JoSLEPI 4 (1) (2026)
Journal of Science Learning Process and Instructional Research
https://journal.riau-edutech.com/index.php/joslepi
ISSN 3031-3252
Publisher :
Andester Riau Edutech
Pusat Inovasi Pendidikan dan Teknologi

EFFECTIVENESS OF A CLIS-BASED MECHANICS KIT ON COGNITIVE LEARNING OUTCOMES IN WORK AND ENERGY CONCEPTS

Joice Simanungkalid[1*], M Nor[1], Muhmmad Syafi'i[1]

[1] *Physics Education, Faculty of Teacher Training and Education, Riau University, Indonesia*

*Corresponding author's email: Joice.michel33@student.unri.ac.id

Submiited: 06/04/2026
Review: 15/04/2026
Accepted: 25/04/2026
Published: 30/04/2026
Vol. 4
No. 1

Abstrak- Physics learning in junior high schools often faces challenges due to students' difficulties in understanding abstract concepts, resulting in low cognitive learning outcomes. Therefore, innovative instructional approaches integrating learning models and interactive media are required to enhance students' understanding of scientific concepts. This study aimed to determine the effectiveness of a Mechanics Kit integrated with the Children Learning in Science (CLIS) model in improving students' cognitive learning outcomes on the topic of work and energy among eighth-grade students. The study employed a quantitative approach using a quasi-experimental method with a posttest-only control group design. The research participants consisted of eighth-grade students from SMPN 20 Pekanbaru, where the experimental class was taught using a Mechanics Kit with the CLIS model, while the control class received conventional instruction. Data were collected using a cognitive achievement test consisting of 20 multiple-choice items covering cognitive levels from C1 to C6 and analyzed using descriptive and inferential statistics. The findings revealed that the experimental class achieved a higher mean score (80.13) than the control class (71.45), with a significant difference ($p < 0.05$). It can be concluded that the implementation of a CLIS-based Mechanics Kit effectively improves students' cognitive learning outcomes in physics learning, particularly on work and energy concepts. Derived from the uploaded study data

Keywords: Children Learning in Science; Cognitive learning outcomes; Mechanics kit; Physics education; Work and energy concept

1 Introduction

Education plays a significant role in developing human resources and improving the quality of a nation. In the twenty-first century, educational systems worldwide are expected to equip students with various competencies, including critical thinking, creativity, communication, and collaboration skills. The advancement of science and technology has transformed educational practices, requiring learning environments that actively engage students in constructing knowledge rather than passively receiving information (Rosnaeni, 2021). Science education, particularly physics education, has become an important component in preparing students to understand natural phenomena and solve real-world problems through scientific reasoning and inquiry.

However, despite various educational reforms and technological developments, learning outcomes in science subjects remain a challenge in many developing countries, including Indonesia. International assessments have indicated that Indonesian students still demonstrate relatively low performance in science literacy and problem-solving skills. Results from the Programme for International Student Assessment (PISA) have consistently shown that Indonesian students perform below the average of many participating countries, indicating the need for improvements in instructional strategies and learning environments (OECD, 2023). Although recent educational policies have attempted to improve learning quality, many

How to Cite
Simanungkalit, J., Nor, M., & Syafi'i, M. (2026). Effectiveness of a CLIS-based mechanics kit on cognitive learning outcomes in work and energy concepts. *Journal of Science, Learning Process and Instructional Research (JoSLEPI)*, 4(1). 39-46

students still experience difficulties in understanding scientific concepts, especially in physics. Physics is a branch of science that studies natural phenomena through observation, experimentation, and logical reasoning. The learning of physics is not limited to memorizing formulas and mathematical calculations but also involves understanding concepts and their applications in daily life (Trianto, 2013). Effective physics learning should enable students to develop conceptual understanding, scientific attitudes, and problem-solving skills. Nevertheless, in practice, physics instruction frequently relies on teacher-centered approaches in which students mainly listen to explanations and record information provided by teachers. Such approaches often reduce students' opportunities to actively construct understanding and connect concepts with real-world experiences.

Several studies have reported that conventional learning methods can negatively affect students' motivation and cognitive achievement because students become passive participants during the learning process (Hidayaturrohman et al., 2017). Teacher-centered instruction often emphasizes knowledge transfer rather than conceptual construction, causing students to perceive physics as difficult and abstract. Consequently, students frequently experience misconceptions and difficulties in understanding scientific principles. One of the topics commonly considered difficult by junior high school students is work and energy. Work and energy concepts involve abstract relationships between force, displacement, and different forms of energy. Students are expected to understand various concepts such as kinetic energy, potential energy, mechanical energy, and energy transformation. However, many students experience difficulties in understanding the relationships among these concepts because they require both conceptual and mathematical understanding (Wambes, 2022). Students often memorize equations without understanding the physical meaning behind them. As a result, they encounter problems in applying scientific concepts to everyday situations.

The challenges in understanding work and energy concepts suggest that learning activities should involve direct experiences and interactive learning environments. One strategy to address this issue is the use of learning media that allow students to observe and investigate scientific phenomena directly. Learning media have an important role in facilitating conceptual understanding because they can transform abstract concepts into concrete experiences (Hasan et al., 2021). The use of instructional media can increase students' attention, motivation, and participation during classroom activities. One instructional medium that can be implemented in physics learning is a Mechanics Kit. A Mechanics Kit consists of a set of experimental tools designed to demonstrate concepts related to force, motion, work, energy, and Newton's laws. Through direct manipulation and experimentation, students can observe physical phenomena and establish connections between theory and practice. According to Naimah (2022), instructional kits can improve learning effectiveness by enabling students to actively participate in scientific investigations. Furthermore, hands-on activities encourage students to become more engaged and improve their understanding of scientific concepts.

However, the use of learning media alone may not be sufficient to maximize learning outcomes. Appropriate learning models are also required to guide students during the learning process and facilitate conceptual development. One learning model based on constructivist theory that can be integrated with learning media is the Children Learning in Science (CLIS) model. The CLIS model was developed to help students construct scientific concepts based on their existing knowledge and experiences through a series of structured learning activities (Driver, 1988). The CLIS model emphasizes active student participation through several stages, including orientation, elicitation of ideas, restructuring of ideas, application of ideas, and review of conceptual changes. During these stages, students are encouraged to express their prior knowledge, discuss concepts with peers, conduct investigations, and reconstruct their understanding based on scientific evidence. According to Bektiarso (2000), the CLIS model can improve students' conceptual understanding because it facilitates active engagement and encourages meaningful learning experiences.

The constructivist principles underlying the CLIS model are consistent with modern educational approaches that emphasize student-centered learning. Constructivism assumes that knowledge cannot simply be transferred from teachers to students; instead, learners actively construct knowledge through interactions with their environment (Suparlan, 2019). Therefore, integrating the CLIS model with a Mechanics Kit may provide opportunities for students to develop conceptual understanding through direct experiences and scientific inquiry activities.

Previous studies have reported that both CLIS and instructional kits positively influence learning outcomes. However, research specifically examining the integration of a Mechanics Kit with the CLIS model on cognitive learning outcomes in work and energy concepts remains limited. Most studies have focused on either the implementation of CLIS or the use of instructional media separately. Therefore, investigating the combined effect of these two instructional components may provide additional insights into improving physics learning effectiveness. Based on the aforementioned issues, this study aims to investigate the effectiveness of a CLIS-based Mechanics Kit on students' cognitive learning outcomes in work and energy concepts among eighth-grade junior high school students. The findings of this study are expected to contribute to physics education by providing an alternative instructional strategy that supports active learning and enhances students' cognitive achievement.

2. Research Methodology

This study employed a quantitative approach using a quasi-experimental research design to investigate the effectiveness of a CLIS-based Mechanics Kit on students' cognitive learning outcomes in the topic of work and energy. Experimental research is commonly used to determine the effect of a particular treatment on a dependent variable under controlled conditions (Sugiyono, 2017). Since the researchers were unable to randomly assign individual participants to different groups due to existing classroom conditions, a quasi-experimental method was considered appropriate. Specifically, this study adopted a posttest-only control group design, where the experimental group received a treatment while the control group received conventional instruction.

The study was conducted at SMPN 20 Pekanbaru during the first semester of the 2025/2026 academic year. The participants consisted of eighth-grade students enrolled in the school. The school had nine eighth-grade classes with a total population of 327 students. The sampling technique used in this study was purposive sampling. This technique was selected because the sample classes were determined based on similarity in academic characteristics and recommendations from subject teachers to ensure equivalent initial abilities.

The selected sample consisted of two classes: class VIII.6 as the experimental group and class VIII.5 as the control group. The experimental group was taught using a Mechanics Kit integrated with the Children Learning in Science (CLIS) learning model, whereas the control group received conventional instruction through teacher-centered learning methods involving lectures, discussions, and question-and-answer sessions. The CLIS learning process consisted of several stages, namely orientation, elicitation of ideas, restructuring ideas, application of ideas, and review of conceptual changes. During the experimental learning activities, students actively interacted with the Mechanics Kit through hands-on investigations and collaborative discussions. The research design used in this study is presented in Table 1.

Table 1. Posttest-Only Control Group Design

Group	Treatment	Posttest
Experimental	X	O_1
Control	–	O_2

Adapted from Sugiyono (2017).

Note:
X = Learning using a CLIS-based Mechanics Kit
O_1 = Experimental group posttest score

O_2 = Control group posttest score

The research procedure consisted of three main stages: preparation, implementation, and evaluation. During the preparation stage, lesson plans, student worksheets, instructional media, and research instruments were developed and validated. The implementation stage involved conducting classroom instruction according to the planned learning activities. The final stage involved administering a posttest to both groups and analyzing the obtained data. The instrument used for data collection was a cognitive learning achievement test in the form of multiple-choice questions. The test consisted of 20 items designed according to Bloom's revised taxonomy levels ranging from remembering (C1) to creating (C6). The questions were developed to assess students' understanding of work and energy concepts comprehensively. The cognitive indicators measured are shown in Table 2.

Table 2. Cognitive Learning Indicators

Cognitive Domain	Indicator
C1	Remembering concepts of work and energy
C2	Understanding principles of work and energy
C3	Applying formulas to solve problems
C4	Analyzing relationships among variables
C5	Evaluating scientific situations and solutions
C6	Creating solutions based on work and energy concepts

Adapted from Anderson and Krathwohl (2001).

Before implementation, the research instruments were validated to determine their content validity and suitability for measuring students' cognitive abilities. Instrument validation was conducted by experts in physics education and learning media. The purpose of the validation process was to ensure that each test item accurately represented the intended learning objectives and cognitive domains. Data obtained from the cognitive learning test were analyzed using descriptive and inferential statistical methods. Descriptive statistics were used to determine the mean, maximum score, minimum score, and standard deviation of students' learning outcomes. Descriptive analysis was intended to provide an overview of students' achievement levels in both groups.

Inferential statistical analysis was performed to determine whether significant differences existed between the experimental and control groups. Prior to hypothesis testing, normality and homogeneity tests were conducted to examine whether the data met the assumptions required for parametric analysis. The normality test aimed to determine whether the distribution of data followed a normal distribution, while the homogeneity test was used to determine whether the variances between groups were equal. After satisfying these assumptions, hypothesis testing was performed using an independent sample t-test with a significance level of 0.05. The hypotheses used in this study were formulated as follows: (1). Null Hypothesis (H_0): There is no significant difference in cognitive learning outcomes between students taught using a CLIS-based Mechanics Kit and those taught using conventional learning methods. (2). Alternative Hypothesis (H_1): There is a significant difference in cognitive learning outcomes between students taught using a CLIS-based Mechanics Kit and those taught using conventional learning methods. (3). If the significance value (p) was less than 0.05, the null hypothesis would be rejected, indicating a significant effect of the treatment on students' cognitive learning outcomes.

The integration of a Mechanics Kit with the CLIS learning model was expected to create a more interactive learning environment by enabling students to actively construct knowledge through observation, experimentation, and collaborative discussion. Through these activities, students could directly experience scientific phenomena related to work and energy concepts, thereby enhancing their conceptual understanding and cognitive achievement.

3. Results and Discussion

3.1 Results

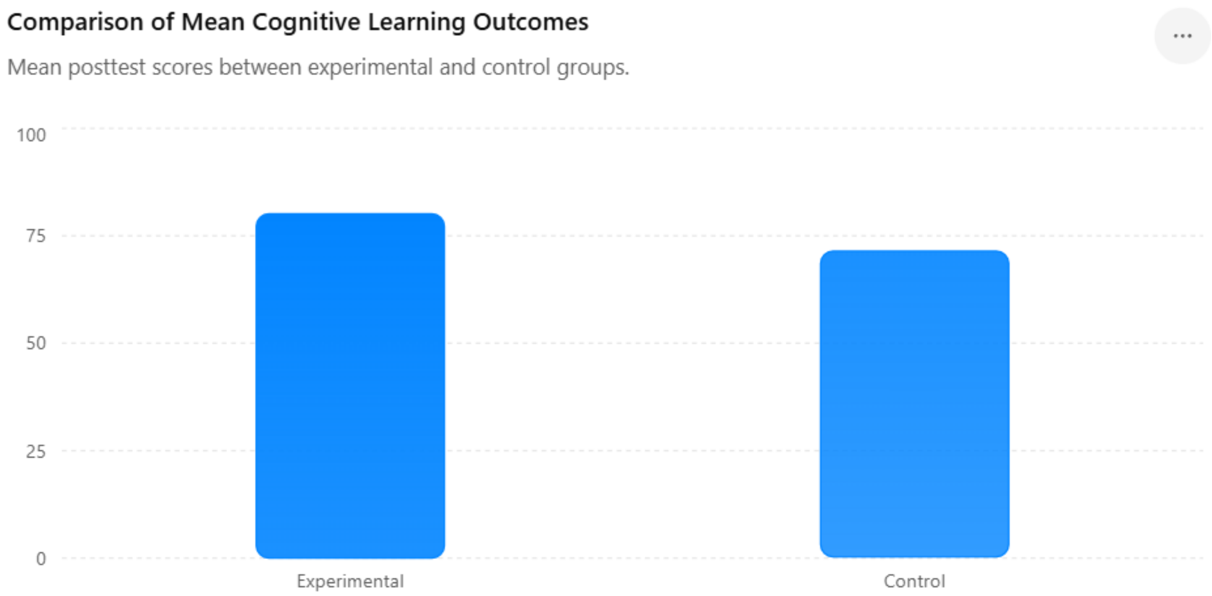
The study investigated the effectiveness of a CLIS-based Mechanics Kit on students' cognitive learning outcomes in the topic of work and energy. Following the instructional intervention, posttest data from both experimental and control groups were analyzed using descriptive and inferential statistics. The experimental group received instruction through the Mechanics Kit integrated with the Children Learning in Science (CLIS) model, whereas the control group received conventional instruction. The descriptive analysis revealed differences in cognitive achievement between the two groups. Students who learned using the CLIS-based Mechanics Kit achieved better performance than those taught using conventional learning methods. The descriptive statistical results are shown in Table 3.

Table 3. Descriptive Statistics of Cognitive Learning Outcomes

Variable	Experimental Group	Control Group	Variable
Number of Students	36	36	Number of Students
Mean Score	80.13	71.45	Mean Score
Highest Score	95	88	Highest Score
Lowest Score	62	55	Lowest Score
Standard Deviation	7.85	8.46	Standard Deviation
Category	**Very Good**	**Good**	**Category**

The results indicate that the experimental group obtained a mean score of **80.13**, whereas the control group achieved **71.45**, resulting in a difference of **8.68 points**. These findings suggest that integrating a Mechanics Kit with the CLIS model produced more effective learning outcomes compared to conventional learning methods.

To visualize the differences between both groups, the posttest scores are presented below.



Inferential statistical analysis was conducted to determine whether the observed difference between groups was statistically significant. Prior to hypothesis testing, normality and homogeneity assumptions were examined. Results indicated that the data were normally distributed and homogeneous, allowing further analysis using an independent sample *t*-test.

Table 4. Hypothesis Testing Results

Variable	Sig. (p-value)	Decision
Posttest score	0.000	H_0 Rejected

The significance value obtained was **p = 0.000 (<0.05)**, indicating a statistically significant difference between students taught using a CLIS-based Mechanics Kit and those taught using conventional methods. Therefore, the alternative hypothesis was accepted.

3.2 Discussion

The findings demonstrated that the implementation of a CLIS-based Mechanics Kit significantly improved students' cognitive learning outcomes in work and energy concepts. Students in the experimental group achieved better performance than those in the control group because the learning process provided direct experiences through experimentation and active concept construction. The superior performance of the experimental group can be explained through the characteristics of the CLIS model itself. The Children Learning in Science model emphasizes students' active participation in constructing knowledge through several stages: orientation, elicitation of ideas, restructuring ideas, application of ideas, and review of conceptual changes. During these stages, students are encouraged to express prior knowledge, conduct investigations, and reconstruct understanding based on scientific evidence.

Unlike conventional instruction where students mainly receive information from teachers, the CLIS approach places students at the center of the learning process. Students become actively involved in observation and discussion activities, allowing them to understand concepts more meaningfully. Constructivist theory supports these findings by suggesting that learning occurs when students actively construct knowledge through interactions with their environment rather than merely receiving information passively (Suparlan, 2019). During the learning process, students in the experimental group observed and manipulated learning materials directly using the Mechanics Kit, enabling them to develop stronger conceptual understanding.

The use of the Mechanics Kit also contributed significantly to the improvement of learning outcomes. The topic of work and energy often presents difficulties because students need to understand relationships among force, displacement, and various forms of energy. These concepts are generally considered abstract and difficult to visualize through lectures alone. The Mechanics Kit transformed abstract ideas into concrete learning experiences. Students could directly observe and measure physical phenomena related to work and energy, helping them understand scientific relationships more effectively. Such hands-on activities improve students' engagement and increase conceptual retention.

These findings are consistent with previous research suggesting that learning media involving direct manipulation of objects can significantly improve cognitive performance. According to Hasan et al. (2021), learning media enhance students' interest and facilitate understanding by making learning experiences more interactive. Similarly, Naimah (2022) stated that instructional kits enable students to participate actively in scientific investigations and promote deeper conceptual understanding. The observed improvement can also be explained by increased student motivation. During experimental activities, students appeared more enthusiastic and actively participated in group discussions. They showed curiosity in exploring scientific phenomena and were willing to ask questions during classroom interactions.

Motivation plays an essential role in determining learning success because motivated students tend to invest greater effort in understanding learning materials. Active learning environments encourage students to become more engaged and responsible for their own learning process. Furthermore, the CLIS learning stages facilitated conceptual change among students. Before instruction, many students possessed misconceptions regarding work and energy concepts. For example, some students believed that energy exists only in moving objects or that work depends solely on force without considering displacement.

During the learning process, these misconceptions gradually changed through experimental observations and peer discussions. Students compared their initial ideas with experimental evidence and reconstructed their understanding accordingly. The improvement across different cognitive domains can be summarized in Table 5.

Table 5. Percentage of Students' Cognitive Learning Outcomes Across Cognitive Levels

Cognitive Level	Experimental (%)	Control (%)
C1 Remembering	88	80
C2 Understanding	84	76
C3 Applying	82	71
C4 Analyzing	79	68
C5 Evaluating	76	65
C6 Creating	72	60

The results indicate that the experimental group achieved higher scores across all cognitive domains, particularly in higher-order thinking skills (C4–C6). This finding suggests that integrating CLIS with a Mechanics Kit not only improved basic knowledge acquisition but also enhanced analytical and problem-solving abilities. Higher-order thinking skills require students to analyze, evaluate, and create solutions based on conceptual understanding. Such abilities are difficult to develop through conventional lecture-based methods alone because students require opportunities to apply and test their ideas. Overall, the findings suggest that integrating a Mechanics Kit with the CLIS model provides a more effective instructional strategy for physics learning. The combination of active learning, direct experimentation, and constructivist approaches creates meaningful learning experiences that improve students' cognitive achievement.

4. Conclusion

This study investigated the effectiveness of implementing a CLIS-based Mechanics Kit in improving students' cognitive learning outcomes on the topic of work and energy among eighth-grade students. The findings demonstrated that integrating a Mechanics Kit with the Children Learning in Science (CLIS) learning model positively influenced students' academic achievement. Students who participated in learning activities using the CLIS-based Mechanics Kit achieved higher cognitive scores compared to students taught using conventional instructional methods. The experimental group obtained a mean score of 80.13, while the control group achieved a mean score of 71.45, indicating a difference of 8.68 points between the two groups. Furthermore, inferential analysis revealed a statistically significant difference between the groups ($p < 0.05$), suggesting that the treatment effectively enhanced students' cognitive performance.

The improvement in learning outcomes can be attributed to several factors associated with the characteristics of the CLIS model and the use of hands-on instructional media. The CLIS model encouraged students to actively participate in learning activities by expressing prior ideas, discussing concepts collaboratively, conducting investigations, and reconstructing their understanding based on scientific evidence. Simultaneously, the Mechanics Kit transformed abstract concepts into concrete experiences, enabling students to directly observe and explore physical phenomena related to work and energy concepts. Such learning experiences facilitated meaningful understanding and reduced misconceptions. Moreover, the integration of interactive learning media with a constructivist-based learning approach also increased students' motivation and engagement during classroom activities. Students became more active in asking questions, conducting experiments, and solving problems collaboratively. Consequently, this study concludes that implementing a CLIS-based Mechanics Kit can serve as an effective alternative instructional strategy for improving cognitive learning outcomes in physics education, particularly in the teaching of work and energy concepts. Future studies are recommended to examine its implementation across different educational levels and broader learning contexts.

Reference

Anderson, L. W., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. Longman.

Bektiarso, S. (2000). Model pembelajaran *Children Learning in Science* dalam pembelajaran fisika. *Jurnal Pendidikan Fisika Indonesia, 7*(4), 742–748.

Driver, R. (1988). *Children's learning in science*. Open University Press.

Hasan, M., Milawati, M., Darodjat, D., Harahap, T. K., Tahrim, T., Anwari, A. M., Rahmat, A., Masdiana, M., & Indra, I. M. (2021). *Media pembelajaran*. Tahta Media Group.

Hidayaturrohman, M., Wahyudi, W., & Nugroho, A. (2017). Implementation of innovative learning methods in physics education. *Journal of Science Education, 5*(2), 45–53.

Kemendikbudristek. (2022). *Kurikulum Merdeka sebagai upaya pemulihan pembelajaran*. Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi Republik Indonesia.

Naimah, N. (2022). The implementation of science kit media in improving students' learning achievement. *Jurnal Pendidikan IPA, 10*(2), 100–105.

OECD. (2023). *PISA 2022 results: Learning during and beyond disruption*. OECD Publishing.

Rosnaeni, R. (2021). Karakteristik dan implementasi pembelajaran abad ke-21. *Jurnal Pendidikan Guru Sekolah Dasar, 6*(4), 4334–4342.

Sugiyono. (2017). *Metode penelitian kuantitatif, kualitatif, dan R&D*. Alfabeta.

Suparlan, S. (2019). Teori konstruktivisme dalam pembelajaran. *Islamika, 1*(2), 79–88.

Trianto. (2013). *Model pembelajaran terpadu: Konsep, strategi, dan implementasinya dalam Kurikulum Tingkat Satuan Pendidikan (KTSP)*. Bumi Aksara.

Wambes, D. Y. (2022). Students' difficulties in understanding work and energy concepts. *Jurnal Pendidikan Fisika Indonesia, 8*(1), 65–72.