, allowing further analysis using parametric statistics. With this assumption met, the research hypothesis testing continued using a Paired Sample t-test to compare pretest and posttest scores for each variable. Although several Shapiro–Wilk significance values were below 0.05, the decision to proceed with parametric testing was based on the robustness of the paired-sample t-test to minor deviations from normality, particularly with sample sizes close to 30. Additionally, the overall score distributions did not show extreme skewness or outliers. Therefore, the use of parametric analysis was considered methodologically acceptable.

c. The Influence of Flip Chart Media on Critical Thinking and Creativity Skills

The research hypothesis was tested to determine the effect of flip-chart media use on the critical thinking and creativity skills of sixth-grade students. Given that the research data met the assumption of normality, an inferential analysis was conducted using a paired-samples t-test to compare pretest and posttest scores for each variable. The results of the paired-samples t-test showed a significant difference between pretest and posttest scores for students' critical thinking and creativity skills after the implementation of flip charts. A summary of the paired sample t-test results is presented in Table 5.

Table 5. Results of the Paired-Sample t-Test

Variables	Mean Difference	t	df	Sig. (2-tailed)
Critical Thinking (Pretest–Posttest)	-12,815	-29,323	26	0,000
Creativity (Pretest–Posttest)	-18,741	-62,467	26	0,000

Based on Table 5, the significance value (Sig. 2-tailed) for both variables is less than 0.05 ($p < 0.05$), so the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted. This indicates that the use of flip chart media significantly improves students' critical thinking and creativity. The negative average difference indicates that the posttest score is higher than the pretest score, indicating an increase in students' abilities after the treatment. To determine the level of improvement in students' abilities after treatment, a Normalized Gain (N-Gain) analysis was conducted. This analysis classifies the treatment's effectiveness based on the difference between pretest and posttest scores, normalizednormalised to the maximum score. A summary of the N-Gain analysis results is presented in Table 6.

Table 6. N-Gain Analysis Results

Variables	N	Minimum	Maximum	Mean N-Gain	Category
Critical Thinking Skills	27	0,46	1,00	0,67	Medium
Creativity	27	0,56	1,00	0,76	High

Based on Table 6, the average N-Gain value for critical thinking ability is in the medium category, while the average N-Gain value for creativity is in the high category. These results indicate that using flip charts is more effective at improving student creativity than at improving critical thinking, although both showed significant improvement. In addition to testing statistical significance and the level of improvement, this study also analyzed effect size using Cohen's d to determine the practical impact of the treatment. This analysis is important because it provides a snapshot of the flip chart's impact on students' critical thinking and creativity, regardless of sample size. A summary of the effect size calculation results is presented in Table 7.

Table 7. Effect Size Analysis Results (Cohen's d)

Variables	Mean Difference	Std. Deviation	Cohen's d	Interpretation
Critical Thinking Skills	12,815	2,272	5,64	Very large effect
Creativity	18,741	1,559	12,02	Very large effect

Based on Table 7, Cohen's d values for both variables are well above the limit for a large effect size (d > 0.8). This indicates that the use of flip charts has a strong, practically meaningful influence on students' critical thinking and creativity. Thus, these results confirm that flip charts are not only statistically significant but also highly effective in science learning in elementary schools. It is important to interpret the large Cohen's d values with caution. The very high effect size may be influenced by the relatively small standard deviation within a homogeneous sample. Therefore, while the statistical results indicate a strong practical impact, the magnitude of the effect should be understood within the contextual limitations of the study design.

3.2 Discussion

The results section presents the statistical findings objectively, while the discussion section interprets these findings in relation to theoretical frameworks and previous empirical studies. This separation is intended to maintain methodological clarity and strengthen the scientific structure of the article. The study found that using flip charts significantly improved elementary school students' critical thinking and creativity. This finding indicates that systematically designed, non-digital visual learning media can facilitate higher-order thinking skills among students, particularly in science.

The improvement in students' critical thinking skills after using flip charts aligns with Ennis (2018) view that critical thinking can develop optimally when students are exposed to learning stimuli that encourage analysis, reasoning, and decision-making based on conceptual understanding. Flip charts, through their visual and step-by-step presentation of material, enable students to observe phenomena, connect concepts, and draw conclusions more systematically. These findings also support previous research showing that contextual visual media can improve cognitive engagement and critical thinking skills in elementary school students (Darling-Hammond et al., 2020). The effectiveness of visual and structured learning media can be explained through Cognitive Load Theory, which posits that well-organized visual information reduces extraneous cognitive load and facilitates meaningful learning (Sweller et al., 2019).

By presenting concepts sequentially and visually, flip charts may help students allocate cognitive resources more efficiently, thereby supporting deeper conceptual processing. Beyond cognitive load considerations, student engagement theory suggests that meaningful learning occurs when learners are behaviorally, emotionally, and cognitively invested in instructional activities (Fredricks et al., 2004). Visual and interactive media, even in non-digital formats, may stimulate deeper cognitive engagement by making abstract concepts more tangible. Recent research also highlights that instructional environments encouraging structured reasoning and reflection significantly predict improvements in students' critical thinking performance (Cavallone et al., 2021). This suggests that pedagogical design, rather than technological sophistication, plays a central role in cultivating reflective cognitive processes.

Meanwhile, the increase in students' creativity in the high category indicates that flip charts have characteristics that strongly support the development of creative abilities. According to Kim (2011), creativity includes the ability to generate ideas fluently (fluency), flexibly (flexibility), and originality (originality), as well as the ability to develop and elaborate on ideas. Recent longitudinal research also indicates that classroom environments emphasizing structured idea generation and reflective dialogue significantly enhance students' creative thinking trajectories over time (Barbot et al., 2019). Creativity is increasingly conceptualized as an instructional outcome shaped by pedagogical scaffolding rather than solely innate potential. Flip charts provide a visual space for students to freely express and modify ideas and relate science concepts to their real-life experiences. This explains why the increase in creativity in this study was greater than that in critical thinking skills. Creativity development is also strongly influenced by learning environments that provide autonomy, open-ended tasks, and opportunities for idea elaboration (Beghetto & Kaufman, 2014). Instructional contexts that encourage risk-taking and multiple solution pathways tend to enhance students' creative confidence and originality.

According to Kraft (2020), effect size analysis provides a clearer picture of instructional impact beyond statistical significance. Therefore, beyond the significant p-values, the very large Cohen's d values obtained in this study indicate a substantial practical impact of flip chart media on students' critical thinking and creativity. This finding is consistent with previous research suggesting that visual-based learning media and exploratory activities significantly improve student creativity (Abrami et al., 2015). Flip charts, as a simple visual medium, can create an active and enjoyable learning environment, thus motivating students to think divergently and generate new ideas during the learning process.

The large effect size values for both variables indicate that the influence of flip chart media is not only statistically significant but also practically meaningful. The magnitude of the treatment effect was analyzed using Cohen's d. According to Lakens (2013), an effect size that far exceeds the threshold for a large effect indicates that the intervention has a strong, practically meaningful impact, not just statistical significance. An effect size value exceeding 0.8 indicates a large effect, while a value far above the threshold indicates a very strong effect. The Cohen's d value obtained in this study indicates that the use of flip chart media has a very large learning impact on students' critical thinking skills and creativity. Thus, the results of this study strengthen previous empirical findings that visual learning media play a strategic role in improving the quality of science learning in elementary schools. Recent methodological discussions emphasize that large effect sizes in small-sample educational interventions should be interpreted alongside contextual variables and implementation fidelity (Cheung & Slavin, 2016). Therefore, while the present findings demonstrate strong practical impact, replication across broader samples is essential

Overall, the results of this study confirm that flip charts are an effective, applicable, and relevant alternative learning medium for elementary school students. These findings have practical implications for teachers, particularly in designing science lessons that are oriented not only toward mastery of concepts but also toward the balanced development of students' critical thinking and creativity. Furthermore, this study provides a theoretical contribution by strengthening the empirical foundation for the effectiveness of non-digital visual learning media in supporting meaningful learning and the development of 21st-century skills at the elementary level. Despite the positive findings, several limitations should be acknowledged. First, the use of a one-group pretest–posttest design without a control group limits causal inference. Second, the relatively small and homogeneous sample may restrict the generalizability of the findings to broader educational contexts. Third, the short duration of the intervention may not fully capture long-term impacts on higher-order thinking skills. Future research is recommended to employ experimental or quasi-experimental designs with larger and more diverse samples to strengthen external validity and provide more comprehensive evidence regarding the effectiveness of non-digital instructional media.

4. CONCLUSION

Overall, the findings of this study synthesize evidence that structured non-digital visual media can function as an effective pedagogical strategy to facilitate higher-order thinking processes in elementary science learning. Rather than merely demonstrating score improvements, the results indicate that appropriately designed visual instruction can meaningfully support both creative idea generation and analytical reasoning within a unified HOTS framework. Based on the results of the data analysis and discussion, it can be concluded that the use of flip chart media significantly influences the creativity and critical thinking skills of sixth-grade students at Elementary School in science learning on the subject of Force and Energy. The use of flip charts has been proven effective in enhancing student creativity. Statistical test results show a significant difference between pre- and post-treatment scores, supported by a high N-Gain value and a very large effect size in practical terms. These findings indicate that flip charts can facilitate the development of aspects of student creativity, such as fluency, flexibility, originality, and idea elaboration, through visual, concrete, and contextual presentation. Furthermore, the use of flip charts significantly improved students' critical thinking skills.

This improvement was demonstrated by a significant difference between pretest and post-test scores, a moderate N-Gain, and a very large effect size. These results indicate that flip charts can help students analyze concepts, understand cause-and-effect relationships, and draw more systematic conclusions during the learning process. Flip chart media is an effective, practical, and relevant learning medium to improve elementary school students' critical thinking and creativity, especially in science learning. Although the study was conducted in a specific rural elementary school context, the findings suggest broader pedagogical implications for resource-limited educational environments. The results indicate that the effectiveness of instructional media is not solely dependent on digital sophistication, but rather on structured design, conceptual clarity, and interactive implementation. This provides a basis for cautious scientific generalization to similar contexts with comparable infrastructural characteristics. This study contributes theoretically by reinforcing the integration of creativity and critical thinking as interconnected dimensions of Higher Order Thinking Skills within elementary science education. Practically, it offers an accessible and context-sensitive instructional alternative for teachers in schools with limited technological infrastructure. By demonstrating the instructional potential of non-digital media, this research broadens the discourse on equitable and sustainable approaches to developing 21st-century competencies.

REFERENCES

Abrami, P. C., Bernard, R. M., Borokhovski, E., Waddington, D. I., Wade, C. A., & Persson, T. (2015). Strategies for Teaching Students to Think Critically. *Review of Educational Research*, *85*(2), 275–314. https://doi.org/10.3102/0034654314551063

Barbot, B., Hass, R. W., & Reiter-Palmon, R. (2019). Creativity assessment in psychological research: (Re)setting the standards. *Psychology of Aesthetics, Creativity, and the Arts*, *13*(2), 233–240. https://doi.org/10.1037/aca0000233

Beghetto, R. A., & Kaufman, J. C. (2014). Classroom contexts for creativity. *High Ability Studies*, *25*(1), 53–69. https://doi.org/10.1080/13598139.2014.905247

Cavallone, M., Ciasullo, M. V., Douglas, J., & Palumbo, R. (2021). Framing higher education quality from a business perspective: setting the conditions for value co-creation. *Studies in Higher Education*, *46*(6), 1099–1111. https://doi.org/10.1080/03075079.2019.1672644

Cheung, A. C. K., & Slavin, R. E. (2016). How Methodological Features Affect Effect Sizes in Education. *Educational Researcher*, *45*(5), 283–292.

https://doi.org/10.3102/0013189X16656615
Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.
Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science*, *24*(2), 97–140. https://doi.org/10.1080/10888691.2018.1537791
Dwyer, C. P., Hogan, M. J., & Stewart, I. (2014). An integrated critical thinking framework for the 21st century. *Thinking Skills and Creativity*, *12*, 43–52. https://doi.org/10.1016/j.tsc.2013.12.004
Ennis, R. H. (2018). Critical Thinking Across the Curriculum: A Vision. *Topoi*, *37*(1), 165–184. https://doi.org/10.1007/s11245-016-9401-4
Fiorella, L., & Mayer, R. E. (2018). What works and doesn't work with instructional video. *Computers in Human Behavior*, *89*, 465–470. https://doi.org/10.1016/j.chb.2018.07.015
Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School Engagement: Potential of the Concept, State of the Evidence. *Review of Educational Research*, *74*(1), 59–109. https://doi.org/10.3102/00346543074001059
Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, *111*(23), 8410–8415. https://doi.org/10.1073/pnas.1319030111
Furtak, E. M., Seidel, T., Iverson, H., & Briggs, D. C. (2012). Experimental and Quasi-Experimental Studies of Inquiry-Based Science Teaching. *Review of Educational Research*, *82*(3), 300–329. https://doi.org/10.3102/0034654312457206
Glaser, J. M. (2002). White Voters, Black Schools: Structuring Racial Choices with a Checklist Ballot. *American Journal of Political Science*, *46*(1), 35. https://doi.org/10.2307/3088413
Hascher, T., & Waber, J. (2021). Teacher well-being: A systematic review of the research literature from the year 2000–2019. *Educational Research Review*, *34*, 100411. https://doi.org/10.1016/j.edurev.2021.100411
Hmelo-Silver, C. E., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and Achievement in Problem-Based and Inquiry Learning: A Response to Kirschner, Sweller, and Clark (2006). *Educational Psychologist*, *42*(2), 99–107. https://doi.org/10.1080/00461520701263368
Kim, K. H. (2011). The Creativity Crisis: The Decrease in Creative Thinking Scores on the Torrance Tests of Creative Thinking. *Creativity Research Journal*, *23*(4), 285–295. https://doi.org/10.1080/10400419.2011.627805
Kraft, M. A. (2020). Interpreting Effect Sizes of Education Interventions. *Educational Researcher*, *49*(4), 241–253. https://doi.org/10.3102/0013189X20912798
Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: A practical primer for t-tests and ANOVAs. *Frontiers in Psychology*, *4*(NOV), 1–12. https://doi.org/10.3389/fpsyg.2013.00863
Maxwell, J. A. (2004). Causal Explanation, Qualitative Research, and Scientific Inquiry in Education. *Educational Researcher*, *33*(2), 3–11. https://doi.org/10.3102/0013189X033002003
OECD. (2019). *PISA 2018 Results (Volume I)*. OECD Publishing. https://doi.org/10.1787/5f07c754-en
Runco, M. A., & Acar, S. (2012). Divergent Thinking as an Indicator of Creative Potential. *Creativity Research Journal*, *24*(1), 66–75. https://doi.org/10.1080/10400419.2012.652929
Schindler, L. A., Burkholder, G. J., Morad, O. A., & Marsh, C. (2017). Computer-based technology and student engagement: a critical review of the literature. *International Journal of Educational Technology in Higher Education*, *14*(1), 25. https://doi.org/10.1186/s41239-017-0063-0
Sweller, J., van Merriënboer, J. J. G., & Paas, F. (2019). Cognitive Architecture and Instructional Design: 20 Years Later. *Educational Psychology Review*, *31*(2), 261–292. https://doi.org/10.1007/s10648-019-09465-5

Voogt, J., & Roblin, N. P. (2012). A comparative analysis of international frameworks for 21 st century competences: Implications for national curriculum policies. *Journal of Curriculum Studies*, *44*(3), 299–321. https://doi.org/10.1080/00220272.2012.668938