Bulletin of Science Education

Vol. 6, No. 2, August 2026
https://attractivejournal.com/index.php/bse/index

Trends in the Development of Learning Videos for Strengthening Science Literacy in Elementary School Science Education: A Systematic Literature Review and Empirical Study of Teachers

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ARTICLE INFO
Article history:
Received
February 19, 2026
Revised
July 11, 2026
Accepted
August 30, 2026

Abstract

The development of digital technology has fundamentally changed the practice of science learning in elementary schools, especially through the use of learning videos as a medium to support the strengthening of science literacy. This study aims to map research trends, thematic structure, and direction of learning video development for science literacy, as well as identify the empirical conditions and needs of teachers in elementary school science learning. An integrative approach is used by combining a Systematic Literature Review (SLR) based on the PRISMA 2020 protocol and a quantitative survey. The literature for the period 2021–2025 was systematically selected based on relevance and indexation criteria, with 18 articles indexed in grades 1–3 designated as the study corpus. Meanwhile, the survey involved 70 elementary school teachers to identify the use practices and needs of learning video development. The mapping shows the trend of research towards the development of learning videos that are interactive, contextual, and oriented towards science literacy. The survey findings show that teachers need videos that not only present science concepts, but also facilitate students in observing phenomena, analyzing information, evaluating evidence, and solving problems. The study contributes by integrating literary and empirical evidence to provide a conceptual basis for the development of science learning videos that are more geared towards strengthening the science literacy of elementary school students.

Keywords: Learning Videos, Science Literacy, Principal Leadership, Teacher Professional Development

Published by CV. Creative Tugu Pena
ISSN 2774-4299
Website https://attractivejournal.com/index.php/bse/

INTRODUCTION

The development of digital technology in recent decades has brought fundamental changes to learning practices in elementary schools. This transformation not only affects the way information is conveyed, but also changes how students build knowledge through more visual, interactive, and contextual learning experiences (Ariyanto et al., 2018; Ashar & Supriansyah, 2023). In Natural Sciences (IPA) learning, these changes are becoming increasingly important because the characteristics of science materials not only require mastery of concepts, but also the ability of students to observe phenomena, explain scientific processes, use evidence, and connect science concepts with problems in daily life.

One of the main competencies that need to be developed in science learning in the 21st century is science literacy. Science literacy is not only interpreted as the ability to understand scientific facts and concepts, but also includes the ability to use scientific knowledge to explain phenomena, evaluate information based on evidence, and make decisions related to scientific issues in life (Hasbullah et al., 2022; Imawati et al., 2022). Therefore, science learning in elementary

school needs to be directed towards learning experiences that allow students to build scientific understanding through observing, analyzing, interpreting, and solving problems.

Science literacy is a fundamental competency that needs to be instilled from the elementary school level so that students are able to understand, apply, and communicate the concepts of Natural Sciences (IPA) in daily life (Kamal et al., 2024). This effort to strengthen science literacy cannot be separated from the need to empower students' critical thinking skills in science learning, as emphasized in the development of a problem-based learning flipbook e-module (Endaryati et al., 2021). The low achievement of science literacy and numeracy of students has also encouraged the birth of digital learning media innovations, including STEM-based digital LKPD which is designed to improve both competencies simultaneously (Kamal et al., 2024).

In this context, video-based learning media is one of the rapidly developing forms of technology in supporting elementary school science learning. Videos have characteristics that are able to integrate visual, audio, animation, text, and illustration elements so that they can help students understand science concepts that are difficult to observe directly. Research on learning videos on materials in the form of substances and their changes shows that video media is able to support the presentation of science concepts in a more concrete way and obtain positive responses from users in the learning process (Hakim et al., 2024; Ismail & Suartama, 2024). Similarly, the use of demonstration-based videos shows that visual representations through videos can help learners understand the phenomenon of science change more meaningfully (Putri et al., 2025).

The development of science learning video research also shows variations in the form of technology, presentation approaches, and learning objectives. Several studies have developed application-based videos such as Powtoon, VideoScribe, Sparkol, Kinemaster, and animated videos to support elementary school science learning (Endaryati et al., 2021; Romodhon et al., 2024). Research on Powtoon-based learning videos on electrical circuit materials shows that video media is able to support concept understanding and improve student learning outcomes (Bersih & Margunayasa, 2021). In addition, research on VideoScribe in science learning shows that the use of technology-based media can increase learning appeal and create a more enjoyable learning experience for students (Sawitri et al., 2025; Wahyuni & Lazuardi, 2024; Widiastawan et al., 2023).

However, the development of learning videos is not only related to technological aspects, but also has undergone a shift in pedagogical orientation. Learning videos are beginning to be directed as a medium that supports the scientific thinking process, not just as a means of conveying information. Research on problem-based learning-based animation videos shows that the integration of visual media with learning approaches can help students understand abstract science concepts and encourage active involvement in the learning process (Widiastawan et al., 2023). Meanwhile, the development of contextual approach-based animation videos shows a tendency to connect science concepts with students' real experiences so that learning becomes more meaningful (Utama et al., 2024).

Although research on science learning videos continues to grow, a review of the available literature shows that research is still spread across various focuses, such as media development, learning approaches, types of technology, and specific science materials (Dewi & Yudiana, 2023; Firdaus & Tegeh, 2024). Most studies provide information on the characteristics of media or the impact of their use in certain learning contexts, but have not provided a comprehensive picture of how the field of learning video research for science literacy has progressed over time.

This condition shows the need to conduct research mapping in a more systematic manner. The development of the wider literature causes research information to be fragmented based on the terms, approaches, technologies, and learning objectives used. Without comprehensive mapping, it is difficult to know the dominant research theme, the relationship between concepts, the development of the direction of study, and aspects that are still not widely studied in the development of learning videos to support elementary school science literacy.

In addition to literature mapping, understanding the development of learning videos also needs to be linked to empirical conditions in the field. Teachers as the main users of learning media have direct experience of the needs, challenges, and characteristics of media that are in accordance with elementary school science learning. Therefore, an analysis of teachers' perceptions and needs is needed to see the extent to which research developments are in line with the needs of learning practices.

Based on this description, this study aims to map the trend of learning video development for science literacy in elementary school science learning through an integrative approach that

combines Systematic Literature Review (SLR) based on the PRISMA 2020 protocol and a quantitative survey of elementary school teachers. This study specifically analyzes the development of the research theme, conceptual structure, the direction of learning video development, and teachers' needs for media that are able to support science literacy activities such as observing phenomena, analyzing information, evaluating evidence, and solving problems. The results of the research are expected to provide a conceptual and empirical basis for the development of science learning videos that are more directed, contextual, interactive, and oriented towards strengthening the science literacy of elementary school students.

METHODS

Research Studies

This study uses a mixed methods approach with an integrative design that combines Systematic Literature Review (SLR) based on the PRISMA 2020 protocol and quantitative surveys using questionnaires. This approach was chosen to gain a more comprehensive understanding of the development of video learning research to support science literacy in elementary school science learning, by integrating scientific literature-based perspectives and empirical conditions in learning practices.

Conceptually, the integrative design in this study is complementary, that is, each approach makes a different but mutually reinforcing contribution. In the first stage, Systematic Literature Review (SLR) is used to identify, select, and synthesize previous research on the development and utilization of learning videos in the context of elementary school science literacy. The literature selection process is carried out systematically based on the inclusion and exclusion criteria that have been set with reference to the PRISMA 2020 protocol. This approach is used to ensure that the literature identification process takes place in a transparent, structured, and replicable manner.

In the second stage, the research was complemented by a quantitative survey using questionnaires to elementary school teachers to obtain empirical information about teachers' use, needs, and perceptions of science learning videos. Survey data was used to understand the extent to which research developments found in the literature were related to learning practices in the field. The aspects studied included the use of learning videos in science learning, the characteristics of videos needed by teachers, the contribution of videos to science literacy activities, and the need for the development of technology-based learning media.

The integration between the results of the SLR and the teacher survey allowed this study to produce a more comprehensive picture of the development of learning videos for science literacy. The literature analysis provided a perspective on the structure and direction of research development, while empirical data from teachers provided context regarding the real needs in the implementation of elementary school science learning. Thus, this study not only describes academic trends, but also identifies the fit between research development and practical needs in the primary education environment.

Systematic Literature Review (SLR)

Data Sources and Search Strategies

This study uses the Systematic Literature Review (SLR) approach combined with bibliometric analysis to map the development of research on learning videos in supporting science literacy in elementary school science learning. Literature data was obtained through the Google Scholar database because it has a wide scope of educational publications, especially educational research articles published in accredited national journals.

The literature search strategy was carried out using a combination of keywords related to the focus of the research. The search was carried out using keywords that included the main concepts of the research, namely "learning videos", "science literacy", and "elementary school science". The combination of keywords was used to obtain articles that specifically discussed the use, development, or study of learning videos in the context of strengthening science literacy at the elementary school level.

The range of publications is limited to the period 2021–2025 to capture the latest research developments regarding the use of digital technology in elementary school science learning. The initial search results obtained 6,590 articles which were then selected based on the criteria of relevance, research context, and publication quality.

Literature Selection Procedure

The literature selection process is carried out following the guidelines of PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) which consists of four main stages, namely identification, screening, eligibility, and inclusion.

At the identification stage, as many as 6,590 articles were found through an initial search on Google Scholar using keywords related to learning videos. Furthermore, an initial screening process was carried out to eliminate articles that were not in accordance with the focus of the research. A total of 6,039 articles were issued, consisting of articles that were not in accordance with the topic of science learning (n = 5,412), articles outside the context of elementary school science (n = 412), and duplicate articles (n = 215).

The next stage is screening based on a more specific keyword, namely "science literacy". At this stage, 551 articles were obtained that are related to science literacy. Furthermore, relevance evaluation was carried out based on the abstract and focus of the study. A total of 536 articles were issued because they did not discuss science literacy substantially (n = 478) and were not in accordance with the context of basic education (n = 58).

In the second screening stage, the articles were again selected based on the context of "elementary school science" so that 34 articles were obtained. The articles then entered the feasibility stage for further analysis based on the quality of the publication and suitability for the purpose of the research.

Eligibility Level

At the eligibility stage, a total of 34 articles were analyzed based on the inclusion criteria that had been set. The evaluation was carried out by considering several aspects, namely: (1) the article discusses learning videos in the context of elementary school science learning; (2) the article is related to strengthening the science literacy or scientific ability of students; (3) the article is published in a scientific journal; and (4) the article has an indexation status that meets the research criteria.

Based on the evaluation process, as many as 16 articles were issued because they did not meet the established journal indexation criteria, namely not included in the SINTA 1–3 category. Articles that did not meet the publication quality standards were not included in the follow-up analysis.

Inclusion Stage

Based on all stages of selection using the PRISMA 2020 protocol, as many as 18 journal articles were obtained that met all inclusion criteria and were determined as the main corpus of research.

The inclusion criteria in this study include: (1) articles published in the 2021–2025 period; (2) articles discussing learning videos in elementary school science learning; (3) articles published in journals indexed by SINTA 1–3; (4) articles related to science literacy, understanding of science concepts, or students' scientific activities; and (5) articles are available in full text form so that they can be analyzed systematically.

Eighteen selected articles were then analyzed using a bibliometric approach to identify publication development patterns, trends in research themes, and conceptual relationships between studies. The results of bibliometric analysis were then combined with literature synthesis to obtain a comprehensive picture of the trend of learning video development oriented towards strengthening science literacy in elementary school science learning.

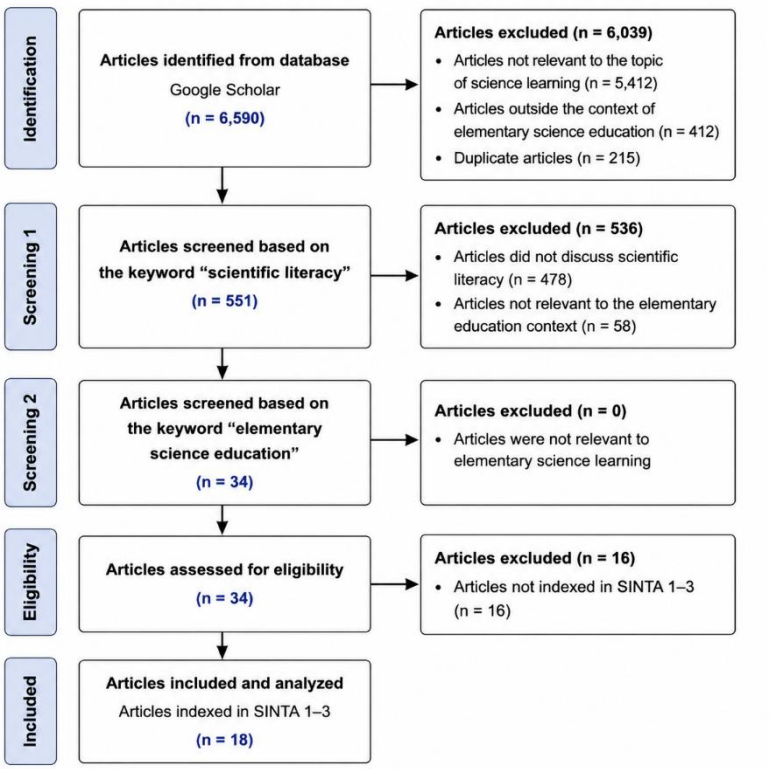

Figure 1. PRISMA flow chart of the study paradigm

Data Analysis Procedure

Data analysis in this study was carried out through two main tracks, namely analysis of the results of Systematic Literature Review (SLR) and bibliometric analysis, as well as empirical data analysis based on quantitative surveys to elementary school teachers. The integration of these two types of data was carried out to obtain a comprehensive picture of the development of research and practical needs for the development of learning videos to strengthen science literacy in elementary school science learning.

In the first stage, literature analysis is carried out through descriptive mapping of articles that have met the inclusion criteria. This analysis is used to identify the development of publications based on the year of publication, article characteristics, study focus, and trends of the research theme. The second stage is carried out through a thematic coding process of selected articles. Each article is analyzed based on several main aspects, namely the characteristics of the learning video developed, the context of science learning, the purpose of using the video, the relationship with science literacy, and the contribution of media to students' scientific activities. The results of the coding are then grouped into broader conceptual categories to identify the development pattern of learning video research in supporting science literacy.

To maintain the consistency of the analysis, the coding process is carried out in stages through reading and re-examination of the analyzed articles. Every decision in the literature selection and classification process is documented based on the stages of PRISMA 2020 so that the research process can be carried out transparently and systematically.

Questionnaire-Based Empirical Surveys

In addition to literature analysis, this study uses quantitative surveys to obtain an empirical picture of teachers' use, characteristics, and needs for elementary school science learning videos. The survey involved 70 elementary school teachers who responded based on their experience in implementing science learning. The research instrument was in the form of a questionnaire developed based on the results of literature synthesis from SLR. The questionnaire consisted of 20 statements using a five-level Likert scale, namely 1 = Strongly Disagree (STS), 2 = Disagree (TS), 3 = Neutral (N), 4 = Agree (S), and 5 = Strongly Agree. The instrument is organized

into five main dimensions. The first dimension, the use of learning videos in science learning (points 1–5), measures teachers' experience in using video as a learning medium, the function of video in explaining science concepts, and the ability of video in connecting concepts with daily life phenomena. The second dimension, characteristics and quality of learning videos (items 6–10), measures teachers' perception of the quality of video presentation, suitability of the material with the characteristics of elementary school students, the use of visual and audio elements, the duration of the video, and the flexibility of its use in learning. The third dimension, learning videos and the development of science literacy (points 11–15), measures the contribution of video in helping students understand science phenomena, make observations, ask questions, analyze information and evidence, and apply science concepts in daily life. The fourth dimension, the integration of video, pedagogy, and technology (points 16–18), measures the relationship between the use of video and learning activities such as discussions, experiments, investigations, and teachers' readiness to integrate technology with science learning strategies. The fifth dimension, the need for the development of learning videos (points 19–20), identifies the need for teachers for science learning videos that are specifically designed to improve science literacy and support activities of observing, reasoning, evaluating information, and solving problems.

Data Collection Procedure

Survey data was collected through the distribution of questionnaires to elementary school teachers in person and online. Respondents provided assessments based on real experience in using science learning videos. Respondents' professional identities such as length of teaching, school level, and experience in using learning videos were also collected as supporting information in the descriptive analysis.

Data Analysis Techniques

The questionnaire results data were analyzed using descriptive statistics to illustrate the tendency of teachers' perceptions towards the use of science learning videos. The analysis included mean values, standard deviation, distribution of respondents' answers, and comparison of scores between research dimensions.

The results of the analysis showed that all dimensions obtained a tendency to respond positively. The dimension with the highest average score was the need for the development of learning videos with an average score of 4.26, indicating that teachers have a strong need for science learning videos specifically designed to support science literacy. Furthermore, the characteristics and quality dimensions of learning videos obtained an average of 4.12, while the use of learning videos in science obtained an average of 4.11.

The dimension of science literacy development through video learning obtained an average of 4.07, which shows that teachers see video as a medium that has the potential to support scientific activities such as understanding phenomena, analyzing information, and connecting science concepts with real life. Meanwhile, the dimension of technology integration and pedagogy obtained an average of 3.99, showing that the aspect of technology integration still needs strengthening, especially in the implementation of video-based learning strategies.

Data Integration

Findings from bibliometric analysis, SLR, and teacher surveys were analyzed integratively to produce a more comprehensive understanding of the development of learning videos for science literacy in elementary school science learning. The results of the literature provide an overview of the direction of research development, dominant themes, and characteristics of developing learning video innovations. Meanwhile, survey data provide empirical context regarding the needs of teachers and the suitability between research development and learning practices in the field.

The integration of the two data sources allows this study to identify the relationship between academic development and practical needs. Thus, the research not only describes the research trends of learning videos, but also provides a conceptual and empirical basis for the development of science learning videos that are more interactive, contextual, and oriented towards strengthening the science literacy of elementary school students.

RESULT AND DISCUSSION

Based on the Systematic Literature Review (SLR) conducted using the PRISMA 2020 protocol, 18 articles indexed in SINTA 1–3 and published between 2021 and 2025 met the inclusion criteria. These articles focused on the development and implementation of learning videos and digital multimedia in elementary school science education. In addition, empirical data were

collected from 70 elementary school teachers to identify their perceptions and needs regarding the use and development of science learning videos

Trends in the Development of Science Learning Videos Based on Literature Studies

The analysis of the 18 selected articles identified three major trends in the development of science learning videos. The first trend concerned the increasing use of digital technologies in the form of animated videos, Powtoon, VideoScribe, demonstration videos, and interactive multimedia. The second trend involved the integration of learning videos with pedagogical approaches such as Problem-Based Learning (PBL), contextual learning, STEM-oriented learning, and demonstration-based learning. The third trend indicated an increasing orientation toward scientific activities and science literacy, particularly activities involving the observation of phenomena, interpretation of information, use of evidence, and problem solving.

The characteristics of these trends are summarized in Table 1.

Table 1. Trends in the Development of Science Learning Videos Based on SLR Results

Development Trends	Characteristics of the Findings	Contribution to Science Learning
Digital technology-based video	Powtoon, VideoScribe, animasi, multimedia interaktif	Help visualize science concepts and increase student engagement
Video-based learning approach	PBL, contextual, STEM, demonstration	Encourage critical thinking and problem-solving activities
Science literacy-oriented videos	Observation of phenomena, analysis of information, use of evidence	Supporting students' scientific ability in understanding science phenomena

Across the selected studies, digital learning videos were primarily developed to provide visual representations of scientific concepts and phenomena. Several studies reported media validity, practicality, learning outcomes, student responses, or conceptual understanding as indicators of the quality and effectiveness of the developed videos. The reviewed studies also showed that video development increasingly incorporated pedagogical approaches rather than using video exclusively as a medium for presenting information (Utama et al., 2024) regarding Powtoon-based learning videos on electrical circuit materials, it shows that the media developed meets the aspects of validity, practicality, and effectiveness in science learning. The media obtained a validation of a material expert of 4.50, a validation of a media expert of 4.44, and an effectiveness of learning based on an N-Gain value of 0.71.

Similar findings were found in the development of VideoScribe-based videos. The media obtained a high level of validity based on the assessment of material experts by 90%, media experts by 89%, and student responses of 96.90%. These results show that the use of technology-based video is able to create a more interesting learning experience and increase student engagement. In addition, several studies have developed learning videos with a visualization approach of science phenomena. The development of learning videos on material forms of substances and their changes shows that video media obtains excellent validity from subject matter experts, media experts, and practitioners and is able to improve student learning outcomes.

Based on these findings, it can be understood that the development of science learning videos is not only related to the use of digital technology, but also the ability of the media to present science phenomena in a more concrete way so as to help students build conceptual understanding (Wisada & Sudarma, 2019).

Integration of Pedagogical Approach in Science Learning Videos

In addition to developments in the technological aspect, the results of SLR show a tendency to integrate video with certain pedagogical approaches. Learning videos are starting to be used as part of a learning strategy that encourages active involvement of students, not solely as a broadcast medium. (Yunita & Wijayanti, 2017) shows that Problem-Based Learning-based animation videos can help students understand abstract science concepts while obtaining excellent assessments from subject matter experts, media experts, learning design experts, teachers, and students. The integration between video and problem-based learning provides space for students to deal with a problem, understand the information presented, and build solutions based on science concepts (Handayani & Dewanti, 2020).

A contextual approach is also found in the development of learning videos. (Ismail & Suartama, 2024) shows that animation videos based on a contextual approach are able to improve concept understanding and student involvement. This approach shows the importance of connecting the material presented in the video with phenomena that are close to students' lives so that science concepts are not studied separately from the context of their application.

These findings indicate that the direction of science learning video development is starting to bring together two important components, namely technology and pedagogy (Jundu et al., 2020; Lusidawaty et al., 2020). Visually appealing videos do not necessarily produce meaningful learning if they are not accompanied by activity designs that encourage students to observe, ask questions, analyze, and solve problems.

Learning Video Orientation to Strengthening Science Literacy

The results of the synthesis also show the relationship between the characteristics of developing digital media and science literacy competencies. This relationship is especially seen in the ability of video to present phenomena, support observations, assist in information interpretation, and connect science concepts with real-life problems.

Nevertheless, it is necessary to distinguish between studies that explicitly measure science literacy and studies that only measure related indicators, such as concept understanding, learning outcomes, critical thinking, or problem-solving. Therefore, SLR's findings do not show that all videos in 18 articles have directly been shown to improve science literacy. A more precise finding is that the characteristics of media development in the literature have potential and tendencies that are increasingly relevant to the science literacy dimension.

This condition also shows a research gap. Some studies still place the success of video in terms of validity, practicality, or improvement of learning outcomes. The development of videos that are explicitly designed to facilitate the ability to observe phenomena, analyze information, evaluate evidence, and solve scientific problems still needs to be strengthened. This gap is then compared conceptually with the needs of teachers through empirical surveys (Annisa et al., 2024; Jundu et al., 2020).

Teacher Survey Findings on the Use and Needs of Science Learning Videos

The results of the literature review were then compared with empirical conditions through a survey of 70 elementary school teachers. The research instrument consisted of 20 statements that covered five dimensions, namely the use of learning videos, characteristics and quality of videos, the development of science literacy, the integration of technology and pedagogy, and the need for the development of learning videos.

The results of the analysis showed that all dimensions obtained a high average score, which indicates that teachers have a positive perception of the use of learning videos in science.

Table 2. Descriptive Statistics of Teachers' Perception of Science Learning Videos (N=70)

Dimensions	Number of Items	Mean	Standard Deviation
Use of learning videos	5	4,11	0,72
Characteristics and quality of the video	5	4,12	0,74
Development of science literacy	5	4,07	0,74
Integration of technology and pedagogy	3	3,99	0,75
Video development needs	2	4,26	0,71

Based on Table 2, the dimension of learning video development needs obtained the highest average score of 4.26. These results show that teachers' needs do not stop at the availability of video as a medium for delivering material. Teachers need science learning videos that are deliberately designed to support science literacy activities, including observing phenomena, reasoning, evaluating information, and solving problems.

The dimensions of video characteristics and quality obtained an average of 4.12. These findings show that teachers pay attention to the suitability of the material with the students' cognitive characteristics, clarity of presentation, the use of visual and audio elements, concrete examples, and the flexibility of the media. Thus, the quality of the video from the teacher's perspective is not only determined by the technical appearance, but also by the suitability between the content of the media and the learning needs of the students.

The dimension of the use of learning videos obtained an average of 4.11. This value shows a positive acceptance of video as a science learning medium. Videos are perceived to help teachers explain concepts that are difficult to convey verbally and allow students to relate science material to phenomena encountered in daily life.

Meanwhile, the dimension of science literacy development obtained an average score of 4.07. These results show that teachers see videos as a potential medium to help students understand phenomena, identify problems, analyze information, and apply science concepts to explain or solve problems.

The dimension with the lowest average is the integration of technology and pedagogy, which is 3.99. Although it still shows a positive response, the score indicates that there is room for reinforcement in the use of video as part of active learning strategies. Video will have a higher pedagogical value when its use is integrated with discussions, questions and answers, experiments, investigations, and problem-solving activities. In other words, passive use of video is not enough to produce science literacy-oriented learning (Atalia et al., 2020; Hanif, 2020).

Integrated Results of the SLR and Teacher Survey

Integration of the two data sources revealed correspondence between the trends identified in the literature and teachers' empirical responses. The literature showed increasing development of digital, visual, contextual, and pedagogy-integrated learning videos. At the same time, teachers reported their highest score for the need for further learning-video development (M = 4.26), whereas technology–pedagogy integration obtained the lowest relative score (M = 3.99).

DISCUSSION

The novelty of this study lies in the integration of two complementary sources of evidence to examine the development of science learning videos in elementary school science education. Rather than examining learning videos exclusively from the perspective of media development or effectiveness, this study combines a Systematic Literature Review of 18 SINTA 1–3 indexed studies published between 2021 and 2025 with empirical evidence from 70 elementary school teachers. This integrative approach makes it possible to examine not only how science learning videos have developed in the academic literature but also whether these developments correspond to teachers' needs in actual learning contexts. Therefore, the originality of the study lies particularly in connecting research trends, pedagogical characteristics, science-literacy orientation, and teachers' empirical needs within a single analytical framework.

The findings reveal three major developments in elementary science learning videos: increasing use of digital visualization, greater integration between video and pedagogical approaches, and stronger orientation toward scientific activities related to science literacy. These findings are reinforced by the teacher survey, in which the need for further video development received the highest mean score (M = 4.26), while the integration of technology and pedagogy obtained the lowest relative score (M = 3.99). The combination of these results is important because it suggests that the central issue is no longer simply whether learning videos are available or technologically attractive. Instead, attention needs to shift toward how videos are pedagogically designed and implemented to engage students in observing phenomena, interpreting information, evaluating evidence, and solving scientific problems.

These findings are consistent with several previous studies on digital media and elementary science learning. Bersih and Margunayasa (2021) demonstrated that demonstration-based learning videos could support the representation of changes in substances in elementary science learning. Imawati et al. (2022) similarly developed learning videos on the human digestive system to strengthen elementary students' science literacy. Utama et al. (2024) reported positive validity, practicality, and effectiveness outcomes for Powtoon-based videos on electrical circuits, whereas Ismail and Suartama (2024) showed the potential of VideoScribe-based science learning videos as technology-supported instructional media. Hakim et al. (2024) also reported positive findings regarding learning videos on states of matter and their changes. From the pedagogical perspective, Widiastawan et al. (2023) demonstrated the potential of Problem-Based Learning animated videos to support students' involvement with abstract science concepts, while Putri et al. (2025) emphasized contextual animation videos that connect science content with students' everyday environments. Thus, the present findings are broadly consistent with previous research indicating that digital visualization becomes more educationally meaningful when it is connected with appropriate content, context, and learning activities.

The similarities between the present study and previous research can be explained by the characteristics of science learning at the elementary level. Many scientific phenomena involve processes, structures, or changes that cannot always be observed directly in classroom settings. Digital videos provide visual and auditory representations that can make these phenomena more accessible to young learners. This may explain why previous studies consistently reported favorable results in terms of media validity, conceptual understanding, student responses, engagement, and learning outcomes. The positive teacher perceptions identified in the present study reflect a similar pattern: teachers considered videos useful for presenting difficult concepts and connecting scientific material with real-life phenomena. Such consistency suggests that visualization remains an important instructional function of video in elementary science education.

Nevertheless, the present findings also reveal an important distinction from much of the existing literature. Many previous studies focused primarily on the development and evaluation of specific media products and commonly used indicators such as validity, practicality, learning outcomes, conceptual understanding, or student responses. In contrast, the present study explicitly examines these developments from the broader perspective of science literacy and teachers' pedagogical needs. Not all studies included in the SLR directly measured science literacy; several measured outcomes that are related to, but not identical with, science literacy. Therefore, the findings should not be interpreted as evidence that every type of learning video automatically improves science literacy. Differences between the findings and claims of previous studies may partly result from differences in outcome variables, research design, science topics, student populations, and instructional contexts. Development studies, for example, often assess the feasibility and effectiveness of a particular media product, whereas the current study synthesizes patterns across studies and compares them with teachers' perceptions.

A particularly important finding is the difference between the high perceived need for learning-video development (M = 4.26) and the relatively lower score for technology–pedagogy integration (M = 3.99). This pattern reveals a technology–pedagogy gap. The growing availability and technological sophistication of learning videos do not necessarily ensure that these media are integrated into meaningful scientific activities. A visually attractive video may still function primarily as a one-way information-delivery medium when students are not required to ask questions, make observations, discuss evidence, conduct investigations, or solve problems. This interpretation is consistent with research emphasizing the importance of active scientific learning and pedagogical strategies in elementary science education (Jundu et al., 2020; Lusidawaty et al., 2020), as well as findings demonstrating the potential of problem-based and contextual learning approaches when integrated with digital media (Widiastawan et al., 2023; Putri et al., 2025). The relatively lower technology–pedagogy integration score in this study may therefore reflect differences between possessing or using digital media and having the pedagogical capacity to integrate that media systematically into active science learning.

The main contribution of this research is the identification of a conceptual relationship between technological features, pedagogical design, scientific activities, and science literacy. Based on the integration of the SLR and teacher-survey findings, the relationship can be conceptualized as digital technology → pedagogical integration → scientific activities → science literacy. Digital technology provides opportunities for visualization and representation; pedagogical integration determines how those representations are incorporated into learning activities; scientific activities engage students in observing, questioning, analyzing information, evaluating evidence, and solving problems; and these processes provide the learning conditions necessary to support science literacy. This perspective extends previous research by suggesting that the educational value of learning videos should not be evaluated solely from their technological quality or media feasibility, but also from the scientific activities that the videos are designed to generate.

From a practical perspective, these findings imply that science learning videos should be designed as components of learning activities rather than as stand-alone presentation materials. Videos can incorporate observable phenomena, contextual situations, guiding questions, pauses for prediction, evidence-analysis tasks, discussion prompts, and problem-solving activities. Teachers should also be supported in integrating videos with discussion, experimentation, investigation, and other active learning strategies. Academically, future studies should move beyond evaluations of validity, practicality, and general learning outcomes by directly examining specific dimensions of science literacy, particularly the ability to explain scientific phenomena, interpret and evaluate evidence, and use scientific knowledge in problem situations. At the policy and professional-

development levels, programs related to educational technology should therefore focus not only on providing access to digital media but also on strengthening teachers' technological–pedagogical competence in science instruction. Future research should additionally test the conceptual relationship proposed in this study through experimental or quasi-experimental designs, involve more diverse teacher and student populations, expand literature sources beyond the current corpus, and directly measure changes in elementary students' science literacy.

CONCLUSION

This research shows that the trend of developing learning videos in elementary school science learning is moving towards media that is increasingly interactive, contextual, and oriented towards strengthening science literacy. Based on the results of the Systematic Literature Review (SLR) of 18 articles indexed by SINTA 1–3 for the 2021–2025 period, three main trends were found, namely the use of digital technology to visualize science concepts and phenomena, the integration of videos with innovative pedagogical approaches, and the increasing media orientation to students' scientific activities. Learning videos no longer only function as a means of delivering material, but are beginning to be directed to support learning experiences that allow students to observe phenomena, understand concepts contextually, analyze information, and solve problems.

The results of the survey of 70 elementary school teachers reinforced the findings of the literature. All dimensions of the survey showed a positive response, with the need for learning video development obtaining the highest average score (M = 4.26), followed by the characteristics and quality of the video (M = 4.12), the use of video in science learning (M = 4.11), the development of science literacy (M = 4.07), and the integration of technology and pedagogy (M = 3.99). The findings show that teachers not only need visually appealing videos, but also media that are deliberately designed to support science literacy activities, such as observing phenomena, reasoning, analyzing information, evaluating evidence, and solving science problems.

The integration of SLR results and teacher surveys shows that there is a correspondence between the direction of research development and empirical needs in elementary schools. However, the relatively lower score of technology and pedagogical integration shows that the availability of learning videos has not always been followed by its optimal utilization in active learning activities. Therefore, the development of science learning videos further needs to place technology, pedagogy, and science literacy as a single design unit. The developed videos need to integrate the visualization of phenomena with triggering questions, analysis activities, the use of evidence, discussion, investigation, and problem solving so that students are not only recipients of information.

The main contribution of this research lies in the integration of literature evidence and empirical data of teachers to provide a conceptual basis regarding the characteristics of science learning videos needed at the elementary school level. The results of the study directed the development of videos on three main characteristics, namely interactive, contextual, and oriented to science literacy. With these characteristics, learning videos have the potential to become a medium that not only clarifies the concept of science, but also builds a more meaningful scientific learning experience for students.

This study has limitations in the number of articles analyzed, namely 18 articles indexed by SINTA 1–3 in the period 2021–2025, as well as the scope of the survey which is limited to 70 elementary school teachers. In addition, this study focuses on teachers' perceptions so that they have not directly tested the influence of the identified video characteristics on students' science literacy skills. The next research is suggested to expand the literature sources and respondent characteristics, develop videos based on the integrative findings of this research, and conduct empirical testing on the effectiveness of video in improving the ability to explain scientific phenomena, analyze and evaluate evidence, and solve science problems in elementary school students.

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