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Enhancing elementary students' science learning outcomes through audiovisual instructional media: A pre-experimental investigation

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Abstract

The integration of instructional media has become increasingly important in promoting meaningful learning experiences and improving students' academic achievement, particularly in elementary science education. This study aimed to investigate the effectiveness of audiovisual instructional media in enhancing fifth-grade students' science learning outcomes. A quantitative approach employing a pre-experimental one-group pretest-posttest design was adopted. The participants consisted of 26 fifth-grade students from SD Negeri 122381 Bane Pematangsiantar, Indonesia. Prior to the main study, the research instrument underwent validity, reliability, item difficulty, and discrimination analyses to ensure its quality. The findings indicated that 20 of the 25 multiple-choice items met the validity criteria, while the reliability coefficient (Cronbach's Alpha = 0.978) demonstrated excellent internal consistency. Students' learning achievement was measured through pretest and posttest assessments administered before and after the implementation of audiovisual instructional media. The descriptive analysis revealed that the mean pretest score increased from 53.8 to 85.2 in the posttest. Furthermore, inferential statistical analysis using SPSS showed a statistically significant difference between students' pretest and posttest scores (Sig. (2-tailed) = 0.000 < 0.05), indicating that the instructional intervention significantly improved students' science learning outcomes. These findings suggest that audiovisual instructional media provide meaningful visual and auditory learning experiences that enhance students' engagement, conceptual understanding, and overall academic achievement in elementary science classrooms. Therefore, integrating audiovisual media into science instruction is recommended as an effective pedagogical strategy for improving learning quality and promoting active classroom participation.

Keywords: audiovisual instructional media; science learning;
elementary education; learning outcomes

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Introduction

Education plays a fundamental role in developing individuals' knowledge, skills, attitudes, and competencies needed to face the challenges of the twenty-first century. Beyond the acquisition of academic knowledge, education aims to cultivate learners who are capable of critical thinking, problem-solving, collaboration, and lifelong learning (Fadhilah et al., 2025). Consequently, classroom instruction should not merely emphasize knowledge transmission but also create meaningful learning experiences that actively engage students throughout the learning process. Achieving these educational objectives requires teachers to adopt effective instructional strategies and appropriate learning media that accommodate students' developmental characteristics and learning needs.

Science is one of the core subjects in elementary education because it enables students to understand natural phenomena through scientific inquiry, observation, experimentation, and logical reasoning (Darling-Hammond et al., 2020). Elementary science education is expected to help students develop scientific literacy while fostering curiosity about the world around them (Fisher et al., 2016; Panjaitan et al., 2025). Rather than memorizing scientific facts, students should be encouraged to construct conceptual understanding through authentic learning experiences that relate scientific concepts to everyday life. Therefore, science instruction should be designed to promote active participation, conceptual understanding, and meaningful engagement.

Despite its importance, science learning in many elementary schools continues to face considerable challenges. Traditional teacher-centered instruction remains dominant, where teachers primarily rely on lectures and textbook explanations with limited use of instructional media. Such practices often reduce students' motivation, attention, and participation during classroom activities, resulting in superficial understanding of scientific concepts. When students are unable to visualize abstract scientific processes, they tend to experience learning difficulties, leading to lower academic achievement and reduced classroom engagement (Ekayani, 2017; Febrita & Ulfah, 2019; Panjaitan et al., 2026).

The preliminary observation conducted at SD Negeri 122381 Bane Pematangsiantar revealed similar instructional problems. During science lessons, classroom activities were largely dominated by verbal explanations with minimal use of instructional media. Existing teaching aids were either unavailable or no longer suitable for classroom use, limiting teachers' ability to provide concrete learning experiences. Consequently, many students showed low learning motivation, limited classroom participation, and difficulty understanding science concepts, particularly those involving dynamic processes such as ecosystems and food chains. These classroom conditions were reflected in students' learning achievement, where a considerable proportion of learners had not yet attained the school's minimum mastery criterion.

To address these instructional challenges, teachers need learning media capable of transforming abstract concepts into concrete and meaningful learning experiences. One instructional approach that has attracted increasing attention is the integration of audiovisual instructional media. Audiovisual media combine visual and auditory information, enabling learners to observe scientific phenomena more realistically through animations, videos, narration, and interactive presentations. Compared with conventional instruction, audiovisual media provide richer learning experiences that facilitate students' attention, comprehension, memory retention, and conceptual understanding (Latief et al., 2021; Wahyuningsih, 2020).

The effectiveness of audiovisual instructional media can also be explained through contemporary learning theories. According to multimedia learning principles, students understand complex concepts more effectively when information is presented simultaneously through verbal explanations and relevant visual representations. Such multimodal presentation reduces cognitive load while promoting meaningful learning by integrating verbal and visual information into coherent mental representations. For elementary learners, who generally possess concrete operational thinking characteristics, audiovisual media offer opportunities to observe scientific processes that cannot easily be demonstrated through

traditional classroom instruction alone.

Numerous previous studies have reported positive effects of instructional media on students' motivation and academic performance. Ekayani (2017) emphasized that appropriate learning media increase students' learning interest and classroom participation. Similarly, Febrita and Ulfah (2019) reported that instructional media significantly contribute to students' motivation and learning engagement, which subsequently influence learning achievement. Nevertheless, many previous investigations have focused primarily on students' motivation or general academic performance rather than specifically examining the effectiveness of audiovisual instructional media in improving elementary students' science learning outcomes through experimental classroom research. Consequently, empirical evidence regarding the implementation of audiovisual media in Indonesian elementary science classrooms remains relatively limited.

Based on these considerations, this study investigates the impact of audiovisual instructional media on fifth-grade students' science learning outcomes at SD Negeri 122381 Bane Pematangsiantar using a pre-experimental one-group pretest-posttest design. By providing empirical evidence regarding the effectiveness of audiovisual instructional media in elementary science instruction, this study is expected to contribute to the growing body of research on innovative teaching practices and offer practical recommendations for elementary school teachers seeking to improve students' learning engagement and academic achievement.

Methodology

1. Research Design

This study employed a quantitative approach using a pre-experimental research design to investigate the effectiveness of audiovisual instructional media in improving elementary students' science learning outcomes. Specifically, the study adopted a one-group pretest-posttest design, which enables researchers to compare students' learning achievement before and after the implementation of an instructional intervention.

In this design, participants completed a pretest to determine their initial understanding of the science topic before receiving the instructional treatment. Subsequently, students participated in science lessons delivered using audiovisual instructional media. At the end of the intervention, a posttest was administered to evaluate changes in students' learning outcomes. The comparison between the pretest and posttest scores provided empirical evidence regarding the effectiveness of the instructional media. The research design is illustrated as follows:

Pretest	Treatment	Posttest
O ₁	X	O ₂

Where:

- O₁ = Pretest
- X = Science instruction using audiovisual instructional media
- O₂ = Posttest

2. Research Site and Participants

The study was conducted during the second semester of the 2025/2026 academic year at SD Negeri 122381 Bane Pematangsiantar, North Sumatra, Indonesia. The participants consisted of 26 fifth-grade students, comprising 15 boys and 11 girls. All students participated in the study because the research employed a one-group pretest-posttest design involving an intact classroom. Since the research focused on evaluating instructional effectiveness within a single classroom, the entire Grade 5 class was selected as the research sample.

3. Research Instrument

Students' science learning outcomes were measured using a researcher-developed multiple-choice achievement test consisting of 25 items aligned with the Grade 5 science curriculum, particularly the topic of food chains within ecosystems. Prior to the implementation of the study, the instrument underwent a pilot test involving students from another elementary school possessing characteristics comparable to those of the research participants. The pilot study aimed to evaluate the psychometric quality of the instrument before it was administered in the actual experiment.

The quality of the instrument was assessed through four analyses:

- Item validity
- Reliability
- Item difficulty
- Item discrimination

The validity of each item was examined using the Pearson Product-Moment correlation coefficient. Instrument reliability was analyzed using Cronbach's Alpha, while the item difficulty and discrimination indices were calculated to ensure that the test appropriately measured students' learning achievement. The final instrument consisted of 20 valid items, which were subsequently administered as both the pretest and the posttest.

4. Data Collection Procedures

Data collection was conducted in three consecutive stages. First, students completed the pretest, which measured their initial understanding of the science topic before receiving any instructional treatment. Second, the researcher implemented classroom instruction using audiovisual instructional media. During the intervention, students observed animated videos and visual presentations illustrating ecosystem interactions and food chains. The instructional activities encouraged students to observe scientific phenomena, discuss concepts collaboratively, and relate visual information to classroom explanations. Finally, after the instructional intervention had been completed, students completed the posttest, which contained the same validated items as the pretest. The posttest measured students' learning achievement following exposure to the audiovisual instructional media.

5. Instrument Validation

Before being administered to the research participants, the achievement test was subjected to several psychometric analyses to ensure its validity and reliability. Item validity was evaluated using the Pearson Product-Moment correlation, whereby items with correlation coefficients exceeding the critical value were retained for the final instrument. Internal consistency reliability was determined using Cronbach's Alpha. A reliability coefficient exceeding 0.60 was considered acceptable, indicating that the instrument consistently measured students' science learning achievement.

Furthermore, item difficulty analysis was conducted to classify questions into easy, moderate, and difficult categories, while item discrimination analysis examined each item's ability to distinguish between high- and low-performing students. Only items satisfying these quality criteria were included in the final achievement test.

6. Data Analysis

The collected data were analyzed quantitatively using IBM SPSS Statistics Version 29. The analysis consisted of several stages.

a) Descriptive Statistics

Descriptive statistics were first calculated to summarize students' pretest and posttest scores, including the mean, minimum score, maximum score, and score distribution.

b) Normality Test

Prior to hypothesis testing, data normality was examined using the One-Sample Kolmogorov-Smirnov Test. Data were considered normally distributed when the significance value exceeded 0.05.

c) Homogeneity Test

The homogeneity of variance was evaluated using Levene's Test. A significance value greater than 0.05 indicated homogeneous variance between observations.

d) Hypothesis Testing

To determine whether audiovisual instructional media significantly improved students' science learning outcomes, hypothesis testing was conducted using a paired-samples t-test.

The decision criteria were established as follows:

- $p < 0.05$: The null hypothesis (H_0) is rejected, indicating a statistically significant improvement in students' learning outcomes.
- $p \geq 0.05$: The null hypothesis (H_0) is accepted, indicating no statistically significant difference between pretest and posttest scores.

All statistical analyses were performed at the 95% confidence level ($\alpha = 0.05$).

Results

1. Instrument Validation

Before the experimental intervention, the research instrument was evaluated to ensure its validity and reliability. The instrument initially consisted of 25 multiple-choice questions that were piloted with students from a school comparable to the research setting. Item validity was examined using the Pearson Product-Moment correlation. The analysis indicated that 20 items met the validity criteria, while five items were excluded because they did not reach the required correlation coefficient. Reliability analysis further demonstrated excellent internal consistency, with a Cronbach's Alpha coefficient of 0.978, indicating that the instrument was highly reliable. In addition, the item analysis revealed that most questions were categorized as easy to moderate in difficulty and showed satisfactory discrimination indices, confirming that the final instrument was appropriate for measuring Grade 5 students' science learning outcomes.

Table 1. Summary of Instrument Validation

Analysis	Result
Total items	25
Valid items	20
Invalid items	5
Cronbach's Alpha	0.978
Difficulty level	20 Easy; 5 Moderate
Discrimination index	19 Good; 1 Very Good; 5 Poor/Very Poor

2. Students' Learning Outcomes

Students' science learning outcomes improved considerably following the implementation of audiovisual instructional media. Prior to the intervention, students achieved a mean pretest score of 53.8, indicating that most learners had not yet reached the expected level of mastery. Following the instructional treatment, the mean posttest score increased to 85.2, representing an improvement of 31.4 points. This substantial increase suggests that the use of audiovisual instructional media effectively enhanced students' understanding of ecosystem and food-chain concepts.

Table 2. Descriptive Statistics of Students' Learning Outcomes

Assessment	Mean	Highest	Lowest
Pretest	53.8	80	25
Posttest	85.2	100	70

3. Hypothesis Testing

Prior to hypothesis testing, the assumptions underlying the statistical analysis were examined. Following these preliminary analyses, a paired-samples *t*-test was performed to evaluate the effectiveness of audiovisual instructional media. The results revealed a statistically significant difference between students' pretest and posttest scores ($t = 30.241$, $p < .001$), indicating that the instructional intervention significantly improved science learning outcomes. Therefore, the null hypothesis was rejected, confirming the effectiveness of audiovisual instructional media in supporting elementary science learning.

Table 3. Summary of Inferential Analysis

Test	Result
Paired-samples <i>t</i> -test	$t = 30.241$
Significance	$p < .001$
Decision	H_0 Rejected
Interpretation	Significant improvement

Discussion

The present study investigated the effectiveness of audiovisual instructional media in improving Grade 5 students' science learning outcomes. The findings demonstrated that the integration of audiovisual media significantly enhanced students' academic achievement. This improvement was evidenced by the substantial increase in the mean score from 53.8 in the pretest to 85.2 in the posttest, while the paired-samples *t*-test confirmed that the difference was statistically significant ($p < .001$). These findings indicate that audiovisual instructional media effectively facilitated students' understanding of ecosystem and food-chain concepts and contributed positively to their overall science learning achievement.

One possible explanation for these findings is that audiovisual media provide students with simultaneous visual and auditory representations of scientific concepts. Rather than relying solely on verbal explanations, students are able to observe scientific processes through animations, narration, and dynamic illustrations, making abstract concepts more concrete and easier to understand. This finding is consistent with multimedia learning theory, which suggests that meaningful learning occurs when verbal and visual information are processed together, allowing learners to construct richer cognitive representations (Mayer, 2021). Similarly, Hattie (2017) argued that instructional approaches promoting active engagement and multiple representations tend to produce greater learning gains than conventional lecture-based instruction.

The findings of this study are also consistent with previous empirical research examining the role of instructional media in elementary education. Ekayani (2017) emphasized that appropriate learning media enhance students' motivation and classroom participation by creating more engaging learning experiences. Likewise, Febrita and Ulfah (2019) reported that instructional media positively influence students' learning motivation, which subsequently contributes to improved academic performance. The present study extends these findings by providing experimental evidence that audiovisual instructional media improve not only students' motivation but also measurable science learning outcomes in elementary classrooms.

Beyond improving academic achievement, audiovisual media appeared to influence students' classroom engagement. During the instructional sessions, students demonstrated greater enthusiasm,

maintained attention for longer periods, and participated more actively in classroom discussions. Such behavioral changes suggest that audiovisual media support a more student-centered learning environment, where learners actively interact with instructional content rather than passively receiving information. This active participation likely contributed to the observed improvement in posttest performance.

From a practical perspective, the findings highlight the importance of integrating technology-supported instructional media into elementary science education. Science concepts often involve dynamic processes that are difficult to explain through textbooks or verbal instruction alone. Audiovisual media enable teachers to visualize scientific phenomena more realistically, thereby facilitating conceptual understanding while simultaneously increasing students' motivation and learning interest. Consequently, teachers are encouraged to incorporate audiovisual resources as complementary instructional tools, particularly when teaching abstract scientific concepts.

Although the findings demonstrate the effectiveness of audiovisual instructional media, several limitations should be acknowledged. First, the study employed a pre-experimental one-group pretest-posttest design without a control group, limiting the ability to attribute learning gains exclusively to the instructional intervention. Second, the sample was limited to a single Grade 5 classroom comprising 26 students, which may restrict the generalizability of the findings to broader educational contexts. Third, the intervention was conducted over a relatively short period; therefore, the long-term impact of audiovisual instructional media on students' conceptual retention remains unclear. Future studies should employ quasi-experimental or true experimental designs involving larger and more diverse samples across multiple schools. Longitudinal investigations are also recommended to examine whether the observed improvements are sustained over time. Furthermore, future research could explore the effectiveness of audiovisual media in other science topics or different subject areas, as well as investigate how individual learner characteristics influence the effectiveness of multimedia-supported instruction.

Overall, this study provides empirical evidence that audiovisual instructional media constitute an effective instructional strategy for improving elementary students' science learning outcomes. By promoting meaningful visualization, increasing classroom engagement, and facilitating conceptual understanding, audiovisual media offer considerable pedagogical potential for enhancing the quality of science instruction in primary education.

Conclusion

This study investigated the effectiveness of audiovisual instructional media in improving fifth-grade students' science learning outcomes at SD Negeri 122381 Bane Pematangsiantar. The findings demonstrated that the integration of audiovisual media significantly enhanced students' academic performance, as reflected by the increase in the mean score from the pretest to the posttest and supported by the results of the paired-samples t-test. These findings confirm that audiovisual instructional media can effectively facilitate students' conceptual understanding of ecosystem and food-chain topics by providing meaningful visual and auditory learning experiences.

The findings also highlight the pedagogical value of incorporating multimedia resources into elementary science instruction. Audiovisual media encourage greater student engagement, sustain learners' attention, and support active classroom participation, all of which contribute to improved learning achievement. Consequently, integrating audiovisual instructional media into science teaching represents a practical instructional strategy for creating more interactive, student-centered, and meaningful learning environments in elementary schools.

Despite these promising findings, further studies employing larger samples, longer intervention periods, and more rigorous experimental designs are recommended to strengthen the generalizability of the results. Future investigations may also examine the effectiveness of audiovisual media across different science topics, grade levels, or educational settings to provide broader empirical evidence regarding their contribution to elementary science education.

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