

Pop-Up Book as a Science Learning Media to Improve Visualization Abilities and Understanding of Science Concepts in SDN Pandanrejo II

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Abstract

Science concepts are often abstract and difficult to understand through conventional teaching methods. Therefore, a more interactive and concrete approach is necessary. Students frequently struggle to imagine or visualize invisible processes, which can lead to misconceptions or difficulty in grasping the material. The pop-up book, as a learning medium designed to accommodate students' characteristics and cognitive needs, can serve as a bridge between abstract concepts and concrete experiences. With its three-dimensional elements that appear as the pages are opened, the pop-up book is expected to enhance visual understanding of complex natural phenomena, such as the water cycle, photosynthesis, and the circulatory system. This study is relevant as it aims to systematically examine how the use of pop-up books can improve visualization abilities and understanding of science concepts among elementary school students. The research used a qualitative approach with a descriptive design, involving 23 third-grade students of SDN Pandanrejo II and a teacher as the research subjects. Data were collected through interviews, observations, and documentation analysis to gain an in-depth understanding of students' and teachers' experiences in using pop-up books during the learning process. The results show that 80–92% of students reported improvement in learning science through pop-up books. Around 80% of students felt engaged and interested, and found it easier to visualize and remember abstract concepts. Additionally, 85% showed better understanding of difficult concepts and became more active in discussions. About 78% showed improved critical thinking skills, and 82% felt learning became more student-centered. Thus, using pop-up books in science learning proved effective in enhancing students' ability to visualize abstract and complex scientific concepts.

Keywords: Pop-Up Books; Learning Media; Visualization; Understanding Concepts

Abstrak

Konsep-konsep IPA, yang sering kali bersifat abstrak dan sulit dipahami dengan metode pembelajaran konvensional, memerlukan pendekatan yang lebih interaktif dan konkret. Sebab siswa tidak mampu membayangkan atau memvisualisasikan proses-proses yang tidak kasat mata, sehingga berpotensi menimbulkan miskonsepsi atau kesulitan memahami materi. Pop-up book sebagai media pembelajaran yang dirancang dengan mempertimbangkan karakteristik dan kebutuhan kognitif siswa dapat menjadi jembatan antara konsep abstrak dengan pengalaman konkret. Dengan adanya elemen tiga dimensi yang muncul saat halaman dibuka, diharapkan dapat menjadi media yang mendukung pemahaman visual terhadap fenomena alam yang rumit, seperti siklus air, fotosintesis, dan peredaran darah. Penelitian ini relevan karena bertujuan untuk mengkaji secara sistematis bagaimana penggunaan pop-up book dapat meningkatkan kemampuan visualisasi dan pemahaman konsep IPA pada siswa SD. Sehingga metode yang digunakan adalah pendekatan kualitatif dengan desain deskriptif, melibatkan 23 siswa kelas 3 SDN Pandanrejo II dan guru sebagai subjek penelitian. Data dikumpulkan

melalui wawancara, observasi, dan analisis dokumentasi untuk memperoleh gambaran yang mendalam tentang pengalaman siswa dan guru dalam menggunakan pop-up book selama proses pembelajaran. Hasil penelitian menunjukkan bahwa, Sebanyak 80–92% siswa melaporkan peningkatan dalam pembelajaran IPA dengan penggunaan pop-up book. Sekitar 80% siswa merasa terlibat dan tertarik, serta lebih mudah memvisualisasikan dan mengingat konsep abstrak. Sebanyak 85% siswa mengalami peningkatan pemahaman konsep sulit dan menjadi lebih aktif dalam diskusi. Selain itu, 78% menunjukkan peningkatan keterampilan berpikir kritis, dan 82% merasa pembelajaran menjadi lebih berpusat pada siswa. Sehingga penggunaan pop-up book dalam pembelajaran IPA terbukti efektif dalam meningkatkan kemampuan visualisasi siswa mengenai konsep-konsep sains yang abstrak dan kompleks.

Kata Kunci: *Pop-Up Book; Media Pembelajaran IPA; Visualisasi; Pemahaman Konsep*

Introduction

Natural Science (IPA) learning in elementary schools has a very important role in forming a foundation of authentic scientific knowledge for students. At this stage, children are in a period of very rapid cognitive development, and are in the concrete operational phase according to Jean Piaget's cognitive development theory. At this phase, children begin to be able to understand logical concepts, but still need support from real objects or events that can be observed directly to truly understand a concept (Kusmiati et al., 2024).

Therefore, science learning is an effective way to introduce scientific thinking from an early age, such as the ability to observe, classify, make predictions, and draw conclusions based on evidence. The concepts introduced, such as changes in the form of objects, the life cycle of living things, and natural phenomena, are part of basic science literacy which will be an important foundation for the learning process at the next level of education. However, although science learning is important, there are challenges in delivering it, especially those related to abstract concepts that are difficult to understand only through verbal explanations or two-dimensional images.

In grade 3 of elementary school, for example, students begin to be introduced to topics that cannot always be observed directly, such as the process of water evaporation in the water cycle, plant growth, or the movement of planets in the solar system are complex phenomena and often cannot be observed directly by students in class. Concepts like these are difficult for students to understand because students' formal thinking skills have not developed optimally. Students are often unable to imagine or visualize invisible processes, which has the potential to cause misconceptions or difficulty understanding the material.

The mismatch between the method of delivering the material and the stage of students' cognitive development can hinder understanding and reduce interest in learning science (Zuhaida and Yustiana, 2023). In this context, the use of learning media becomes very crucial. Learning media designed by considering the characteristics and cognitive needs of students can be a bridge between abstract concepts and concrete experiences. One media that has great potential is a pop-up book. The function of a pop-up book is not only limited to presenting visualizations, but also creating a more interactive learning experience. This book encourages students' physical involvement, because students must open, pull, or move certain parts to see the visual effects.

This kind of interaction is very appropriate for the learning characteristics of elementary school children who tend to have visual and kinesthetic learning styles

(Darmawan et al., 2024). Pop-up books are a form of learning media that has great potential in supporting the educational process, especially at the elementary school level. Pop-up books are defined as books equipped with three-dimensional elements that can appear or move when the pages are opened. These elements are usually designed to present objects or events visually and dynamically, so that they not only function as reading material, but also as attractive visual aids (Mulyati and Winarni, 2023).

In the context of learning, especially science learning, pop-up books provide an alternative presentation of material that is much more concrete and enjoyable compared to conventional textbooks. The advantage of pop-up books in learning lies in their ability to convey information in an interesting, interactive way, and in accordance with students' cognitive development. Its visual and three-dimensional nature allows children to understand science concepts more concretely, which is in accordance with the concrete operational thinking development stage according to Piaget (Lestari et al., 2023).

In addition, the combination of text and visuals in pop-up books facilitates information processing through two different pathways in the brain, namely the verbal and visual pathways. This increases the likelihood of the information being stored in long-term memory. Pop-up books can also reduce students' cognitive load because the presentation of information in an attractive visual form is easier to process than complex verbal explanations. In addition, pop-up books also encourage the creation of a fun and non-boring learning atmosphere. This atmosphere is very important in children's learning, because motivation and positive emotions play a major role in supporting successful learning (Arum and Hanif, 2025).

When students feel interested and happy with the material presented, students will find it easier to focus and be open to the learning process. Thus, pop-up books are not only visual aids, but also pedagogical strategies that can create a conducive and fun learning environment. Thus, pop-up books have great potential in supporting science learning in elementary schools. With its ability to present abstract concepts visually and concretely, increase student engagement and interest in learning, and provide an interactive and enjoyable learning experience, this media is very suitable to be integrated into the learning process.

The development and use of appropriate pop-up books will be an innovative step in answering the challenges of science learning that are still faced by many students at the elementary school level. Pop-up books are one of the media that have great potential to answer these challenges. With its characteristics that combine text, images, and three-dimensional elements that can move or appear when the page is opened, pop-up books are able to provide a more concrete and meaningful learning experience (Norhayati et al., 2023).

These interactive visual elements are very appropriate for the learning characteristics of elementary school students, especially students who are at the concrete operational stage, where understanding concepts is easier to achieve through direct experience and visualization (Wardani, 2023). Thus, the presence of pop-up books in learning is expected to be able to help students form mental representations of science material that has been difficult for students to understand, such as the process of changing the shape of objects, the movement of objects, or the life cycle of living things.

The relevance of this research is closely related to the demands of today's education world which prioritizes active, enjoyable learning, and is able to accommodate various student learning styles. In the current era of educational transformation, learning methods and media are increasingly needed that are not only informative, but also interactive and able to stimulate direct student involvement in the learning process (Hasnawiyah and Maslena, 2024). Especially in learning Natural Sciences (IPA) in

elementary schools, there are many challenges in delivering material, especially abstract concepts that are difficult for students to understand. This is the main background for the importance of innovation in delivering material, one of which is through the development of visual and manipulative-based learning media, such as pop-up books.

This study is relevant because it aims to systematically examine how the use of pop-up books can improve students' visualization skills and understanding of science concepts, especially in grade 3 elementary school students. The selection of grade 3 as the subject of the study is also very appropriate, because at this level students begin to be introduced to more complex concepts and require more creative learning strategies. Through this study, it is expected that empirical data can be obtained regarding the effectiveness of pop-up books as a learning medium, both in terms of improving conceptual understanding and in terms of student involvement and enthusiasm during the learning process.

In addition, the results of this study can provide real contributions in the development of more innovative and responsive learning models to the learning needs of students in the 21st century. Pop-up books are not only expected as learning aids, but can also be developed as learning media integrated with the scientific approach and applicable curriculum. With empirical evidence supporting the effectiveness of this media, teachers can have new alternatives to deliver science materials more interestingly and effectively, as well as provide a fun learning experience for students. Therefore, this research is very relevant and important to be conducted, considering that there are still many challenges in science learning at elementary school level.

By using pop-up books as research objects, it is expected that the right strategy will be found in designing and implementing learning media that can improve the quality of education, especially in terms of understanding science concepts from an early age. The purpose of this study was to analyze the effect of using pop-up books as a learning medium on improving visualization skills and understanding of science concepts in grade 3 elementary school students. This study focuses on how pop-up book media with interactive three-dimensional visual elements can help students understand science concepts that are abstract and difficult to observe directly. In addition, this study also aims to explore the extent to which pop-up books can increase student engagement in the learning process, as well as strengthen students' understanding of science materials through more concrete and enjoyable learning experiences.

Method

This study uses a descriptive qualitative approach that aims to explore in depth how the use of pop-up books as learning media affects the visualization abilities and understanding of science concepts of grade 3 elementary school students. This approach was chosen because it is able to provide a complete picture of students' learning experiences and teachers' perceptions of the use of visual and interactive learning media. Through this approach, researchers seek to understand the learning process contextually, based on the perspective of the research subject.

The determination of the subjects was done purposively by considering direct involvement in the learning process using Pop-Up Book media, namely 23 3rd grade elementary school students and science teachers at SDN Pandanrejo II who have used interactive media-based learning approaches, including pop-up books. This location was chosen selectively based on the availability of facilities, openness to learning innovation, and the readiness of teachers and students in implementing visual media-based learning. The research instruments used include interview guidelines, observation sheets, and documentation. In addition, the data collection techniques used are, First, In-depth

interviews were conducted with students and teachers. Interviews with students aimed to find out how students understand science material after using pop-up books, and how this media helps students visualize science concepts.

Meanwhile, interviews with teachers aimed to obtain views on the effectiveness, benefits, and challenges faced during learning. Second, Observations were conducted directly during the learning process to observe student engagement, student interaction with media, and student responses to the delivery of material using pop-up books. These observations helped researchers capture the actual dynamics of the class. Third, Documentation in the form of field notes, student work results, and images produced during learning are used as visual and written evidence of students' understanding of the science material being studied.

Through a combination of these approaches and instruments, it can be analyzed using qualitative data analysis techniques that include data reduction, data presentation, and drawing conclusions to describe the effectiveness of using Pop-Up Books in science learning. This provides a comprehensive picture of the effectiveness of using pop-up books in improving students' understanding and visualization abilities of science concepts in elementary schools.

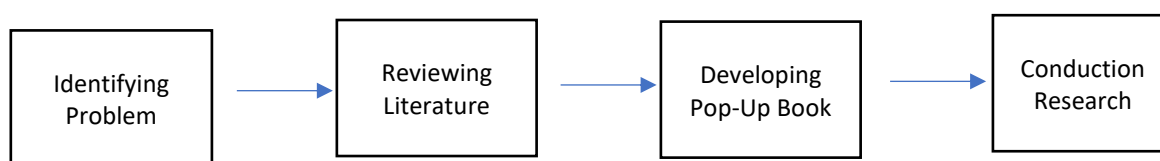


Figure 1. Research Design Steps

Result and Discussion

1. The Effect of Pop-Up Books on Visualization Ability

Based on data obtained from observations and interviews with students, 80% of students experienced an increase in their ability to visualize abstract science concepts, such as photosynthesis, the water cycle, and changes in the shape of objects after using pop-up books as learning media. Students reported that the three-dimensional elements in pop-up books helped students to better understand the sequence and processes involved in natural phenomena. The use of three-dimensional elements in pop-up books provides a more interactive learning experience.

As many as 80% of students reported that they felt more involved in the learning process when using pop-up books compared to traditional methods. Based on their experience, students felt that pop-up books helped them visualize science concepts such as photosynthesis and the water cycle more clearly through three-dimensional images. Students said that learning became more interactive because they could open, touch, and explore the contents of the book directly. In addition, students found it easier to understand and remember the material because they interacted visually with interesting and moving images.

Students who are able to visualize science concepts have the ability to transform abstract ideas into more tangible and easily understood forms. Visualization in pop-up books helps students capture the essence of a concept in a more concrete way, so that understanding is not only limited to theory, but also deeper and more comprehensive (Resta and Kodri, 2023). With this ability, students can see the relationship between concepts and scientific processes more clearly, which ultimately improves their memory and analytical skills.

Visualization is also an important means of developing imagination and creativity in learning science, so that students are able to connect the knowledge gained with real-

world situations. Interactive learning places students as active participants in the learning process. In this learning model, students not only receive information passively, but are also encouraged to participate, ask questions, discuss, and explore the material directly. This approach allows students to develop critical thinking and problem-solving skills better, because they are actively involved in exploring and understanding the lesson material (Subarjo et al., 2024).

The interactions that occur between students and teachers and between students themselves create a dynamic and motivating learning atmosphere, so that the learning process becomes more meaningful and effective. Visual interaction using popup books also plays an important role in supporting the learning process. The use of visual media such as images, diagrams, and animations allows students to absorb information more quickly and easily. Through visual interaction, students can recognize patterns and relationships between various concepts more intuitively. Visual media also provides space for students to express their ideas and understanding in varied and creative ways, thus helping to strengthen mastery of the material (Wulandari et al., 2025).

In addition, learning accompanied by visual elements tends to make students more focused and enthusiastic, thereby improving the quality and effectiveness of learning as a whole. These three aspects the ability to visualize science concepts, learn interactively, and interact visually play a synergistic role in creating a comprehensive and meaningful learning experience. By developing these three abilities, students not only gain knowledge, but are also able to apply and develop critical and creative understanding in various contexts. This is very important to form a generation that is ready to face future challenges with a more analytical and innovative way of thinking.

2. The Influence of Pop-Up Books on Understanding Science Concepts

During the science learning process using pop-up books, it was seen that most students showed an increase in understanding of concepts that were previously considered abstract, such as the water cycle, photosynthesis, and blood circulation. This can be seen from how students found it easier to re-explain these processes after studying the material through three-dimensional visualization in pop-up books. The classroom atmosphere became more lively and interesting because as many as 90% of students seemed more enthusiastic and actively participated in learning, with many asking questions and discussing the material being studied.

This interaction shows that the interactive elements of the pop-up book have succeeded in increasing student engagement significantly. In addition, around 80% of students were seen to be very engaged in learning, not only passively receiving information, but also actively participating in exploring the material. Students' critical thinking skills also increased, with 78% of students able to connect cause and effect in the various scientific processes they learned. Students feel they understand the learning material better, indicating an effective cognitive process in internalizing and assimilating scientific concepts presented through pop-up books.

This deep understanding is the result of a knowledge construction process in which students do not simply memorize information mechanically, but are also able to integrate new knowledge with pre-existing mental schemes (Nurusiah et al., 2024). This allows them to build meaningful and applicable meanings from the material being studied. With a strong understanding, students can transfer knowledge to other contexts and develop problem-solving skills more optimally. Therefore, student understanding is an important indicator in assessing the success of the learning process that is oriented towards the development of cognitive competence as a whole. In addition, students' activeness in the learning process is a manifestation of their active involvement in the

construction of knowledge. This activeness includes various forms of participation, such as asking questions, discussing, expressing opinions, and exploring and reflecting on learning materials through pop-up book media.

Within the framework of constructivist and humanistic learning, this active involvement is considered a crucial factor that facilitates the development of deep understanding and high-level thinking skills (Afkarina and Hazawawi, 2025). These intensive learning activities allow students to internalize concepts critically and creatively, while developing a positive attitude towards the learning process itself. Thus, student activeness contributes to increasing intrinsic motivation that encourages the sustainability of the learning process independently and sustainably.

Student engagement in learning through pop-up book media also includes emotional, cognitive, and social dimensions that are integral to the process of acquiring knowledge. Emotional engagement is related to a high sense of enthusiasm and interest in the subject matter, while cognitive engagement reflects the focus of attention and mental effort in understanding the learning content (Salsabila et al., 2025). The social dimension includes interactions with teachers and peers that support collaborative learning.

These three dimensions play a synergistic role in creating a conducive learning atmosphere, where students are able to optimize their mental and emotional resources to achieve maximum learning outcomes. This high engagement also has implications for increasing learning resilience, the ability to complete tasks, and success in achieving predetermined learning objectives. So that the ability to think critically through pop-up book media in science learning is one of the high-level cognitive competencies that are very much needed in the world of modern education. Critical thinking involves the ability to analyze in-depth, evaluate evidence and arguments, and synthesize information systematically and logically.

Students who are able to think critically not only receive information passively, but are also able to assess the validity and relevance of information objectively, identify assumptions, and formulate conclusions based on strong reasons (Robbani, 2025). The development of these critical thinking skills is very important in equipping students to face complex challenges in various fields, as well as forming individuals who are rational, independent, and adaptive to change. Therefore, an effective learning process must be designed in such a way as to be able to stimulate students' critical thinking skills through an approach that involves problem solving, critical discussion, and deep reflection.

Therefore, a better sense of understanding, activeness in learning, comprehensive involvement in the learning process, and critical thinking skills are key aspects that are interrelated and support the achievement of quality education goals. By developing these four aspects, students not only master the subject matter in theory, but are also able to apply knowledge and skills creatively and critically in real-life contexts. This is an important foundation in forming a generation of learners who are ready to face global dynamics and challenges competently and highly competitively.

3. Student Engagement In Learning

The results showed that the use of pop-up books increased student engagement in learning. Around 85% of students were more active in discussions and presentations of materials, and showed improved speaking and collaboration skills. In addition, 82% of students felt that learning was more student-centered, providing opportunities to explore materials independently. Overall, 80% of students felt more interested and involved in science learning with this method. Students' interest in science learning through pop-up book media is an important indicator in improving the quality and effectiveness of the

learning process. This intrinsically growing interest shows that students experience emotional and cognitive connectedness with the material being studied, so that they are encouraged to be more active in seeking and understanding information in depth (Nurjanah and Alani, 2025).

High interest through pop-up books not only increases learning motivation but also strengthens students' commitment to following the learning process consistently and enthusiastically. In the context of educational psychology, a strong interest in learning acts as the main driver in directing students' attention, energy, and time towards learning activities related to science (Oktayani et al., 2025). Therefore, creating a learning environment that can foster and maintain students' interest in science is crucial to support the achievement of optimal scientific competence. Student activeness in discussions is a manifestation of social and cognitive involvement in the science learning process through pop-up books.

Discussion as a collaborative activity provides opportunities for students to express ideas, question concepts, and respond to arguments critically and constructively (Hikmatunnisa et al., 2024). Through this intense verbal interaction, students not only deepen their conceptual understanding but also hone their communication, analytical thinking, and evaluative skills. The discussion process allows for the social construction of knowledge, where individual understanding is formed and enriched through the exchange of ideas with peers and educators.

Pedagogically, structured discussions can stimulate critical and creative thinking, encourage reflection, and strengthen students' ability to formulate and defend opinions based on evidence and logical reasons. In addition, providing opportunities for students to explore learning materials through pop-up books is a fundamental aspect of student-centered learning (Mogi et al., 2025). Exploration in the context of science learning includes activities such as experiments, observations, investigations, and the use of various sources of information to find, test, and develop concepts independently.

These exploratory activities allow students to experience an active and reflective learning process, so that they can build knowledge based on direct experience and reasoning. With exploration, students not only receive knowledge passively, but are also involved in the creation and modification of new knowledge, which has an impact on increasing understanding and high-level thinking skills such as analysis, synthesis, and evaluation through pop-up books. This approach is in line with constructivism theory which emphasizes the importance of students' active role in building knowledge contextually and meaningfully.

So that students' interest in science, activeness in discussions, and opportunities for exploration are integral aspects that support each other in creating an effective and meaningful learning experience. These three aspects not only enrich students' cognitive and social processes, but also increase motivation, involvement, and critical thinking skills that are very necessary in science learning. Thus, education that is able to systematically integrate these three elements will produce students who not only master the material, but are also ready to become independent learners and competent problem solvers in the future.

4. Implications of Using Pop-Up Books in Science Learning

Based on the research results, the use of pop-up books in science learning has a significant positive impact on student understanding and engagement. Around 85% of students reported an increase in understanding of difficult concepts such as the water cycle, photosynthesis, and blood circulation after using pop-up books. In addition, teachers also reported that 92% of students felt that pop-up books were very helpful in

teaching complex concepts to 3rd grade elementary school students. Pop-up books enrich the learning experience, increase student activity, and help students understand abstract material in a more concrete and interesting way. In the context of learning, especially in science subjects, providing opportunities for students to explore is a very important aspect in supporting an effective and meaningful learning process.

Exploration in learning refers to activities in which students actively seek, discover, and understand concepts or phenomena independently or with minimal guidance from teachers. This approach encourages students to develop critical thinking skills, analytical skills, and creativity in solving problems. By exploring through pop-up book media, students not only receive information passively, but experience a more dynamic and contextual learning process, which can strengthen their conceptual understanding of the subject matter.

One innovation in learning media that can facilitate student exploration is the use of pop-up features. Pop-ups in the context of learning are interactive elements that appear automatically or through user interaction to present additional information, visualizations, animations, or deeper explanations of a concept (Darmawan et al., 2024). In science learning, these pop-ups act as visual and informative aids that can enrich students' learning experiences. For example, when students are studying cell structure, a pop-up can display a three-dimensional animation of cell parts that are difficult to explain with text or static images alone.

The advantages of using pop-ups in science learning include their ability to present information multimodally, which integrates text, images, sound, and animation simultaneously (Resta and Kodri, 2023). This is very important because learning that involves various cognitive modalities can significantly improve students' memory and understanding. In addition, pop-ups can also stimulate students' curiosity and motivation to learn, because they can access information directly and interactively according to their individual needs and learning speed. Thus, the combination of providing exploration opportunities and utilizing pop-up features in science learning creates a more constructive and meaningful learning environment. Students not only gain theoretical knowledge, but can also experience, observe, and analyze phenomena interactively, which will ultimately improve their overall scientific competence and skills.

Conclusion

The use of pop-up books in Natural Science (IPA) learning has made a significant contribution to improving the quality of learning. This media has proven effective in helping students visualize abstract and complex science concepts, such as the water cycle, photosynthesis, and the circulatory system. The three-dimensional representation presented in pop-up books makes it easier for students to imagine scientific processes more concretely, so that their conceptual understanding becomes better. In addition to the cognitive aspect, the use of pop-up books also increases students' interest and active involvement in the learning process. Students are no longer passive, but are directly involved in discussion activities, group work, and presentations. This has a positive impact on the development of social skills, such as communication and collaboration, and encourages students to learn more independently and exploratively. Thus, pop-up books function not only as visual aids, but also as interactive and multisensory learning media that enrich students' learning experiences. In the context of elementary education, this media is very relevant because it is in accordance with the stage of students' cognitive development, especially in simplifying scientific concepts that are difficult to understand only through text or two-dimensional images. Thus, pop-up books are an effective alternative media to create more enjoyable, in-depth, and meaningful science learning.

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