



## Development of interactive pop-up book learning media for human circulatory system material to increase high school students' interest in learning

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### ABSTRACT

This research aims to create a learning media in the form of a pop-up book that is applied to the content of the human circulatory system, which meets the requirements of validity, practicality, and effectiveness, and can increase students' interest in learning. The method used is Research and Development (R&D) with a 4D model, which consists of Define, Design, Develop, and Disseminate, but in this study, it is only up to the Develop stage. This study involved 33 students of grade XI Science 1 and a biology teacher at SMAS Cerdas Murni. Data was collected using validation sheets, practicality questionnaires for teachers and students, student learning interest questionnaires, and pretest and posttest questions. The validation results show that this media is highly valid, as validated by media and material experts. The practicality test showed efficient responses from teachers and students. The effectiveness of the media can be seen from the N-Gain score, indicating a high level of effectiveness, and the results of the student learning interest questionnaire show a very high level of interest. Based on these findings, this pop-up book is considered suitable as a learning tool because it meets the standards of validity, practicality, and effectiveness. In addition, this media also helps students understand the human circulatory system and grow their interest in learning biology.

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### ABSTRAK

Penelitian ini memiliki tujuan untuk menciptakan media pembelajaran berbentuk pop-up book yang diterapkan untuk konten sistem peredaran darah manusia, yang memenuhi syarat validitas, praktikalitas, dan efektivitas, serta dapat meningkatkan minat peserta didik dalam belajar. Metode yang digunakan adalah Riset dan Pengembangan (R&D) dengan model 4D, yang terdiri dari Define, Design, Develop, dan Disseminate, tetapi dalam penelitian ini hanya sampai tahap Develop. Penelitian ini melibatkan 33 peserta didik kelas XI IPA 1 dan seorang guru Biologi di SMAS Cerdas Murni. Data dikumpulkan menggunakan lembar validasi, angket kepraktisan untuk guru dan peserta didik, angket minat belajar peserta didik, serta soal pretest dan posttest. Hasil validasi menunjukkan media ini sangat valid, dari ahli media dan ahli materi. Uji kepraktisan memperlihatkan tanggapan yang sangat praktis dari guru dan peserta didik. Efektivitas media terlihat dari skor N-Gain menunjukkan kategori tinggi dan hasil angket minat belajar peserta didik menunjukkan kategori sangat tinggi. Berdasarkan temuan tersebut, pop-up book ini dinilai cocok sebagai alat pembelajaran karena memenuhi standar validitas, kepraktisan, dan efektivitas. Selain itu, media ini turut membantu peserta didik dalam memahami sistem peredaran darah manusia dan menumbuhkan minat mereka untuk belajar Biologi.

**Kata Kunci:** minat belajar peserta didik; pop-up book; sistem peredaran darah manusia

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## INTRODUCTION

Biology is a field of study that investigates life and requires a creative approach to learning it. Because it is related to everyday life, Biology is often considered easy to understand (Harefa *et al.*, 2022). However, there are still many problems that need to be solved. Students have difficulty connecting biological concepts with their personal experiences because most biological concepts cannot always be observed directly and are abstract in nature. Furthermore, without learning resources, teachers will not be able to explain important concepts clearly. This affects the level of students' understanding. By using modules, learning materials, or engaging media, learning will become more meaningful and organized. Learning media and materials are expected to assist students (Lestari *et al.*, 2020).

The education system must fully utilize media to support student learning (Gulo, 2022). Learning media play a role not only as a means of delivering information, but also are very important in helping students understand the material more deeply and comprehensively. In certain situations, media can also help organize the learning process to be more structured and provide feedback that can enhance students' understanding. Therefore, media enables more dynamic communication between teachers and students, which in turn creates more effective learning interactions. Visual media, in particular, have been proven effective in conveying information in an easy-to-understand, engaging, and clear manner (Umiroh & Rahmi, 2025).

Learning media play a crucial role in facilitating the process of monitoring conditions and understanding material, while also supporting students' learning activities. Pop-up books are considered highly effective media for achieving this goal because they present material in an attractive, interactive, and captivating visual format (Fadilah *et al.*, 2023). Pop-up books harmoniously combine illustrations and learning material, stimulate students' imagination, and enhance their thinking abilities (Hidayah *et al.*, 2020). In addition to their three-dimensional appearance, pop-up books also incorporate movement elements, providing a more engaging and enjoyable reading experience (Hazumi, 2020). This medium uses paper as a creative tool that can be shaped, folded, twisted, or moved to create a dynamic visual display and encourage reader participation (Umar & Tajeb, 2020).

Pop-up book learning media is considered to have a unique appeal to students. In three-dimensional form through folding techniques, movement, and the appearance of images, the surprise effects and sense of wonder that arise when students open each page make information easier to remember and understand (Sianturi *et al.*, 2023). The main strength of this media lies in its visual aspect, namely the presentation of images that look realistic and closely resemble their original forms (Ardini & Safran, 2024; Kholil & Nisa, 2025). In addition, the use of this media can also stimulate interest and encourage students' enthusiasm for learning, as each page presents engaging illustrations that provide visual surprises, motivating them to read and understand the material (Hafifah *et al.*, 2023). Pop-up books are used to deepen understanding through the process of learning and thinking, because comprehension requires basic knowledge in order to grasp a concept (Lestariningsih *et al.*, 2021).

An interview with the Biology teacher of class XI IPA-1 at SMAS Cerdas Murni was conducted as part of a preliminary study to identify the needs and obstacles in the learning process of human circulatory system material. The results of the interview showed that the learning process is still monotonous, dominated by lecture methods, and there is minimal use of visual media due to limited facilities, such as a lack of projectors. The teacher also revealed that students experience difficulties in understanding abstract material, which results in low interest and engagement in learning. Referring to this situation, the development of visual and interactive learning media becomes very important. The selection of high school students, particularly class XI, as research subjects was based on the cognitive characteristics of students

who are already capable of understanding abstract concepts logically. The human circulatory system material is also part of the 11th-grade curriculum and has a high level of complexity, so it requires support from learning media that can explain biological processes in a tangible and engaging way.

To address this issue, innovative learning media based on data processing, communication, and presentation are needed. One suitable choice of media is a pop-up book, a 3D visual medium that can stimulate imagination and capture students' attention through dynamic physical displays. The developed pop-up book enhances students' responses and learning abilities (Hidayah *et al.*, 2020; Khaerunnisa, 2023).

Although some previous studies have shown that pop-up books are quite effective, the development of this medium to support learning about the human circulatory system at the high school level is still limited. Previous studies generally only focused on aspects of validity and practicality, without measuring students' interest in learning quantitatively using tools such as questionnaires. Interest in learning is one of the significant affective components to support the achievement of learning outcomes. Based on this, this study was conducted to address these issues by creating an interactive pop-up book that not only meets the criteria of validity and practicality but is also effective in improving learning outcomes and students' interest in the human circulatory system material.

## LITERATURE REVIEW

### Learning Media

The word "media" comes from the Latin word "medius," which means "middle," "intermediary," or "connector" (Suparlan, 2020). On the other hand, learning is a process that facilitates education. Therefore, there are various learning media designed to meet educational needs (Haptanti *et al.*, 2024). The use of learning media from the beginning of the learning process can enhance the effectiveness of material delivery as well as maintain students' attention, thereby avoiding boredom (Rosyiddin *et al.*, 2023). Media is also an important element that teachers must consider in supporting the learning process and deepening students' understanding, including technology-based learning media (Alfitriani *et al.*, 2021). Learning media are intermediaries or connectors used in the educational process to facilitate the delivery of material. Their use from the beginning is very important to enhance learning effectiveness and keep students' attention from getting bored.

### Pop-up Book

A pop-up book is defined as a 3D medium that displays realistic visual elements when opened. Its high appeal makes it a very efficient learning tool. This medium has the potential to enhance students' creativity, facilitate conceptual understanding through engaging visualizations, and foster a love of reading. Furthermore, the use of pop-up books can stimulate active student participation, improve learning outcomes, and sharpen critical thinking skills (Kholil & Nisa, 2025). *A pop-up book is a three-dimensional medium that presents realistic visuals and is considered very efficient for learning. This medium can enhance creativity, active participation, and student learning outcomes through engaging visualizations.*

### Student Learning Interest

Learning interest refers to students' participation in learning activities, driven by enjoyment, engagement with the learning process, and motivational support from teachers and the environment. Indicators of this interest include feelings of enjoyment, attraction, involvement, enthusiasm for learning, and concentration in learning activities, as well as sincere efforts to achieve learning goals (Khaira *et al.*, 2023; Wafa &

Darmawan, 2025). Furthermore, learning interest is also one of the important aspects that must be developed in students because high learning interest can lead to good learning outcomes and performance (Zulfah, 2023). Learning interest is the attraction and active participation of students driven by enjoyment and motivation in learning activities. High interest is a crucial factor because it can directly result in better learning performance and outcomes.

## **Human Circulatory System**

The circulatory system is a field that studies the process of blood circulation to and from the heart, as well as the role of blood vessels, blood, and other organs in maintaining the physiological balance of the human body. This topic requires visual and conceptual understanding because it involves processes that cannot be directly observed. Many learners have difficulty understanding this topic through verbal and textual explanations alone because the processes are abstract and complex (Putri *et al.*, 2022). Therefore, learning tools that can realistically illustrate blood circulation are needed, such as visual and interactive media in the form of a pop-up book.

The circulatory system is a complex topic that is difficult for students to understand through text alone due to its abstract nature. Therefore, visual and interactive learning media, like a Pop-Up Book, are needed to depict the process in a realistic way.

## **METHODS**

This research and development (R&D) aims to create interactive learning media in the form of a pop-up book that explains the human circulatory system. The methodology used is the 4D development model, which includes four phases: Define, Design, Develop, and Disseminate. Currently, this research has reached the development phase due to time constraints and is being conducted at SMAS Cerdas Murni. The research sample consists of 33 eleventh-grade science students from class XI IPA-1 and one Biology teacher, selected using purposive sampling, as this class matches the target audience for the media to be developed. The development process is carried out in three stages, namely

### **1. Definition Stage**

At this stage, curriculum analysis is conducted, along with an analysis of the needs of teachers and students through interviews, as well as an analysis of the characteristics of the material. The results of the interviews indicate that the learning process tends to be monotonous, dominated by lectures, and the use of visual media is still limited due to the lack of projectors.

### **2. Design Stage**

The researcher developed a pop-up book media using the Canva application, with dimensions of 25×117 cm and printed on 120 gsm ivory paper. The book content was tailored to material on the human circulatory system for 11th-grade students, complete with colored illustrations, text with varied fonts, and a QR code linking to a learning video. The design of this media considered aspects of readability, comprehension, and visual interaction for students.

### **3. Development Stage**

In the Development stage, the media is validated by two experts, namely a media expert and a content expert. The results of this validation are used to revise the media before conducting a trial. A limited trial is conducted to evaluate the practicality and effectiveness of the media for students and teachers. This process also involves administering pretests and posttests to measure the improvement in students' learning outcomes, as well as interest questionnaires to evaluate students' affective responses to the media used

## Assessment Instrument

In this study, the Research Assessment Instruments used four tools to collect data. The first tool is a validation sheet for media and learning materials, designed with a Likert scale from 1 to 5. This sheet aims to assess content relevance, language clarity, visual presentation quality, and technical ease of media use. The second tool is a practicality questionnaire, given to educators and students after the media trial. This questionnaire aims to evaluate ease of use, clarity of information, presentation attractiveness, and the learning benefits of the media. The third instrument is a student learning interest questionnaire, using a closed statement format with a Likert scale from 1 to 4. This instrument measures aspects of learning interest such as student attention, interest in the learning material, enjoyment during learning, and active participation during learning activities. Finally, the pretest and posttest questions are used to assess students' understanding of the human circulatory system, both before and after the use of the media. These questions are multiple-choice, consisting of twenty questions that align with the learning objectives, achievements, and performance standards established in the curriculum.

## Research Data Analysis Techniques

This study employs descriptive methods, both quantitative and qualitative, to analyze the data. Data were collected through validation from experts, practicality questionnaires filled out by teachers and students, student learning interest questionnaires, as well as pretest and posttest scores. Descriptive analysis was conducted by calculating the mean and percentage of all data. To assess the effectiveness of the media in improving student learning outcomes, the N-Gain test was used. Meanwhile, qualitative data, which were analyzed narratively to support quantitative findings, were obtained from interviews with teachers, observations during the trial process, and comments from validators. In understanding the results of the questionnaires and quantitative assessments, two different Likert scales were used, each adjusted to the characteristics of the instrument. The validity and practicality of the media instruments are measured on a scale of 1–5, ranging from very poor (1), poor (2), sufficient (3), good (4), to very good (5). Meanwhile, the student learning interest questionnaire uses a scale of 1–4, with the categories strongly disagree (1), disagree (2), agree (3), and strongly agree (4). The validity and practicality of the media are determined based on assessments by validators who have competence and experience in their field. Each component assessed by the validators is then tabulated, and the average score calculation is done using the following formula.

$$\text{Percentage\%} = \frac{\text{Score obtained}}{\text{Highest score}} \times 100$$

The results of these calculations were then categorized according to the criteria shown in **Table 1**:

**Table 1.** Criteria for the Validity and Practicality of Pop-up Books

Achievement Percentage	Validity Criteria	Practicality Criteria	Learning Interest Questionnaire Score Criteria
81 - 100%	Very Valid	Very Practical	Very High

Achievement Percentage	Validity Criteria	Practicality Criteria	Learning Interest Questionnaire Score Criteria
61 - 80%	Valid	Practical	High
41 - 60%	Moderately Valid	Moderately Practical	Moderately High
21 - 40%	Less Valid	Less Practical	Low
0 - 20%	Not Valid	Not Practical	Very Low

Source: Adapted from Isnaini et al. (2022) and Batubara et al. (2021)

The effectiveness of learning media is measured from the pretest and posttest of the students, followed by an N-Gain test and a questionnaire on students' learning interest. N-gain can be calculated using the following formula.

$$N-Gain = \frac{Post\ test - Pre\ test}{Maksimum - Pre\ test}$$

In addition, effectiveness is also reviewed based on students' learning interest questionnaires and the data obtained through the learning interest questionnaire, consisting of 10 statements, each arranged on a Likert scale with four answer choices. After respondents complete the questionnaire, the scores for each statement are summed to obtain the total score for each student, and to calculate the average score and convert it into a percentage.

## RESULT AND DISCUSSION

The learning media produced from this research is a pop-up book focused on the human circulatory system material, and it is specifically designed for eleventh-grade students at SMAS Cerdas Murni. Findings from the research and development process indicate that this media effectively enhances students' understanding and knowledge significantly, while also promoting a more efficient learning experience. Students demonstrated higher enthusiasm and engagement during learning sessions when using the pop-up book. The four-dimensional (4D) model serves as the basis for creating this media. However, due to limited time and the primary focus of the research on product creation, this study only reached the development stage. A detailed explanation of the pop-up book development process in this research will be presented below:

### Definition Stage

The Define stage is carried out through five main steps. First, front-end analysis is conducted through teacher interviews to identify learning problems and media limitations. Second, an analysis of the students is conducted to understand their characteristics and to determine their initial level of ability regarding the material being taught. Third, task analysis is carried out, including formulating learning outcomes and objectives based on the Merdeka Curriculum. Fourth, concept analysis is conducted to select important and challenging content, such as the mechanism of blood circulation and transfusion. Fifth, learning objectives are formulated as the basis for developing media content that meets the needs of the students.

## 1. Front-End Analysis

The analysis was conducted through interviews with the Biology teacher at Cerdas Murni Private High School. The results showed that lectures still dominate learning, the use of media is limited to PowerPoint, and it relies on textbooks and student worksheets. The teacher expressed the need for alternative media that is more engaging, interactive, and makes it easier for students to understand the human circulatory system material. A pop-up book was chosen due to its advantages in presenting attractive visuals, a combination of text and images, and its ability to increase student motivation and engagement.

## 2. Student Analysis

Interviews were conducted to understand the characteristics of the students, including their preferred media, learning motivation, and their prior understanding of the material. It was found that students had difficulty understanding the material through lectures and books alone, and felt helped by visual media such as a pop-up book, which allows for independent review and easier comprehension.

## 3. Task Analysis

This analysis includes learning outcomes (LO), learning objectives (LO), indicators, and the material to be included in the media. Everything is arranged based on the Merdeka Curriculum Phase F and refers to relevant skill competencies.

## 4. Concept Analysis

Concept analysis is carried out by determining the content of the material based on interviews with Biology teachers, specifically material considered difficult to teach and often creating obstacles in learning, namely the human circulatory system.

## 5. Formulation of Learning Objectives

Learning objectives are formulated based on the achievements and sequence of learning objectives from the Merdeka Curriculum. The objectives include the ability to identify the structure and function of the heart and blood vessels, distinguish types and mechanisms of blood circulation, analyze the blood group system and transfusions, and understand disorders and technologies related to the circulatory system.

## Design Stage

The media design stage begins with the preparation of text reviewed based on the material in the Class XI Biology textbook, according to the Merdeka Curriculum. The selection of media is adjusted to the needs of students to address the problems they encounter in understanding the material. The pop-up book format is designed using the Canva application with a size of 25 cm x 117 cm, printed on 120 gsm ivory paper with a thickness of 0.206 mm. The fonts used are a combination of several types, namely Chewy, Times New Roman, Celandine, Cooper BT, Childos Arab, Bree Serif, and Alkatara, with variations in black, brown, red, and pink colors. The initial design consists of several pages with different sub-topics accompanied by illustrations, along with QR codes linked to learning videos as supplementary material.

The function of this pop-up book is to respond to students' needs for learning media that can present material in an engaging and easy-to-understand way. This media is designed not only to explain the complex and abstract concepts of the circulatory system but also to provide an interactive and enjoyable learning experience. With a visual approach and communicative design, it is hoped that this media can serve as an effective tool to enhance students' understanding and interest in Biology lessons.

**Development Stage**

This stage includes the process of media validation, practicality testing, and effectiveness testing carried out to identify the strengths and weaknesses of the product, with the aim of producing a better quality product. The results of validity and practicality are presented in **Table 2**.

**Table 2.** Results of Validity and Practicality

Type of Data	Total Score	Maximum Score	Percentage(%)	Category
Media Validation	72	75	96%	Very Valid
Material Validation	71	75	94%	Very Valid
Educator Response Questionnaire	48	50	96%	Very Practical
Student Response Questionnaire	1475	1650	89,39	Very Practical

Source: 2025 Research Results

Based on the results of this study, the validation process was conducted after one revision. Validation by media experts, which involved two aspects, namely graphics and presentation, showed that the learning media in the form of a pop-up book had a validity level of 96%. Meanwhile, validation by material experts, which covered two aspects, namely content and presentation, indicated that the material validity reached 94%. Both of these validation scores fall into the category of "Very Valid." In addition, the teacher response questionnaire, which consisted of three aspects: material content, learning motivation, and presentation, showed a material validity level of 96%. The results of the practicality assessment, based on a questionnaire from 33 students with 10 statement categories covering various aspects, obtained a percentage of 89.39%, and both responses fall into the "Very Practical" category.



**Figure 1.** Changes in Media Appearance After Revision

Source: 2025 Research Results

Changes in the appearance of the table of contents on the first page of the pop-up book media: before the revision, the table of contents only listed the main title "Human Circulatory System" without detailing subtopics, making it look less informative. After revisions were made based on expert input on the media, the table of contents was reorganized by adding important sections of the material to make it more

structured and help learners understand the scope of the content, as can be seen in **Figure 1** marked with the letter (A). Changes in content appearance: in the initial stage or before revision, the references in the pop-up book media only listed a single source from a book. This was considered not to reflect the diversity of learning sources needed. After revisions were made, the list of references in the media was supplemented with various sources, including several books and journals, according to expert suggestions, in order to enrich the literature and support the accuracy of the material content, as seen in **Figure 1** labeled (B). Changes to the presentation of the material in the pop-up book media, or before revision, the material content was presented without clearly citing reference sources, thus not yet showing a strong scientific basis.

After the revisions were made, reference citations began to be included directly in the presentation of the material, in accordance with expert suggestions, so that the sources of information would be clearer and more accountable, as shown in **Figure 1** with the letter (C). The initial display of the researcher's placement and profile in the pop-up book media, before revision, had the researcher's profile placed on the front page in a door-like format that could be opened, making it immediately visible at the beginning of the media. However, based on feedback from media experts, this placement was deemed inappropriate and could potentially distract students from focusing on the learning material. After revision, the researcher's profile was moved to the back page (end cover), and it was recommended to use stronger paper, such as ivory paper, to be more durable and less prone to damage, as shown in **Figure 1** with the letter (D).

**Table 4.** Effectiveness Test Results Based on N-Gain and Students' Learning Interest

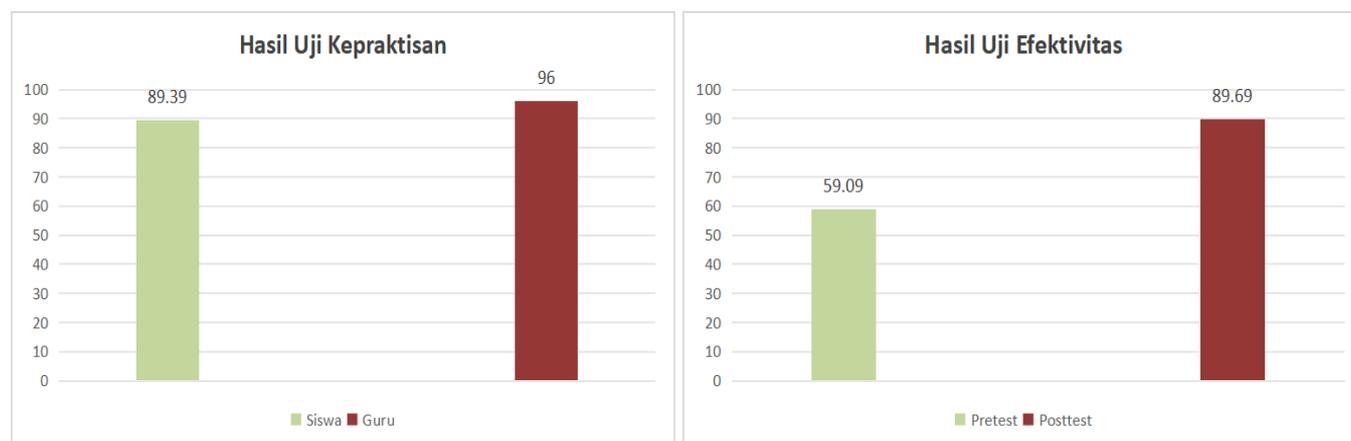
A. N-Gain						
Average Pretest	Average Pretest	Posttest-Pretest	Maximum Score - Pretest	N-Gain	Percentage (%)	Category
59,09	89,69	30,60	42,27	0,73	73	High
B. Students' Learning Interest						
Number of Students		Total Score	Maximum Score	Percentage (%)	Kategori	
33 Students		1.216	1.320	92,12%	Very High	

Source: 2025 Research Results

To test the effectiveness of a product in learning, an analysis was conducted that compared students' learning outcomes before and after using the product, as shown in **Table 4**. This product was applied to 33 students of class XI IPA 1 at SMAS Cerdas Murni. Student assessments when using this product were obtained from the analysis of pretests and posttests conducted during the learning process in class. The purpose of the pretest and posttest is to compare the scores achieved by students before and after learning using the pop-up book media on the human circulatory system material. In addition, a learning interest questionnaire was also distributed to students to measure their level of interest, enjoyment, engagement, and concentration during learning, especially when using the pop-up book media.

Sebelum memulai proses pembelajaran dengan menggunakan media *pop-up book* dalam materi sistem peredaran darah manusia, peserta didik terlebih dahulu mengikuti *pretest*. Hasil *pretest* menunjukkan rata-rata nilai peserta didik sebesar 59,09. Setelah itu, peserta didik terlibat dalam kegiatan belajar mengajar dengan media *pop-up book*. Setelah selesai, peserta didik menjalani *posttest*, yang menghasilkan rata-rata nilai sebesar 89,84. Perbandingan antara nilai *pretest* dan *posttest* menunjukkan adanya peningkatan rata-rata nilai peserta didik. Dari data tersebut, diperoleh nilai gain ternormalisasi sebesar 0,73, yang dianggap tinggi. Selain itu, survei mengenai minat belajar peserta didik menunjukkan skor 92,12%, yang

tergolong sangat tinggi. Dengan demikian, media *pop-up book* terbukti efektif dalam meningkatkan minat belajar peserta didik kelas XI IPA 1 SMAS Cerdas Murni.



**Figure 2.** Graph of Practicality and Effectiveness Test Results

Source: 2025 Research results

The developed pop-up book media has successfully met the criteria of being valid, practical, and effective. The media is considered attractive, user-friendly, and supportive of the learning process based on validation from media experts, teachers, and students. The significant increase in scores from pretest to posttest indicates that students experienced an improvement in understanding after using the media. As shown in Figure 2, the use of visually-based learning aids such as pop-up books helps students understand abstract concepts, particularly in subjects related to human organ systems, such as the circulatory system. Student enthusiasm and involvement in learning have increased, and this medium has expanded the variety of teaching approaches. The three-dimensional and interactive visualization promotes more meaningful and engaging learning participation.

## Discussion

A pop-up book is a type of interactive visual media designed to enhance the learning process by displaying three-dimensional elements when opened. This uniqueness not only adds visual appeal but also creates a more enjoyable learning experience, encouraging students to actively engage and show greater interest in learning. In Biology education, especially on abstract topics such as the human circulatory system, this media is highly relevant. The three-dimensional visualization provided allows students to understand complex concepts in a more concrete way so that that information can be retained and understood longer (Erica & Sukmawarti, 2021). By using a pop-up book, students can see more clearly and structurally the process of blood circulation, the relationships between organs, and how the heart works. Several previous studies have developed pop-up book media for various subjects, such as basic chemical law materials and mathematics learning regarding three-dimensional shapes in elementary schools (Hasanah *et al.*, 2023; Pradiani *et al.*, 2023). In the field of Biology, there has also been the development of pop-up book media on the topic of biodiversity (Sianturi *et al.*, 2023). However, research on the use of pop-up books in Biology learning, particularly the human circulatory system, is still relatively limited. Therefore, this study will explore the development of interactive pop-up books to visualize the circulatory system comprehensively, with the hope of aiding the learning process and improving students' understanding of the material.

The evaluation results from media and material experts show that the developed pop-up book media is very valid, both in terms of content, visual appearance, and relevance to learning objectives. This media can enhance students' understanding of learning concepts because it presents information in an engaging and visual form. The presence of three-dimensional elements also contributes to students' emotional involvement in the learning process, which in turn improves concentration and material retention. In other words, realistic and lively visualization helps students retain the information they learn for a longer period. In terms of practicality, this media is highly appreciated by teachers and students (Lanti *et al.*, 2022). Teachers stated that the use of this media in the classroom is very easy without requiring additional processes. Students also feel that this media makes learning more enjoyable, easier to understand, and increases learning efficiency through systematic and visual presentation (Silqi & Febrianto, 2022).

This media is very effective in boosting students' learning interest. According to survey results, the majority of students showed high enthusiasm, felt encouraged to ask questions and engage in discussions actively, and were more focused during the learning process. Interactive visual media can enhance students' motivation and engagement. This increase in learning interest is very significant in Biology learning, especially because the material, which contains many scientific terms, often makes it difficult for students to understand concepts deeply. In addition, the use of pop-up books also plays a role in increasing learning motivation (Kamal *et al.*, 2024; Sari *et al.*, 2024). High levels of enthusiasm, the courage to ask questions, and maintained concentration during lessons indicate that motivated students tend to be more active in discussions, seek additional information, and are able to remember the material longer. All of this supports the achievement of meaningful learning in accordance with curriculum objectives (Wafa & Darmawan, 2025).

In general, the findings of this study support the results of several previous studies that show that pop-up book media can be an innovation in learning. This media has been proven to be valid and practical, as well as having the potential to increase students' interest and understanding of the material being taught. By taking into account the characteristics of high school students and the challenges in Biology material, it is hoped that pop-up book media can be an appropriate, applicable, and effective innovative alternative in enhancing the quality of classroom learning.

## CONCLUSION

This study aims to create a learning aid in the form of an engaging pop-up book focused on the human circulatory system, with the hope of increasing students' interest in learning. Based on the development results and trials, the tool developed was deemed valid, practical, and effective. The high validity scores from media and content expert evaluations indicate the quality of the tool, while positive feedback from teachers and students suggests its practicality. The effectiveness of this tool is evident from the improvement in student learning outcomes, measured by high N-Gain scores and positive responses in student interest surveys. Therefore, this pop-up book can serve as an alternative learning aid, especially for abstract-concept material such as the human circulatory system.

The pop-up book media that have been created have potential as a replacement for learning tools in Biology, especially for topics that require strong visualization. It is recommended that future development consider its application in other subjects and combine it with active or digital learning models to accommodate the diverse learning preferences of students. Further research could also explore the impact of this media on critical thinking, innovation, or long-term learning outcomes, to expand its influence and ensure its sustainability in the future.

## **AUTHOR'S NOTE**

The author declares that there is no conflict of interest related to the publication of this article. The author affirms that the data and content of the article are free from plagiarism.

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