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Literature Review on the Application of Interactive Media in Science Learning in Elementary Schools for the Period 2020-2025

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A B S T R A C T

This study aims to explore the application of interactive media in Science Education (IPA) for elementary schools from 2020 to 2025, focusing on its impact on student engagement, understanding, and learning outcomes. The research method used is a literature review, analysing 25 studies on the development and use of interactive media in teaching science concepts. The findings indicate that interactive media, such as animation videos, e-modules, augmented reality, educational games, and mobile applications, significantly improve student comprehension of complex science concepts by providing dynamic, visual, and engaging learning experiences. Moreover, these media foster greater student motivation and interest in learning, overcoming the limitations of traditional, teacher-centred methods. However, challenges remain, including unequal access to technology, readiness of teachers, and the need for curriculum adaptations. The study concludes that while interactive media is an effective tool for enhancing science education, further support is necessary from policymakers and educators to ensure its widespread and optimal use in elementary schools.

1. Introduction

Rapid technological advances encourage innovation in learning strategies to suit the character of the digital generation (Wahyudi, 2023). Especially in an effort to overcome traditional problems in science education in primary schools - especially the low desire to learn and the achievement of student learning outcomes - this is very relevant. Students often become passive and quickly bored with one-way science education, lectures that lack investigation and visualisation (Pratiwi, 2021). If not supported by media that can close the gaps in students' knowledge, the quality of science, which includes many abstract ideas, exacerbates the dilemma. Students then struggle to relate the topics to their actual experiences, which causes their drive to learn to decrease and their learning outcomes to be less than ideal (Parnawi,

2019). Interactive media is essential in this case to provide more interesting, relevant and meaningful learning.

Although the possibilities of interactive media in improving science education are enormous, their use in primary schools from 2020 to 2025 is still not ideal. Many schools are not yet regularly using interactive media in the learning process (Rihani, et al., 2022). Various elements contribute to this, ranging from inadequate infrastructure, teacher training deficits, to a lack of consistent rules on the use of interactive technologies in relation to the national curriculum (Famella et al., 2024). As a result, despite the lack of success in creating student interest and engagement, teachers usually revert to the more familiar traditional learning approaches (Hamdy et al., 2025).

The use of digital media during the COVID-19 epidemic has reportedly surged significantly, largely in reaction to distance learning (Aisyah & Kurniawan, 2021). However, the use of digital and interactive media is inconsistent geographically, in terms of infrastructure availability, and teachers' capacity to control them efficiently (Lestyaningrum, et al., 2022). This disparity results in differences in the quality of education, even in disciplines that demand visual and exploratory approaches (Ali et al., 2024).

The use of interactive media-including digital simulations and experimental videos-can improve understanding of scientific ideas and inspire students' desire to learn (Hariyono, et al. 2024). Research by Rakhman, et al. (2024) for example, showed that students who used interactive media fared much better in learning assessment results than those who followed traditional education. This suggests that interactive media is an educational tool as well as a technique that can increase student engagement (Depita, 2024).

While there has been much research on learning media in the context of primary education, most of the existing research has not specifically emphasised the use of interactive media in science learning in primary schools, especially in 2020-2025. Many of these studies are generalised or only test the efficacy of one form of media on a limited scale without addressing the dynamics that occur throughout the shift to digital education caused by the COVID-19 pandemic. This suggests a gap in a more thorough, methodical and time-specific literature review.

In addition, there is currently little research linking the quality of primary school children in Indonesia to the effectiveness of interactive media. Evaluation of effective use of interactive media has not been influenced much by factors such as socio-economic background, technology availability, teacher readiness, and variations in learning styles. Effective media should really be able to fulfil the various demands of students, not only in terms of improving academic scores. This research helps to close this gap. This study intends to provide a comprehensive overview of the trends in the use of interactive media and its effectiveness in learning through an in-depth literature evaluation on the use of interactive media in science learning in primary schools over the past five years. The study also covers the extent to which interactive media can improve student learning outcomes from

the cognitive, emotional and psychomotor domains as well as the challenges typically faced during the implementation process.

Based on a survey of relevant literature, the aim of this study is to evaluate and assess the use of interactive media in science education in primary schools in the period 2020-2025. This study also intends to evaluate the effect and efficacy of interactive media on student learning outcomes, as well as provide useful suggestions for teachers, media makers, and policy makers in developing more flexible and creative learning techniques.

Therefore, this research will review various studies that address the use of interactive media in science education to provide an overview of the trends, advantages and problems experienced so far. The findings of this research are expected to serve as a foundation for creating a more efficient learning methodology in line with the needs of the times in the primary school environment.

2. Methodology

This study reviewed 25 research titles on the use of interactive technologies in science education in primary schools for the decade 2020-2025. Among the resources used were educational games created to improve students' knowledge of ideas, motivation and learning outcomes, augmented reality and other multimedia-based interactive media. A qualitative descriptive methodology using a literature review was used. The sampling method was purposive by selecting 25 research titles that met the predetermined inclusion and exclusion criteria. Among the factors examined were the type of interactive media used, the learning design used, and the outcomes and impact of using such media on students' motivation and learning outcomes. Data were collected through an in-depth examination of the abstracts and content of the articles; these were then thematically analysed to highlight patterns and trends. The research sought to provide a complete picture of the use of interactive technologies in science education in the primary schools studied during the period under review.

3. Results and Discussion

Improving Understanding of Science Concepts Through Interactive Media

Learning Science, especially at the primary school level, is essentially about understanding ideas. However, the nature of science, which is rich in abstract ideas, often makes it difficult for students to understand the content in detail if only presented through traditional approaches. Therefore, interactive media is the answer that allows students to create better and more meaningful conceptual knowledge (see in Table 1).

Table 1. Effectiveness of Interactive Media for Improving Understanding of Science Concepts

Interactive Media	Researcher	Focus
Interactive Video	Aurora et al. (2024)	Breathing (video)
SIDAR-MAN	Rochmiyatun & Prayogo	Blood circulation (simulation)
AR	Ningrum et al.	Circulatory (AR)
ADDIE Model	Charmelita et al.	Blood circulation (ADDIE)
TPACK HOTS	Sofia et al. (2023)	Blood circulation (module)
The game	Safitrah et al.	Human body (game)
Visual Animation	Ameyaw & Kyere (2019)	Blood circulation (animation)
Story Digital	Wangid et al. (2021)	Science-mathematics (story)

Interactive video media, as researched by Aurora, et al. (2024) (in Figure 1), is one example of the use of interactive media. Students' knowledge was enhanced by interactive videos on human respiratory system information in the study. The dynamic depiction of the breathing process allows students to see the mechanism of the organ in real time, which has been difficult to depict using text or static graphics

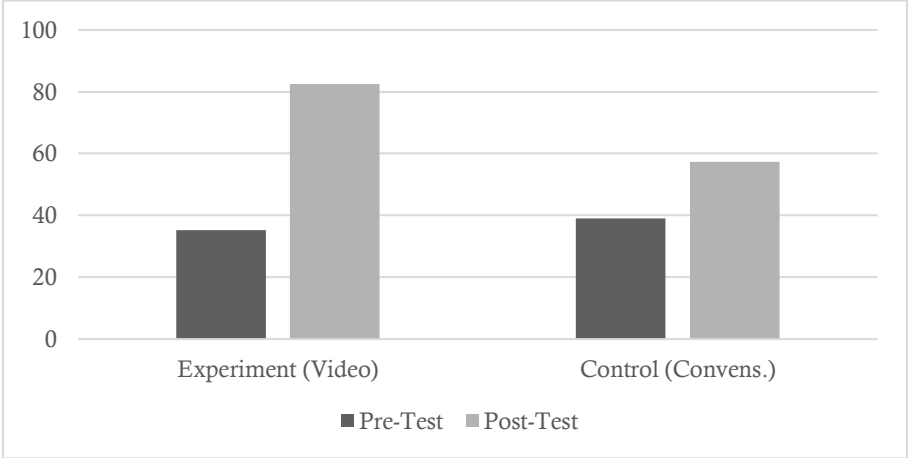

Figure 1. Effectiveness of Interactive Media in the Form of Video

Another discovery is the result of making SIDARMAN media researched by Rochmiyatun and Prayogo (2021), this media has proven to be successful in increasing students' knowledge of the human circulatory system. Features such as animated simulations and interactive tests make students actively involved in the learning process and provide immediate feedback on their knowledge.

Augmented reality (AR) technology has also proven useful. According to Ningrum, et al. (2022) (in Figure 2), augmented reality (AR) linked with electronic comics allows students to see the circulatory system in three-dimensional form. This technology connects abstract ideas to real and interactive ones, thus increasing engagement and knowledge.

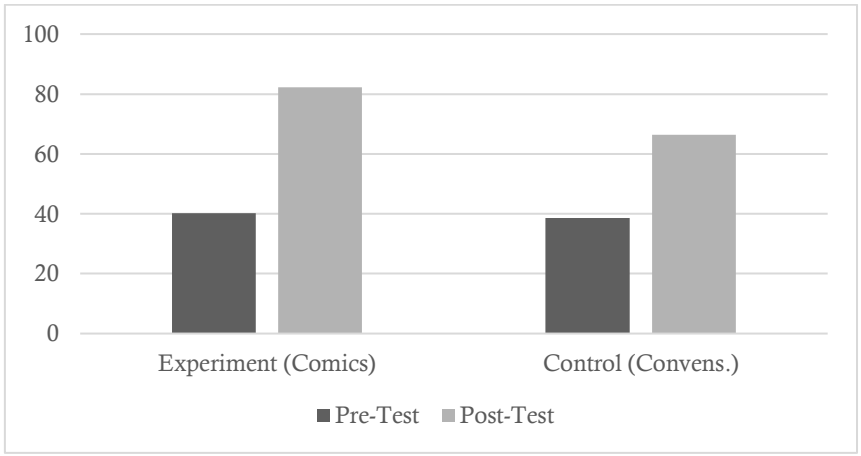

Figure 2. Effectiveness of Interactive Media in the Form of Video

Learning media design also utilises systematic development techniques such as ADDIE. Using the ADDIE model, Charmelita et al. (2022) created interactive media for blood circulation material. Each stage of development - from analysis to evaluation - is intended to produce media that meets the needs of grade five students and has clear learning objectives.

In addition to the interactive media format, learning methods also play an important role. Using the TPACK method, Sofia et al. (2023) created a science module based on higher order thinking skills (HOTS). Their findings showed that the combination of technology and pedagogy in this module was able to help students to think critically while understanding the circulatory system material better.

Safitrah, et al. (2023) showed that more competitive and fun types of media have also been successful. They showed that technology-based instructional games can improve students' understanding and motivation to learn about the human body. The game encourages children to actively learn in a fun environment. Ameyaw and Kyere's (2019) comparative analysis of teaching strategies also underlines the benefits of visual media. The findings showed that, compared to lecture or comparison techniques, the use of animations was more successful in improving knowledge of circulatory system ideas.

Ultimately, developments in the form of digital science-mathematics narratives help improve students' knowledge and problem-solving skills. Digital story-based media, according to Wangid, et al. (2021), can help students use scientific information in everyday life and make learning more relevant and contextualised.
Some of the above research results suggest that interactive technologies, in various forms and ways, offer considerable hope for improving students' understanding of scientific ideas. This also emphasises the importance of creating media that are not only aesthetically pleasing but also educationally integrated and appropriate to the needs of primary school students.

The graphical results also show that the use of interactive media in science learning can significantly improve students' concept understanding compared to

conventional learning methods. Media such as interactive videos and electronic comics equipped with augmented reality make students more interested and motivated so that learning outcomes increase. In addition, interactive media is also considered very feasible and appropriate by experts, teachers, and students. This shows that interactive media is not only effective in improving learning outcomes, but also well received in the learning process, so it can be a solution to improve the quality of science learning.

Increasing Motivation and Interest in Learning Science with Interactive Media

Students' low interest and drive towards science in primary school is one of the fundamental difficulties. Many students find Science a boring, challenging topic that has no relevance to everyday life. Therefore, a learning strategy that can stimulate students' interest and desire to learn is needed. Because it can provide learning visually, contextually, and involve students actively, interactive media is one of the answers. Various studies that show the effect of interactive media in increasing primary school students' motivation and interest in learning science will be discussed in this section (Table 2).

Table 2. Effect of Interactive Media on Motivation and Interest in Learning Science

Media. Methods	Researcher	Focus Media/ Methods	Impact on Motivation & Interest
Examples & Non-examples	Yuliati (2020)	Visualisation of blood circulation	Facilitate understanding, increase interest
Educational Games	Sumilat et al.	Science learning game	Increased engagement & enjoyment, healthy competition
Scientific Narrative	İpek & Özdemir (2023)	Science story	Attracts interest & emotional connection to the material
PBL (Problem Based Learning)	Dinda & Atmojo (2024)	Contextual problem	Increased motivation, active participation

Yuliati (2020) found that learning motivation of grade 5 primary school students can be improved by using examples and non-examples in learning the human circulatory system. Students find it easier to understand and develop interest in the topic being learnt when actual visuals related to the subject matter are presented.

Sumilat, et al. (2023) also found the same phenomenon when creating game-based scientific learning media. Their research findings showed that game-based media not only increased student engagement, but also increased the level of difficulty and enjoyment in the learning process. In addition to fostering a good sense of competition, direct contact through games allows students to learn without feeling pressurised.

In addition, scientific narrative-based approaches have been shown to inspire students in learning science. İpek and Özdemir (2023) point out that using scientific stories in education helps to capture students' interest and increase their emotional

connection with the content. Engaging scientific stories provide real-life backgrounds that help students connect scientific ideas to everyday situations.

On the other hand, the problem-based learning (PBL) method has been proven to be successful. Research by Dinda and Atmojo (2024) showed that PBL in science learning in grade 5 at SDN 1 Padokan can increase student motivation. Presenting difficult contextual problems motivates students to think critically, debate, and search for answers, so they more actively participate in the learning process.

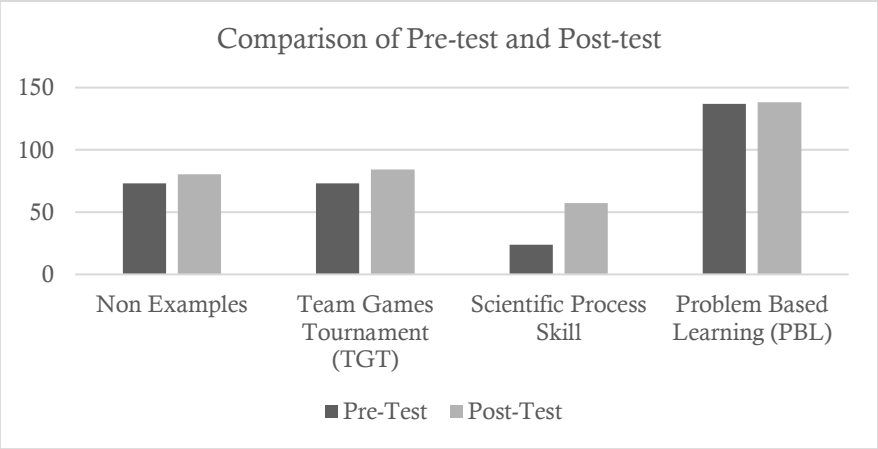

Figure 3. Effectiveness of Interactive Learning Media/Methods

Figure 3 shows the improvement of students' learning outcomes in several science learning models in primary school. Examples Non Examples and Team Games Tournament models show a clear increase in the average score after learning. The Problem Based Learning model also shows significant improvement in problem solving ability and learning motivation. However, in scientific process skills, although there was a slight increase after learning, the change was not statistically significant. This illustrates that while innovative learning methods are effective for learning outcomes and motivation, the development of scientific process skills requires a more specialised and sustained approach.

The results of this study show that interactive media play an important role in designing a stimulating and enjoyable learning environment. Students are more motivated to engage actively and have a keen interest in scientific topics when learning is packaged in an interesting and demanding way.

Use of Innovative Learning Approaches in Science Learning

Science learning in primary schools requires methods that not only convey knowledge, but also shape students' scientific abilities and conceptual awareness as a whole. Creative learning methods, such as the use of interactive media and problem-solving-based teaching techniques, have been shown to improve the effectiveness of science education. This sub-section discusses some of the creative models and methods that have been researched related to science learning in

primary schools that appear to benefit students' understanding of ideas, critical thinking skills and scientific attitudes.

Table 3. Innovative Models and Methods in Elementary Science Learning

Model/Method	Researcher	Focus. Implementation	Key Impacts
Problem Based Learning (PBL)	Dinda & Atmojo (2024)	Contextual challenges, problem solving	Improve critical thinking & problem solving skills
Science Technology Society (STS)	Muhibbuddin et al. (2019)	Integration of science, technology, social	Improving science literacy and processes
Contextual	Hill (2022)	Relate the material to everyday life	More meaningful understanding, improved learning outcomes
Process Skills	Kusumaningrum & Widiyono (2022)	Experimentation, independent exploration	Foster scientific attitudes and knowledge
Audiovisual	Agangba & Ayiwah (2019)	Sound and picture media	Facilitates understanding of complex concepts
ADDIE Model (Game/Media)	Charmelita et al.	Media/game development ADDIE	Systematic media, fun, improved learning outcomes

Based on Table 3, Problem Based Learning (PBL) is one method that is often used. Research by Dinda and Atmojo (2024) showed that the use of PBL in science learning in grade five elementary school can improve students' problem-solving skills. PBL encourages student interest and naturally triggers higher-order thinking processes by providing contextual challenges as a starting point for learning. Muhibbuddin, et al. (2019) also examined the Science Technology Society (STS) method, which combines scientific with social and technological issues. Their findings showed that the STS method successfully improved students' science process skills and science literacy. This strategy allows students to see the connection between scientific ideas and reality, thus motivating them to learn more.

Research by Bukit (2022) also supports the efficacy of the contextual approach. Contextual methods allow students to understand scientific ideas in a more real and relevant way by relating the subject matter to their daily life circumstances. Students' learning outcomes will improve when they understand the meaning of the ideas being studied, rather than just memorising. Kusumaningrum and Widiyono (2022) also examined how the process skills method is used in primary school science education. The findings show that this method not only improves students' knowledge of the subject, but also fosters scientific attitudes including curiosity, objectivity, and tenacity. The process skills method teaches students to independently observe, categorise, measure and make conclusions through experiments or exploratory activities.

Agangba and Ayiwah (2019), on the other hand, underlined how well audiovisual media help students understand scientific content. It makes complex ideas more

tangible and easier for students to understand by combining engaging sound and visual components.

Methods based on media development using methodical models have also shown success. Charmelita, et al. (2022) mentioned a scientific learning game based on the ADDIE model intended to improve the learning outcomes of primary school children. The ADDIE paradigm ensures that the media created is fun to use, has a systematic learning flow, and meets the needs of students. The results of this study show that creative learning strategies - whether through media production, technology integration or teaching techniques - have been shown to improve the quality of science education in primary schools. This emphasises the need for continuous innovation in the teaching and learning process to keep up with the times and the demands of students.

Analysis of Difficulties and Misconceptions in Science Learning

Science education in primary school not only requires students to understand ideas, but also to be able to relate them to events happening around them. Meanwhile, many students find it difficult to understand scientific content in reality, which can lead to misunderstanding or misinterpretation of scientific ideas.

Table 4. Interactive Media Solutions in Science Learning

Aspects	Researcher	Key Findings	Interactive Media Solutions
Circulatory system misconceptions	Izza, et al. (2021)	Students misunderstand the function of atrium & ventricle, difficult with verbal/2D explanation	Interactive animation & 3D visual simulation
Lack of learning media	Sihaloho, et al. (2022)	Lectures & textbooks make students less engaged, low retention	Interactive media, videos and educational games

Based on Table 4, research by Izza, et al. (2021) shows that many grade 5 students misunderstand the human circulatory system, especially in terms of atrial and ventricular functions. Students had difficulty describing the circulatory process using only verbal explanations or static two-dimensional visuals, which led to this misunderstanding. Students often get an understanding that does not match the scientific idea when the idea is not depicted correctly.

Further research from Sihaloho, et al. (2022) found that the lack of use of learning media by teachers caused students to experience difficulties in the area of good blood circulation. Using only lecture techniques and textbooks to deliver content left students less engaged and struggling to understand abstract ideas. Low retention of information and student performance were affected by this. These results imply that interactive media not only increase interest and drive to learn, but also help clarify ideas with possible misunderstandings through interaction. Modern learning media can close the gap between abstract ideas and meaningful learning experiences for primary school children through a more visual, interactive and explorative approach.

Utilisation of TPACK (Technological Pedagogical Content Knowledge) in Interactive Media Development

Digital education requires teachers to not only know how to use educational resources, but also understand how to present them through engaging and relevant media. TPACK, or technological pedagogical content knowledge, is one such conceptual framework that helps integrate technology into education. TPACK underscores the need to combine knowledge of materials, pedagogy and technology to provide a successful learning environment. This subchapter discusses the use of the TPACK model in creating interactive media for science education in primary schools and its effect on learning quality.

The study by Sofia, et al. (2023) showed that the creation of a HOTS (Higher Order Thinking Skills) based module using the TPACK method in grade V science learning was proven to improve students' critical thinking skills. Supported by technology that enables interactive learning, the programme combines scientific material with a learning methodology that promotes analysis, assessment and discovery. The TPACK model ensures that each element-materials, techniques and media-is harmoniously linked and mutually supportive.

Therefore, the TPACK method offers a strong conceptual basis for creating and implementing interactive media that are not only engaging, but also educationally relevant and essential. It also enables educators to be more methodical and introspective in their selection of technology and its modification to suit the learning needs of students in the digital age. TPACK is a highly strategic framework to close the gap between theory and efficient learning practices in the context of scientific education, which often includes difficult and complex ideas.

Evaluation and Validation of Interactive Media in Science Learning

Evaluation and validation are important components in the development of interactive media as they help to ensure that the media is effective, appropriate for the students and meets the learning objectives. Various studies that emphasise the need for the assessment and validation stage in the creation of interactive media for science education in primary schools are included in this section (in Table 5).

Table 5. Evaluation and Validation of Interactive Media in Science Learning

Media. Module	Researcher	Evaluation/Validation Stage	Key Findings	Benefits of Evaluation
Blood Circulation Interactive Media (ADDIE)	Charmelita et al.	Analysis, Design, Development (pre-implementation)	Media is built methodically according to students' needs	Ensure media is fit for purpose and effective
TPACK-based HOTS Module	Sofia et al. (2023)	Feasibility assessment & student reaction (post-implementation)	Effective modules improve critical and evaluative thinking	Provide feedback for module improvement

The creation of interactive media to ensure its effectiveness and quality relies on evaluation and validation, two very important stages. Using the ADDIE approach, Charmelita, et al. (2022) explained the function of creating interactive media based on blood circulation. The analysis, design, and development stages were the emphasis of this study. Although this work lacks implementation and user evaluation, the development following the ADDIE model guarantees that the media is methodically built according to student demand, thus maximising its potential effectiveness after passing the assessment stage.

Sofia, et al. (2023) also developed a TPACK-based HOTS science module. This study underlined the need for an assessment to assess the feasibility of the module and students' reactions after its use. The module maximised the use of technology in education and emphasised students' critical, analytical and evaluative thinking skills. The findings from this assessment will provide significant insights to hone and improve the learning tool

The Effect of Android-Assisted Interactive Media in Science Learning

Table 6. Effect of Android-Based Interactive Media in Science Learning

Researched Aspects	Researcher	Key Findings	Impact on Science Teaching
Cognitive and Metacognitive Techniques	Diken (2020)	Students use simulations, adaptive quizzes, and animations for learning strategies.	Improved knowledge and academic preparation.
Variations in Male & Female Learning Challenges	Sugiyaningrum et al. (2023)	Android media helps customise learning according to student needs.	Overcoming learning challenges, increasing flexibility.

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From Table 6 it is known that android-assisted interactive media in science education provides a more flexible and engaging approach for students. Diken's (2020) research shows that when answering questions, students use different cognitive and metacognitive techniques. Students can access Android-based interactive media elements such as simulations, adaptive quizzes and interactive animations that allow them to apply learning tactics more effectively. This can improve their knowledge and preparation for academic assessments.

On the other hand, research by Sugiyaningrum et al. (2023), draws attention to the variation in learning challenges between male and female students. By providing a more customised and flexible learning environment, Android-assisted interactive media can help address these challenges by allowing students to learn based on their learning needs and preferences. In scientific education, Android-based interactive media can generally improve concept understanding and allow students to create more efficient learning techniques that suit their characteristics.

Interactive Media Assisted Video Animation in Science Learning

Animated films in scientific education assist interactive media that help students understand difficult ideas in a visual and engaging way.

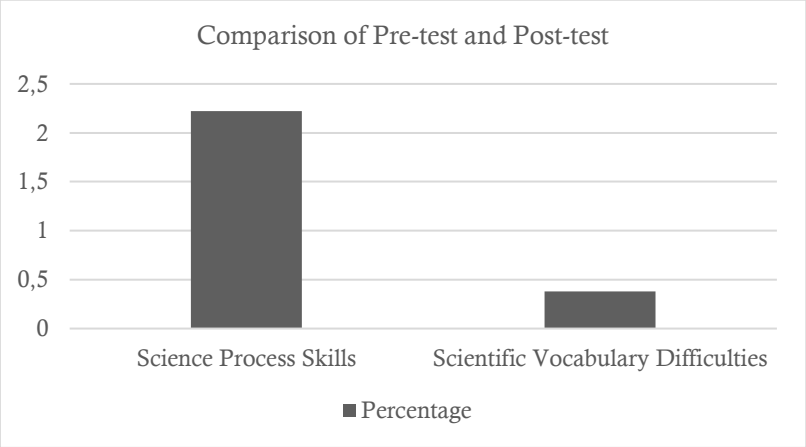

Figure 4. Student Challenges in Science Learning

Figure 4 shows that students face two main challenges in learning science: low ability in scientific thinking processes, especially in terms of analysis and inference, and difficulty in using scientific vocabulary appropriately. These challenges hinder students' understanding of concepts and ability to accurately convey knowledge.

Table 7. Effect of Interactive Media Based on Animated Video in Science Learning

Researched Aspects	Researcher	Key Findings	Benefits of Animated Video Media
Science Process Skills	Işiker & Emre (2020)	Students lack understanding of data analysis and interpretation in the science process.	Helps develop science process skills through interactive virtual simulations and experiments.
Scientific Vocabulary Difficulties	Seah (2021)	Students struggle to process and present scientific knowledge.	Simplify scientific terminology with attractive visuals that facilitate student understanding.

Based on Table 7, Işiker & Emre's (2020) research emphasises students' ignorance of science process abilities, especially in data analysis and interpretation. Animated video-based interactive media can help develop these abilities by offering scientific simulations and interactive virtual experiments.

On the other hand, Seah's (2021) research revealed that many students have difficulties in processing and presenting knowledge which causes them to struggle with scientific vocabulary. Animated films can be visual aids that explain complex ideas and simplify scientific terminology, thus facilitating students' understanding of the content being taught.

An efficient strategy in science teaching at the primary school level is the combination of interactive media and animated films, which can enhance students' analytical ability and help them understand ideas better.

4. Conclusion

A literature review of 25 studies conducted between 2020 and 2025 concluded that the use of interactive media in science education in primary schools can improve the quality of the learning process and student learning outcomes. Animated films, e-modules, augmented reality, educational games and digital applications among other interactive media have been proven to help students understand abstract scientific ideas in a more interesting, visual and participatory way. These media also help inspire and engage students during the learning process by breaking the monotony caused by traditional one-way teaching approaches. The results of many further studies show that media production methods based on the ADDIE model and the incorporation of the TPACK framework are able to produce media that are not only creative, but also appropriate to the needs and characteristics of primary school children. However, the use of these interactive media has not been evenly spread across schools and there are issues with teacher readiness, technical infrastructure and curricula that can adapt to digital innovations. Therefore, this study underscores the need for continuous assistance from various stakeholders-including the government, educational institutions and technology developers-to increase access and improve teachers' ability to integrate interactive media into science education. Thus, interactive media will not only be a learning tool, but also a bridge towards transforming science education that is more relevant, contextualised and in line with the times.

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