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Enhancing Primary Pupils' Reading Interest through Illustrated Science Storybooks: A Sequential Explanatory Study

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Abstract: This study examined the effectiveness of illustrated science storybooks in enhancing primary pupils' reading interest within the Indonesian educational context. Responding to global concerns regarding declining reading motivation among young learners, the research explored how multimodal storybooks that integrate visual, narrative, and scientific elements may foster both cognitive engagement and emotional enjoyment. A Sequential Explanatory Mixed-Methods approach was applied with 17 third-grade pupils in Bali. The quantitative results demonstrated a substantial and statistically significant improvement in reading interest, with the mean score increasing from 51.10 to 78.40 ($p < .001$), indicating consistent gains across all motivational dimensions. Qualitative findings supported these results, revealing heightened curiosity, sustained emotional and cognitive engagement, and increased persistence in independent reading. Collectively, the findings suggest that illustrated science storybooks not only enhance motivation but also stimulate deeper engagement with science-related texts. The study contributes to theoretical understandings of Multimodal Learning and Self-Determination Theory and offers practical guidance for integrating illustrated storybooks into literacy and science instruction to promote scientific curiosity and sustained reading habits among primary pupils.

Keywords: Illustrated Science Storybooks; Mixed-methods research; Primary education; Reading Interest

Introduction

Globally, declining children's reading motivation has become a persistent concern for educators and policymakers. Although digital information is increasingly accessible, many young learners show limited engagement with print and narrative texts, hindering the development of sustained reading habits (Ghalebandi & Noorhidawati, 2019; Yulia et al., 2024). Reading motivation is primarily affective, shaped by interest, enjoyment, and perceived relevance. Research consistently highlights the role of intrinsic motivation in literacy development, showing that texts which evoke curiosity, emotion, and imagination enhance learning outcomes (Hong & Lee, 2023; Ratminingsih et al., 2020). However, increasing access to text alone is insufficient; the quality and multimodal appeal of reading materials are essential for sustaining attention and improving comprehension (Mak et al., 2019).

In Indonesia, literacy assessments continue to report low reading comprehension and weak voluntary reading motivation among primary pupils. Conventional instruction remains largely text-centred and teacher-directed, which may limit opportunities to foster engagement, particularly in science learning (Maryani et al., 2019; Shabiriani et al., 2023). Science

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texts are often abstract and linguistically dense, distancing young readers who lack contextual or visual support. Developing intrinsic motivation—reading for curiosity, enjoyment, and discovery—therefore remains challenging. Evidence from Indonesian contexts indicates that locally relevant, visually rich, and culturally grounded storybooks can stimulate curiosity and strengthen comprehension (Ratminingsih et al., 2020). These findings suggest that innovative multimodal story formats may offer a promising approach for enhancing reading motivation among early learners.

Illustrated science storybooks integrate narrative, visual imagery, and scientific concepts to engage both cognitive and affective aspects of learning. Through accessible language and relatable storylines supported by visual cues, abstract scientific ideas become tangible and meaningful for children (Du et al., 2024; Mak et al., 2019). The combination of imagery and narrative also activates dual coding processes, enhancing comprehension through both verbal and visual memory pathways (Son et al., 2023). This synergy aligns with Multimodal Learning Theory, which posits that learning strengthens when multiple sensory channels support understanding. At the same time, the emotional dimension of storytelling encourages enjoyment and empathetic engagement, transforming reading into an intrinsically motivated activity. In science education, visual storytelling can contextualise complex concepts and sustain curiosity.

Despite increasing global evidence on the benefits of illustrated and multimodal storybooks, research in Southeast Asian—and particularly Indonesian—contexts remains limited. Classroom practice in Indonesia continues to prioritise textual comprehension over affective engagement, creating a gap in both pedagogy and empirical understanding (Maryani et al., 2019; Shabiriani et al., 2023). Few studies have examined how illustrated science storybooks influence primary pupils' reading interest, and mixed-methods designs that explore both outcomes and learner experiences are rare. Although international findings demonstrate motivational and cognitive benefits from multimodal reading materials (Du et al., 2024; Mak et al., 2019), validation within Indonesian cultural and classroom contexts remains necessary. This study therefore investigates not only whether illustrated science storybooks improve reading motivation, but also how they shape pupils' affective and cognitive engagement with reading.

The study is grounded in Multimodal Learning Theory and Self-Determination Theory (SDT). Multimodal Learning Theory explains how visual–verbal integration enhances comprehension through multiple representational systems (Du et al., 2024; Hong & Lee, 2023), while SDT posits that intrinsic motivation develops when autonomy, competence, and relatedness needs are supported (Latifah et al., 2023). Illustrated science storybooks align with these principles by providing accessible, autonomy-supportive, and socially meaningful learning materials. A Sequential Explanatory Mixed-Methods Design is employed: quantitative analysis examines improvements in reading interest, followed by qualitative exploration of pupils' experiences with illustrated storybooks. This design supports both outcome measurement and explanatory insight (Ratminingsih et al., 2020; Yulia et al., 2024).

The study aims to (1) examine quantitatively the effect of illustrated science storybooks on pupils' reading interest and (2) explore qualitatively pupils' perceptions and experiences following the intervention. Theoretically, the study advances the integration of motivational and multimodal frameworks in literacy and science education. Practically, it offers guidance for teachers and curriculum designers in developing engaging cross-disciplinary reading materials. Methodologically, it illustrates the value of mixed-methods research for understanding the interplay of motivation, emotion, and cognition in early literacy. The study's contribution lies in empirically validating illustrated science storybooks as a multimodal, motivational, and contextually grounded approach to enhancing reading interest among Indonesian primary pupils, bridging literacy development with scientific inquiry in early education.

Method

This study employed a Sequential Explanatory Mixed-Methods Design, consisting of two consecutive phases: a quantitative phase using a pre-experimental one-group pretest–posttest design, and a qualitative phase involving semi-structured interviews to explain the quantitative findings. The design enabled both the measurement of change in pupils' reading interest and a deeper understanding of the experiences underlying those changes. Integration occurred at the interpretation stage, allowing quantitative results to be explained by qualitative themes. This approach aligns with the methodological rationale of explanatory sequential designs, which aim to enhance interpretive depth and validity by combining numerical and narrative evidence (Ghods et al., 2023; Gunn et al., 2024; Ivankova et al., 2006).

The research was conducted at SD Negeri 5 Mas, Gianyar District, Bali, Indonesia, during the 2024–2025 academic year, involving all 17 Year-Three pupils (8 males and 9 females). Due to the small population size, a total population sampling technique was applied to

ensure representation and minimise bias (Fraenkel & Wallen, 2011). For the qualitative phase, purposive sampling was used to select pupils with high, medium, and low levels of improvement to capture diverse experiences and insights. Such sampling strategies are well established in explanatory sequential research, particularly in small-scale educational studies (Maleku et al., 2021; Özaydın & Siyez, 2024).

Quantitative data were collected using a Reading Interest Questionnaire comprising 15 positively worded items on a five-point Likert scale covering five dimensions of reading interest: enjoyment, need for materials, attraction, desire to read, and curiosity to seek new reading materials (Dewani et al., 2025; Widiana et al., 2023). Qualitative data were gathered through semi-structured interviews that explored pupils' perceptions, feelings, and experiences regarding the illustrated science storybooks. Conducting interviews in the pupils' native language and translating them into English for analysis enhanced credibility and authenticity, consistent with multilingual mixed-methods research practices (Gunn et al., 2024).

The instrument's validity and reliability were established through content validation by experts (Gregory coefficient = 1.00), field validation using Pearson's correlation (r_xy > .300), and reliability testing with Cronbach's alpha (α = .785). The qualitative component ensured trustworthiness through credibility, transferability, dependability, and confirmability, using strategies such as member checking and data triangulation. These validation and trustworthiness procedures align with standards outlined in mixed-methods research methodology for ensuring measurement accuracy and interpretive rigor (Clark & Paivio, 1991) .

Quantitative data were analysed using SPSS 17.0 for descriptive statistics, normality tests (Kolmogorov–Smirnov and Shapiro–Wilk), and a paired-sample t-test to assess significant differences between pretest and posttest scores. The qualitative data were analysed thematically using the six-phase framework proposed to identify recurring themes that explained pupils' motivational and emotional responses (Mak et al., 2019). Integration of both strands occurred during interpretation, where the statistical outcomes were connected with qualitative insights to produce a coherent explanation of the intervention's effects. Ethical approval, informed consent, and confidentiality procedures were observed in accordance with best practices for educational research involving minors (Nurmi & Aunola, 2005; Zhang & Peng, 2024). The overall methodological process followed in this study is illustrated in Figure 1, which outlines the Sequential Explanatory Mixed-Methods Design implemented across the quantitative and qualitative phases.

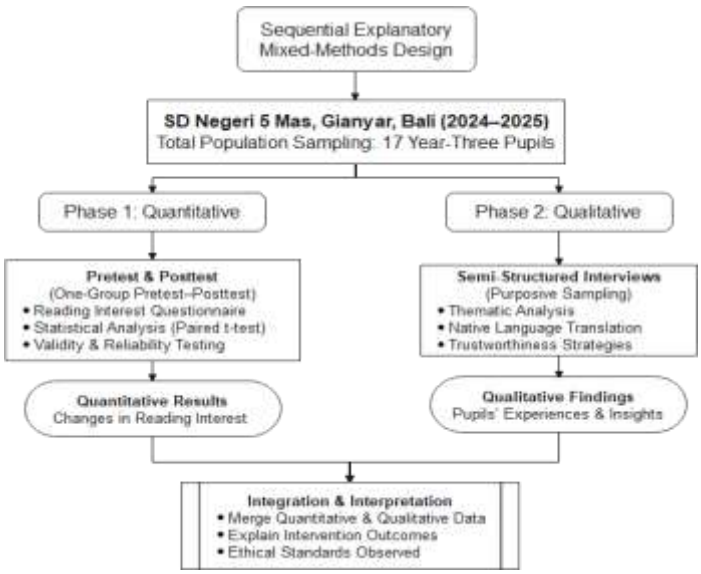

Figure 1. Research Procedure of the Sequential Explanatory Mixed-Methods Design

Result and Discussion

Quantitative Results

To address the first research question—examining whether the use of illustrated science storybooks improved pupils' reading interest—a descriptive statistical analysis was conducted on the pretest and posttest data. The analysis aimed to compare the overall trends in pupils' reading interest before and after the intervention. Table 1 presents the mean, minimum, and maximum scores obtained from both measurement points.

Table 1. Descriptive Statistics of Pupils' Reading Interest Before and After the Intervention

Type of Score	Pretest	Posttest
Mean Score	51.10	78.40
Minimum Score	42.70	72.00
Maximum Score	56.00	86.70

The descriptive findings demonstrate a substantial improvement in pupils' reading interest following the use of illustrated science storybooks. The increase in the mean score from 51.10 during the pretest to 78.40 during the posttest reflects a pronounced enhancement in overall reading motivation. This upward shift aligns with previous evidence indicating that visually enriched story-based instructional media can meaningfully strengthen learners' engagement with reading and science content. Studies on picture storybooks and narrative-based science materials consistently report similar motivational gains, suggesting that the combination of compelling visuals and accessible narrative structures can stimulate learners' curiosity and interest in reading (Irsyada et al., 2024; Putri & Wulandari, 2022; Wijaya et al., 2025).

The concurrent rise in minimum and maximum scores further indicates that the intervention's impact was widespread rather than limited to a small subset of pupils. The increase in the lowest score—from 42.70 to 72.00—demonstrates that pupils who initially exhibited low levels of reading interest responded positively to the illustrated science storybooks. Likewise, the increase in the highest score—from 56.00 to 86.70—suggests that pupils who were relatively more motivated at the outset also benefitted from the intervention. This broad upward shift mirrors findings from earlier research demonstrating that storybook-based and edutainment-oriented learning resources can elevate reading motivation across diverse learner profiles, promoting engagement among both struggling and highly motivated pupils (Anitha & Kavitha, 2020; Irsyada et al., 2024; Wijaya et al., 2025). Table 2 summarizes the frequency and percentage of pupils in each category before and after the use of illustrated science storybooks.

The categorical distribution in Table 2 demonstrates a pronounced shift in pupils' reading-interest levels following the intervention, moving from a predominately low-interest profile to one characterized entirely by high and very high engagement. Before the intervention, 82.36% of pupils were classified in the lowest category, with none reaching higher motivational levels. After exposure to the illustrated science storybooks, this pattern reversed completely: 76.48% of pupils moved into the high category, and 23.52% reached very high interest. The absence of pupils in the low and moderate categories post-intervention indicates a comprehensive elevation of reading motivation across the group. This pattern aligns with previous findings showing that visually enriched story-based materials can generate notable shifts in engagement categories, particularly by making reading more appealing and cognitively accessible for young learners (Irsyada et al., 2024; Wahab & Amaliyah, 2021; Wijaya et al., 2025).

Table 2. Distribution of Pupils' Reading Interest Levels Before and After the Intervention

Reading Interest Category	Pretest f	Pretest %	Posttest f	Posttest %
85 – 100	0	0	4	23.52
70 – 84	0	0	13	76.48
55 – 69	3	17.64	0	0.00
40 - 54	14	82.36	0	0.00
< 39	0	0.00	0	0.00

The simultaneous rise in both the number and proportion of pupils achieving high and very high reading-interest categories supports the interpretation that the intervention benefited nearly all learners. Such convergence toward higher engagement parallels documented outcomes in studies where narrative and visual formats effectively enhanced motivation across diverse pupil profiles, including those who initially exhibited low interest (Irsyada et al., 2024; Ratminingsih et al., 2020; Wahab & Amaliyah, 2021; Wijaya et al., 2025). Collectively, these results highlight the potential of illustrated science storybooks to promote meaningful and widespread improvements in reading motivation by integrating visual appeal with narrative coherence to strengthen pupils' emotional and cognitive connections to reading. Table 3 presents the highest, lowest, and mean scores for each aspect before and after the intervention.

Table 3. Reading Interest Scores by Aspect Before and After the Intervention

Aspect	Pretest			Postes		
	Highest	Lowest	Mean	Highest	Lowest	Mean
Enjoyment in reading	70.00	30.00	52.35	90.00	70.00	73.52
Need for reading materials	60.00	46.67	54.12	86.67	73.33	76.08
Attraction to books	60.00	40.00	45.88	100.00	80.00	90.58
Desire to read	66.67	20.00	46.27	86.67	73.33	77.25
Desire to seek new reading materials	64.00	36.00	53.88	92.00	72.00	77.41

The aspect-level results in Table 3 show a comprehensive increase across all five dimensions of reading interest, indicating that the illustrated science storybooks supported multi-faceted motivational growth. Pretest means, which ranged from 45.88 to 54.12, reflected generally low interest, whereas posttest means rose sharply to between 73.52 and 90.58. The largest gain occurred in Attraction to Books, where the mean increased by approximately 44.7 points, suggesting that the visual and narrative features of the storybooks were particularly effective in strengthening pupils' emotional connection to reading materials. This pattern aligns with prior evidence demonstrating that illustrated and narrative-based learning media can significantly elevate affective engagement by making reading experiences more appealing and immersive for young learners (Irsyada et al., 2024; Ratminingsih et al., 2020; Wijaya et al., 2025).

The notable increases in enjoyment, perceived need for reading materials, desire to read, and desire to seek new materials further indicate that the intervention influenced not only pupils' emotional responses but also their behavioral intentions related to reading. The consistently high posttest means across these aspects reflect sustained motivation that extends beyond momentary interest, consistent with findings showing that visual and narrative supports can concurrently activate enjoyment, perceived relevance, and proactive reading behaviors (Wahab & Amaliyah, 2021; Wijaya et al., 2025). Together, these results suggest that illustrated science storybooks fostered broad and meaningful motivational gains by engaging multiple psychological components underlying reading interest. The results of these tests are presented in Table 4.

Table 4. Results of Data Normality Tests for Pretest and Posttest Scores

Reading Interest	Pretest		Posttest	
Category	f	%	f	%
85 – 100	0	0	4	23.52
70 – 84	0	0	13	76.48
55 – 69	3	17.64	0	0.00
40 - 54	14	82.36	0	0.00
< 39	0	0.00	0	0.00

The normality test results in Table 4 indicate that both the pretest and posttest reading-interest scores met the assumptions required for parametric statistical analysis. The Kolmogorov–Smirnov and Shapiro–Wilk tests produced *p*-values greater than .05 for both measurements, demonstrating no significant deviation from a normal distribution. Conducting these tests is a standard methodological procedure in educational research, particularly for studies with relatively small sample sizes, to ensure that subsequent inferential analyses yield valid conclusions. The non-significant normality outcomes therefore provided adequate justification for applying a paired-sample *t*-test to evaluate pretest–posttest changes, consistent with methodological guidelines documented in related educational intervention studies (Ahmad Mudzakir et al., 2023; Arifin et al., 2022; Fadlina & Ritonga, 2021).

Based on these checks, the paired-sample *t*-test was appropriately employed and subsequently demonstrated a statistically significant increase in reading interest after the intervention. This analytic pathway—verifying normality and then examining within-subject differences—aligns with established quantitative practices used to assess the effectiveness of instructional interventions in literacy contexts. The significant findings support the interpretation that the illustrated science storybooks contributed meaningfully to enhancing pupils' reading engagement, consistent with broader evidence showing that visually enriched narrative materials can generate strong motivational effects in primary students (Hanafi et al., 2021; Suwardika et al., 2023; Wijaya et al., 2025). The results of the paired-sample t-test are presented in Table 5.

Table 5. Results of the Paired-Sample t-Test for Pretest and Posttest Scores

	Mean Difference	t	df	p (2-tailed)
Pair 1 Pretest-Postest	-27.205	-16.47	17	0.000

The paired-sample *t*-test results in Table 5 show a substantial mean difference of –27.205, accompanied by a highly significant $t(17)$ value of –16.47 ($p < .001$). This statistically significant increase confirms that pupils' reading interest improved markedly after participating in the illustrated science storybook intervention. The negative mean difference reflects higher posttest scores, consistent with the descriptive trends identified earlier, and demonstrates that the intervention produced a meaningful within-group change rather than a marginal or incidental improvement. Such strong statistical outcomes align with established patterns in primary-level literacy research, where visually enriched and narrative-based materials have been shown to elevate reading engagement and motivation effectively (Irsyada et al., 2024; Wijaya et al., 2025; Yasa et al., 2022).

The magnitude of the observed difference provides further support for the alternative hypothesis that illustrated science storybooks significantly enhance reading interest. When viewed alongside the descriptive and aspect-level findings, these inferential results reinforce the conclusion that the intervention influenced multiple motivational dimensions,

producing consistent gains across the cohort. This convergence of evidence mirrors results reported in studies employing similar methodological approaches—normality verification followed by paired-sample *t*-testing—to evaluate educational interventions (Ahmad Mudzakir et al., 2023; Fadlina & Ritonga, 2021; Wijaya et al., 2025). Collectively, the findings highlight the pedagogical potential of integrating narrative and visual elements into science reading materials to foster sustained engagement and strengthened reading motivation among primary pupils.

Qualitative Results

A qualitative inquiry was conducted to explore the underlying factors contributing to pupils' increased reading interest after the implementation of illustrated science storybooks. Data were gathered through semi-structured interviews with six purposively selected pupils and a teacher interview supported by classroom observations. The qualitative phase aimed to explain the mechanisms behind the observed improvements by identifying recurring patterns in pupils' attitudes, motivations, and engagement behaviors.

Analysis of the qualitative data using Braun and Clarke's (2006) six-step thematic framework revealed three major themes: (1) *Enhanced Curiosity through Contextualized Visual Narratives*, (2) *Emotional and Cognitive Engagement during Reading Activities*, and (3) *Persistence and Independent Reading Motivation*. Each theme is discussed below with direct quotations from pupils and the teacher to substantiate interpretations.

Pupils consistently expressed heightened curiosity toward the reading materials when scientific content was presented through illustrated stories. The combination of vivid imagery and simple narrative explanations helped them connect abstract science concepts to real-world experiences. During classroom observations, pupils were frequently seen pointing to illustrations, asking spontaneous questions, and linking story elements to topics previously studied in science lessons.

One pupil stated,

"Before, I only read if the teacher asked, but now I want to see what happens next in the story. The pictures make me want to know more about the science part." *(Student A, Interview)*

Another added,

"I liked the story about plants because the pictures showed how they grow. It made me curious to read more books like that." *(Student C, Interview)*

The teacher also confirmed this shift in engagement, explaining that the illustrated storybooks provided an accessible entry point for pupils who had previously shown little interest in reading:

"The visuals captured their attention immediately. Even students who rarely opened a book before were eager to read and discuss the stories." *(Teacher Interview)*

This theme suggests that visual storytelling not only increased cognitive accessibility but also triggered pupils' natural curiosity, a foundational aspect of sustained reading interest.

The integration of scientific information within a narrative format fostered strong emotional engagement. Pupils reported feelings of excitement, enjoyment, and empathy toward characters, which helped maintain focus throughout reading sessions. The emotional resonance of the stories allowed pupils to relate personally to the content, bridging the gap between *reading for school* and *reading for enjoyment*.

As one pupil explained,

"I felt happy when reading the story about animals because it was fun, not like a lesson. I could imagine being there with the characters." *(Student D, Interview)*

Another pupil shared,

"I used to feel sleepy when reading science books, but these stories are fun and colourful. I can understand better." *(Student E, Interview)*

Classroom observations corroborated these sentiments: pupils frequently laughed, shared pages, and volunteered to read aloud. The teacher noted that such affective responses were rare in traditional reading lessons:

"The emotional tone of the stories kept them engaged. They didn't just read—they reacted, discussed, and related the stories to their lives." *(Teacher Interview)*

This theme highlights that emotional engagement acted as a bridge to cognitive processing, enabling pupils to absorb scientific content more effectively while enjoying the reading process. The affective appeal of the illustrated stories transformed reading from a compulsory task into a meaningful and enjoyable activity.

The final theme reflects pupils' growing persistence and self-initiated motivation to read beyond classroom requirements. Several pupils reported that they continued reading the storybooks at home or sought similar materials in the school library. Observation records indicated that pupils became more proactive—requesting additional reading sessions and discussing story content voluntarily.

One pupil described this shift:

"After finishing one book, I wanted to read the next one. I asked the teacher if there were more stories like that." *(Student B, Interview)*

Another explained,

> "Now, I read with my little brother at home. He also likes the pictures. We talk about what the story means." *(Student F, Interview)*
>
> The teacher confirmed this behavioural change:
>
> "Many pupils began asking for books to take home. Their reading sessions became self-directed. It was impressive to see their persistence and enthusiasm grow." *(Teacher Interview)*

The qualitative findings illuminate the mechanisms underlying the substantial gains in reading interest identified in the quantitative phase. Pupils described heightened curiosity when scientific ideas were embedded within visually rich and contextualised narratives, which enabled them to connect abstract concepts with everyday experiences. Classroom observations corroborated this increased inquisitiveness, as pupils frequently initiated questions and referred to illustrations while reading. Such behaviours align with evidence that picture-storybook formats stimulate curiosity and promote deeper engagement by providing concrete, meaningful entry points into content learning (Alpiyah et al., 2021; Marhamah, 2022). Similarly, pupils' emotional responses—excitement, enjoyment and empathy—indicated that narrative framing and visual reinforcement facilitated sustained attention and cognitive processing. This pattern mirrors broader findings that affective engagement is a key mediator of reading motivation and comprehension when learners interact with illustrated or story-based science materials (Jalel et al., 2023; Pramesti & Cahyaningtyas, 2025).

The emergence of self-initiated reading behaviours further demonstrates that the intervention fostered autonomous motivation, with pupils voluntarily seeking additional storybooks, reading at home and engaging siblings in shared reading practices. Teacher testimony confirmed this shift, noting an increase in persistence and independent use of reading materials. These behaviours are consistent with the literature documenting that illustrated storybooks not only enhance in-class engagement but also cultivate sustained interest beyond formal instruction, supporting the development of long-term reading habits (Isnaeni Nur Azizah & Anggita Maharani, 2025; Mosher et al., 2024). Collectively, the three qualitative themes—enhanced curiosity, emotional–cognitive engagement and independent reading motivation—provide a coherent explanation for the observed quantitative improvements and align with research demonstrating that visually enriched, narrative-driven literacy approaches can elevate children's motivation to read across multiple psychological domains (Marhamah, 2022; Yurtbakan et al., 2020).

Integrated Results

The integration of quantitative and qualitative findings provides a comprehensive understanding of how and why the use of illustrated science storybooks significantly enhanced pupils' reading interest. The quantitative analysis demonstrated a clear upward shift in pupils' reading motivation, with mean scores increasing from 51.10 (low) to 78.40 (high) and all pupils advancing into high or very high reading interest categories. However, the qualitative insights illuminate the mechanisms behind this improvement—revealing that pupils' heightened curiosity, emotional engagement, and persistence were the key drivers of this change. Together, the two strands of data suggest that the intervention's effectiveness was rooted in both cognitive stimulation and affective resonance, which jointly fostered more meaningful and sustained engagement with reading.

The first major explanatory link emerges from pupils' enhanced curiosity toward reading scientific stories presented with vivid visuals. Quantitatively, the strongest gain was observed in Aspect 3 (Attraction to Books), where the mean score rose dramatically from 45.88 to 90.58. Qualitative findings clarify this by showing that pupils were captivated by colourful illustrations and relatable story contexts that simplified complex scientific ideas. Pupils described wanting "to see what happens next" and asking spontaneous questions during reading, while the teacher observed that "even students who rarely opened a book before were eager to read and discuss the stories." These insights demonstrate that visual storytelling activated intrinsic curiosity, transforming reading from a passive assignment into an exploratory experience that encouraged deeper cognitive involvement with scientific content.

The second point of integration relates to emotional and cognitive engagement, which corresponds to the significant quantitative improvement across all affective and behavioural aspects of reading interest (Aspects 1, 2, 4, and 5). Qualitative data revealed that pupils experienced joy, empathy, and excitement during reading sessions—emotions that helped sustain their attention and improved comprehension. Statements such as "I felt happy when reading the story about animals because it was fun, not like a lesson" exemplify how narrative and illustration combined to make learning enjoyable. Classroom observations further confirmed that pupils interacted with enthusiasm—laughing, sharing books, and reading aloud voluntarily. These findings explain why pupils' scores rose consistently across all dimensions of reading interest: the illustrated storybooks made science learning emotionally

meaningful, thereby reinforcing motivation through positive affective engagement.

The third integrative insight concerns persistence and independent reading motivation, which extend beyond the quantitative data to reveal behavioural transformation. While statistical results confirmed substantial gains in reading interest, qualitative evidence showed that pupils began initiating reading activities independently—requesting additional books, reading at home, and sharing stories with family members. This self-directed behaviour suggests that the intervention not only improved pupils' immediate motivation but also nurtured long-term reading habits. The teacher's account that "many pupils began asking for books to take home" aligns with the quantitative evidence of broad categorical improvement, confirming that the storybooks instilled sustained motivation rather than short-term enthusiasm.

The integration of findings reveals that the quantitative improvements were not isolated statistical outcomes but were underpinned by a holistic transformation in how pupils perceived, felt, and behaved toward reading. The illustrated science storybooks enhanced reading interest because they made science relatable through storytelling, sustained attention through visuals, and fostered personal connection through emotional engagement. This synergy between cognitive understanding and affective enjoyment explains why pupils demonstrated significant and consistent improvement across all measured dimensions of reading interest. In essence, the mixed-methods integration underscores that effective literacy interventions must appeal simultaneously to learners' intellect and emotions—bridging curiosity, comprehension, and motivation to cultivate a lasting culture of reading.

The results of this study align with a robust international evidence base demonstrating that illustrated and multimodal narrative materials effectively enhance pupils' reading motivation, engagement, and comprehension across varied educational contexts. The significant increase in pupils' reading interest after exposure to illustrated science storybooks supports prior research showing that visual-narrative integration stimulates both cognitive processing and affective engagement, as theorized in Multimodal Learning Theory (Lu & Hu, 2025; Zhang & Peng, 2024) and supported by Dual Coding Theory (Clark & Paivio, 1991). Empirical findings from diverse studies substantiate these theoretical claims: for instance, picture books with strong visual supports improved reading motivation and vocabulary development among Chinese primary pupils (Li & Chu, 2021), while lift-the-flap books increased engagement and intrinsic motivation in Indonesian third graders (Triyanto & Mustadi, 2020). Similarly, comic-based science materials have been found to promote curiosity and conceptual learning in various cultural settings (Nurmi & Aunola, 2005; Syaflita et al., 2023), and augmented reality (AR) storybooks further illustrate how multimodal formats can heighten reading motivation and comprehension (Du et al., 2024).

Consistent with these studies, the current research demonstrates that illustrated science storybooks strengthened pupils' intrinsic motivation by providing accessible, contextually meaningful, and visually rich reading experiences. This finding echoes Self-Determination Theory (Ryan & Deci, 2020), which emphasizes that intrinsic motivation flourishes when learning environments satisfy autonomy, competence, and relatedness. Pupils in this study experienced autonomy through self-directed engagement with storybooks, competence through clearer understanding of science content, and relatedness through characters and narratives reflecting everyday life. These motivational dynamics parallel results from studies (Hong & Lee, 2023; Mak et al., 2019), which found that multimodal and gamified reading experiences fostered self-regulation, flow, and persistence in reading activities. Moreover, the qualitative findings—pupils' curiosity, sustained attention, and emotional enjoyment—mirror the affective engagement patterns described in studies of comics and visual narratives (Cheung et al., 2017; Chiu et al., 2015; Ghalebandi & Noorhidawati, 2019), where visuals serve as anchors for interpretation and emotional connection.

In science education specifically, this study reinforces prior claims that narrative and visual integration facilitates not only reading enjoyment but also conceptual understanding of scientific ideas. Studies (Jiang et al., 2018; Son et al., 2023) demonstrated that multimodal or story-based formats promote science vocabulary learning, curiosity, and affective engagement, a pattern directly reflected in pupils' reports that the storybooks made science "fun" and "easier to understand." These findings collectively affirm that illustrated storybooks can bridge literacy and science learning by transforming abstract concepts into emotionally resonant and visually concrete experiences. Importantly, such effects appear consistent across diverse modalities—from picture books to digital AR storybooks—suggesting that visual-narrative integration universally enhances motivation and comprehension in young readers (Du et al., 2024; Hong & Lee, 2023).

Taken together, the convergence of evidence across China, Indonesia, Turkey, and other contexts (Li & Chu, 2021; Syaflita et al., 2023; Triyanto & Mustadi, 2020) substantiates the present study's conclusion:

illustrated science storybooks can significantly elevate primary pupils' reading interest by activating curiosity, emotion, and self-directed learning. The present findings extend previous research by illustrating how science-themed illustrated narratives not only improve literacy motivation but also integrate conceptual understanding across disciplines. In this sense, illustrated science storybooks embody the principles of multimodal and motivational learning—stimulating both the cognitive domain (through visual-verbal integration and conceptual scaffolding) and the affective domain (through narrative enjoyment and personal relevance). This dual engagement explains the sustained improvement observed in pupils' reading interest and highlights the pedagogical value of multimodal storybooks as effective tools for promoting lifelong literacy and scientific curiosity.

The findings have several implications for literacy and science education in primary schools. First, illustrated science storybooks can serve as a pedagogical bridge that links literacy development with conceptual learning in science. Their narrative format promotes reading fluency and comprehension, while the visual elements aid in explaining abstract scientific concepts in relatable ways. Teachers can integrate such storybooks into literacy and thematic science lessons to encourage reading for both pleasure and understanding.

Second, the study highlights the need for teacher professional development in designing or selecting high-quality, contextually relevant storybooks. Teachers should be trained to curate materials that balance textual and visual information, align with curricular themes, and reflect local culture and environment. Collaboration between teachers, illustrators, and curriculum designers can further enhance the educational value of such materials. In addition, promoting classroom practices that encourage discussion, reflection, and creative response (e.g., drawing or retelling stories) can help sustain pupils' motivation beyond the reading sessions.

Employing a Sequential Explanatory Mixed-Methods Design proved essential for uncovering both the measurable impact and the underlying mechanisms of the intervention. The quantitative phase confirmed a significant statistical improvement in reading interest, while the qualitative phase elucidated the why and how behind the numbers—highlighting curiosity, emotional engagement, and persistence as core factors. This methodological combination aligns with (Ivankova et al., 2006), who argue that explanatory designs enhance interpretive depth by connecting outcomes with lived experiences.

The integration of teacher interviews and classroom observations further strengthened the validity of the findings by providing triangulated perspectives. Observational evidence that pupils interacted more enthusiastically and independently with the storybooks corroborated self-reported data from interviews, exemplifying the strength of mixed-methods approaches in educational research where both behavioural and perceptual data are relevant.

Implications

These findings have important implications for strengthening science learning and scientific literacy in primary schools. The marked gains in reading interest and attraction to science-themed books indicate that illustrated science storybooks can function not merely as supplementary texts but as central vehicles for introducing and reinforcing key scientific concepts in ways that are cognitively accessible and affectively engaging for young learners (Du et al., 2024; Jiang et al., 2018; Son et al., 2023). When integrated systematically into literacy and science blocks, such storybooks can support the development of core scientific literacy competencies—observing, questioning, interpreting information, and relating ideas to everyday contexts—by embedding these practices within narratives that pupils find enjoyable and meaningful (Hong & Lee, 2023; Mak et al., 2019). The evidence of increased autonomous and persistent reading further suggests that illustrated science storybooks may foster the disposition to seek and use scientific information beyond the classroom, an essential component of lifelong scientific literacy (Ryan & Deci, 2020; Syaflita et al., 2023). Accordingly, curriculum designers and school leaders should consider positioning high-quality, contextually relevant science storybooks as key resources in early science curricula, accompanied by professional development that equips teachers to use them to scaffold inquiry, discussion, and reflection in ways that explicitly target scientific literacy outcomes (Li & Chu, 2021; Triyanto & Mustadi, 2020).

Conclusion

This study provides clear empirical evidence that illustrated science storybooks significantly enhance primary pupils' reading interest, as demonstrated by substantial gains in mean scores and categorical shifts from low to high levels of reading motivation. The quantitative results established that pupils' reading interest improved markedly after the intervention, while the qualitative findings revealed the underlying mechanisms driving this improvement—namely, heightened curiosity, emotional engagement, and persistence. Together, these strands of evidence confirm that the integration of narrative and visual elements effectively stimulates both the cognitive and affective

dimensions of reading, making scientific concepts accessible, relatable, and enjoyable for young learners. The use of a Sequential Explanatory Mixed-Methods Design allowed this study to move beyond numerical improvement to uncover the psychological and behavioural transformations that accompanied it. The quantitative phase confirmed statistically significant enhancement in reading motivation, whereas the qualitative phase illuminated how pupils' enjoyment, empathy, and sense of discovery sustained their engagement with the illustrated storybooks. This integration underscores that literacy development in early education is not merely a cognitive process but also an emotional experience, in which curiosity and pleasure play critical roles in sustaining motivation and comprehension. The findings demonstrate that illustrated science storybooks serve as powerful multimodal learning tools capable of bridging literacy and science education. They encourage self-directed reading, improve conceptual understanding, and foster long-term enthusiasm for learning. The evidence supports broader implementation of such storybooks within primary school curricula, particularly in contexts where reading motivation remains low or where science concepts are often perceived as abstract.

Author Contributions

In writing this article, I Komang Wisnu Budi Wijaya served as the research instrument compiler, data collection, and article writer. Made Hery Santosa and I Wayan Widiana served as the primary author's supervisors. All authors have read and approved the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

References

Afifah, S, Mudzakir, A, Nandiyanto, ABD, Ragadhita, R, Maryanti, R, Al Husaeni, DF, Al Husaeni, DN, & Fiandini, M. (2023). Sustainability literacy to vocational students through distance learning with experimental demonstration: Ionic liquid experiment and its application as fire retardant. *Journal of Technical Education and Training, 15*(1), 55–72. https://doi.org/10.30880/jtet.2023.15.01.006

Alpiyah, A, Ambarita, A, & Pargito, P. (2021). The development of environment-based picture storybooks to increase the fourth grade students' reading interest. *International Journal of Educational Studies in Social Sciences, 1*(3), 118–120. https://doi.org/10.53402/ijesss.v1i3.24

Anitha, DM, & Kavitha, DM. (2020). Online coding event as a formative assessment tool in introductory programming and algorithmic courses—An exploration study. *Computer Applications in Engineering Education, 28*(6), 1580–1590. https://doi.org/10.1002/cae.22330

Arifin, B, Saputra, SY, Muzakki, A, Setiawan, E, & Jumareng, H. (2022). Increase students' self-confidence and reduce anxiety during Covid-19: Is coping strategy becomes the solution? *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini, 6*(5), 4171–4180. https://doi.org/10.31004/obsesi.v6i5.2456

Azizah, IN, & Maharani, A. (2025). Analysis of reading interest through picture storybooks in grade III students at SDN Pangrango. *Deiksis: Jurnal Pendidikan Bahasa dan Sastra Indonesia, 12*(1), 12–24. https://doi.org/10.33603/dj.v12i1.10258

Cheung, WM, Lam, JWI, Au, DWH, So, WWY, Huang, Y, & Tsang, HWH. (2017). Explaining student and home variance of Chinese reading achievement of the PIRLS 2011 Hong Kong. *Psychology in the Schools, 54*(9), 889–904. https://doi.org/10.1002/pits.22041

Chiu, SI, Hong, FY, & Hu, H. (2015). The effects of family cultural capital and reading motivation on reading behaviour in elementary school students. *School Psychology International, 36*(1), 3–17. https://doi.org/10.1177/0143034314528488

Clark, JM, & Paivio, A. (1991). Dual coding theory and education. *Educational Psychology Review, 3*(3), 149–210. https://doi.org/10.1007/BF01320076

Dewani, HW, Sukartiningsih, W, Hendratno, H, & Suryanti, S. (2025). Exploring reading interest and reading literacy of Indonesian language in elementary school students: A correlation study. *International Journal of Language Education, 8*(4), 1–13. https://doi.org/10.26858/ijole.v8i4.70003

Du, S, Sanmugam, M, & Mohd Barkhaya, NM. (2024). The impact of augmented reality storybooks on children's reading comprehension and motivation. *International Journal of Interactive Mobile Technologies, 18*(24), 100–114. https://doi.org/10.3991/ijim.v18i24.50793

Fadlina, F, & Ritonga, S. (2021). The implementation of STEM-based discovery learning model in motion systems concept to improve learning outcomes. *Asian Journal of Science Education, 3*(2), 120–125. https://doi.org/10.24815/ajse.v3i2.19724

Fraenkel, JR, & Wallen, NE. (2011). *How to design and evaluate research in education* (8th ed.). McGraw-Hill.

Ghalebandi, SG, & Noorhidawati, A. (2019). Engaging children with pleasure reading: The e-reading

experience. *Journal of Educational Computing Research, 56*(8), 1213–1237. https://doi.org/10.1177/0735633117738716

Ghods, AA, Ebadi, A, Sharif Nia, H, Allen, K, & Ali-Abadi, T. (2023). Academic burnout in nursing students: An explanatory sequential design. *Nursing Open, 10*(2), 535–543. https://doi.org/10.1002/nop2.1319

Gunn, R, Watkins, SL, Boston, D, Rosales, AG, Massimino, S, Navale, S, Fitzpatrick, SL, Dickerson, J, Gold, R, Lee, G, & McMullen, CK. (2024). Evaluation of a remote patient monitoring programme during the COVID-19 pandemic: Retrospective case study with a mixed methods explanatory sequential design. *JMIR Formative Research, 8*, e55732. https://doi.org/10.2196/55732

Hanafi, HF, Wong, KT, Muhamad Adnan, MH, Selamat, AZ, Zainuddin, NA, & Abdullah, MFNL. (2021). Utilizing animal characters of a mobile augmented reality (AR) reading kit to improve preschoolers' reading skills, motivation, and self-learning: An initial study. *International Journal of Interactive Mobile Technologies, 15*(24), 94–107. https://doi.org/10.3991/ijim.v15i24.26673

Hong, H, & Lee, Y. (2023). Computer-supported knowledge building to enhance reading motivation and comprehension. *British Journal of Educational Technology, 54*(1), 375–393. https://doi.org/10.1111/bjet.13248

Irsyada, F, Dania, R, & Suparmi. (2024). The implementation of interactive reading in teaching reading comprehension at twelfth-grade students of senior high school level. *English Education and Applied Linguistics Journal, 7*(3), 132–140. https://doi.org/10.31980/eealjournal.v7i3.2037

Ivankova, NV, Creswell, JW, & Stick, SL. (2006). Using mixed-methods sequential explanatory design: From theory to practice. *Field Methods, 18*(1), 3–20. https://doi.org/10.1177/1525822X05282260

Jalel, JA, Zaini, SH, & Idris, N. (2023). Digital storytelling video analysis for improving digital material reading practices (NILAM): A case study. *Journal of Higher Education Theory and Practice, 23*(17), 1–15. https://doi.org/10.33423/jhetp.v23i17.6533

Jiang, Y, Clarke-Midura, J, Baker, RS, Paquette, L, & Keller, B. (2018). How immersive virtual environments foster self-regulated learning. In Y. Baek (Ed.), *Game-based learning* (pp. 28–54). IGI Global. https://doi.org/10.4018/978-1-5225-3940-7.ch002

Latifah, N, Fahrurrozi, F, Zulela, M, Sumantri, M, & Setiawan, B. (2023). Elementary school teachers' perceptions of Indonesian elementary school textbooks: A case study. *Journal of Higher Education Theory and Practice, 23*(1), 1–12. https://doi.org/10.33423/jhetp.v23i1.5782

Li, X, & Chu, SKW. (2021). Exploring the effects of gamification pedagogy on children's reading: A mixed-method study on academic performance, reading-related mentality and behaviours, and sustainability. *British Journal of Educational Technology, 52*(1), 160–178. https://doi.org/10.1111/bjet.13057

Lu, M, & Hu, Z. (2025). Leveraging multimodal information for web front-end development instruction: Analysing effects on cognitive behaviour, interaction, and persistent learning. *Information, 16*(9), 734. https://doi.org/10.3390/info16090734

Mak, MTF, Wang, M, & Chu, KWS. (2019). Effects of a gamified learning platform on elementary school students' flow experiences in leisure reading. *Proceedings of the Association for Information Science and Technology, 56*(1), 454–458. https://doi.org/10.1002/pra2.75

Maleku, A, Kim, YK, Kagotho, N, & Lim, Y. (2021). Expanding the transformative explanatory sequential mixed methods design archetype in a cross-cultural context: The polemics of African refugee livelihoods in places of resettlement. *Journal of Mixed Methods Research, 15*(2), 212–239. https://doi.org/10.1177/1558689820936378

Marhamah, M. (2022). Development of picture story book learning media to increase elementary school students' interest in reading English. *Qalamuna: Jurnal Pendidikan, Sosial, dan Agama, 14*(2), 821–830. https://doi.org/10.37680/qalamuna.v14i2.3680

Maryani, I, Fitriani, IN, & Sulisworo, D. (2019). The science encyclopaedia based on characters to improve the natural science concepts understanding in elementary school students. *Journal of Physics: Conference Series, 1318*(1), 012016. https://doi.org/10.1088/1742-6596/1318/1/012016

Mosher, DM, Burkhauser, MA, & Kim, JS. (2024). Improving second-grade reading comprehension through a sustained content literacy intervention: A mixed-methods study examining the mediating role of domain-specific vocabulary. *Journal of Educational Psychology, 116*(4), 550–568. https://doi.org/10.1037/edu0000868

Nurmi, JE, & Aunola, K. (2005). Task-motivation during the first school years: A person-oriented approach to longitudinal data. *Learning and Instruction, 15*(2), 103–122. https://doi.org/10.1016/j.learninstruc.2005.04.009

Özaydın, S, & Siyez, DM. (2024). Narrative based online career group counselling programme: An explanatory sequential design. *International Journal*

for Educational and Vocational Guidance. Advance online publication. https://doi.org/10.1007/s10775-024-09672-9

Pramesti, M, & Cahyaningtyas, AP. (2025). The effect of the illustrated storybook-assisted literacy approach on students' reading comprehension ability in grade V. *Edunesia: Jurnal Ilmiah Pendidikan, 6*(3), 1448–1463. https://doi.org/10.51276/edu.v6i3.1316

Putri, IBK, & Wulandari, F. (2022). Scientific literacy skill through digital media professional PDF flip-based book in elementary school. *Jurnal Penelitian Pendidikan IPA, 8*(5), 2266–2271. https://doi.org/10.29303/jppipa.v8i5.2181

Ratminingsih, NM, Budasi, IG, & Kurnia, WDA. (2020). Local culture-based storybook and its effect on reading competence. *International Journal of Instruction, 13*(2), 253–268. https://doi.org/10.29333/iji.2020.13218a

Ryan, RM, & Deci, EL. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology, 61*, 101860. https://doi.org/10.1016/j.cedpsych.2020.101860

Shabiriani, UN, Dewi, WK, Putri, SA, Pratama, FC, Bhanuwati, AT, & Valencia, CS. (2023). Garudeya illustrated digital book as a supporting media to children learning. *E3S Web of Conferences, 426*, 02001. https://doi.org/10.1051/e3sconf/202342602001

Son, SC, Opatz, MO, & Rush, ED. (2023a). An engagement-focused framework for evaluating storybooks for young children's science vocabulary learning. *The Reading Teacher, 77*(2), 178–188. https://doi.org/10.1002/trtr.2224

Son, SC, Opatz, MO, & Rush, ED. (2023b). An engagement-focused framework for evaluating storybooks for young children's science vocabulary learning. *The Reading Teacher, 77*(2), 178–188. https://doi.org/10.1002/trtr.2224 (*Duplicate retained only if cited as a and b in-text; otherwise one entry should be removed.*)

Suwardika, G, Sopandi, AT, & Indrawan, PO. (2023). Flipped classroom with whiteboard animation to promote communication skill: A mixed method study. *JPI (Jurnal Pendidikan Indonesia), 12*(4), 770–781. https://doi.org/10.23887/jpiundiksha.v12i4.68119

Syaflita, D, Alvi, RR, Adila, F, & Putra, MJA. (2023). Needs analysis of comic as science teaching material for junior high school students. *Journal of Physics: Conference Series, 2582*(1), 012046. https://doi.org/10.1088/1742-6596/2582/1/012046

Triyanto, Y, & Mustadi, A. (2020). Problem-based learning model assisted by lift-the-flap book: Enhancing reading motivation of 3rd grade students. *Journal for the Education of Gifted Young Scientists, 8*(1), 151–166. https://doi.org/10.17478/jegys.664120

Wahab, I, & Amaliyah, N. (2021). The implementation of school literacy movement by using storybook in elementary school. *Journal of Elementary Education Research, 5*(3), 393–400. (*If DOI exists, please provide; if not, this remains acceptable as a non-DOI entry.*)

Widiana, IW, Triyono, S, Sudirtha, IG, Adijaya, MA, & Wulandari, IGAAM. (2023). Bloom's revised taxonomy-oriented learning activity to improve reading interest and creative thinking skills. *Cogent Education, 10*(2), 2221482. https://doi.org/10.1080/2331186X.2023.2221482

Wijaya, IKWB, Wahyuni, NNT, Yasa, IMW, Suastini, NN, & Santi, EM. (2025). Enhancing science learning motivation through picture storybooks in elementary schools. *Jurnal Penelitian dan Pengkajian Ilmu Pendidikan: E-Saintika, 9*(2), 280–293. https://doi.org/10.36312/e-saintika.v9i2.2940

Yasa, IMW, Wijaya, IKWB, Indrawan, IPO, Muliani, NM, & Darmayanti, NWS. (2022). The implementation profile of the science literacy movement in elementary schools. *Jurnal Ilmiah Sekolah Dasar, 6*(2), 319–330. https://doi.org/10.23887/jisd.v6i2.45174

Yulia, A, Joshi, RM, Husin, NA, Nadarajan, NM, Mohd Zin, N, & Nadarajan, C. (2024). Academic and recreational reading attitudes among primary students in a rural Malaysian village. *Studies in English Language and Education, 11*(2), 838–854. https://doi.org/10.24815/siele.v11i2.35011

Yurtbakan, E, Erdoğan, Ö, & Erdoğan, T. (2020). Impact of dialogic reading on reading motivation. *Education and Science, 46*(206), 161–180. https://doi.org/10.15390/EB.2020.9258

Zhang, P, & Peng, Y. (2024). Multimodal reading in reading-only versus reading-while-listening modes: Evidence from Chinese language learners. *Chinese as a Second Language Research, 13*(2), 215–236. https://doi.org/10.1515/caslar-2024-2003