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The Effect of Animated Videos on Elementary School Students' Understanding of the Concept of Changes in the State of Matter

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Abstract

Background: *Conceptual understanding is an important aspect of science education in elementary schools, particularly in learning abstract concepts such as changes in the state of matter. Students often experience difficulties in understanding these concepts because the processes cannot always be directly observed. This study aims to determine the effect of animated video media on fourth-grade elementary school students' conceptual understanding of changes in the state of matter.* **Methodology:** *This study employed a quantitative approach using a quasi-experimental method with a nonequivalent control group design. The participants consisted of 50 fourth-grade students at SDN Warakas 06, with 25 students assigned to the experimental class and 25 students to the control class. Data were collected using an essay test administered as a pretest and posttest. Before implementation, the instrument was validated through expert judgment and a field trial. The experimental class received instruction using animated video media for three meetings, with each video lasting approximately 15 minutes and presenting visual and narrated explanations of melting, freezing, and evaporation. Meanwhile, the control class received conventional learning media for the same number of meetings. Data analysis included the Shapiro-Wilk normality test, Levene's homogeneity test, independent-samples t-test, and Cohen's d effect size analysis.* **Findings:** *The results showed that the experimental class mean increased from 64.20 to 74.40, while the control class increased from 64.40 to 72.60. The hypothesis test produced a significance value of 0.001 < 0.05, with a calculated t-value of 5.524 exceeding the critical t-value of 2.010. The effect size was 0.709, indicating a medium-to-large effect.* **Contributions:** *This study contributes empirical evidence on the effectiveness of animated videos in facilitating elementary students' understanding of changes in the state of matter.*

Keywords: *Animated Video; Conceptual Understanding; Changes In The State of Matter; Elementary School; Science Education*

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INTRODUCTION

Education plays a vital role in developing students' abilities so they can understand the various concepts they learn and apply them in daily life (Putri et al., 2026). One of the learning objectives of IPAS in elementary school is to foster a solid conceptual understanding so that students not only memorize information but are also able to explain, interpret, classify, and provide examples of the concepts they have learned (Ummah et al., 2025). In the revised Bloom's Taxonomy, understanding is a cognitive skill that requires students to grasp the meaning of information and connect it to their prior knowledge (Marta et al., 2025). Conceptual understanding serves as a crucial foundation for students to develop critical thinking, problem-solving, and decision-making skills based on their existing knowledge (Budianti et al., 2026).

In elementary school science (IPAS) instruction, conceptual understanding plays a crucial role because most of the curriculum involves natural phenomena that require logical and systematic thinking (Aulia & Alyani, 2024; Urushibata, 2022). One topic that often poses difficulties for students is the changes in the states of matter. This topic covers the concepts of melting, freezing, evaporation, condensation, and sublimation—processes that, under certain conditions, cannot be directly observed by students (Anggraini & Anas, 2026). As a result, students tend to merely memorize definitions without fully understanding the processes behind changes in the state of matter (Sumalia & Listiaji, 2024). Poor conceptual understanding can lead to students struggling to explain phenomena occurring in their surroundings and to connect the curriculum to their daily experiences (Aprilliyah et al., 2024).

Students' difficulties in understanding the concept of changes in the state of matter are closely related to the characteristics of cognitive development in elementary school-aged children (Anggraini & Anas, 2026). According to Piaget's theory of cognitive development, children aged 7–12 years are in the concrete operational stage—a stage when logical thinking begins to develop but still relies on tangible objects and direct experience (Imanulhaq & Ichsan, 2022). At this stage, students tend to struggle with understanding abstract concepts unless supported by instructional media that can visualize these concepts concretely. Therefore, teachers need to design instruction that aligns with students' developmental characteristics (Meo et al., 2025) so that the learning process becomes more meaningful and easier to understand.

One factor influencing students' success in understanding concepts is the use of appropriate instructional media (Putri et al., 2026). Instructional media serve as tools to help teachers present material in a more engaging, clear, and easily understandable way for students (Asrifah et al., 2025). The use of appropriate media can increase students' attention, motivation to learn, and active engagement in the learning process (Blau et al., 2025). When teaching the abstract concept of changes in the state of matter, the use of instructional media capable of visually demonstrating the process of change is essential so that students can gain a deeper understanding of the concept being studied (Putri et al., 2024).

With the advancement of educational technology, animated videos have become one of the most widely used learning media in elementary schools (Magdalena et al., 2023). Animated videos combine visual, audio, text, and motion elements to present information in an engaging and interactive way

(Lovandri et al., 2024). Through animated videos, abstract concepts can be visualized in a more concrete way, making it easier for students to understand the learning material. Additionally, the use of narration, illustrations, colors, and sound effects can enhance students' focus and motivation during the learning process (Arsyad & Rahman, 2013).

In the topic of changes in the state of matter, animated videos allow students to observe the processes of melting, freezing, evaporation, condensation, and sublimation more clearly than through verbal explanations or static images (Alwis et al., 2024). Presenting concepts in the form of moving images helps students understand the cause-and-effect relationships that occur in each process of matter's state changes. Thus, Jannah et al., (2023) animated videos can help bridge the limitations of elementary school students' abstract thinking and improve their conceptual understanding (Herlyana et al., 2025)

Various previous studies have shown that the use of animated videos has a positive impact on the learning process and outcomes. A study conducted by (Lovandri et al., 2024) showed that animated videos can increase students' attention and engagement during instruction. Another study also found that animated media is effective in helping students understand abstract science concepts through more concrete and engaging visualizations (Utami, 2025). Furthermore, the use of animated videos has been shown to improve learning outcomes, learning motivation, and conceptual understanding among elementary school students because the information presented is easier to understand compared to conventional instruction (Arsyad & Rahman, 2013). Nevertheless, Research specifically examining the impact of animated videos on students' conceptual understanding of the topic of changes in the states of matter among fourth-grade elementary school students remains limited. Most previous studies have primarily investigated the effects of animated videos on students' learning outcomes, learning motivation, and classroom engagement rather than on conceptual understanding of a specific science (Muntaqiyah et al., 2024). Therefore, further research is needed to specifically analyze the effect of using animated videos on students' conceptual understanding of changes in the states of matter, thereby providing empirical evidence regarding the effectiveness of this instructional medium in elementary school IPAS learning (Janah & Hidayati, 2025). Most previous studies have focused more on improving students' learning outcomes or learning motivation in general (Yanda & Stavinibelia, 2024). Therefore, research is needed that specifically analyzes the effect of using animated videos on students' conceptual understanding of the topic of changes in the states of matter, thereby providing empirical evidence regarding the effectiveness of this medium in IPAS instruction in elementary schools (Putri & Apriza, 2024).

Based on this background, this study aims to determine the effect of using animated videos on students' conceptual understanding of the topic of changes in the physical state of matter in the IPAS curriculum for fourth-grade students at SDN Warakas 06. The results of this study are expected to serve as a reference for teachers in selecting innovative and effective instructional media to enhance students' conceptual understanding, as well as to provide a basis for future research related to the use of animated video media in IPAS instruction in elementary schools.

METHOD

This study employed a quantitative approach using a quasi-experimental research design. The research design used was the Nonequivalent Control Group Design, which involves two groups—an experimental class and a control class—that were not selected randomly but were both administered pretests and posttests to examine the effect of the treatment (Amin et al., 2023). In this design, both groups took a pretest before the intervention and a posttest after the intervention to determine changes in students' conceptual understanding following the learning process. The experimental class received instruction using animated video media, while the control class participated in instruction without the use of animated video media.

Table 1. The research design

Group	Pretest	Treatment	Posttest
Experiment	O_1	X	O_2
Control	O_3	–	O_4

Description,
O_1 = Pretest for the experimental class
O_2 = Posttest for the experimental class
O_3 = Pretest for the control class
O_4 = Posttest for the control class
X = Learning using animated videosSample or Participant

Sample or Participant

The study was conducted at SDN Warakas 06 during the even semester of the 2025/2026 school year. The study population consisted of all fourth-grade students at SDN Warakas 06. The sample comprised 50 students divided into two classes: 25 students in Class 4A as the experimental group and 25 students in Class 4B as the control group. The sample was selected using purposive sampling, taking into account the similarity in academic characteristics and the number of students in both classes.

Instrument

The research instrument used was a conceptual understanding test on the topic of changes in the state of matter, administered to students as a pretest and posttest. The instrument was developed based on indicators of conceptual understanding, which included the ability to explain concepts, classify, provide examples, identify changes in the state of matter, and apply concepts in daily life.

Before being used in the study, the instrument first underwent expert validation (expert judgment) and a field trial with 25 fourth-grade students at SDN Warakas 06. The validity test was conducted using SPSS version 22 by comparing the calculated r value and the table r value. The results of the validity test showed that of the 15 test

items administered, 10 were deemed valid and met the criteria for use in the study, while 5 were deemed invalid and were not used in the data collection process.

Table 2. Instrument Validity Test Results

Classification	Number of item
Valid	10
In valid	5
Total	15

Next, the reliability of the validated instrument was tested using Cronbach's alpha. The results of the analysis showed a reliability coefficient of 0.751, which falls into the high category. Thus, the conceptual understanding test instrument was deemed reliable and suitable for use as a research data collection tool.

Table 3. Results of the Instrument Reliability Test

Cronbach's Alpha	N of Items	Category
0,751	15	High

Data collection

Data collection in this study was conducted through concept comprehension tests administered to students before and after the intervention. The first stage began with a pretest for both the experimental and control classes to assess students' initial understanding of the material on changes in the state of matter. After the pretest, the experimental class received an intervention involving instruction using animated video media, while the control class participated in instruction using the media typically employed by the teacher without the aid of animated videos.

The learning process in the experimental class was carried out by showing animated videos covering the topic of changes in the state of matter, including the processes of melting, freezing, evaporation, condensation, and sublimation. Animated videos were used as the primary medium for presenting the material so that students could observe the processes of changes in the state of matter visually and more concretely. Meanwhile, in the control class, instruction was conducted using conventional teaching methods supported by presentation software (PowerPoint) without the use of animated videos.

After all instructional activities were completed, both groups were administered a posttest using the same instrument as the pretest. The pretest and posttest data were then used to analyze improvements in students' conceptual understanding and to test the effect of using animated videos on conceptual understanding of the material on changes in the state of matter.

Procedure

This study was conducted in four stages: the preparation stage, the pretest stage, the treatment stage, and the posttest stage. During the preparation stage, the researcher developed a conceptual understanding test instrument, validated the instrument through expert judgment, and conducted validity and reliability tests on the instrument before using it in the study. The instrument, which met the criteria for validity and

reliability, was then used to measure students' conceptual understanding of the topic of changes in the state of matter.

The next stage involved administering the pretest to the experimental and control classes. The pretest was given to assess students' initial understanding of the topic of changes in the states of matter before the intervention was implemented. The experimental and control classes each consisted of 25 students. The pretest results served as a baseline for comparing the initial abilities of the two groups before the learning process began.

During the intervention stage, students in the experimental class participated in lessons using animated video media. Animated videos were used to present the material on changes in the state of matter in a visual and interactive manner so that students could observe the processes of melting, freezing, evaporation, condensation, and sublimation more clearly. Meanwhile, students in the control class participated in the learning process without using animated videos, relying solely on the learning media typically used by the teacher.

The final stage involved administering a posttest to both groups after the entire learning process was completed. The posttest was administered using the same instrument as the pretest to determine the improvement in students' conceptual understanding following the instruction. The data obtained from the pretest and posttest results were then analyzed using SPSS version 22 through normality tests, homogeneity tests, independent samples t-tests, and Cohen's d effect size tests to determine the significance and magnitude of the impact of animated video use on students' conceptual understanding.

Data analysis

The research data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 22. Data analysis began with prerequisite tests, including tests of normality and homogeneity. The test of normality was conducted using the Shapiro–Wilk test to determine whether the data were normally distributed. Next, the homogeneity test was conducted using Levene's test to determine the equality of variances between the experimental and control classes.

After meeting the prerequisite tests, hypothesis testing was conducted using an independent samples t-test at a significance level of 0.05 to determine the effect of using animated videos on students' conceptual understanding. Additionally, to determine the magnitude of the effect of using animated videos on students' conceptual understanding, an effect size analysis was performed using *Cohen's d* formula. The effect size values were then interpreted as small, moderate, or large based on *Cohen's* criteria.

RESULT AND DISCUSSION

Result Clear Parameters

This study aims to determine the effect of using animated videos on students' conceptual understanding of the topic of changes in the state of matter in the fourth-grade class at SDN Warakas 06. Research data were collected by administering

pretests and posttests to the experimental and control classes. The data were then analyzed using normality tests, homogeneity tests, hypothesis tests, and effect size calculations to determine the effect of using animated videos on students' conceptual understanding.

Table 4. Descriptive Statistics

Group	N	Pretest Mean	Posttest Mean	Increase
Experiment	25	64.20	73.80	10.20
Control	25	64.40	72.60	8.20

According to Table 4, the average pretest score for the experimental class was 64.20, which increased to 73.80 on the posttest. Meanwhile, the average pretest score for the control class was 64.40, which increased to 72.60 on the posttest. These results indicate that the improvement in conceptual understanding was greater in the experimental class than in the control class.

Normality Test

Before testing the hypothesis, a normality test using the Shapiro–Wilk test is first conducted to determine whether the data are normally distributed. Based on Table 5, all data points have significance values greater than 0.05; therefore, it can be concluded that the research data are normally distributed.

Table 5. Results of the Normality Test

Data	Sig.	Description
Pretest Experiment	0.624	Normal
Posttest Experiment	0.558	Normal
Pretest Control	0.102	Normal
Posttest Control	0.146	Normal

Homogeneity Test

A homogeneity test was conducted using Levene's test to determine whether the variances between the two study groups were equal. The results of the homogeneity test showed a significance value of 0.596 (> 0.05), so it can be concluded that the data in both groups have homogeneous variances.

Table 6. Results of the Homogeneity Test

Levene Statistic	Sig.	description
0.283	0.596	Homogen

Hypothesis Testing

Hypothesis testing was conducted using an independent samples t-test to determinehthe effect of using animated videos on students' conceptual understanding.

Table 7. Result of *Independent sample t-test*

Variable	t Value	t Tabel	Sig. (2-tailed)

students' conceptual understanding	5,524	2,010	0,001

Based on Table 7, the calculated t-value is 5.524 with a significance level of 0.001. Since the significance level is less than 0.05 (0.016 < 0.05) and the calculated t-value is greater than the critical t-value (5.524 > 2.010), H_0 is rejected and H_1 is accepted. Thus, there is a significant effect of the use of animated videos on students' conceptual understanding of the topic of changes in the state of matter.

Disccusion

The results of the study show that the use of animated videos has a significant effect on students' conceptual understanding of the topic of changes in the state of matter. This is evidenced by an increase in the average score in the experimental class from 64.20 to 73.80, which is higher than the increase in the control class from 64.40 to 72.60. Furthermore, the results of the Independent Samples t-test showed a p-value of 0.001, which is less than 0.05, thus supporting the research hypothesis. These findings indicate that the use of animated videos is more effective at improving students' conceptual understanding than instruction without animated videos (Bidari et al., 2026).

The improvement in conceptual understanding in the experimental class occurred because animated videos present the topic of changes in the state of matter in a more concrete and easily understandable way (Ummah et al., 2025; Yanda & Stavinibelia, 2024). The topic of changes in the state of matter is one of the IPAS topics that involves abstract concepts, such as the processes of evaporation, condensation, and sublimation, which are difficult for students to observe directly. Through animated videos, these processes can be visualized in the form of moving images accompanied by narration, making it easier for students to understand the relationships between the concepts being studied. Engaging visualizations help students develop a deeper understanding compared to simply receiving verbal explanations (Aditiya et al., 2023).

These research findings align with Piaget's theory of cognitive development, which states that elementary school students are in the concrete operational stage. At this stage, students find it easier to understand material presented through real objects or concrete visualizations than through abstract concepts. Therefore, the use of animated videos is a medium well-suited to the cognitive developmental characteristics of elementary school students because it transforms abstract concepts into something more tangible and easier to understand. Consequently, students can connect the learning material to experiences they encounter in their daily lives (Angelika & Mahendra, 2025).

CONCLUSION

Based on the research results, it can be concluded that the use of animated videos has a significant effect on students' conceptual understanding of the topic of changes in the state of matter in the fourth-grade class at SDN Warakas 06. The

analysis results show that the average conceptual understanding score in the experimental class increased from 64.20 on the pretest to 73.80 on the posttest, while in the control class it increased from 64.40 to 72.60. The results of the Independent Samples t-test showed a p-value of 0.001 < 0.05 and a calculated t-value of 5.524 > the critical t-value of 2.010, thus supporting the research hypothesis. These findings indicate that the use of animated videos is more effective at improving students' conceptual understanding than instruction without animated videos. Furthermore, the effect size analysis yielded a Cohen's d value of 0.709, which falls into the moderate-to-large category. These results indicate that animated videos not only have a statistically significant effect but also exert a sufficiently strong practical impact on improving students' conceptual understanding. Thus, animated videos can serve as an effective alternative learning medium to help students understand abstract IPAS concepts, particularly regarding the change of state of matter. Therefore, teachers are advised to make optimal use of animated videos in the learning process to improve the quality of instruction and students' conceptual understanding in elementary school.

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