Enhancing Science Learning Motivation through Picture Storybooks in Elementary Schools

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Abstract

The motivation to learn science among elementary school students in Indonesia remains suboptimal, often hindered by monotonous teaching methods and a lack of engaging learning materials. This study addresses this issue by evaluating the effectiveness of a newly developed science picture storybook intervention designed to enhance student motivation through contextual, narrative-based learning. Unlike conventional textbooks, the storybook embeds scientific concepts within age-appropriate stories accompanied by colorfull illustrations, aiming to foster intrinsic motivation and conceptual understanding. While previous research has validated its practicality and content validity, its effectiveness in improving science motivation had not been empirically tested. This quasi-experimental study involved third-grade students at SD Negeri 5 Mas, Gianyar Regency, Bali (n=17), using a one-group pretest-posttest design. A science motivation questionnaire was administered, and the data were analyzed using paired sample t-tests and normalized gain scores. The findings showed a statistically significant improvement in students' science learning motivation after using the picture storybook (p < 0.05), with a moderate normalized gain score (g = 0.42). These results highlight the storybook's moderate yet meaningful impact. The novelty of this intervention lies in its integration of scientific content into culturally relevant narratives to promote engagement and motivation in early science education. The study contributes to the growing field of science education by demonstrating that picture storybooks can serve as an effective motivational tool in elementary classrooms, especially in contexts where motivation is low and student engagement is critical.

Keywords: Science Books; Picture Books; Science Learning Motivation; Learning Media; Storybook Intervention

INTRODUCTION

Natural Science (IPA) is a field of knowledge that plays an essential role in helping individuals understand the natural environment, act wisely in maintaining its sustainability, and apply scientific principles for the benefit of humanity (Dewi & Wijaya, 2021; Yasa et al., 2022; Prista et al., 2024; Wijaya & Adnyani, 2025). Science is not merely a collection of facts, but a comprehensive process involving observation, reasoning, experimentation, and reflection, leading to knowledge that is both applicable and ethical (Sakila et al., 2023; Dwisetiarezi & Fitria, 2021). In educational practice, science is conceptualized as a process, product, application, and attitude that

should be introduced from early levels of schooling. In Indonesia, science has been integrated into the elementary school curriculum through the subject of IPAS *(Ilmu Pengetahuan Alam dan Sosial)*, which aims to develop students' scientific literacy and awareness from a young age (Darmayanti et al., 2022; Pratiwi et al., 2024; Wijayanti & Ekantini, 2023).

However, in practice, students' motivation to learn science at the elementary level remains low. Research at the national level, such as by Zhang et al. (2023), reported that elementary students often perceive science as difficult and unengaging due to monotonous teaching methods dominated by lectures. Rusydiana et al. (2023) also noted that a lack of variation in instructional media results in decreased student interest. This pattern of low motivation is not unique to Indonesia. International research also reveals a systemic issue in science education: curricula that are overloaded, abstract, and disconnected from students' lived experiences reduce motivation and long-term interest in science (OECD, 2019; Harlen, 2010). In many countries, including developed education systems, motivation to learn science declines as students' progress through school when pedagogical approaches fail to be engaging, imaginative, or contextually relevant (Murphy & Beggs, 2005). These findings point to a broader, global challenge in making science learning both accessible and motivating for young learners.

One response to this challenge is the development of contextual and visually engaging media, such as picture storybooks, which present science concepts through narrative and illustration. Wijaya et al. (2024) developed a science-themed picture storybook tailored to third-grade students, validated by experts for content and practicality. While this is a promising innovation, the prior study was limited to formative evaluation without empirical testing of learning outcomes or motivational impact. Furthermore, few studies have explored how such narrative-based media affect multiple dimensions of science learning motivation, particularly in early elementary education. The present study addresses this gap by testing the effectiveness of the picture storybook using a comprehensive set of motivation indicators, adapted from McClelland's Achievement Motivation Theory and Deci & Ryan's Self-Determination Theory, including desire and willingness to succeed, need for learning, future aspirations, recognition, learning interest, and environmental support (Suari et al., 2022). In addition, the storybook used in this study is characterized by its localized cultural context, age-appropriate illustrations, and science concepts embedded within two-page stories, offering a distinct and innovative design aligned with elementary-level cognitive and affective development (Dewi et al., 2022; Sutherland, 2009; Ratminingsih et al., 2020; Du et al., 2024).

The objective of this study is to examine the effectiveness of the picture storybook in enhancing science learning motivation among third-grade students at SD Negeri 5 Mas, Gianyar Regency, Bali. Third-grade students were chosen as the target group because this stage marks a critical period of transition in science learning—students begin engaging with more structured scientific content while still depending on concrete representations and narrative forms for comprehension. The six motivational aspects measured in this study: (1) desire and willingness to succeed, (2) motivation and need to learn, (3) future aspirations and goals, (4) recognition in learning, (5) activities that make learning interesting, and (6) a supportive learning environment—were selected to capture a broad and nuanced understanding of students' motivation

in the science classroom (Suari et al., 2022). Through this approach, the study aims to contribute both empirical evidence and theoretical insight into how narrative-based, culturally grounded learning media can support science education in the early grades.

METHOD

Research Design

This study applied a quasi-experimental method with a one-group pretest-posttest design, where students' science learning motivation was measured before and after the use of a picture storybook intervention. This design is suitable for small-scale classroom-based studies where control groups are not feasible due to logistical constraints (Campbell & Stanley, 1963). Although this model has limitations in internal validity—such as maturation and testing effects—it remains effective for preliminary evaluations of instructional interventions in authentic educational settings. To enhance clarity, the structure of the research design is illustrated in Table 1, where O_1 is pretest measurement of science learning motivation; X is intervention using the science picture storybook during classroom learning; and O_2 is posttest measurement after the intervention.

Tabel 1. One-Group Pretest-Posttest Research Design

Pretest	Intervention using picture storybook	Posttest
O1	X	O2

Participants

This research was conducted at SD Negeri 5 Mas, Gianyar Regency, Bali Province, with a total of 17 third-grade students in the 2024/2025 academic year. The saturated sampling technique was employed, in which all members of the accessible population were included in the study (Sugiyono, 2022). While saturated sampling is appropriate for small populations, the sample size is relatively limited, which restricts the generalizability of the findings. The results may reflect the specific socio-cultural, academic, and environmental conditions of the study site and cannot be assumed to represent all elementary students. Future studies involving larger and more diverse samples are necessary to confirm the broader applicability of the intervention.

Instruments and Procedures

The instrument used in this study was a science learning motivation questionnaire adapted from Suari et al. (2022), based on McClelland's Achievement Motivation Theory and Self-Determination Theory by Deci & Ryan. The questionnaire consisted of 22 positively framed statements distributed across six motivational aspects: Desire and willingness to succeed; Motivation and need to learn; Future aspirations and goals; Recognition in learning; Interest in learning activities; Supportive learning environment.

Responses were recorded on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). The questionnaire underwent both expert validity testing, achieving a Gregory score of 1.00 (very valid), and empirical validity testing via product moment correlation, with all items scoring above the critical r-value. Reliability analysis using Cronbach's Alpha yielded a coefficient of 0.946, indicating high internal consistency. The instrument's blueprint is presented in Table 2.

Table 2. Science Learning Motivation Questionnaire Blueprint

No	Aspect	Items
1	Desire and willingness to succeed	1, 2, 3, 4, 5, 6
2	Motivation and need to learn	7, 8
3	Future aspirations and goals	9, 10, 11, 12, 13
4	Recognition in learning	14, 15, 16
5	Activities that make learning interesting	17, 18, 19, 20
6	Supportive learning environment	21, 22

Description of the Picture Storybook (Intervention)

The intervention used in this study was a science-themed picture storybook developed by Wijaya et al. (2024), designed specifically for third-grade elementary students. The storybook integrates science concepts into short, engaging narratives supported by colorful illustrations, aimed at improving students' intrinsic motivation and conceptual understanding. Each story consists of two pages and includes the following features: (1) culturally contextual themes, drawn from students' everyday experiences (e.g., local environment, family life); (2) visual storytelling using vivid illustrations tailored to the cognitive level of young learners; (3) simple and clear language, integrating IPAS concepts relevant to the grade level; and (4) opportunities for guided reading and teacher-led discussion, supporting apperception, concept reinforcement, and science literacy. Figure 1 shows the example of picture storybooks used in this study.

Figure 1. Picture Storybook used in learning treatment

Data Analysis

Data analysis was conducted using both descriptive and inferential statistical techniques. Descriptive statistics were used to calculate the mean scores and classify motivation levels based on score intervals from Basam (2022). Inferential statistics included: (1) paired sample t-tests to assess significant differences between pretest and posttest scores; (2) normalized gain scores (g) to measure the relative increase in motivation effectiveness (Nurcahyati, 2012); and (3) Cohen's d to determine the effect size of the intervention, offering a practical interpretation of its impact.

Prior to the t-test, normality assumptions were tested using the Kolmogorov–Smirnov and Shapiro–Wilk methods. All p-values exceeded 0.05, confirming that the data were normally distributed and appropriate for parametric testing. All statistical analyses were conducted using SPSS 17 for Windows with a 5% significance level.

Ethical Statement

This study was conducted with ethical approval from school authorities at SD Negeri 5 Mas, Gianyar Regency, Bali. Participation involved third-grade students, with informed consent obtained from their parents or guardians. Students were informed of the study's purpose, and their participation was voluntary with the right to withdraw at any time. The intervention and data collection posed minimal risk, using a validated and reliable motivation questionnaire suited to the students' age. Anonymity and confidentiality were maintained throughout. The picture storybook used was educationally appropriate, culturally relevant, and integrated into regular classroom activities. All procedures followed ethical standards for research involving minors, in accordance with the Declaration of Helsinki.

RESULTS AND DISCUSSION

Description of Pre-test Results on Science Learning Motivation

The pre-test phase of this study aimed to establish the baseline level of students' motivation toward science learning before the intervention with picture storybooks. The results are presented in two main tables: Table 3 provides an overall summary of motivation scores and their distribution into predefined categories, while Table 4 details the performance across six motivational sub-aspects.

Table 3. Pre-test Science Learning Motivation Scores

Pre-test Score and Frequency						
No	Aspect	Score	Criteria	Criteria	F	%
1	Highest Score	55.45	Moderate	Very High	0	0.00
2	Lowest Score	40.90	Low	High	0	0.00
3	Average Score	47.27	Low	Moderate	1	5.88
4				Low	16	94.12
5				Very Low	0	0.00

Table 3 illustrates the central tendencies and categorical distribution of the pre-test scores. The highest recorded score was 55.45, while the lowest was 40.90, resulting in an average score of 47.27. These scores are mapped onto a motivation classification rubric, showing that the entire cohort fell predominantly within the "low" motivation category. Specifically, 94.12% of students were categorized as having low motivation, and only 5.88% reached the moderate category. Notably, no student scored within the

high or very high motivation categories, underscoring the critical need for motivational intervention at this stage.

Table 4. Pre-test Science Learning Motivation Scores Per Aspect

No	Aspect of Science Learning Motivation	Highest Score	Lowest Score	Average Score
1	Desire and Willingness to Succeed	56.66	33.33	45.68
2	Motivation and Need to Learn	70.00	30.00	47.64
3	Future Aspirations and Goals	60.00	40.00	48.70
4	Recognition in Learning	60.00	33.33	49.80
5	Activities that Make Learning Interesting	65.00	25.00	47.64
6	Supportive Learning Environment	60.00	20.00	43.52

Table 4 disaggregates the motivation scores into six specific components: (1) desire and willingness to succeed, (2) motivation and need to learn, (3) future aspirations and goals, (4) recognition in learning, (5) engagement in interesting learning activities, and (6) the influence of a supportive learning environment. The average scores for these aspects ranged from 43.52 to 49.80, with the lowest motivation observed in the "supportive learning environment" aspect and the highest in "recognition in learning." This suggests that external acknowledgment may play a more pivotal role in students' science learning motivation than environmental support, which was notably lacking.

The dispersion of scores across all aspects reflects a uniformly low motivational baseline, thereby reinforcing the relevance of the study's proposed intervention. These findings highlight a critical motivational deficit across multiple dimensions of science learning, justifying the implementation of pedagogical strategies aimed at fostering both intrinsic and extrinsic motivation.

Description of Post-test Results on Science Learning Motivation

Following the picture storybook-based intervention, the posttest assessment demonstrated significant positive shifts in students' science learning motivation, both in general and across specific motivational domains. Tables 5 and 6 encapsulate the transformative effects of the intervention, revealing a marked elevation in motivation levels.

The summary data from Table 5 indicate a dramatic improvement in students' motivational standings. The average posttest score surged to 77.96, positioning the cohort squarely within the "high" motivation category—a stark contrast to the pre-intervention average of 47.27 categorized as "low." No student scored in the low or very low categories post-intervention, suggesting that the instructional strategy had a uniformly positive effect. Furthermore, 17.64% of students achieved "very high" motivation scores (above 85), while the remaining 82.36% attained "high" motivation levels (scores ranging from 70.90 to 85.44). This distribution reflects a substantial upward shift in student engagement and enthusiasm for science learning, effectively eliminating the previously dominant low motivation segment.

<div align="center">**Table 5.** Post-test Science Learning Motivation Scores</div>

| Post-test Score and Frequency						
No	Aspect	Score	Criteria	Criteria	F	%
1	Highest Score	85.45	Very High	Very High	3	17.64
2	Lowest Score	70.90	High	High	14	82.36
3	Average Score	77.96	High	Moderate	0	0.00
4				Low	0	0.00
5				Very Low	0	0.00

Based on Table 6, the post-intervention assessment reveals substantial gains across all six aspects of science learning motivation, underscoring the comprehensive impact of the picture storybook approach on students' motivational dynamics. Post-intervention results revealed marked improvements in all six aspects of students' science learning motivation. The most notable gain was in Activities That Make Learning Interesting, which achieved the highest average score of 88.23—indicating that the picture storybook approach significantly enhanced students' enjoyment and engagement with science. Similarly, Supportive Learning Environment rose sharply to 78.82, suggesting that students felt more encouraged and supported during learning, likely due to the interactive and inclusive nature of the intervention.

<div align="center">**Table 6.** Post-test Science Learning Motivation Scores Per Aspect</div>

No	Aspect of Science Learning Motivation	Highest Score	Lowest Score	Average Score
1	Desire and Willingness to Succeed	86.66	63.33	75.88
2	Motivation and Need to Learn	80.00	50.00	70.00
3	Future Aspirations and Goals	88.00	64.00	75.29
4	Recognition in Learning	93.33	60.00	77.64
5	Activities that Make Learning Interesting	100.00	65.00	88.23
6	Supportive Learning Environment	100.00	50.00	78.82

Contrasted with the pre-test results, where all motivational dimensions were rated low (averaging around the mid-40s), the post-test scores, ranging from 70.00 to 88.23, demonstrate a comprehensive uplift. Particularly striking is the complete elimination of "low" and "very low" categories across the board, with 100% of students reaching either "high" or "very high" motivation levels. These changes affirm the effectiveness of the storybook-based strategy in boosting both intrinsic motivation (e.g., desire to succeed, future goals) and extrinsic factors (e.g., recognition, learning environment).

These changes are visually reinforced in Figure 2, which compares the average, maximum, and minimum motivation scores between pre-test and post-test conditions. The graphical representation enhances readability and allows a more intuitive understanding of the motivational gains. It clearly illustrates the upward shift in all central tendency indicators, confirming the overall improvement across the sample.
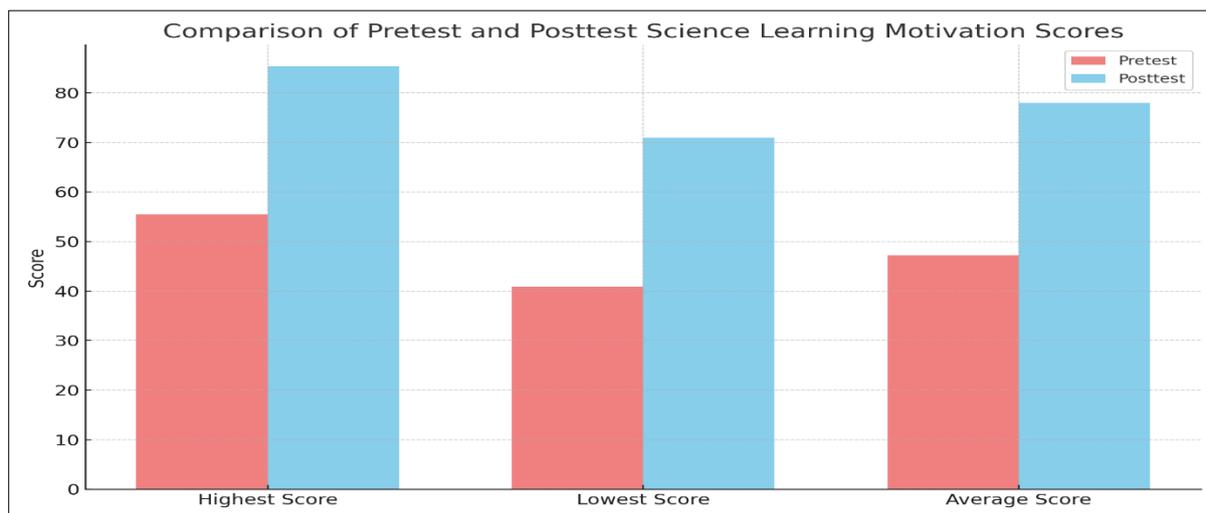
Figure 2. Comparison of Pre-test and Post-test Science Learning Motivation Scores

Statistical Analysis Results

Next, hypothesis testing was conducted using the paired sample t-test. Before conducting the paired sample t-test, normality tests were performed on the pre-test and post-test scores. The results of the normality tests are presented in Table 7.

Table 7. Normality Test Results

Data	Kolmogorov Smirnov			Shapiro Wilk		
	Statistic	df	sig	Statistic	df	sig
Pretes	0.120	18	0.200	0.968	18	0.758
Postes	0.122	18	0.200	0.939	18	0.278

The data in Table 7 show that both the pretest and posttest data have Kolmogorov Smirnov and Shapiro Wilk significance values greater than 0.05, indicating that the data is normally distributed. The hypothesis test was then performed using the paired sample t-test. The results of the test are presented in Table 8.

Table 8. Paired Sample T-Test Results

	Mean	t	df	Sig (2-tailed)
Pair 1 Pretes-Posttes	-30.20889	-17.725	17	0.000

Statistical analysis using the paired sample t-test (Table 8) yielded a significance value of 0.000 ($p < 0.05$), indicating a statistically significant increase in motivation following the intervention. Additionally, the normalized gain score was 0.42, falling within the moderate effectiveness category (Nurcahyati, 2012). The Cohen's d effect size was calculated at 2.86, suggesting a very large effect based on educational research standards (Cohen, 1988).

Discussion

These results affirm the positive impact of picture storybooks as a motivational tool in science learning. The moderate gain score, coupled with the large effect size, suggests that while the intervention produced meaningful improvements, further

refinement and integration with other strategies (e.g., discussion, hands-on learning) could amplify its effectiveness. The data also reflect how visual-narrative learning media aligns with students' cognitive development at the elementary level. By embedding science concepts into stories supported by illustrations, the storybook reduced perceived complexity and increased enjoyment—factors consistently linked to learning motivation (Dewi, Jampel, & Parmiti, 2022; Putri & Suniasih, 2022). The results support previous findings that narrative-based interventions are effective in making science learning more relatable and engaging (Hsieh et al., 2023; Du et al., 2024).

The observed increase in students' motivation to learn science can be empirically rationalized through established educational principles that emphasize the role of engagement, relevance, and affect in learning. The picture storybook used in this study combines narrative, visuals, and contextual familiarity, all of which are recognized elements that contribute to intrinsic motivation—especially in early childhood and primary education. According to Deci and Ryan's Self-Determination Theory, intrinsic motivation is fostered when learners experience a sense of autonomy, competence, and relatedness. The storybook supports autonomy by allowing students to engage with material through self-directed silent reading. It enhances competence through simplified, developmentally appropriate language that scaffolds understanding of science concepts, and builds relatedness by connecting scientific content to students' everyday lives and cultural context (Suari et al., 2022; Dewi, Jampel, & Parmiti, 2022).

Moreover, the use of narrative and illustration aligns with dual coding theory (Paivio, 1990), which posits that combining verbal and visual information improves processing and retention. The vivid, context-rich illustrations in the storybook likely helped students construct mental models of abstract science concepts, reducing cognitive load and increasing engagement (Dewi et al., 2022; Putri & Suniasih, 2022; Latipah, 2023). This finding is further supported by Hsieh et al. (2023), who reported that visual-narrative storybooks based on the 5E model significantly enhanced scientific thinking in young learners. Similarly, Kao et al. (2016) found that colorful, interactive reading materials increased student interest and chromatic concept understanding in elementary settings. These studies emphasize that aesthetically engaging, meaningfully contextualized media can serve as powerful motivational tools—particularly for students with limited prior exposure to formal science learning environments. In the current study, the highest gain was observed in the "interest in learning activities" aspect, suggesting that engagement was a key driver of the motivational improvement. This aligns with the work of Dewi et al. (2022), who found that integrating science content into familiar, imaginative narratives significantly boosts motivation and comprehension in elementary classrooms.

These results resonate with previous studies conducted in various cultural and educational contexts. For example, Hsieh et al. (2023) demonstrated that the use of picture books based on the 5E model significantly enhanced scientific thinking among first-grade students in Taiwan. Similarly, Hui et al. (2020) found that English picture books incorporating positive psychology improved motivation among young ESL learners in Hong Kong. Du et al. (2024) and Zhang et al. (2023) also reported increased reading motivation and comprehension in Malaysia when using augmented reality storybooks.

While these international findings align with the present study in terms of general outcomes, it is essential to note that the success of such interventions is often shaped by cultural and contextual factors. In the Indonesian setting, where science is often taught through conventional lecture methods, the use of storybooks represents a significant pedagogical shift. The integration of local cultural themes and visual storytelling in the intervention likely contributed to its effectiveness, making science more relatable and enjoyable for students. However, in more developed or digitally advanced educational systems, similar interventions might interact differently with student expectations, prior exposure, and curriculum structures. Thus, while the results are promising, their transferability to other contexts must consider differences in teacher practices, curriculum rigidity, student literacy levels, and resource availability.

The present study is also framed within two key motivational theories—McClelland's Achievement Motivation Theory and Deci & Ryan's Self-Determination Theory—which offer a strong foundation for interpreting the observed changes. The increase in motivation across all six measured aspects suggests that the intervention not only addressed students' cognitive interest in science but also supported their psychological needs for competence, autonomy, and relatedness, which are central to sustained motivation.

Limitations

Despite these encouraging findings, several limitations must be acknowledged. First, the use of a one-group pretest-posttest design without a control group limits the internal validity of the study. While statistical improvements were evident, it is not possible to entirely rule out alternative explanations such as testing effects, maturation, or external influences unrelated to the intervention. Including a control group in future studies would allow for stronger causal claims about the effectiveness of the storybook. Second, the sample size of only 17 students from a single school restricts the external validity and generalizability of the results. The participants may not represent the diverse range of students across different schools, regions, or socio-economic backgrounds in Indonesia. As such, these results should be interpreted as exploratory and context-specific. Future research with larger, more diverse samples across multiple schools would be valuable to validate and extend the present findings. Lastly, the study did not evaluate long-term retention or sustained motivation over time. While short-term gains were evident, longitudinal studies would help determine whether the motivational effects persist across subsequent science learning experiences.

CONCLUSION

This study provides evidence that the use of picture storybooks in science learning can meaningfully enhance students' motivation at the elementary level. Beyond the statistical improvements, the findings underscore the importance of using narrative-based, visually engaging, and culturally relevant materials to create a more enjoyable and meaningful science learning experience. The intervention responded not only to students' cognitive needs but also addressed emotional and contextual dimensions of learning, aligning with contemporary motivational and instructional design theories. By integrating science concepts into familiar stories with age-appropriate illustrations, the storybook offered a pedagogical alternative to

traditional, text-heavy instruction. This approach helped students see science as accessible, relevant, and engaging. As such, the study contributes to the growing body of research advocating for contextual and student-centered media in science education, especially for early-grade learners who benefit from concrete and imaginative content delivery. While the results are promising, their generalizability remains limited by the study's small scale and lack of a control group. However, the outcomes suggest strong potential for picture storybooks to serve not only as supplementary materials but also as core components of motivation-oriented science instruction. Future research is encouraged to explore this approach in more diverse school settings and to examine long-term impacts on learning outcomes and scientific literacy development.

RECOMMENDATIONS

Based on the findings and limitations of this study, several concise recommendations can be made. Practically, science picture storybooks are recommended as an effective alternative medium for elementary science instruction, particularly in classrooms with low motivation and limited resources. These books are suitable for activities such as concept introduction, reinforcement, and promoting science literacy. Educators and curriculum designers should develop science content that is both accurate and engaging—imaginative, culturally relevant, and visually rich—to foster student interest.

Theoretically, the integration of Self-Determination Theory and McClelland's Achievement Motivation Theory into this study highlights the importance of addressing both cognitive and affective domains in learning. Storybooks can fulfill students' needs for autonomy, competence, and relatedness, supporting intrinsic motivation. Future studies should explore other media formats, such as digital storytelling, comics, or augmented reality, to evaluate alternative ways of enhancing motivation.

To improve generalizability, further research should use experimental or mixed-method designs with larger, more diverse samples. Longitudinal studies are needed to assess lasting impacts on motivation and academic achievement. Additionally, examining how factors such as gender, reading skills, and prior science interest influence outcomes could offer deeper insights into how media-based interventions interact with learner characteristics.

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