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The Effect of Digital Media-Assisted CORE Model on Students' Science Conceptual Understanding

Nurkholis Khoirur Rokhim[1], Bambang Eko Hari Cahyono[2], Endang Sri Maruti[3]

[1,2,3] Universitas PGRI Madiun
Correspondence E-mail: nurkholis_2202101218@mhs.unipma.ac.id

A B S T R A C T

The low understanding of science concepts among elementary school students in abstract materials such as changes in the state of matter requires contextual and interactive learning innovations. This study aimed to evaluate the effect of implementing the Connecting, Organizing, Reflecting, Extending (CORE) learning model assisted by digital media on the understanding of science concepts in fourth-grade elementary school students. The approach used was quantitative with a one-group pretest-posttest experimental design. Data were collected through a multiple-choice objective test instrument consisting of 20 items and analyzed using the paired samples t-test assisted by SPSS version 26. The results showed a significant increase in the students' average concept understanding score from 64.69 in the pre-test to 77.19 in the post-test. Hypothesis testing obtained a significance value (2-tailed) of 0.000 and a t-count value of 4.697 which was greater than the t-table of 2.131, meaning that H_0 was rejected and H_a was accepted. The conclusion of this study is that the implementation of the CORE learning model assisted by digital media has a significant effect on improving the understanding of science concepts in fourth-grade elementary school students.

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1. INTRODUCTION

Science education in elementary school plays a fundamental role in developing students' scientific thinking from an early age. Rather than merely memorizing information, students are encouraged to explore scientific concepts and apply them to real-life situations. Conceptual understanding serves as the essential foundation because every scientific concept is closely interconnected (Murtiyasa & Sari, 2022). Through this understanding, students acquire a range of related concepts that enable them to develop comprehensive knowledge within a particular scientific domain (Fahreza et al., 2024). They are expected to master scientific ideas, formulate appropriate solutions to problems, and implement those ideas in everyday contexts (Zuleni & Marfilinda, 2022). Consequently, science learning fosters curiosity while establishing the basis for students' higher-order thinking skills.

Classroom observations indicate that many elementary school students encounter difficulties in understanding abstract science concepts. Science instruction continues to rely heavily on memorizing terms and factual information, limiting students' ability to grasp the relationships among scientific concepts in a comprehensive manner. As a result, students often struggle to classify changes in the states of matter and to connect scientific concepts with phenomena they observe in their daily lives (Fahreza et al., 2024). These findings highlight the need for instructional strategies that enable students to construct their own conceptual understanding through learning experiences that are active, meaningful, and closely related to real-world contexts.

This issue is also reflected in the results of the Programme for International Student Assessment (PISA). According to the OECD's 2022 PISA report, Indonesia achieved a science score of 383, which remains well below the OECD average of 485. Furthermore, most Indonesian students are still classified at lower proficiency levels, indicating that they have not yet developed the ability to apply scientific knowledge effectively when explaining phenomena or making evidence-based decisions. These findings suggest that students' conceptual understanding and scientific reasoning skills in Indonesia require systematic improvement (Yusmar & Fadilah, 2023).

Previous studies have attempted to address this issue by implementing a range of innovative instructional approaches. Metravia et al. (2025) examined the use of the Discovery Learning model supported by animated videos. In another study, Sugiartini et al. (2024) applied Project Based Learning to improve students' conceptual understanding of science. Febrianti et al. (2025) demonstrated the effectiveness of the Teams Games Tournament model, while Ikstanti & Yulianti (2023) confirmed that Problem Based Learning successfully enhanced students' critical thinking skills. More specifically, the Connecting, Organizing, Reflecting, Extending (CORE) learning model has been shown to effectively strengthen conceptual understanding (Simanjuntak et al., 2023; Handayani et al., 2023). Despite these promising findings, several limitations remain. Most existing studies have implemented the CORE model in mathematics instruction, whereas its application in elementary school science classrooms has received relatively little attention.

Based on these limitations, a notable research gap lies in the limited integration of the CORE learning model with digital media. Rahayu et al. (2023) investigated the implementation of the CORE model supported by video media; however, their study focused exclusively on students' learning motivation. It did not specifically examine the development of scientific conceptual understanding. The absence of instructional innovations that combine the pedagogical framework of the CORE model with digital visualization limits students'

opportunities to transform abstract information into concrete representations. This shortcoming represents a significant gap in the current body of academic literature. Therefore, further research is still needed to investigate the implementation of the CORE learning model integrated with digital media to enhance elementary school students' conceptual understanding of science.

The identified research gap forms the basis for the novelty of this study, which integrates the CORE learning model with Google Sites-based digital media developed as the central platform for learning activities. The Google Sites platform incorporates instructional videos, interactive animations, and learning materials organized according to the connecting, organizing, reflecting, and extending stages. This design enables each phase of the learning process to support students in activating their prior knowledge, organizing new information, reflecting on their learning experiences, and extending their conceptual understanding through contextual visual representations. Such integration is expected to help students develop a more concrete and meaningful understanding of the topic of changes in the states of matter. Accordingly, this study aims to examine the effect of the CORE learning model supported by Google Sites-based digital media on the science conceptual understanding of fourth-grade elementary school students.

2. RESEARCH METHODOLOGY

The study employed a quantitative approach using a one-group pretest-posttest experimental design to compare students' scores before and after the implementation of the treatment. Since this design did not include a control group, its ability to control for the influence of external variables was limited. The experiment was conducted at SD Negeri Klitik 1 in May 2026. A saturated sampling technique was applied, involving the entire population of 16 fourth-grade students. Students' science conceptual understanding was assessed using a 20-item multiple-choice objective test. The instrument met the requirements for content validity and demonstrated high reliability, with a Cronbach's Alpha coefficient of 0.90.

Data were collected systematically through three sequential stages. At the beginning of the study, the researcher administered a pre-test, followed by the implementation of the CORE learning model supported by digital media. A post-test was then conducted at the end of the experimental period. The collected data were analyzed using SPSS version 26. The analytical procedures included descriptive statistical analysis and a normality test to examine the distribution of the data. Subsequently, the research hypothesis was tested using a paired samples t-test at a significance level of 0.05 to determine the effect of the learning model on students' science conceptual understanding.

3. RESULT AND DISCUSSION

3.1. Descriptive Statistical Analysis

This study describes the characteristics of the data through descriptive statistical analysis involving 16 participants. The test results present the variation in fourth-grade students' pre-test and post-test scores before and after the implementation of the instructional intervention.

Table 1 Results of Descriptive Statistical Analysis

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Pre-test	16	40	85	64,69	12,970
Post-test	16	40	95	77,19	16,327

The data presented in Table 1 indicate an increase of 12.50 points in the mean score of students' science conceptual understanding. The average pre-test score rose from 64.69 to 77.19 on the post-test. The minimum score remained unchanged at 40, whereas the maximum score increased from 85 to 95. In addition, the standard deviation increased from 12.970 to 16.327, suggesting that students' achievement became more varied following the learning intervention.

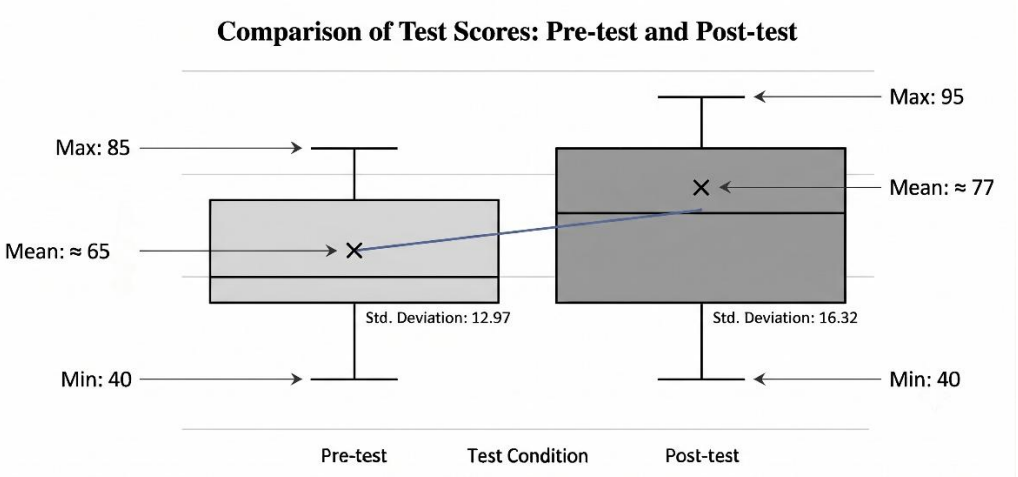

Figure 1. Pre-test and Post-test Data on Science Conceptual Understanding

3.2. Normality test

The normality test aimed to determine whether the research data were normally distributed or not. This study assessed the normality assumption using the Shapiro-Wilk test, as the sample consisted of fewer than 50 students.

Table 2. Normality Test Results

Variable	Significance value	Sig.	Conclusion
Pre-test	Sig > 0,05	0,479	Normally Distributed
Post-test		0,090	Normally Distributed

The normality test results presented in Table 2 show that the significance values for the pre-test (0.479) and post-test (0.090) both exceed the 0.05 threshold. These findings indicate that the data satisfy the assumption of normal distribution. Consequently, the dataset was considered appropriate for parametric statistical analysis. Based on this result, the study proceeded with hypothesis testing using a paired samples t-test.

3.3. Paired Sample t-Test

Hypothesis testing in this study was conducted using a paired samples t-test. This statistical procedure was selected because it is appropriate for a research design involving a single group of participants assessed on two occasions, namely before the intervention through the pre-test and after the intervention through the post-test. The decision criterion for the paired sample t-test was that if the Sig. (2-tailed) value < 0.05, then there is a significant difference.

Table 3. Paired Sample t-Test Results

Comparison	Std. Deviation	t	df	Sig. (2-tailed)

Pre-test - Post-test	10,646	4,697	15	0,000

The results presented in Table 3 indicate a significance (2-tailed) value of 0.000, which is lower than the established significance level of 0.05. In addition, the calculated t value of 4.697 exceeds the critical t value of 2.131. Based on these findings, the study concludes that H_0 is rejected and H_a is accepted. These results demonstrate that the intervention produced a significant effect on students' cognitive achievement.

3.4. Discussion

Based on the research results, the implementation of the CORE learning model supported by digital media had a significant effect on students' science conceptual understanding. The improvement observed in this study can be attributed to a learning process that shifted away from one-way information delivery toward a systematic process of cognitive assimilation and accommodation. When students encountered abstract scientific concepts, such as the mechanisms of heat absorption and heat release, digital media helped reduce cognitive load by presenting information through concrete, clear, and dynamic visual representations. These visual materials were then processed more thoroughly through the stages of the CORE learning model, which actively engaged students' cognitive structures throughout the learning process. Rather than simply memorizing information presented in the visual materials, students connected new knowledge with their prior experiences, reorganized relationships among concepts in a logical manner, reflected on their own understanding, and applied the acquired concepts to solve problems in different contexts. The integration of digital media with students' active participation across the CORE learning stages enabled abstract scientific concepts to be linked with observable phenomena, resulting in conceptual understanding that became deeper, more meaningful, and more firmly retained within students' knowledge structures.

The CORE learning model supports the reconstruction of knowledge through four systematic stages integrated with digital technology. During the connecting stage, students relate their prior knowledge to new concepts by observing videos of natural phenomena available on the Google Sites platform. The organizing stage then guides students in establishing relationships among concepts through structured group discussions. In this phase, students classify the characteristics of solids, liquids, and gases using digital schematic diagrams. These activities assist students in organizing scientific ideas in a logical and well-structured manner.

The reflecting stage plays a crucial role in reducing students' misconceptions about science concepts. At this stage, students reexamine and evaluate their misunderstandings of evaporation and condensation by engaging with interactive simulations. The learning process then progresses to the extending stage, where students are encouraged to apply their understanding of changes in the states of matter to unfamiliar situations encountered in everyday life. For example, students analyze why water inside a plastic bag forms bubbles when exposed to intense sunlight. Through this sequence of activities, students strengthen their critical thinking skills while broadening their scientific understanding.

The findings of this study provide further support for constructivist theory and multimedia learning theory. A constructivist approach is considered effective in improving students' science conceptual understanding because it encourages learning through direct experience and active cognitive engagement. According to Nasriyanti et al. (2021), the CORE learning model is grounded in constructivist theory, which emphasizes that students actively

construct knowledge through learning experiences and social interaction. Within this instructional framework, students do not passively receive information. Instead, they develop their own understanding by connecting prior experiences with new knowledge, organizing information, reflecting on what they have learned, and extending the application of scientific concepts.

In addition, the findings of this study can be interpreted through the Theory of Multimedia Learning (TMM) developed by Mayer. This theory proposes that learning becomes more effective and meaningful when students receive information through the simultaneous integration of visual and verbal elements, as the learning process engages complementary visual and auditory channels (Mayer, 2024). In the present study, the instructional videos delivered through Google Sites supported students in understanding the relationships among concepts related to changes in the states of matter by combining images, text, animations, illustrations of scientific phenomena, and audio explanations. This integration enabled students to process, comprehend, and retain the information more effectively.

The findings of this study complement and extend the results reported by (Nasriyanti et al., 2021) and (Simanjuntak et al., 2023). While earlier studies confirmed the effectiveness of the CORE learning model in conventional instructional settings, the present study demonstrates its added value when integrated with Google Sites. This technological integration provides a more centralized and systematic learning environment that supports students throughout each stage of the cognitive process. Furthermore, these findings offer a more comprehensive perspective than the studies conducted by Metravia et al. (2025) and Saputri et al. (2024), which primarily examined the independent use of interactive videos. In this study, multimedia resources were deliberately incorporated into the connecting and organizing stages, leading to stronger conceptual retention. Students did not merely watch instructional videos. Instead, they immediately processed the visual information through guided discussion and reflective activities.

This study offers a practical contribution by providing an adaptive instructional model that can be implemented by elementary school teachers. Educators may utilize open digital platforms to create learning environments that are interactive, contextual, and student-centered. Nevertheless, the study has several limitations, including a relatively small sample size and a research setting confined to a single school. Future studies should expand the scope of the investigation by involving a larger number of schools and participants. In addition, future researchers are encouraged to integrate the CORE learning model with other innovative forms of interactive digital media across different science topics.

4. CONCLUSION

The findings of this study demonstrate that the implementation of the Connecting, Organizing, Reflecting, Extending (CORE) learning model supported by digital media has a significant effect on the science conceptual understanding of fourth-grade elementary school students. The instructional intervention produced a substantial improvement in students' conceptual understanding, as reflected in the increase in the mean score from 64.69 on the pre-test to 77.19 on the post-test. Statistical analysis confirmed the rejection of the null hypothesis, indicating a significant treatment effect. After participating in a systematic, interactive, and technology-supported learning process, students demonstrated a more advanced understanding of scientific concepts related to changes in the states of matter.

From a practical perspective, this study offers important implications for improving the quality of science instruction in elementary schools. The proposed learning model can serve as

an effective instructional strategy for reducing misconceptions associated with abstract scientific concepts. Through contextual instructional videos and interactive simulations, the approach enables students to construct their own mental representations of scientific ideas. In addition, the findings provide schools with empirical evidence to support the implementation of technology-enhanced learning programs. The effectiveness of this intervention further indicates that active, student-centered instruction can significantly strengthen students' conceptual understanding of science.

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