

ENHANCING ELEMENTARY STUDENTS' SCIENCE LEARNING OUTCOMES AND MOTIVATION THROUGH POP-UP BOOK MEDIA ON ANIMAL LIFE CYCLES

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Abstract

The limited use of science instruction that transforms abstract concepts into concrete learning experiences remains a challenge in elementary education, despite its importance for improving students' motivation and learning outcomes. This study aims to describe the implementation of pop-up book media and analyze its effect on third-grade students' motivation and science learning outcomes on the topic of animal life cycles. A Classroom Action Research design with qualitative and quantitative approaches was employed, involving 13 third-grade students at SDIT Tahfidzul Qur'an Mutiara Insan Sukoharjo. The study was conducted in two cycles. Data were collected through achievement tests, learning motivation questionnaires, observations, interviews, and documentation, and were analyzed using descriptive-comparative techniques. The findings show that the use of pop-up book media increased student activity from 39.90% in Cycle I to 78.37% in Cycle II. Learning mastery improved from 61.54% in the pre-cycle stage to 100% in Cycle II, while students' learning motivation reached 87.54%, which was categorized as very high. These findings indicate that pop-up book media is effective in concretizing science concepts, sustaining students' attention, and encouraging active participation in learning. This study contributes to elementary science education by demonstrating that visually interactive media can strengthen conceptual understanding, motivation, and learning achievement, particularly in topics that require concrete representation of biological processes.

Keywords: Pop-Up Book Media; Science Learning; Learning Motivation; Learning Outcomes; Classroom Action Research.

INTRODUCTION

Science education in elementary schools requires an approach that can make abstract concepts more concrete so that they are easier for students to understand. Several international studies, including Noetel et al. (2022), Prayoga et al. (2025), and Utami et al. (2025), show that the use of visual and interactive media significantly improves student engagement and comprehension compared with conventional teacher-centered methods. Instructional media functions not only as a tool, but also as a means of activating students' cognitive processes through meaningful visual representation (Candido & Cattaneo, 2025). In this context, science learning requires strategies that integrate conceptual visualization so that students do not merely memorize information but develop conceptual understanding. Therefore, innovation in instructional media has become an important issue in improving the quality of science learning in elementary schools.

Globally, research on multimedia learning, such as that conducted by Habibiyah & Ridwan (2025), Mayer (2024), and Mutlu-Bayraktar et al. (2019), shows that visual-verbal learning design can improve learning effectiveness by helping students manage cognitive load more effectively and has drawn increasing attention to the use of visual-based interactive media as a solution for improving students' motivation and learning outcomes. Visual media are considered capable of supporting information processing through dual coding, namely the integration of verbal and visual information that strengthens students' understanding and memory retention (Clark & Paivio, 1991). This is highly relevant in science learning, which is rich in process- and change-based concepts, such as the life cycles of living things. Thus, the use of media that can present concrete visualization is a pedagogical necessity rather than merely a supplement to instruction.

In the national context, various studies such as Rahmawati et al. (2025), Resta & Kodri (2023), dan Sinta et al. (2025) show that science learning in elementary schools still faces classic problems, such as low learning motivation, limited student engagement, and the dominance of lecture-based instruction. Yet recent research indicates that intrinsic motivation and active student engagement are strongly associated with successful science learning in elementary school age students (Tsoumanis et al., 2024). Therefore, learning media are needed that are not only visually appealing but also capable of fostering attention, curiosity, and active participation throughout the learning process.

These issues are even more apparent in science topics that are sequential and process-oriented, such as animal life cycles. Such material requires an understanding of gradual stages and therefore calls for visual media that can depict the process concretely and systematically. A study by Ardiansari et al. (2025) shows that the use of three-dimensional visual media can help students understand concepts of change more clearly and increase their interest in learning. Accordingly, the use of innovative media such as pop-up books becomes a relevant alternative for addressing this need.

In response to this issue, the researcher views the pop-up book as one of the promising instructional innovations for improving the quality of science learning. This media has three-dimensional visual characteristics that can attract students' attention while providing a more concrete and interactive learning experience. Research by Nasution et al. (2025) and Nisrina & Prasetyaningtyas (2025) shows that pop-up books can enhance students' learning motivation because they introduce an element of surprise and direct involvement in the learning process. In addition, this media helps students understand concepts more easily because the information is presented in a visually engaging and systematic form.

Expert opinion from Mayer (2024) also strengthens the view that effective instructional media must be able to adapt to learner characteristics and support their cognitive processes. In this regard, the pop-up book functions not only as a visual medium but also as a tool that stimulates students' mental activity through visual exploration. This media enables students to learn actively, thereby making the learning process more meaningful. Thus, the use of pop-up books in science learning can be an appropriate solution for improving students' motivation and learning outcomes.

Previous research has shown that the use of pop-up book media has a positive effect on elementary students' learning outcomes. Arip & Aswat (2021) found that pop-up books can significantly improve science learning outcomes and make students more active in class. Other studies by Sumayana et al. (2021) and Nahari et al. (2023) show that pop-up books can increase students' learning motivation while also gradually improving learning outcomes through cycle-based instruction. These findings indicate that pop-up book media has substantial potential to improve the quality of learning in elementary schools.

However, most of these studies still have limitations, whether in terms of the variables examined or the research context. Alman & Nugrahaeni (2022) dan Situmorang et

al. (2025) examined only learning outcomes without considering motivation, while other studies were conducted at different grade levels or in subjects other than science. In addition, there are still limited studies that specifically examine the application of pop-up book media among third-grade students in the topic of animal life cycles. This indicates a research gap that should be addressed by studies that are more contextual and comprehensive.

This gap is further reinforced by learning theories that emphasize the importance of visualization in the learning process. Multimedia learning theory states that learning will be more effective when information is presented through a combination of visual and verbal modes (Mayer, 2024). Meanwhile, constructivist theory emphasizes that students build knowledge through concrete and meaningful learning experiences (Chand, 2023; Wiyono et al., 2025). In this regard, pop-up book media can serve as a means of supporting both theories because it provides interactive and visual learning experiences. In addition, motivation theory also explains that a learning environment that is engaging and enjoyable can increase student involvement and learning outcomes (Nongko et al., 2025; Nurcahayani et al., 2025). Innovative instructional media such as pop-up books can become a stimulus that encourages students' intrinsic motivation to learn. Thus, the use of this media affects not only the cognitive domain but also the affective domain of students.

Unlike previous studies that generally emphasize only the effectiveness of pop-up book media on learning outcomes, this study simultaneously examines learning motivation and learning outcomes as two interrelated outcomes in science learning. The novelty of this study lies in the use of pop-up book media in a third-grade elementary school context for the topic of animal life cycles, a topic that is process-oriented and requires sequential visualization so that it can be easily understood by students at the concrete operational stage. Thus, this study not only tests the effectiveness of three-dimensional visual media, but also demonstrates how such media work to build students' attention, engagement, and conceptual understanding simultaneously. Theoretically, this study expands empirical evidence that interactive visual media can support elementary science learning through the strengthening of cognitive and affective processes; practically, it provides an alternative instructional medium that is relevant, easy to implement, and contextually appropriate for elementary school teachers in improving the quality of science learning.

Based on the description above, this study focuses on the use of pop-up book media in science learning to improve the motivation and learning outcomes of third-grade elementary students on the topic of animal life cycles. This study aims to describe the process of implementing pop-up book media and to analyze the improvement in students' motivation and learning outcomes after the media is used in instruction. It is expected that this focus will make a meaningful contribution to the development of effective and contextually relevant instructional media innovation in elementary schools, especially in science learning.

METHODS

This study employed a Classroom Action Research (CAR) approach with both qualitative and quantitative data. This approach was selected because the study aimed to improve elementary science teaching practice directly while also measuring changes in students' motivation and learning outcomes after the implementation of pop-up book media. Conceptually, CAR is a reflective study conducted iteratively in an authentic classroom context to improve the quality of both the learning process and its outcomes. The qualitative approach was used to describe the learning process, teacher and student activities, and students' responses to the use of the media, whereas the quantitative approach was used to measure improvements in students' motivation and learning outcomes. This is consistent with John W. Creswell's (2014) view that educational research should not only emphasize final outcomes but also seek to understand learning processes in natural contexts.

The research design adopted the action model proposed by Stephen Kemmis and Robin McTaggart (2013), which consists of four stages in each cycle: planning, action, observation, and reflection (Siregar, 2025). The study was conducted in two cycles, preceded by a pre-cycle stage. During the planning stage, the researcher prepared the lesson plan, pop-up book media, observation sheets, learning outcome tests, and motivation questionnaires. The action stage involved implementing the pop-up book media in science learning on the topic of the animal life cycle. Observation was then conducted to examine the implementation of the lesson, teacher and student activities, and students' responses throughout the learning process. The reflection stage was used to evaluate weaknesses in the previous cycle and design improvements for the next cycle.

The study was conducted in the first semester of the 2025/2026 academic year at SDIT Tahfidzul Qur'an Mutiara Insan Sukoharjo. The participants were all 13 students in Class III Abu Bakar As-Siddiq. The participants were selected using purposive sampling because the class exhibited a real problem, namely low motivation and low science learning outcomes, particularly on the topic of animal life cycles. This technique is in line with Sugiyono's (2019) view that purposive sampling is used when researchers make specific considerations regarding the characteristics of the participants. In the context of CAR, all students in the class were included as participants because the study focused on contextual improvement of classroom learning.

The research instruments consisted of a learning outcomes test, a learning motivation questionnaire, observation sheets, interviews, and documentation. The learning outcomes test was used to measure students' mastery of the animal life cycle material at the end of each cycle. The motivation questionnaire was used to determine students' level of motivation after the implementation of the pop-up book media. The observation sheets were used to assess teacher and student activities during the learning process. Interviews were conducted with the classroom teacher to obtain initial information about classroom conditions and responses to the intervention, while documentation was used to strengthen the research data in the form of activity photos, score records, and other learning documents. All instruments were developed based on relevant indicators and were consulted with experts before being used in the instructional intervention. The research instrument blueprint is presented in Table 1 below.

Table 1. Research Instrument Blueprint

Variable	Indicator	Instrument	Data Form
Science learning outcomes	Understanding the concept of the animal life cycle, accuracy in answering, ability to explain the stages of the life cycle	Evaluation test	Test scores
Learning motivation	Persistence in learning, attention to instruction, curiosity, active participation, responsibility	Motivation questionnaire	Questionnaire scores
Teacher activity	Classroom management, use of media, delivery of material, reinforcement	Observation sheet	Observation scores
Student activity	Attention, engagement, courage to ask questions, cooperation, response to the media	Observation sheet	Observation scores
Supporting data	Learning constraints, teacher responses, intervention documentation	Interviews and documentation	Narrative data

Instrument validity was established through content validity using expert judgment. The instruments were consulted with the supervising lecturer and the classroom teacher to assess the relevance of the indicators, the readability of the language, and the alignment of the instruments with the research objectives. Revisions were made based on the validators' feedback before the instruments were used in the learning intervention. Instrument reliability was maintained through consistent use of the indicators, uniform measurement procedures across cycles, and the use of the same observation rubric throughout the study. The observation rubric employed a four-point scale, namely 4 = very good, 3 = good, 2 = fair, and 1 = poor. The rubric was used to assess lesson implementation and student activity in a more systematic and objective manner.

Data collection was carried out through observation, tests, questionnaires, interviews, and documentation. Observation was conducted throughout the learning process to examine the implementation of the intervention and student activity. Tests were administered at the end of each cycle to determine improvements in student learning outcomes. The motivation questionnaire was given after the instructional intervention to measure changes in students' motivation in science learning using the pop-up book media. Interviews were conducted on a limited basis with the classroom teacher to obtain supporting information regarding changes in student behavior and engagement during the intervention. Documentation was used to strengthen the research findings and complement the observational data.

Data analysis was conducted using qualitative and quantitative descriptive methods. Qualitative data were analyzed using the interactive analysis model proposed by Matthew B. Miles, A. Michael Huberman, and Johnny Saldaña (2018), which includes data reduction, data display, and conclusion drawing. Quantitative data were analyzed using descriptive statistics in the form of means, percentages, and mastery levels. The percentage of learning mastery was calculated using the formula:

$$P = \frac{F}{N} \times 100\%$$

where (P) is the mastery percentage, (f) is the number of students who achieved mastery, and (N) is the total number of students.

Meanwhile, the percentage of learning motivation was calculated using the formula:

$$M = \frac{\text{Obatined Score}}{\text{Maximum Score}} \times 100\%$$

The motivation categories were determined based on the following percentage intervals: 81–100% = very high, 61–80% = high, 41–60% = moderate, 21–40% = low, and 0–20% = very low. The analysis was conducted comparatively across cycles to examine changes in students' motivation and learning outcomes after the implementation of the pop-up book media. In addition, improvements in learning outcomes were analyzed by comparing the development of mastery levels and average scores in the pre-cycle, Cycle I, and Cycle II, so that the changes could be observed more systematically.

RESULTS

The results of this study show that the application of pop-up book media in science learning on the topic of animal life cycles had a clear positive impact on the learning process, learning outcomes, and students' learning motivation. Field findings indicated that learning, which initially tended to be passive, gradually became more lively, interactive, and student-centered. In the early stage, students still appeared less focused and were not yet accustomed to learning with visual-interactive media. However, after the intervention was implemented through two cycles, student engagement increased, the classroom atmosphere became more conducive, and academic achievement showed consistent improvement.

Implementation of Learning through Pop-Up Book Media

In general, the implementation of pop-up book media was carried out in accordance with the planned action design. In Cycle I, the teacher began introducing the media as a visual aid for explaining the stages of the animal life cycle. Students showed an initial positive response, but their engagement was still unstable. After reflection on Cycle I, the action was improved in Cycle II through more structured classroom management, greater opportunities for question-and-answer interaction, and more interactive use of the media. As a result, learning in Cycle II was more active, students were more willing to participate, and the teacher was more effective in guiding the flow of learning.

Table 2. Learning Implementation in Each Cycle

Observed Aspect	Cycle I	Cycle II
Teacher activity	61 points; 80.26%	67 points; 88.16%
Student activity	83 points; 39.90%	163 points; 78.37%

The data in the table 2 show a strong increase in the learning process. Teacher activity increased by 7.90 percentage points, while student activity rose sharply by 38.47 percentage points. This increase indicates that pop-up books are not only visually appealing, but also effective in promoting more active and focused learning interactions.

The much greater increase in student activity compared to teacher activity is important because it shows that the core success of the intervention was not merely the teacher's classroom management skills, but the media's ability to shift the center of activity to the students. In other words, the pop-up book helped learning move from a teacher-dominated explanatory model toward a more participatory one.



Figure 1. Changes in Student Activity Across Cycles

In Figure 1, the nearly twofold increase in student activity shows that the pop-up book effectively stimulated students' attention, interaction, and willingness to respond to the lesson. In process terms, this indicates that students were no longer merely physically present, but were genuinely engaged in the learning activity.

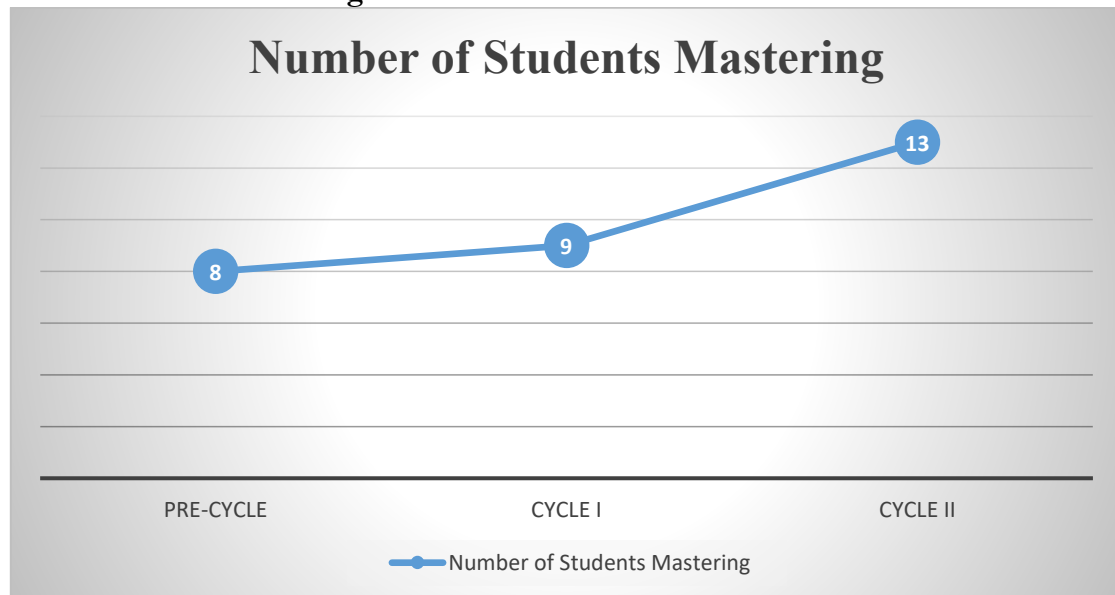
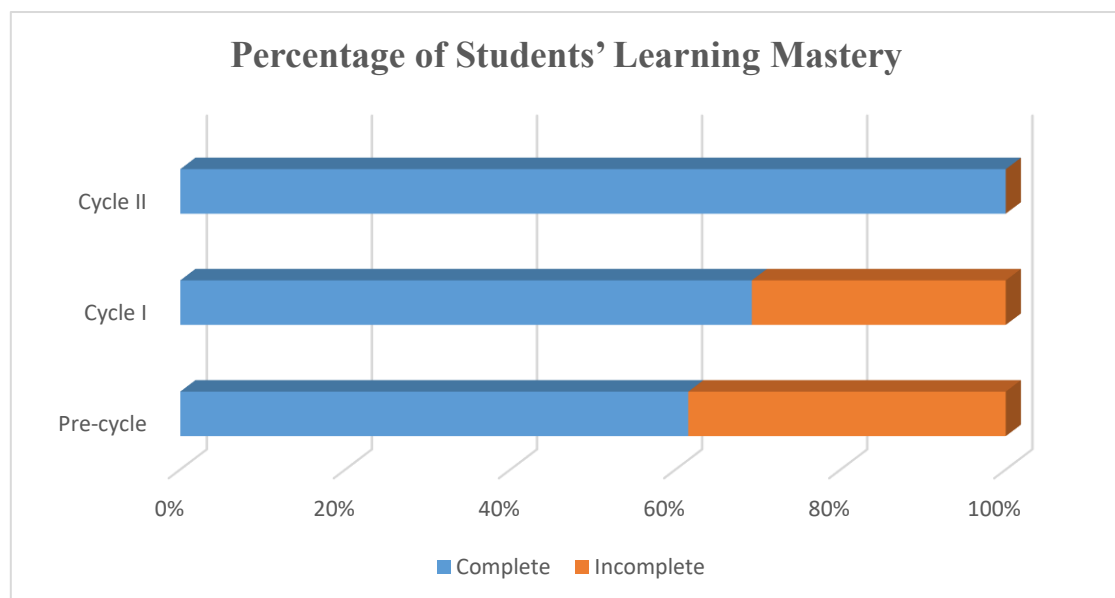
Improvement in Science Learning Outcomes

The most notable change was seen in students' learning outcomes. In the pre-cycle stage, only 8 out of 13 students achieved mastery, or 61.54%, while the remaining 5 students had not yet achieved mastery. After the action in Cycle I, the number of students who achieved mastery increased to 9, or 69.23%, although the improvement was not yet optimal. In Cycle II, all students achieved learning mastery, namely 13 students or 100%. The average learning outcome also increased from 72.38 in Cycle I to 87.69 in Cycle II. These findings show that pop-up book media made a real contribution to strengthening students' conceptual understanding of the animal life cycle material. These findings are summarized in Table 2 below.

Table 2. Development of Student Learning Outcomes

Stage	Number of Students Mastering	Mastery Percentage	Average Score
Pre-cycle	8	61.54%	69.62%
Cycle I	9	69.23%	72.38
Cycle II	13	100.00%	87.69

Table 2 is illustrated in Figure 2 below.

**Figure 2. Diagram of the Development in the Number of Students Achieving Mastery****Figure 3. Percentage of Students' Learning Mastery**

Viewed as a trend in figure 3, the increase from Cycle I to Cycle II reached 30.77 percentage points in learning mastery and 15.31 points in average score. Pedagogically, this increase indicates that concrete visualization through the pop-up book helped students

understand the sequence of the animal life cycle more comprehensively, so that their answers on the evaluation became more accurate and more evenly distributed across students.

Improvement in Learning Motivation

The questionnaire results show that students' learning motivation after the use of pop-up book media was in the very high category. Of the 13 students, the total questionnaire score reached 569, with an average score of 43.77 and a percentage of 87.54%. This figure falls within the 81%–100% range, and is therefore interpreted as very high. These findings reinforce that pop-up book media is effective not only in the cognitive domain, but also in the affective domain, especially in terms of interest, enthusiasm, curiosity, and willingness to engage in learning. students' learning motivation results show in table 3.

Table 3. Students' Learning Motivation Results

Indicator	Value
Number of students	13
Total questionnaire score	569
Average score	43.77
Motivation percentage	87.54%
Category	Very high

Substantively, the high motivation score was consistent with classroom observations during the intervention. Students appeared more enthusiastic when opening the pop-up pages, more focused when the teacher explained the material, and more active in responding to questions. In other words, the media was not merely a visual aid, but a learning stimulus that succeeded in transforming the classroom atmosphere into one that was more meaningful and enjoyable.

Analysis by Motivation Indicator

The motivation instrument in this study included the indicators of persistence in learning, attention to instruction, curiosity, active participation, and responsibility. Although the thesis did not present separate scores for each indicator, observational findings showed that all of these indicators improved after the pop-up book media was applied.

Table 4. Qualitative Analysis of Motivation Indicators

Indicator	Field Findings	Meaning of the Change
Persistence in learning	Students were more willing to stay engaged until the lesson ended	The learning process was not easily abandoned
Attention to instruction	Students were more focused when the pop-up pages were opened	The media successfully maintained attention
Curiosity	Students seemed curious about the next page	There was an impulse for learning exploration
Active participation	Students more often answered and responded to the teacher's questions	Classroom interaction increased
Responsibility	Students took tasks and notes more seriously	Learning awareness improved

In Table 4, this analysis shows that learning motivation was reflected not only in questionnaire scores, but also in classroom behavior. Students were no longer simply following the lesson; instead, they began to show more consistent persistence, attention, and active engagement. This is important because positive changes in motivation are usually reflected in the quality of student involvement during learning.

Cycle Reflection

Cycle reflection became an important part of explaining why the improvement occurred. In Cycle I, the pop-up book media already provided initial appeal, but student participation was still unstable. Some students were still waiting for the teacher's instructions, and classroom interaction had not yet become evenly distributed. This condition shows that attractive media alone is not enough; teachers need to provide more structured guidance, clearer prompting questions, and greater opportunities for interaction.

After reflecting on Cycle I, the actions in Cycle II were improved through more focused classroom management and more active interaction. These changes had a direct impact on increasing student activity, learning mastery, and learning motivation. In other words, the success of Cycle II was not merely the result of using the same media, but rather the result of refining the learning strategy based on the reflection from the previous cycle. This demonstrates that CAR works dynamically: the problems that emerged in Cycle I became the basis for improvement in the next cycle.

DISCUSSION

Result Analysis

The findings of this study indicate that the implementation of pop-up book media in science learning on the topic of animal life cycles was effective not merely because the media was visually appealing, but because it helped students process information in a more structured manner. Within the framework of the Cognitive Theory of Multimedia Learning (CTML), multimedia learning occurs through two primary channels—visual and verbal—with limited working memory capacity, requiring learners to actively select, organize, and integrate information in order to construct coherent mental representations (Mayer, 2024). The findings revealed that student activity increased from 39.90% in Cycle I to 78.37% in Cycle II, while learning mastery reached 100%. These results suggest that the pop-up book media helped students focus on relevant information, understand conceptual sequences systematically, and connect new knowledge with prior understanding. Thus, the effectiveness of the media should be understood not simply as a result of visual attractiveness, but as its ability to reduce cognitive load and strengthen students' conceptual schema formation.

This explanation becomes even more relevant when linked to the procedural and sequential nature of the animal life cycle topic. Such material requires students to understand relationships between stages in a systematic order, making three-dimensional visual media particularly useful for simplifying complex mental processes. According to dual coding theory, verbal and visual information processed simultaneously produces stronger memory representations than verbal presentation alone (Clark & Paivio, 1991). Consequently, when students observed life cycle stages through concrete and dynamic visual forms, they did not merely memorize sequences of change, but developed more stable conceptual understanding. These findings are consistent with Rexigel et al. (2024), who demonstrated that the use of multiple visual representations in STEM education enhances conceptual understanding and memory retention by helping students establish connections between concepts. Therefore, the improvement in learning outcomes observed in this study can be explained through deeper cognitive mechanisms involving the integration of visual and verbal representations in the learning process.

From a constructivist perspective, pop-up book media was also effective because it enabled students to construct understanding through concrete and meaningful learning

experiences. Constructivist theory emphasizes that knowledge is not simply transmitted from teacher to student; rather, it is actively built through interaction between new experiences and learners' prior knowledge structures. In this study, students did not merely listen to the teacher's explanations; they also observed, opened, and explored each section of the media directly. These activities promoted higher levels of mental engagement compared with conventional lecture-based instruction. This finding aligns with the study by Cetin-Dindar (2015), which found that constructivist learning environments can enhance intrinsic motivation, self-confidence, and student engagement in science learning. Thus, the pop-up book functioned effectively because it provided opportunities for students to construct meaning through more authentic visual and interactive experiences.

The effectiveness of this media was also closely related to the cognitive developmental characteristics of elementary school students, particularly third-grade students who are at the concrete operational stage. At this stage, learners tend to understand information more easily when it is concrete, visual, and directly observable rather than abstract and verbally explained. Therefore, pop-up book media was highly relevant because it translated procedural concepts into concrete and comprehensible learning experiences. Mayer (2024) further argues that effective multimedia design must consider the limited capacity of students' working memory to avoid cognitive overload. In this study, the use of raised images, colors, and simplified visual sequences helped students maintain attention throughout the learning process. This was reflected in increased student participation in answering questions, asking questions, and completing tasks more actively compared with conditions prior to the intervention.

From the perspective of learning motivation, the findings showed that students' motivation was categorized as very high, with a percentage score of 87.54%. These results demonstrate that pop-up book media influenced not only the cognitive domain, but also students' affective domain. Motivation theory suggests that engaging, challenging, and positive learning environments can strengthen students' intrinsic motivation to participate in learning activities. During the intervention, students appeared more enthusiastic when opening the media pages, more curious about subsequent illustrations, and more active in responding to the teacher's questions. These behaviors indicate that the interactive and surprising visual elements of the pop-up book stimulated curiosity and emotional engagement. The findings are consistent with Nongko et al. (2025) and Nurcahayani et al. (2025), who found that learning motivation is positively associated with student

engagement and academic achievement. Moreover, Rayan & Watted (2024) emphasized that interactive and enjoyable learning environments can improve active participation and the quality of elementary students' learning processes. Accordingly, the improvement in learning outcomes observed in this study cannot be separated from the increase in students' intrinsic motivation throughout the instructional process.

The findings also demonstrate that the effectiveness of instructional media is strongly influenced by the alignment among media characteristics, subject matter characteristics, and learner characteristics. Pop-up book media proved particularly effective for the topic of animal life cycles because the material required understanding concrete and sequential stages. In addition, third-grade elementary students still rely heavily on visual support to maintain focus and comprehend new concepts. Therefore, the effectiveness of the media cannot be separated from the context in which it was applied. These findings extend previous research that generally reported improvements in learning outcomes without explaining the pedagogical mechanisms underlying such improvements. Consequently, the primary contribution of this study lies in its explanation that three-dimensional visual media works effectively because it reduces cognitive load, strengthens mental representation, promotes constructive learning experiences, and simultaneously enhances students' intrinsic motivation.

The findings of this study are consistent with those of Arip & Aswat (2021), who reported that pop-up book media could improve elementary students' science learning outcomes. The most notable similarity lies in the role of the media as a visual aid that helps students understand material more concretely. However, the present study differs in that it not only examined learning outcomes, but also captured changes in learning motivation as an essential component of the learning process. Thus, this study expands empirical evidence that the effectiveness of pop-up books extends beyond the cognitive domain and also encompasses the affective domain, which plays a critical role in sustaining student learning.

The findings are also consistent with those reported by Sumayana et al. (2021) as well as Nahari et al. (2023), who found that pop-up books can simultaneously improve students' motivation and learning outcomes. These similarities indicate that the characteristics of pop-up book media are particularly relevant for elementary-level learning, which requires visual elements, sequential clarity, and active student engagement.

Nevertheless, this study focused specifically on third-grade science learning on the topic of animal life cycles, making its context narrower yet more in-depth. This contextual distinction is important because it demonstrates that media effectiveness is strongly influenced by the compatibility between media characteristics, subject matter, and learner characteristics.

This study also differs from studies such as Alman & Nugrahaeni (2022) and Situmorang et al. (2025), which focused primarily on learning outcomes without directly linking them to learning motivation. This distinction suggests that the present study offers a more comprehensive contribution by examining two important outcomes simultaneously: motivation and learning achievement. In educational practice, these two aspects are inseparable; high motivation tends to foster active learning engagement, which in turn contributes to academic achievement. Therefore, this study reinforces the view that effective instructional media should not only “help explain” material, but also “stimulate the desire to learn.”

Research Implications

This study provides theoretical, empirical, and practical implications for the development of elementary science education. Theoretically, the findings reinforce the Cognitive Theory of Multimedia Learning (Mayer, 2024), which posits that learning becomes more effective when information is presented through integrated visual and verbal representations that help students organize and integrate information meaningfully. In this study, pop-up book media functioned not only as a visual aid, but also as a cognitive tool that helped students construct mental representations of the procedural and sequential concepts involved in animal life cycles. The increase in student activity from 39.90% to 78.37%, along with the improvement in learning mastery to 100%, indicates that three-dimensional visualization helped reduce students' cognitive load and facilitated more systematic conceptual understanding. Consequently, this study extends the application of multimedia learning theory within the context of elementary science education, particularly for students at the concrete operational stage.

The study also reinforces dual coding theory, which explains that integrating visual and verbal information results in stronger information processing than verbal presentation alone (Clark & Paivio, 1991). In this context, the raised images, colors, and visual sequences in the pop-up book helped students connect the teacher's explanations with

concrete representations that were easier to understand. This explains why students not only demonstrated improved learning outcomes, but also showed behavioral changes such as increased attention, curiosity, and active participation during instruction. Therefore, the study confirms that the effectiveness of three-dimensional visual media lies in its ability to strengthen information-processing mechanisms and create more meaningful learning experiences.

Empirically, this study expands evidence regarding the effectiveness of pop-up book media in elementary science learning. Unlike previous studies that primarily emphasized learning outcomes, this study demonstrates that improvements in learning motivation and learning achievement can occur simultaneously when media are designed in accordance with the characteristics of the material and students' developmental stages. The finding that students' learning motivation reached 87.54%, categorized as very high, indicates that interactive visual media supports not only cognitive development but also emotional engagement and intrinsic motivation. This empirical contribution is important because it demonstrates that successful elementary science learning is determined not only by students' ability to understand concepts, but also by the quality of the learning experiences they encounter throughout the instructional process.

Practically, this study demonstrates that effective instructional innovation does not always depend on complex digital technology. Pop-up books, as simple, affordable, and easily developed media, proved capable of creating more active, engaging, and participatory learning environments. These findings provide important implications for elementary school teachers, suggesting that contextualized instructional media aligned with students' characteristics can produce significant pedagogical impact. In science learning, three-dimensional visual media such as pop-up books can serve as a strategic alternative for helping students understand abstract and procedural concepts more concretely. Therefore, this study not only provides evidence of media effectiveness, but also offers a practical instructional model that can be replicated and adapted by teachers across different topics and educational levels.

Research Limitations

Although this study demonstrates that the implementation of pop-up book media significantly improved students' motivation and learning outcomes, the findings should be interpreted proportionally in light of several methodological and contextual limitations.

First, this study employed a Classroom Action Research (CAR) design focused on improving instructional practice within a specific classroom context; therefore, the findings are better understood as contextual rather than universally generalizable. The relatively small number of participants—13 students from a single class in one school—also limits the broader applicability of the findings to more diverse elementary school contexts. Consequently, further investigation is needed to determine the effectiveness of pop-up book media across different student characteristics, school environments, and instructional materials.

Second, the observational process in this study relied heavily on the researcher and the classroom teacher as implementers of the intervention, making some degree of subjectivity in assessing student activity and instructional implementation unavoidable. Although observation sheets and scoring rubrics were used to maintain consistency, interpretations of students' classroom behavior still carried the possibility of observational bias. Furthermore, the teacher's involvement as part of the intervention process may have produced a teacher expectancy effect, in which students responded more positively because they were aware of receiving special attention, a new instructional approach, or heightened teacher enthusiasm regarding the media being used. Therefore, the increase in students' activity and motivation cannot be entirely separated from the social interaction dynamics occurring during the intervention.

Third, the increase in students' motivation and engagement may also have been influenced by a novelty effect, namely students' initial attraction to the use of a new instructional medium different from their usual classroom experience. The pop-up book possessed visually appealing three-dimensional characteristics and had rarely been used previously in science instruction within the class, making it likely that students' early enthusiasm was partially driven by the novelty of the medium itself. As a result, this study cannot yet determine whether students' motivation and engagement would remain stable if the media were implemented over a longer and repeated period of time.

Finally, the study was conducted over a relatively limited duration, consisting of only two action cycles focused on a single instructional topic. Consequently, the observed effects of the pop-up book media remain short-term in nature. The study did not examine the sustainability of the media's influence on concept retention, consistency of learning motivation, or transfer of understanding to other science topics. In addition, inferential

statistical analyses and effect size measurements were not employed, meaning that the reported improvements remain primarily descriptive and comparative across cycles. Therefore, future studies are recommended to employ longer research durations, involve larger samples, and apply experimental or mixed-methods designs to provide a more comprehensive understanding of the effectiveness of pop-up book media in elementary science education.

CONCLUSION

This study demonstrates that the implementation of pop-up book media in science learning on the topic of animal life cycles effectively improved the motivation and learning outcomes of third-grade elementary school students. The findings indicate that the use of three-dimensional visual media not only enhanced academic achievement, but also transformed the overall quality of the learning process. Student activity increased significantly from 39.90% in Cycle I to 78.37% in Cycle II, while learning mastery improved from 61.54% in the pre-cycle stage to 100% in Cycle II. In addition, students' learning motivation was categorized as very high, reaching 87.54%. These findings suggest that pop-up books were effective in fostering students' attention, curiosity, active participation, and emotional engagement throughout the learning process. Therefore, this study confirms that instructional media designed to be visual, concrete, and interactive can serve as an effective means of improving the quality of elementary science education.

Conceptually, the findings reinforce the Cognitive Theory of Multimedia Learning and dual coding theory, both of which explain that learning becomes more effective when information is presented through the integration of visual and verbal elements that support the construction of students' mental representations. In the context of this study, pop-up book media helped students understand the procedural concept of animal life cycles through concrete visualization and systematic sequencing, enabling them not merely to memorize information but to develop more stable conceptual understanding. The findings also support the constructivist perspective that students build knowledge through meaningful and interactive learning experiences. Accordingly, the theoretical contribution of this study lies in its explanation of the pedagogical mechanisms through which three-dimensional visual media reduce cognitive load, enhance intrinsic motivation, and simultaneously strengthen student engagement in learning.

Empirically, this study extends existing evidence regarding the effectiveness of pop-up book media in elementary science education, particularly among third-grade students learning about animal life cycles, a topic that requires sequential conceptual understanding. Unlike previous studies that primarily focused on learning outcomes, this study demonstrates that improvements in academic achievement occurred simultaneously with increases in learning motivation and student activity. These findings emphasize that successful science learning is determined not only by students' conceptual understanding, but also by the quality of the learning experiences they encounter throughout the instructional process. Practically, the study shows that simple, inexpensive, and easily developed media such as pop-up books can generate significant pedagogical impact without relying on sophisticated digital technology. Therefore, the study offers important implications for elementary school teachers seeking to develop more contextual, interactive, and developmentally appropriate learning environments that align with students' cognitive characteristics.

Nevertheless, the findings should be interpreted within certain limitations. The study was conducted in a single classroom with a relatively small number of participants and within a limited intervention period consisting of only two cycles; therefore, caution is needed when generalizing the findings to broader contexts. In addition, potential observational bias, the teacher's involvement as the intervention implementer, and the possibility of a novelty effect associated with the use of new instructional media may also have influenced the results. Accordingly, future research is recommended to employ longer study durations, involve larger and more diverse samples, and apply experimental or mixed-methods designs to examine the effectiveness of pop-up book media more comprehensively. Further studies may also explore the use of three-dimensional visual media in other science topics or integrate such media with digital technology to enrich students' learning experiences. In this way, the development of visual-interactive instructional media is expected not merely to become a temporary pedagogical innovation, but rather to contribute to a more meaningful, participatory, and student-centered transformation of elementary science education.

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