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The Effectiveness of Using Interactive Animation Media in Enhancing Interest in Science Learning in Primary Schools: Systematic Literature Review

Salma Khairunnisa*, Rohmani

Elementary Teacher Education Study Program, Universitas Muhammadiyah Kotabumi, Indonesia

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Corresponding Author:

khairunnisasalma622@gmail.com

ABSTRACT

Science learning in elementary schools is still dominated by conventional teacher-centered methods, which often result in low student motivation, boredom, and limited active participation in the learning process. However, science is a subject that contains many abstract concepts and therefore requires more engaging, interactive, and student-friendly learning media to support better understanding. This study aims to analyze the effectiveness of interactive animation media in improving students' interest in learning science at the elementary school level based on previous research. The method used is a Systematic Literature Review (SLR) guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework. Data were collected through literature searches in the Google Scholar and SINTA databases covering publications from 2021 to 2025. The search was conducted using the keywords "interactive animation media," "learning interest," "science learning," and "elementary school." The selected articles were then screened based on inclusion and exclusion criteria, resulting in 10 relevant studies for further analysis. The findings show that interactive animation media effectively increase students' attention, interest, participation, and enthusiasm in science learning. In addition, this media helps visualize abstract concepts in more concrete forms, making them easier for elementary school students to understand. The implications of this study indicate that interactive animation media can be used as an effective alternative learning tool to improve the quality of science learning; therefore, teachers should integrate it in a well-planned manner supported by adequate facilities and teacher training to ensure optimal implementation in the classroom. In conclusion, interactive animation media plays an important role in creating more effective, interactive, and enjoyable science learning in elementary schools.

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■ INTRODUCTION

Science education in elementary schools plays an important role in helping students understand scientific concepts while fostering their interest in various natural phenomena (Parong & Mayer, 2021). At the elementary school level, science learning is not only directed toward providing students with conceptual knowledge but also toward developing logical thinking skills, curiosity, observational skills, and the ability to solve simple everyday problems. Through science learning, students are introduced to various phenomena closely related to their environment, such as weather changes, plant growth, the circulatory system, and changes in the states of matter. Therefore, science education becomes one of the most important subjects in building students' scientific literacy from an early age.

At the elementary school age, students are in the concrete operational stage; therefore, they understand learning materials more easily when presented in a concrete, engaging, and experience-based manner. At this developmental stage, students tend to have difficulty understanding abstract concepts when they are explained only verbally, without appropriate learning media. Therefore, science learning requires approaches that connect abstract concepts to concrete visual representations, enabling students to understand the material more effectively. Science education is intended not only to help students master subject content but also to develop critical thinking and basic problem-solving skills for daily life (Han, 2021). Thus, science learning processes need to be designed interestingly and interactively so that students can actively participate throughout the learning

activities

However, in practice, science learning in elementary schools is still frequently conducted using conventional methods, such as lectures and textbooks as the primary learning resources (Han, 2021). Teachers still dominate the learning process, while students tend to listen only to explanations and do not actively participate in learning activities. Monotonous learning methods cause students to become less engaged and less interested in the material being delivered (Mou, 2023). This condition indicates that the learning process has not fully created an active and enjoyable learning environment for elementary school students. In addition, overly teacher-centered learning can make students passive and reduce their opportunities to explore knowledge independently.

Some science topics that are abstract in nature, such as blood circulation, the water cycle, or changes in the states of matter, are often difficult for students to understand when explained only verbally, without engaging learning media (Makransky & Mayer, 2022). Under these conditions, students often struggle to imagine the processes being studied because the material is delivered only through oral explanations or textbook descriptions. As a result, students quickly become bored and experience a decline in attention during learning. Such conditions may eventually cause students to lose interest in science learning (Lai & Hwang, 2016). If this situation continues, the objectives of science learning in developing conceptual understanding and scientific thinking skills will be difficult to achieve optimally

Learning interest is one of the most important aspects in the success of the learning process. Learning interest can be understood as students' feelings of enjoyment and attraction toward learning activities, which encourage them to participate without coercion (Huang et al., 2021; Garcia & Fernandez, 2025). Learning interest is also closely related to attention, motivation, curiosity, and students' active involvement during the learning process. Students with high learning interest tend to demonstrate enthusiasm, focus on the material being studied, and have a strong desire to understand the lessons more deeply.

Students with learning interests are generally more focused, active, and enthusiastic during classroom activities. They also tend to be more eager to ask and answer questions and to complete assigned tasks (Rosser & Chalk, 2026). In contrast, students with low learning interest are usually passive, inattentive to the teacher, easily distracted, and lack strong motivation to participate in learning activities. Therefore, learning interest becomes an important indicator that should receive attention in elementary school science learning. When students have a strong interest in learning, the learning process can be more effective because they are actively involved both physically and mentally.

One common problem in elementary schools is students' low interest in learning science. Many students appear passive, uninterested, and easily bored during classroom activities. Low learning interest may be influenced by several factors, such as monotonous teaching methods, limited use of engaging learning media, insufficient learning facilities, and the lack of varied learning activities that actively involve students. This condition is often caused by the limited variation of methods and learning media used to attract students' attention (Sumanti et al., 2025). If this situation continues, the learning process will become less optimal, and science learning objectives will be difficult to achieve. Therefore, more creative efforts are needed to improve students' learning interest (Korkmaz & Correia, 2019)

Several previous studies have shown that the use of interactive animation media in science learning can help improve students' interest in learning (George et al., 2023; Guo & Zhang, 2022; Kalemkus & Kalemkus, 2023). Animated media is considered effective in attracting students' attention because it presents material visually and dynamically, making it more interesting than conventional explanations (George et al., 2023). Interactive animation media allows students to observe scientific processes or phenomena more realistically by combining images, text, sound, and movement. Consequently, students can understand learning materials more easily because abstract concepts are presented in more concrete visual forms.

In addition, interactive animations with quizzes or simulations can make students more active and engaged during learning (Guo & Zhang, 2022). Interactivity in learning media provides opportunities for students to participate directly throughout learning activities. Students do not merely receive information passively; they can also explore materials, answer questions, run simulations, and receive immediate feedback from the media they use. Such conditions can increase students' attention and engagement, making the learning process more meaningful (Kalemkus & Kalemkus, 2023; Liu et al., 2020).

Nevertheless, findings from previous studies remain scattered and have not been

comprehensively summarized in a systematic review (Kalemkus & Kalemkus, 2023; Liu et al., 2020). Most previous studies only discussed the effectiveness of interactive animation media in specific contexts or particular science topics. Furthermore, there are still differences among studies regarding which indicators of learning interest improved after the implementation of interactive animation media. Therefore, a more systematic review is needed to synthesize previous findings and provide a clearer overview of the effectiveness of interactive animation media in elementary school science learning.

Based on this, this study focuses on the effectiveness of interactive animation media in enhancing elementary school students' interest in science learning. This study specifically highlights indicators of learning interest, such as attention, curiosity, enjoyment, and student engagement in the teaching process. Thus, this research not only discusses learning outcomes but also emphasizes learning interest as a crucial factor in science education.

Based on the above description, the research questions for this study are: (1) what are the characteristics of interactive animation media in elementary school science education, as indicated by published research findings; (2) how does interactive animation media influence elementary school students' interest in science learning; and (3) which indicators of learning interest show improvement through the use of interactive animation media. The purpose of this study is to analyze and summarize the results of previous research on the application of interactive animation media in elementary school science lessons using the Systematic Literature Review (SLR) method. Through the SLR approach, this study aims to provide a clearer, more comprehensive description of the effectiveness of interactive animation media in increasing interest in learning science among elementary school students.

■ METHOD

Research Design

This study employed a Systematic Literature Review (SLR) approach guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework. The PRISMA guidelines were applied to ensure that the processes of searching, screening, selecting, and analyzing articles were conducted systematically, transparently, and in a scientifically accountable manner (Xu et al., 2019). The SLR approach was selected because it provides a comprehensive overview of prior research on the implementation of interactive animation media in elementary school science learning, particularly regarding its impact on students' learning interest. In addition, this approach helps identify research trends, reveal research gaps, and provide a foundation for future studies (Al-Zubidy & Carver, 2019)

Search Strategy

Data collection was conducted through literature searches in the Google Scholar, SINTA, and Scopus-indexed international journal databases. Google Scholar was used to broadly identify articles. In contrast, SINTA and Scopus were used to ensure the quality of the selected studies, particularly articles with SINTA accreditation of at least 3 or Scopus indexing. The search was limited to articles published between 2021 and 2025. The search process employed a Boolean search string to systematically obtain relevant articles. The search query used was: ("interactive animation media" OR "animated video" OR "interactive multimedia") AND ("learning interest" OR motivation OR engagement) AND ("science learning" OR "science education" OR IPA) AND ("elementary school" OR "primary school"). Furthermore, the article search and selection procedures followed the PRISMA flow, which includes the stages of identification, screening, eligibility, and inclusion until suitable articles were obtained for analysis.

Inclusion and Exclusion Criteria

The articles selected in this study were determined based on predefined inclusion and exclusion criteria. The inclusion criteria consisted of: (1) articles discussing interactive animation media in elementary school science learning; (2) articles published between 2021 and 2025; (3) articles accredited at a minimum of SINTA 3 or indexed in Scopus; and (4) articles reporting findings related to students' learning interest, learning motivation, or learning outcomes. Meanwhile, the exclusion criteria included: (1) articles irrelevant to the research topic; (2) conference proceedings, undergraduate theses, or non-journal scientific works; (3) articles that were not available in full text; and (4) articles containing insufficient data or inadequate discussion for further analysis. Based on this selection process, 10 articles met the criteria and were considered suitable for analysis.

The data extraction process was conducted manually using a Microsoft Excel-based data matrix to facilitate the organization and synthesis of information from each article. The extracted data included authors' names,

publication year, research objectives, research methods, characteristics of the interactive animation media, science content taught, research findings, and research recommendations. In addition, quality assessment was conducted by considering the topic's relevance, the clarity of the research methods, the completeness of the research data, and the alignment of the findings with the SLR's focus. Articles with unclear methods, incomplete data, or discussions irrelevant to the research objectives were excluded during the eligibility screening stage. Therefore, the analyzed articles were considered to have sufficient quality and relevance to support the research synthesis.

Data Analysis

The selected articles were then analyzed descriptively based on several aspects, including research objectives, research methods, media characteristics, science content taught, research findings, and research recommendations. In addition, the synthesized findings were categorized into major themes emerging from the selected studies, such as increased learning interest, learning motivation, student engagement, and understanding of abstract concepts through interactive animation media. This analysis aimed to provide a more systematic overview of the use of interactive animation media in improving the quality of science learning at the elementary school level.

The PRISMA flowchart illustrates the systematic article selection process conducted through Google Scholar, SINTA, and Scopus-indexed international journals using the keyword "Interactive Animated Media," which initially yielded 652 articles. The articles were then limited to publications from 2021–2025 and further filtered using the keywords "Interest in Learning," "Science," and "Elementary School," resulting in 109 articles. During the eligibility stage, articles were selected based on inclusion and exclusion criteria, namely scientific journal articles relevant to the use of interactive animation media in elementary school science learning, available in full text, and at least accredited at the SINTA 3 level or indexed in Scopus (Q1–

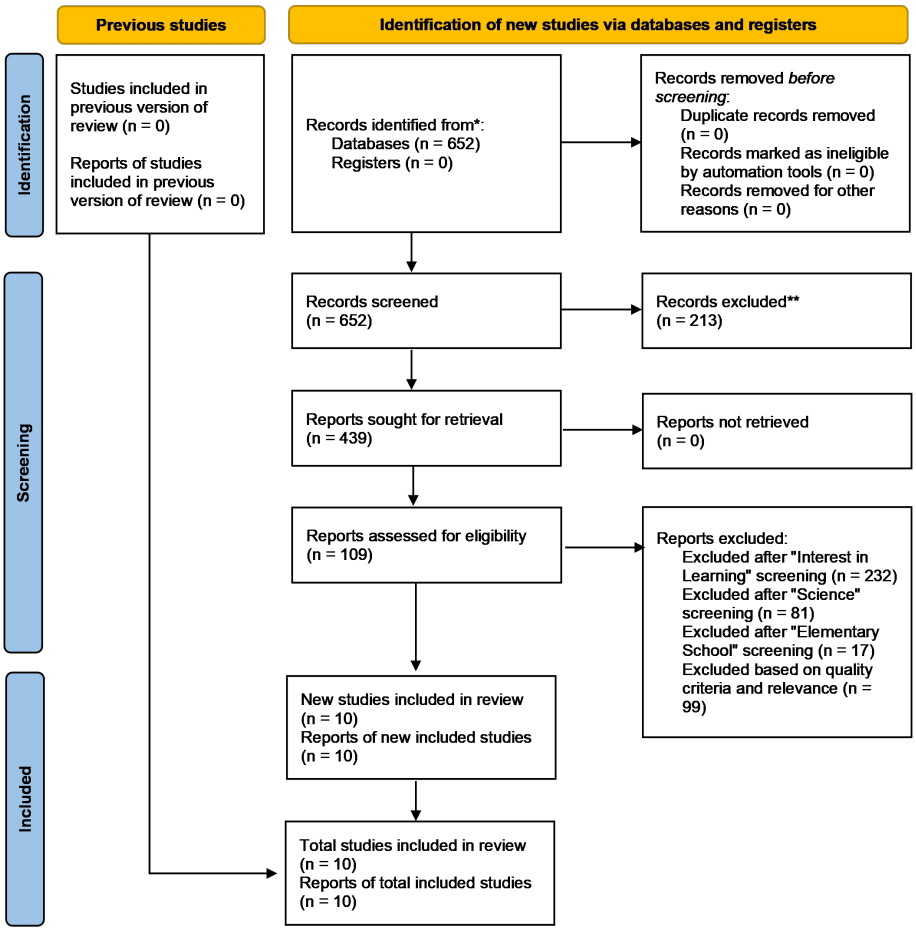

Figure 1. PRISMA flowchart

Q4). Conference proceedings, book chapters, undergraduate theses, dissertations, non-journal scientific works, duplicate articles, and studies with irrelevant topics or insufficient research data were excluded from the selection process. After completing the identification, screening, eligibility, and inclusion stages in accordance with the PRISMA flow, 10 articles were deemed eligible for further analysis.

■ RESULT AND DISCUSSION

The data for this study were sourced from scientific articles relevant to the study's focus. The search was conducted via Google Scholar, SINTA, and international journals indexed in Scopus. In the initial stage, several articles were obtained and then classified into books, conference proceedings, and scientific articles. However, this study focuses only on indexed scientific articles, specifically those with a minimum SINTA 3 or Scopus indexing, as they are deemed to better meet the quality standards for analysis using the Systematic Literature Review (SLR) approach.

The articles analyzed were identified using the keywords "Interactive Animated Media," "Interest in Learning," "Science," and "Elementary School," and were limited to the years 2021–2025 to examine the latest research developments. The publication trends during this period are then presented in Figure 2 as an overview of the development of studies on the application of interactive animated media to foster interest in learning science in elementary schools.

There has been an increase in publications on Google Scholar discussing interactive animated media to foster interest in learning science among elementary school students from 2021 to 2025. In 2021, there were 12 articles, increasing to 13 articles in 2022, then decreasing to 10 articles in 2023. This number rose significantly again in 2024 to 21 articles, then peaked in 2025 at 53 articles. This indicates that 2025 had the highest number of publications on this topic.

Thus, based on the results of the literature review for the period 2021 to 2025, it is evident that publications regarding interactive animated media in elementary school science lessons have shown fairly consistent annual growth in the Google Scholar, SINTA, and Scopus databases. This indicates that interactive animated media is increasingly gaining attention as a learning innovation at the elementary school level. Based on the percentage of articles discussing interactive animated media in enhancing interest in learning science in elementary schools from 2021 to 2025, there is a noticeable variation in the annual contribution of publications. In 2021, there were 12 articles, accounting for approximately 9% of total publications, which increased to 13 articles, or about 12%, in 2022. In 2023, the number decreased to 10 articles, or about 9%, but rose again in 2024 to 21 articles, or about 19%. The peak contribution occurred in 2025, with 53 articles, accounting for about 49%. These data indicate a growing interest among researchers in using interactive animation media to foster interest in science learning among elementary school students over time.

In line with these developments, this study analyzes the most relevant articles on interactive animation media in fostering interest in science learning at the elementary school level. In the Systematic Literature Review (SLR), a systematic screening was conducted to identify 10 articles that met the inclusion criteria and were suitable for further analysis. Unlike a linear presentation of findings, the results of this study are organized around emerging key themes derived from the synthesis of the selected articles, enabling the findings to address the formulated research questions directly. These thematic categories include increased student attention, enhanced learning interest and motivation, and improved understanding of abstract concepts through interactive animation media.

The results indicate that the effectiveness of interactive animation media in elementary school science learning is closely tied to the media characteristics identified in the 10 selected articles. Among these studies, the majority (Sa'adah et al., 2025; Imamah et al., 2025; Viorenica & Aprina, 2025; Hermita et al., 2021) demonstrate that interactive animation media, in the form of animated videos, hypermedia, and 3D animations, are effective in enhancing students' motivation, learning interest, and conceptual understanding in science. In addition, several studies, such as Hidayat & Rahmi (2025) and Sari et al. (2025), developed media integrated with instructional models such as Inquiry-Based Learning and Problem-Based Learning (PBL), which indirectly reflect alignment with modern learning principles that emphasize active learning and knowledge construction. However, not all articles explicitly state or design their media based on Cognitive Load Theory or Mayer's Multimedia Learning Theory. Therefore, the use of these theories in this discussion serves primarily as an interpretative framework for explaining the empirical findings derived from the studies analyzed (Sweller et al., 2011).

Furthermore, the synthesis of the 10

selected articles revealed that none of the studies explicitly stated that Mayer's Multimedia Learning Theory was the basis for the design of the developed media. Nevertheless, all the media exhibited characteristics consistent with Mayer's principles, including the integration of visual, audio, animated, and interactive elements (Mayer, 2009). These findings suggest that the effectiveness of interactive animation media in improving elementary students' learning outcomes, motivation, and learning interest is largely supported by the alignment of media features with students' learning needs, which indirectly reflects the principles of multimedia learning

Based on the analysis of the 10 selected articles, the studies were further categorized according to the types of media used. This classification aims to identify the most frequently employed forms of interactive animation media in elementary science learning. The distribution of media types used across the reviewed articles is presented in Figure 2 below.

Based on the distribution of articles according to the type of media used, 2D Animated Videos and Educational Games were the most frequently identified media types, with each appearing in two articles (Sa'adah et al., 2025; Imamah et al., 2025; Mutiara et al., 2025; Aman et al., 2025). Meanwhile, Interactive Video, Powtoon-based Media, Hypermedia, Interactive Digital Animation, 3D Animation, and Interactive Media were each represented by one article (Viorenica & Aprina, 2025; Hidayat & Rahmi, 2025; Apriliniawati & Yuliani, 2025; Hermita et al., 2021; Sari et al., 2025; Tristaningrat et al., 2024). These findings indicate that animation-based learning media and educational games are the most dominant approaches in elementary science education, as they are capable of presenting learning content in an engaging, interactive, and developmentally appropriate manner for elementary school students (Sa'adah et al., 2025; Imamah et al., 2025; Mutiara et al., 2025; Aman et al., 2025).

More specifically, the synthesis results indicate that the effectiveness of interactive animated media is significantly influenced by the alignment of the media's characteristics with the type of science content being taught. For concrete topics such as plant parts, 2D animated media with attractive colors and simple narration have proven effective in helping students visually recognize their structure and function (Imamah et al., 2025). Meanwhile, for more abstract topics such as heat transfer, the human digestive system, and human evolution, digital simulation-based media, interactive games, and 3D animations are more effective because they can visualize processes that are difficult to observe directly (Mutiara et al., 2025; Aman et al., 2025; Hermita et al., 2021). Furthermore, problem-based media, such as PBL animated videos and PBL-integrated 3D animations, have been shown to develop students' critical thinking and problem-solving skills by motivating active engagement during instruction (Sa'adah et al., 2025; Sari et al., 2025). This indicates that the selection of animation media needs to be tailored to the material's characteristics to ensure optimal benefits.

To identify the learning interest indicators most frequently enhanced by interactive animation media in elementary school science learning, an analysis was conducted of the findings from the 10 selected articles. The indicators of learning interest examined included attention, engagement, enjoyment, and curiosity. The results of this classification are presented in a stacked bar chart to illustrate the frequency with which each indicator was reported to improve through the

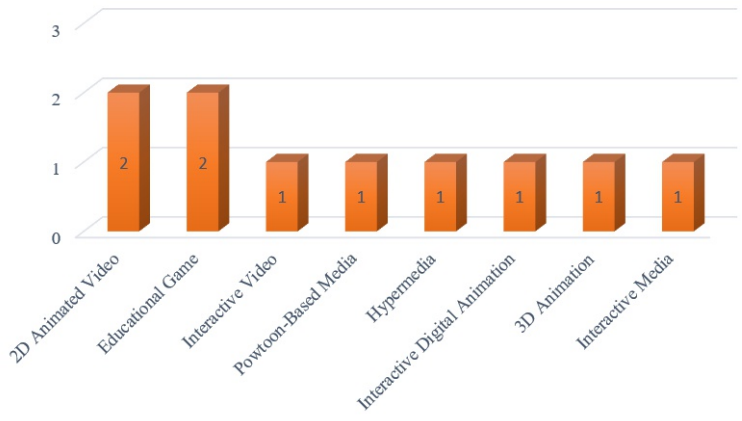

Figure 2. Types of interactive animation media used in the selected studies

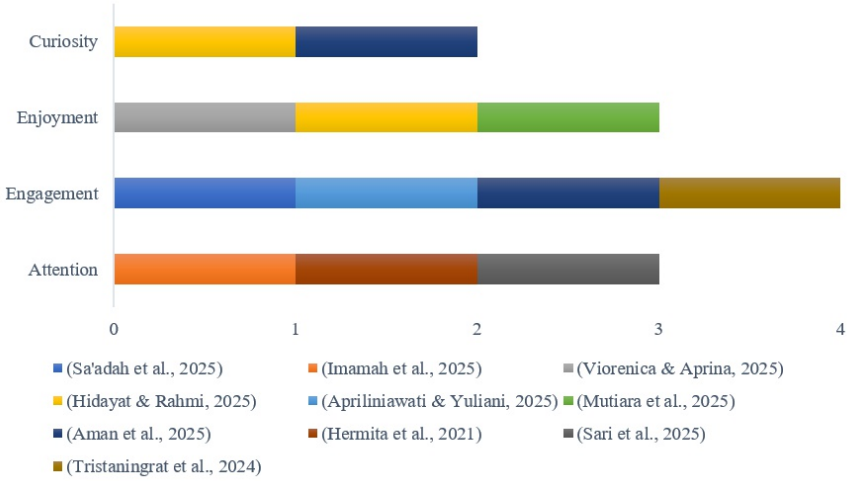

Figure 3. Learning interest indicators

implementation of interactive animation media, as shown in Figure 3.

Based on the figure above, Engagement was the learning interest indicator most frequently reported to improve through the use of interactive animation media, appearing in four studies (Sa'adah et al., 2025; Apriliniawati & Yuliani, 2025; Aman et al., 2025; Tristaningrat et al., 2024). Meanwhile, the indicators of Attention and Enjoyment were each identified in three studies (Imamah et al., 2025; Hermita et al., 2021; Sari et al., 2025; Viorenica & Aprina, 2025; Hidayat & Rahmi, 2025; Mutiara et al., 2025). In addition, Curiosity was identified in two studies (Hidayat & Rahmi, 2025; Aman et al., 2025). These findings suggest that interactive animation media is most effective in enhancing students' engagement during the learning process, followed by improvements in attention, enjoyment, and curiosity toward science learning (Sa'adah et al., 2025; Apriliniawati & Yuliani, 2025; Aman et al., 2025; Tristaningrat et al., 2024).

From an affective perspective, students' interest and motivation in learning through interactive animation media can be explained by Hidi & Renninger's (2006) Theory of Interest Development, which posits that learning interest involves attention, engagement, and the gradual development of sustained interest in learning activities. In addition, learning motivation can be explained through Keller's (1987) ARCS Motivation Model, which includes attention, relevance, confidence, and satisfaction as key components of the learning process. These theoretical concepts are also used in the study by Tristaningrat et al. (2024) as a framework for analyzing students' learning interest. Interactive animation media can attract students' initial attention through elements such as motion, color, audio, and interactivity, thereby helping them remain focused during the learning process. This is consistent with the findings of Viorenica & Aprina (2025), who reported an increase in fifth-grade students' interest in learning through interactive videos in integrated science. In addition, Sa'adah et al. (2025) found an increase in students' motivation to learn through Problem-Based Learning (PBL)-based animated videos, while Apriliniawati & Yuliani (2025) showed that video-based hypermedia can enhance student engagement in third-grade science learning. Thus, interactive animation media not only contribute to improvements in cognitive learning outcomes but also strengthen students' affective and motivational aspects in the learning process.

To identify the science topics most frequently addressed in studies of interactive animation media at the elementary school level, the science content across the 10 selected articles was categorized and analyzed. The topics included General Science, Integrated Science and Social Studies (IPAS), Plant Parts, the Human Digestive System, Human Evolution, Heat Transfer, Third-Grade Science, and Fourth-Grade IPAS. This analysis aims to provide an overview of the science topics that have received the greatest attention in the development and implementation of interactive animation media in elementary school learning, as presented in Figure 4

Based on the figure 4, General Science, Integrated Science, and Social Studies (IPAS) were the most frequently represented topics in the analyzed articles, each appearing in two studies (Sa'adah et al., 2025; Sari et al., 2025; Viorenica & Aprina, 2025; Tristaningrat et al., 2024). Meanwhile, Plant Parts, Human

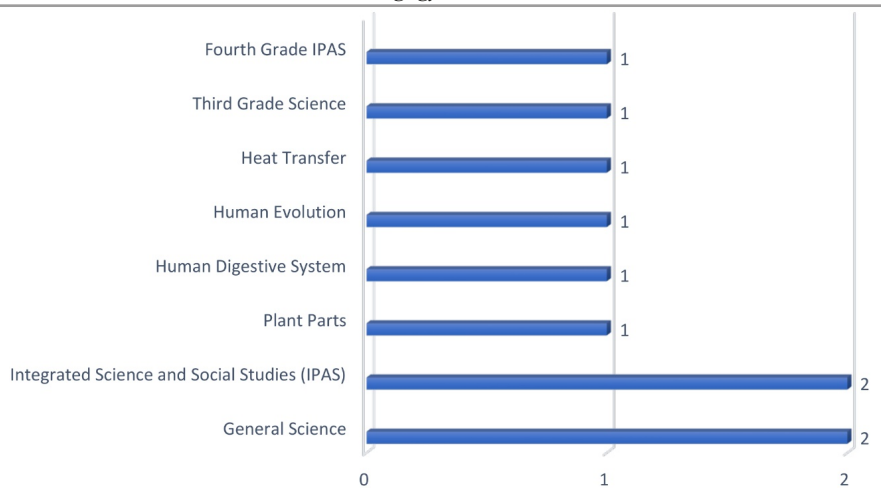

Figure 4. Science content covered in the selected studies

Digestive System, Human Evolution, Heat Transfer, Third-Grade Science, and Fourth-Grade IPAS were each represented in one study (Imamah et al., 2025; Mutiara et al., 2025; Aman et al., 2025; Hermita et al., 2021; Apriliniawati & Yuliani, 2025; Hidayat & Rahmi, 2025). These findings indicate that interactive animation media has been applied across a wide range of science topics at the elementary school level, including both general and specific content areas, demonstrating its broad potential to support conceptual understanding and enhance students' interest in learning science (Imamah et al., 2025; Mutiara et al., 2025; Aman et al., 2025; Hermita et al., 2021; Apriliniawati & Yuliani, 2025; Hidayat & Rahmi, 2025).On the other hand, the effectiveness of interactive animation media is further enhanced when combined with the appropriate learning model.

The use of the inquiry model supported by Powtoon has been shown to produce valid and practical instructional materials, as students are encouraged to discover concepts independently through visual stimuli and investigative questions (Hidayat & Rahmi, 2025). Similarly, the Numbered Heads Together (NHT) model supported by interactive media has been shown to improve learning outcomes because animated media facilitates group discussions and collaboration among students (Tristaningrat et al., 2024). These findings align with constructivist perspectives, which emphasize that understanding is built through active interaction among students in the learning environment. Therefore, animated media will be more effective if used not merely as a presentation tool, but as a means for interaction, discussion, and exploration of science concepts.

However, the integration of interactive animation media in elementary schools still faces several challenges, as identified through a synthesis of the 10 selected articles. The main challenges relate to teachers' ability to develop and operate animation-based media, such as Powtoon, hypermedia, and educational games, as well as infrastructure limitations, including access to digital devices, projectors, and stable internet connectivity. In addition, several studies indicate that the effectiveness of media depends on the alignment between media design and learning objectives. Media that are overly complex or poorly structured may distract students and increase cognitive load (Sweller et al., 2011). Therefore, the successful implementation of interactive animation media is influenced by the availability of supporting facilities, the quality of media design, and classroom readiness. Continuous teacher training, improved school infrastructure, and the development of simple yet pedagogically sound media are needed to support effective and sustainable implementation.

Analysis of the Use of Interactive Animation Media in Enhancing Interest in Science Learning in Elementary Schools

Science education in elementary schools plays a crucial role in building students' mastery of scientific concepts and in developing their critical and creative thinking skills (Greussing et al., 2020). However, various studies indicate that science education is still conducted conventionally, dominated by lecture-based methods and rote memorization, resulting in students who are often passive and struggle to connect the material to real-world experiences (Fatchurahman et al., 2022; Sari et al., 2025). This situation contributes to a decline in interest in learning and is inconsistent with students' mastery of the subject matter. Therefore, more interactive teaching strategies that capture students' attention are needed.

One approach is to integrate interactive animation media into science lessons. This media helps students grasp abstract concepts through dynamic, engaging visual presentations, making them easier to understand and fostering greater interest in learning (Ibáñez et al., 2020; Crompton et al., 2016). Topics such as ecosystems, changes in the state of matter, or food chains can be visualized more clearly, allowing students to observe the processes and relationships between concepts. The use of interactive animation media also encourages students to actively observe, experiment, and discuss, thereby fostering the development of their thinking skills and creativity.

Not only that, but the characteristics of effective interactive animated media in science education need to be better understood to ensure their optimal use. Effective media not only feature engaging animations but are also designed in accordance with learning principles, such as alignment with learning objectives, students' cognitive development levels, and the clarity of information presentation. From the perspective of Multimedia Learning theory, media that integrate visual and verbal elements are easier for students to understand (Mayer, 2009). Furthermore, according to Cognitive Load Theory, the presentation of information must minimize unnecessary cognitive load so that students can focus on the core content (Sweller et al., 2011). Therefore, key characteristics of interactive animation media include a simple yet engaging interface, interactivity that encourages active participation, and relevance to students' daily lives.

Interactive animated media offers several benefits for science education. First, it helps students master concepts by presenting the material in more visual and tangible ways (Ramasany et al., 2022). Second, they foster critical and creative thinking skills by encouraging students to analyze and solve problems through interactive displays (Silva et al., 2023; Murod et al., 2021). Third, it encourages communication and cooperation through discussions or group work. Additionally, the learning atmosphere becomes more engaging, thereby increasing student interest and participation (Schnotz & Rasch, 2005; Bond et al., 2021).

On the other hand, indicators of students' interest in learning through the integration of interactive animation media also need to be explained in a more structured manner to enable clear measurement. In general, interest in learning can be observed in several key aspects: attention, engagement, enjoyment, and curiosity (Hidi & Renninger, 2006). Attention is demonstrated through students' focus on learning; engagement is evident from their active participation in activities; and enjoyment is reflected in their enthusiasm and positive attitude during learning. Curiosity, meanwhile, is evident from students' drive to explore the material further or ask questions. With these clear indicators, the measurement of learning interest is not merely subjective but can be supported by observational data and instruments such as questionnaires.

However, the use of interactive animation media also presents several challenges, such as limited facilities, limited instructional time, and teachers' lack of skills in operating digital media (Kong & Wang, 2024). Therefore, effective planning, adequate resource support, and teacher training are necessary to ensure these media are utilized to their full potential. Comprehensive learning evaluations must also be conducted to ensure that learning objectives are met, both in terms of conceptual mastery and increased interest in learning (Crompton et al., 2016).

Based on the results of the systematic literature review, the use of interactive animation media has theoretical and practical implications (Hwang et al., 2020; Garcia & Fernandez, 2025). Theoretically, these findings support the view that students learn better when they are actively engaged and have meaningful learning experiences (Lai & Hwang, 2016). Interactive animated media can bridge abstract scientific concepts, making them more concrete and increasing interest in learning (Sumanti et al., 2025). Practically, the results of this study can serve as a reference for teachers in designing more engaging science lessons, as well as for schools to provide the necessary facilities and training support (Mou, 2023; Sari et al., 2025).

Consequently, this study has several limitations, particularly regarding the number and scope of articles analyzed, as well as the heterogeneity of research designs across the reviewed studies. Based on the synthesis, most of the included articles employed quasi-experimental and instructional media development designs; however, many did not include a strong control group or used only pre-experimental designs, which limits the strength of the evidence regarding the media's effectiveness. In addition, variations in measurement instruments, intervention duration, and sample characteristics across studies may have affected the consistency of the synthesized findings. Furthermore, several studies focused more on cognitive learning outcomes rather than students' learning interest

and social skills. Therefore, future research is recommended to expand data sources, employ more robust research designs such as true experimental studies with clearly defined control groups, and use more consistent measurement instruments. In addition, future studies should explore the use of interactive animation across a wider range of learning materials and contexts to yield more comprehensive and generalizable findings.

■ CONCLUSION

Based on the analysis of 10 articles from a Systematic Literature Review (SLR), interactive animation media is effective in improving students' interest in learning science at the elementary school level, as indicated by increased attention, engagement, and motivation to learn. This effectiveness is primarily supported by the ability of interactive animation media to transform abstract concepts into more concrete, interactive, and easily understandable forms, thereby encouraging students' active participation in the learning process. In addition, the implementation of interactive animation media in science learning still faces several challenges, such as limited school facilities, insufficient instructional time, and teachers' readiness to integrate digital media effectively. Overall, these findings suggest that interactive animation media not only enhance students' learning interest but also contribute to more active, meaningful, and contextual science learning in elementary schools.

Based on these findings, teachers are advised to systematically integrate interactive animated media into science lessons to enhance students' interest in learning and their conceptual understanding. Schools and policymakers also need to provide support, including resources and training, to help teachers use digital media. For future research, it is recommended that the scope of science material be expanded, not merely focusing on the cognitive domain but also examining students' affective and social aspects, and employing a more diverse methodological approach so that research results can be applied more broadly.

■ DECLARATION OF GENERATIVE AI USAGE IN THE WRITING PROCESS

The authors used several artificial intelligence (AI)-assisted tools in preparing this manuscript. ChatGPT (OpenAI) and Prof AI were used to support language refinement, organization of ideas, and the development of clarity in academic writing. In contrast, DeepL was used for translation assistance and grammar checking to enhance readability and linguistic accuracy. All outputs generated by these tools were carefully reviewed, edited, and validated by the authors. The AI-assisted technologies were used solely to support the writing and language-editing process and did not contribute to the research design, data collection, data analysis, interpretation of findings, or the formulation of conclusions. The authors take full responsibility for the content of this manuscript.

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