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The Effect of Pop-Up Book Teaching Media on Students' Learning Interest in Science: Evidence from Junior High School in Indonesia

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Abstract
This study examines whether pop-up book teaching media are associated with students' learning interest in science, focusing on the human respiratory system topic. A quantitative correlational design was employed with a purposive sample of 21 eighth-grade students (class VIII-A) from SMP Negeri 21 Bengkulu Selatan, Indonesia. Learning interest and perceptions of the pop-up book were measured using validated Likert-type questionnaires totaling 32 items (16 items per construct). Data were analyzed using Pearson's product–moment correlation and a follow-up significance test. Results showed a strong positive association between the use of pop-up book media and students' learning interest ($r = 0.781$, $p < 0.05$), confirmed by a significant t-value ($t(19) = 5.446 > t\_table = 2.093$). These findings indicate that innovative three-dimensional, interactive print media can meaningfully enhance students' engagement with science content that is typically abstract at the lower-secondary level. The study contributes empirical evidence from an Indonesian junior-high context and offers practical implications for teachers to adopt visually rich, hands-on instructional tools to stimulate learning interest.
Keywords: **Human respiratory system; Junior high school; Learning interest; Pop-up book; Science education.**

INTRODUCTION

Education in the twenty-first century faces increasing challenges and opportunities due to rapid technological advancement and the growing demand for innovative teaching strategies that enhance student engagement. Teachers are no longer merely transmitters of knowledge; they are facilitators who must foster meaningful learning experiences and sustain students' interest in the learning process (W. O. Lee & Tan, 2018; Sjølie et al., 2021; Soipimai & Sanrattana, 2023). Student interest in learning is widely recognized as a key determinant of academic achievement and long-term motivation, particularly in science subjects, which often require abstract reasoning and the ability to integrate complex concepts (Hekmah et al., 2019; Mao et al., 2021; Setiati & Jumadi, 2022). Consequently, pedagogical approaches that combine cognitive and affective dimensions are needed to stimulate active participation and deeper understanding among students.

One of the primary obstacles in science education, especially at the junior high school level, is the low level of student engagement and interest in learning. Many students perceive science as difficult, abstract, and monotonous, which often leads to disengagement, lack of motivation, and poor learning outcomes (Ayuso Fernández et al., 2022; Haryanto et al., 2022; Patall et al., 2018; Zaki et al., 2020). Empirical studies show that when learning activities fail to capture students' interest, they are more likely to experience boredom, distraction, and lower retention of knowledge (Gasser et al., 2018; Halim et al., 2022; Xie, 2021).This situation underscores the necessity of adopting instructional media that are interactive, visually appealing, and capable of transforming abstract concepts into more tangible representations. Instructional media not only function as tools to transfer knowledge but also serve as stimuli that can enhance motivation and shape positive attitudes toward learning (Ndoa & Jumadi, 2022; Sailer & Homner, 2020; Sun et al., 2022).

Among various instructional media, the pop-up book has emerged as a promising innovation in the context of science learning. Pop-up books are three-dimensional and interactive learning resources that present information in a visually stimulating manner, making abstract content more concrete and easier to understand (B. Lee et al., 2021; Ningrum et al., 2018; Rakhmawati et al., 2020). They combine elements of visual art, motion, and narrative, thus stimulating multiple sensory

modalities, which are known to improve comprehension and retention according to multimedia learning theory (N. R. Dewi et al., 2018; Noetel et al., 2021, 2022). Previous research indicates that the use of pop-up books in science classes significantly increases student engagement and enthusiasm, leading to higher academic performance and more positive attitudes toward learning (Adnyana & Parmiti, 2020; Huang & Wang, 2022; Sentarik & Kusmariyatni, 2020). Furthermore, such media are aligned with the demands of 21st-century learning, where creativity, problem-solving, and self-regulated learning play a central role (Brenner, 2022; Stehle & Peters-Burton, 2019; Voskamp et al., 2022).

Learning interest, as a psychological construct, encompasses affective, cognitive, and behavioral dimensions, including enjoyment, attention, and willingness to participate in learning activities (Ben-Eliyahu et al., 2018; Hidi & Renninger, 2019; Wassalwa et al., 2022). Students with high learning interest are generally more motivated, attentive, and proactive, which contributes to their long-term academic success. Conversely, low learning interest is often associated with passive learning behaviors, reduced persistence, and lower achievement (Arga et al., 2022; Nurtjahjanti et al., 2021; Renninger & Hidi, 2022). Research has identified various factors that influence learning interest, including teaching methods, instructional media, teacher competence, and the learning environment (Ahmad et al., 2021; Räisänen et al., 2022; Theobald et al., 2020). Therefore, the use of innovative teaching aids such as pop-up books is expected to positively affect students' interest by making learning more engaging and relatable.

Despite a growing body of literature highlighting the benefits of pop-up books and other interactive media, most prior studies have focused on their implementation at the primary school level or on different subject areas, such as literacy or social studies (Adnyana & Parmiti, 2020; S. M. Dewi et al., 2021; Pan et al., 2021). Relatively few empirical studies have investigated the effectiveness of pop-up book media in junior high school science education, particularly in complex topics like the human respiratory system, which often challenge students' conceptual understanding. Moreover, while several studies have confirmed that pop-up books improve student achievement, fewer have examined their specific effect on learning interest as a psychological construct (Ningrum et al., 2018; Putra & Parmiti, 2020; Viana Sari & Kusmariyatni, 2020). This indicates a gap in the literature regarding the extent to which pop-up book teaching aids can influence students' motivation and interest in science learning at the secondary level.

To address this gap, the present study aims to investigate the effect of using pop-up book teaching media on students' learning interest in science, specifically on the topic of the human respiratory system among eighth-grade students in Indonesia. By employing a quantitative correlational approach, this research seeks to contribute empirical evidence on the pedagogical value of interactive visual media in enhancing student engagement. The findings are expected to enrich the theoretical discourse on multimedia learning and provide practical insights for educators seeking innovative strategies to foster interest in science education.

METHODS

This study employed a quantitative correlational research design aimed at examining the relationship between the use of pop-up book teaching media (independent variable, X) and students' learning interest (dependent variable, Y). The quantitative approach was selected because it allows for the collection and analysis of numerical data, which are essential for identifying patterns, testing hypotheses, and establishing statistical relationships between variables (Cresswell, 2014; Sugiyono, 2015)

Population and Sample

The research population consisted of all eighth-grade students at SMP Negeri 21 Bengkulu Selatan, totaling 41 students. From this population, a purposive sampling technique was applied to select one intact class, namely class VIII A, which comprised 21 students. This sampling strategy was considered appropriate because the selected class met the specific criteria required for the study, including prior exposure to science learning using conventional media and readiness to be introduced to innovative instructional media (Etikan, 2016; Sugiyono, 2015)

Research Instrument

The data were collected through structured questionnaires and supported by observation and documentation. The questionnaires were developed to measure two constructs:

1. Pop-up book teaching media (X) – consisting of 16 items reflecting students' perceptions of the media's design, usability, and relevance.
2. Learning interest (Y) – consisting of 16 items covering indicators such as enjoyment, attention, participation, and curiosity in science learning.

The questionnaire items were presented on a four-point Likert scale: strongly agree (4), agree (3), disagree (2), strongly disagree (1) for positively worded statements, and the reverse scoring for negatively worded statements.

Prior to data collection, the instruments underwent content validity and reliability testing. Expert validation was conducted by lecturers from UIN Fatmawati Sukarno Bengkulu and a science teacher at SMP Negeri 21 Bengkulu Selatan. The results indicated that the instruments were valid and feasible for use. Reliability testing was conducted using Cronbach's Alpha, confirming that all items achieved acceptable internal consistency (≥ 0.70) (Cohen et al., 2017; Tavakol & Dennick, 2011)

Validation of the Pop-up Book Media

In addition to the questionnaire, the pop-up book teaching media itself was validated by expert judges. Validation was carried out by two experts, who assessed the content, design, and applicability of the media. Scores were converted into percentages using the following formula:

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

Where:
P = percentage of respondent agreement,
f = total score obtained,
N = maximum possible score.

Table 1. Instrument Validation Rating Scale

Where	Score
Poor	1
Fair	2
Good	3
Very Good	4

The results of this validation process indicated that the developed pop-up book media was in the "very valid" category and therefore suitable for implementation in the learning process.

Data Collection Procedure

The research was conducted over several stages:

1. Preparation – including development of the instruments, expert validation, and pilot testing.
2. Implementation – the use of pop-up book media during science learning sessions in class VIII A, followed by the distribution of questionnaires.
3. Data Collection – students completed the validated questionnaires after engaging with the instructional media.
4. Documentation – supporting evidence such as lesson plans, student activity records, and photographs were also collected.

Data Analysis

The data analysis was carried out using Pearson's product-moment correlation to examine the relationship between the use of pop-up book media (X) and students' learning interest (Y). The correlation coefficient (r) was computed with the following formula:

$$rxy = \frac{n\sum xy - (\sum \mathrm{x})\,(\sum \mathrm{y})}{\sqrt{n\sum x^2 - (\sum x)^2 \,.\, n\sum y^2 - (\sum y)^2}}$$

where:
rxy = correlation coefficient between variable X and Y,
N = number of respondents,
X = scores of independent variable (pop-up book media),
Y = scores of dependent variable (learning interest).

The interpretation of correlation coefficients followed the guidelines presented in Table 2.

Table 2. Interpretation of Correlation Coefficient

Interval Coefficient	Strength of Relationship
0,00 – 0,199	Very Weak
0,20 – 0,399	Weak
0,40 – 0,599	Moderate
0,60 – 0,799	Strong
0,80 – 1,000	Very Strong

To test the significance of the correlation, a t-test was conducted using the following formula:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

where:
t = calculated t value,
r = correlation coefficient,
n = sample size.

The calculated t value was compared with the critical value of t table at the 5% significance level (α = 0.05). If the t calculated value exceeded the t table value, the null hypothesis (H0) was rejected and the alternative hypothesis (H1) was accepted, indicating a significant relationship between the variables.

RESULTS AND DISCUSSION

This study investigated the relationship between the use of pop-up book teaching media and students' interest in learning science, particularly on the topic of the human respiratory system. The data were obtained through validated questionnaires administered to 21 eighth-grade students at SMP Negeri 21 Bengkulu Selatan. Prior to hypothesis testing, the media and instruments underwent a validation process to ensure their appropriateness for implementation.

Validation Result

The validation process involved expert assessments of both the pop-up book teaching media and the research instruments. Table 3 presents the results of the pop-up book validation, which showed that the instructional media achieved a very high level of validity, with an overall score of 95.31%. This indicates that the developed pop-up book was highly feasible for classroom use.

Table 3. Validation Results of Pop-up Book Media

Validator	Total Score	Presentage	Criteria
Validator 1	32	95,31%	Very Valid
Validator 2	29		
Total	**61**		

Similarly, the validation of the research instruments (questionnaires) yielded a score of 100%, categorized as "very valid," as shown in Table 4 This ensured that the instruments were both reliable and appropriate for measuring students' perceptions.

Table 4. Validation Results of Instruments

Validator	Total Score	Percentage	Criteria
Validator	32	100%	Very Valid

To test the hypothesis, Pearson's product-moment correlation was employed to examine the

relationship between the use of pop-up book media (X) and students' learning interest (Y). The calculation results are presented in Table 5.

Table 5. Correlation Data Results

No	X	Y	XY	X^2	Y^2	Total
1	49	54	2646	2401	2916	8066
2	58	56	3248	3364	3136	9862
3	48	55	2640	2304	3025	8072
4	57	58	3306	3249	3364	10034
5	48	57	2736	2304	3249	8394
6	45	50	2250	2025	2500	6870
7	58	58	3364	3364	3364	10208
8	59	56	3304	3481	3136	10036
9	52	55	2860	2704	3025	8696
10	57	60	3420	3249	3600	10386
11	58	60	3480	3364	3600	10562
12	58	58	3364	3364	3364	10208
13	47	52	2444	2209	2704	7456
14	58	59	3422	3364	3481	10384
15	58	59	3422	3364	3481	10384
16	53	56	2968	2809	3136	9022
17	57	56	3192	3249	3136	9690
18	53	54	2862	2809	2916	8694
19	53	55	2915	2809	3025	8857
20	58	62	3596	3364	3844	10924
21	60	59	3540	3600	3481	10740
Total	1144	1189	64979	62750	67483	197545

The results of the analysis revealed a correlation coefficient (r) of 0.781, which falls within the strong category (0.60–0.799). At a significance level of 5% with N = 21, the critical value of r table was 0.433. Since the correlation coefficient was greater than the critical value (0.781 > 0.433), the null hypothesis (H0) was rejected, and the alternative hypothesis (H1) was accepted. Furthermore, hypothesis testing using the t-test produced a calculated t value of 5.446, which exceeded the critical t table value of 2.093 (df = 19, $\alpha = 0.05$). This confirms that there is a significant positive relationship between the use of pop-up book media and students' interest in learning science.

The results clearly indicate that pop-up book teaching media are effective in fostering students' interest in learning. This finding is consistent with the study by Sentarik & Kusmariyatni (2020), who concluded that the use of pop-up books had a positive influence on students' learning interest in science. Likewise, research by Putra & Parmiti, (2020)demonstrated that pop-up books encouraged student enthusiasm and improved learning outcomes in primary school contexts. The present study reinforces these conclusions and extends them to junior high school students, highlighting the adaptability of pop-up books to more advanced learning levels. Moreover, the findings resonate with Eri Karisma et al., (2020), who found that pop-up books improved students' understanding of abstract biological processes. In this study, students displayed higher attentiveness and curiosity when studying the human respiratory system, suggesting that the three-dimensional representations in the pop-up book effectively bridged the gap between abstract concepts and students' cognitive processing abilities.

The positive impact of pop-up book media on students' motivation also corroborates the findings of Aprilia Agata et al. (2022), who emphasized that such media enhance both comprehension and learning motivation. The multisensory stimulation provided by colors, interactive features, and three-dimensional designs aligns with Mayer (2014) cognitive theory of multimedia learning, which asserts that learners acquire knowledge more effectively when information is presented in multiple modalities. Moreno &

Mayer (2015) further explained that interactive multimodal learning environments are capable of increasing student engagement and knowledge retention, a notion supported by the outcomes of the present research.

When compared with studies examining other types of instructional media, such as digital platforms, the current study highlights the distinctive advantages of pop-up books. While digital media are often praised for interactivity, their implementation depends on the availability of technological infrastructure, which may not always be accessible in resource-limited contexts (Clinton, 2019; Damayanti & Yudiana, 2021). Pop-up books, in contrast, are cost-effective, reusable, and accessible, making them a sustainable instructional tool in diverse learning environments. The current findings therefore emphasize the unique contribution of pop-up books as both a traditional and innovative form of media that successfully combines tangibility with creativity.

The novelty of this study lies in its application of pop-up book media to junior high school science education, particularly in teaching the human respiratory system. Previous studies have primarily focused on the use of pop-up books in elementary education or in subjects such as literacy and social studies. By addressing an abstract and complex biological concept at the secondary level, this study extends the scope of existing research and provides new empirical evidence regarding the potential of pop-up books to foster learning interest beyond primary contexts.

The implications of these findings are twofold. Theoretically, the study strengthens the discourse on multimedia learning by demonstrating that simple, low-cost, and non-digital media can significantly influence student motivation and interest, confirming the importance of multisensory and interactive learning environments. Practically, the results suggest that teachers should integrate creative media such as pop-up books into science classrooms to stimulate student engagement and interest, particularly in schools where access to digital technologies is limited. This study offers a valuable pedagogical alternative for educators seeking to foster more dynamic and enjoyable learning experiences.

Nevertheless, the study is not without limitations. The relatively small sample size (N = 21) limits the generalizability of the findings, and future research should involve larger and more diverse student populations to enhance external validity. Furthermore, the study was confined to a single science topic the human respiratory system. Expanding research to include multiple science topics would provide a more comprehensive understanding of the effectiveness of pop-up book media. Finally, the reliance on self-reported questionnaires may introduce response bias, and subsequent studies are encouraged to include additional methods of data collection such as classroom observations, interviews, or performance-based assessments to obtain more holistic insights.

CONCLUSION

This study concludes that the use of pop-up book teaching media has a significant and positive influence on students' learning interest in science, particularly on the topic of the human respiratory system among eighth-grade students at SMP Negeri 21 Bengkulu Selatan. The results of the correlation analysis ($r = 0.781$, $p < 0.05$) and hypothesis testing ($t = 5.446 > t$ table $= 2.093$) confirm that pop-up books effectively foster student engagement by making abstract biological concepts more concrete, interactive, and visually appealing. These findings extend previous research by demonstrating that the application of pop-up books is not only effective in elementary education but also relevant at the junior high school level, thereby contributing to the literature on innovative instructional media. The study highlights the novelty of integrating three-dimensional learning resources into science education, offering both theoretical implications for multimedia learning theory and practical implications for educators in designing engaging classroom environments. While the findings underscore the potential of pop-up books as low-cost and sustainable tools for enhancing learning motivation, the study acknowledges limitations related to the small sample size, the focus on a single topic, and reliance on self-reported data, suggesting that future research should involve larger samples, broader curricular topics, and multiple data sources to strengthen the generalizability and robustness of the results.

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