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THE EFFECTIVENESS OF THE 7E LEARNING CYCLE MODEL ASSISTED BY VIRTUAL LABORATORY MEDIA IN IMPROVING STUDENTS' COGNITIVE LEARNING OUTCOMES ON MOTION AND FORCE

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Abstrak- This research was conducted to investigate the impact of applying the 7E Learning Cycle model supported by virtual laboratory media on the cognitive learning achievement of seventh-grade students in the topic of motion and force. The study took place at SMP Negeri 40 Pekanbaru during the first semester of the 2025/2026 academic year and employed a quasi-experimental approach using a post-test only control group design. The participants consisted of two randomly selected classes: an experimental class that received instruction through the 7E Learning Cycle model integrated with a virtual laboratory, and a control class that experienced conventional teaching methods. The instrument used in this study was a written post-test containing 15 multiple-choice items designed to assess students' cognitive abilities from levels C1 to C6 according to Bloom's Taxonomy. The collected data were processed using both descriptive and inferential statistical analyses, with the Mann–Whitney test applied to determine differences between groups. The findings revealed that students in the experimental class achieved an average cognitive learning score of 83.09, categorized as very high, while the control class obtained an average score of 66.21, categorized as high. Furthermore, the Mann–Whitney analysis produced a significance value of $p = 0.001$ ($p < 0.05$), demonstrating a statistically significant difference between the cognitive learning outcomes of the two classes. These results indicate that the use of the 7E Learning Cycle model combined with virtual laboratory media effectively improves students' cognitive achievement in learning motion and force concepts. Therefore, this instructional model can be considered an effective alternative for science learning to promote student participation and deepen conceptual understanding.

Keywords: *7E Learning Cycle; virtual laboratory; cognitive learning outcomes; motion and force; science learning; quasi-experiment*

1 Pendahuluan

The rapid advancement of science and technology in the era of globalization requires the education sector to continuously adapt and innovate in order to create learning processes that are relevant to the demands of the twenty-first century. Modern education is no longer focused solely on the mastery of factual knowledge, but also emphasizes the development of critical thinking, problem-solving skills, creativity, and collaborative abilities among students (Nabilla et al., 2021). In this context, schools play an important role as formal educational institutions in preparing qualified, competitive, and character-driven human resources through meaningful and student-centered learning activities. Effective learning places students as active participants in constructing knowledge, while teachers function as facilitators who guide and support the learning process. This perspective is closely related to the constructivist learning theory, which states that knowledge is not directly transferred from teachers to students, but is actively built through experience, social interaction, and personal reflection (Kusnandar, 2019). Therefore, learning activities should be designed to accommodate differences in students' characteristics, prior knowledge, and learning styles

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Science education, particularly physics, requires active student involvement in scientific processes. Physics should not merely be viewed as a collection of facts, concepts, laws, and theories, but also as a scientific activity involving observation, experimentation, analysis, and conclusion drawing (Putri, 2021). Consequently, physics learning should provide opportunities for students to discover and construct concepts independently through investigative and contextual learning experiences. However, in classroom practice, several problems still hinder the achievement of optimal physics learning outcomes. One of the science topics that students often find difficult is motion and force. This topic represents a fundamental concept in physics that is closely related to everyday phenomena and serves as the basis for understanding more advanced physics concepts. Despite its importance, students' achievement in learning motion and force at the junior high school level remains relatively low and has not yet met the expected standards (Ngatini, 2024).

The low learning outcomes in motion and force are influenced not only by the complexity of the concepts but also by the limited implementation of appropriate learning models and instructional media. Learning activities that are still teacher-centered, dominated by lecture methods, and lacking practical activities tend to make students passive, less motivated, and unable to understand concepts deeply. As a result, students' higher-order thinking skills, such as analyzing, evaluating, and applying physics concepts in real-life situations, are not optimally developed. Learning outcomes are important indicators used to evaluate the success of the educational process. According to Subekti and Ariswan (2016), learning outcomes reflect behavioral changes in cognitive, affective, and psychomotor domains. In science learning, the cognitive domain becomes a primary aspect in assessing students' intellectual abilities, ranging from remembering and understanding to applying, analyzing, evaluating, and creating, as classified in the revised Bloom's Taxonomy (Sholihah & Astuti, 2025). Therefore, improving students' cognitive learning outcomes should become a major concern in physics education.

The selection of an appropriate learning model significantly affects students' learning achievement. A learning model functions as a conceptual framework that guides teachers in planning, implementing, and evaluating instructional activities systematically (Taufiq et al., 2019). Effective learning models should encourage active student participation, facilitate knowledge construction, and promote critical thinking and problem-solving abilities. One learning model based on constructivist theory and considered effective in science education is the Learning Cycle model. This model emphasizes systematic learning stages centered on students' learning experiences. Over time, the Learning Cycle model has evolved from 4E to 5E and eventually to the 7E Learning Cycle, which aims to strengthen the relationship between students' prior knowledge and newly acquired concepts (Nuraisyah et al., 2025).

The 7E Learning Cycle model consists of seven stages: elicit, engage, explore, explain, elaborate, evaluate, and extend (Rohani et al., 2020). Each stage is designed to encourage students to actively construct concepts, test their understanding, and connect knowledge with real-life situations. This model also provides opportunities for students to develop higher-order thinking skills through discussions, experiments, and reflective activities. Although the 7E Learning Cycle model has strong potential to improve learning quality, its implementation in schools often faces challenges, particularly limited laboratory facilities. Practical activities, which are essential components of physics learning, cannot always be conducted effectively due to insufficient equipment, materials, time, and financial resources. Such limitations highlight the need for alternative learning media that can replace or complement conventional laboratory functions.

One innovative solution that can address this issue is the use of virtual laboratory media. A virtual laboratory is a computer-based instructional medium that provides interactive and safe laboratory simulations. Through this medium, students can perform virtual experiments, visualize abstract concepts, and repeat experiments without limitations of time and cost (Ismail et al., 2016). In addition, virtual laboratories can enhance students' motivation and strengthen conceptual understanding through macroscopic, submicroscopic, and symbolic visualizations. The integration of virtual laboratory media into the 7E Learning Cycle model is believed to create more effective, interactive, and meaningful learning experiences. During the explore stage, students can conduct virtual experiments to test hypotheses and collect data. This process supports knowledge assimilation and accommodation as explained in Piaget's constructivist theory (Rianduli & Sianturi, 2023). Therefore, learning activities become oriented not only toward final results but also toward the scientific process experienced by students.

Several previous studies have shown that the implementation of the 7E Learning Cycle model can significantly improve students' learning outcomes. Nurhajjah et al. (2018) reported that the 7E Learning Cycle effectively improved junior high school students' science achievement. Similarly, Hidayah and Derlina (2025) found that the model positively influenced students' physics learning outcomes compared to conventional learning methods. Furthermore, the use of virtual laboratory media has been proven to increase student engagement and understanding in science learning (Saputri et al., 2024). Despite these findings, empirical studies integrating the 7E Learning Cycle model with virtual laboratory media in teaching motion and force at the junior high school level are still limited, particularly within the Indonesian science education context. Therefore, further research is necessary to systematically investigate the influence of implementing the 7E Learning Cycle model assisted by virtual laboratory media on students' cognitive learning outcomes.

Based on the issues described above, this study aims to analyze the cognitive learning outcomes of students who participate in learning activities using the 7E Learning Cycle model assisted by virtual laboratory media on the topic of motion and force. In addition, this research seeks to examine the differences in cognitive learning outcomes between students taught using this model and those taught through conventional learning methods. The findings of this study are expected to contribute both theoretically and practically to the development of innovative, effective, and twenty-first-century-oriented science learning models and instructional media.

2. Research Methodology

2.1 Research and Design

This study employed a quasi-experimental research method, which is a type of experimental research that allows researchers to provide treatment to the experimental group without fully controlling all external variables (Abraham & Supriyati, 2022). The research applied a post-test only control group design in which students' learning outcomes were measured only after the instructional treatment had been completed. The use of this design enabled the researcher to compare the cognitive learning outcomes between students taught using the 7E Learning Cycle model assisted by virtual laboratory media and those taught through conventional learning methods without the influence of pre-test effects. The experimental group received instruction through the 7E Learning Cycle integrated with virtual laboratory activities, whereas the control group participated in conventional classroom instruction.

Table 1. Desain Penelitian

Kelompok	Perlakuan	Post-test
Kelas Eksperimen	Model 7E Learning Cycle berbantuan virtual lab	O_1
Kelas Kontrol	Pembelajaran konvensional	O_2

Sumber: (Abraham & Supriyati, 2022: 2480)

2.2 Research Location and Time

The research was conducted at SMP Negeri 40 Pekanbaru during the first semester of the 2025/2026 academic year, specifically from October to November 2025.

2. 3 Population and Sample

The population of this study consisted of all seventh-grade students of SMP Negeri 40 Pekanbaru, totaling 247 students distributed across six classes. The sample selection was carried out using a simple random sampling technique. Prior to sampling, normality and homogeneity tests were conducted on students' previous daily test scores to ensure that the initial abilities of the classes were relatively equivalent (Sugiyono, 2019).

Based on the random selection process, two classes were chosen as the research sample. Class VII A was assigned as the experimental class, while Class VII B served as the control class. The total number of participants involved in the study was 83 students.

2.4 Research Instrument

The research instrument consisted of 15 multiple-choice questions developed based on the revised Bloom's Taxonomy and covering cognitive levels from C1 to C6 (Sholihah & Astuti, 2025). The questions were designed according to the learning indicators and validated before being administered. The profile of the cognitive learning outcome test instrument is presented in Table 2 below.

Table 2. Profile of Cognitive Learning Outcome Test Instrument

Cognitive Level	Indicator	Number of Questions
C1	Remembering	3
C2	Understanding	4
C3	Applying	3
C4	Analyzing	2
C5	Evaluating	2
C6	Creating	1
Total		15

2.5 Data Analysis Technique

The collected data were analyzed using both descriptive and inferential statistical methods. Descriptive statistics were employed to describe the average scores of students' cognitive learning outcomes and to classify them according to the learning achievement criteria (Rosidi, 2021). Before conducting the hypothesis test, prerequisite analyses were performed, including normality and homogeneity tests. The normality test was carried out using the Shapiro–Wilk test, while the homogeneity test was conducted using Levene's test with the assistance of SPSS version 27 software (Agustin & Permatasari, 2020). Since the post-test data were not normally distributed, the hypothesis testing was conducted using the Mann–Whitney U test, a non-parametric statistical test used to determine the differences in cognitive learning outcomes between the experimental and control groups. The hypothesis testing was performed at a significance level of $\alpha = 0.05$.

3. Results and Discussion

3.1 Research Results

This study aimed to investigate students' cognitive learning outcomes on the topic of motion and force through the implementation of the 7E Learning Cycle model assisted by virtual laboratory media, as well as to compare the outcomes with those obtained through conventional teaching methods. The data on cognitive learning achievement were collected from post-test results administered after all instructional activities had been completed in both the experimental and control classes.

3.2 Descriptive Statistical Analysis

Descriptive statistical analysis was conducted to describe students' cognitive achievement at each level of the revised Bloom's Taxonomy, ranging from C1 to C6. The findings revealed a considerable difference in average scores between the experimental and control groups.

Table 3. Average Scores of Students' Cognitive Learning Outcomes

Cognitive Indicator	Experimental Class (Mean)	Category	Control Class (Mean)	Category
C1 (Remembering)	89.68	Very High	82.11	High
C2 (Understanding)	81.54	Very High	65.24	High
C3 (Applying)	90.47	Very High	63.41	High
C4 (Analyzing)	84.52	Very High	78.04	High
C5 (Evaluating)	78.57	High	59.75	Moderate
C6 (Creating)	73.80	High	48.78	Moderate
Total Average	83.09	Very High	66.21	High

The data presented in Table 3 indicate that students in the experimental class consistently achieved higher average scores than those in the control class across all cognitive indicators. The overall mean score of the experimental group reached 83.09, which falls into the very high category, whereas the control group obtained an average score of 66.21, categorized as high. The highest achievement in the experimental class was observed in the C3 indicator (applying), while the lowest was found in C6 (creating). Conversely, students in the control class achieved their highest scores in C1 (remembering) and their lowest in C6 (creating). These findings suggest that conventional learning methods tend to emphasize lower-order thinking skills rather than higher-order cognitive abilities.

Inferential Statistical Analysis

Before conducting the hypothesis test, the post-test data were analyzed through normality and homogeneity tests. The Shapiro–Wilk normality test indicated that the data from both groups were not normally distributed ($p < 0.05$). Meanwhile, the homogeneity test showed that the variances of the two groups were homogeneous ($p > 0.05$). Based on these prerequisite test results, the hypothesis testing was performed using the Mann–Whitney U test to identify differences in cognitive learning outcomes between the experimental and control groups.

Table 4. Mann–Whitney U Test Results

Test Statistic	Value
Mann–Whitney U	436.5
Z	-3.927
Sig. (p-value)	0.001

The Mann–Whitney U test produced a significance value of $p = 0.001$ ($p < 0.05$), indicating that the null hypothesis (H_0) was rejected. Therefore, it can be concluded that there was a statistically significant difference in cognitive learning outcomes between students taught using the 7E Learning Cycle model assisted by virtual laboratory media and those taught using conventional instructional methods.

Discussion

The findings of this research demonstrate that the implementation of the 7E Learning Cycle model supported by virtual laboratory media significantly improved students' cognitive learning outcomes in the topic of motion and force. These results support the constructivist perspective, which emphasizes that meaningful learning occurs when students actively participate in constructing their own understanding (Kusnandar, 2019). In the C1 cognitive level (remembering), students in the experimental class obtained higher scores compared to those in the control group. This indicates that the 7E Learning Cycle model is effective not only in fostering higher-order thinking skills but also in strengthening students' mastery of basic concepts. The elicit and engage stages allow teachers to activate students' prior knowledge and connect new material with everyday experiences, making learning more memorable (Rohani et al., 2020). More noticeable differences appeared in the C2 (understanding) and C3 (applying) indicators. During the explore stage, students conducted experiments through virtual laboratory simulations in collaborative groups. These activities enabled students to directly observe, analyze, and interpret motion and force phenomena. According to Ismail et al. (2016), virtual laboratories are effective tools for visualizing abstract scientific concepts and improving conceptual comprehension through interactive representations.

The applying indicator (C3) achieved the highest score in the experimental class. This finding indicates that students were capable not only of understanding concepts but also of applying them to solve contextual problems. The elaborate and extend phases encouraged learners to relate newly acquired knowledge to real-life situations and unfamiliar contexts. This result is consistent with the findings of Andini et al. (2024), who reported that the 7E Learning Cycle model effectively enhances students' ability to apply physics concepts. In the C4 indicator (analyzing), the experimental class also outperformed the control class. Group discussions and worksheet-based investigations conducted during the elaborate stage helped students identify relationships among variables, analyze experimental findings, and formulate conclusions systematically. Such learning activities contribute significantly to the development of analytical thinking skills, which are central objectives of science education (Putri, 2021).

The largest differences were observed in the higher-order cognitive indicators, namely C5 (evaluating) and C6 (creating). Although the achievement levels in these indicators were lower than those of the preceding indicators, students in the experimental class still demonstrated better performance than those in the control group. This result is understandable because higher-order thinking skills require more practice and deeper cognitive engagement. Nevertheless, the superior performance of the experimental class indicates that the 7E Learning Cycle model positively contributed to the development of students' evaluative and creative thinking abilities. By contrast, the conventional learning approach implemented in the control class primarily relied on one-way instruction from teacher to students. Such a learning environment mainly trained students' memorization abilities while providing limited opportunities for the development of complex cognitive skills such as evaluation and creation. This finding aligns with Taufiq et al. (2019), who argued that teacher-centered instruction is less effective in promoting higher-order thinking skills.

The significant result obtained from the Mann–Whitney U test further supports the descriptive analysis. The significance value of $p = 0.001$ confirms statistically that the implementation of the 7E Learning Cycle model assisted by virtual laboratory media was more effective than conventional learning in improving students' cognitive learning outcomes. These findings are also consistent with previous studies demonstrating the effectiveness of the 7E Learning Cycle model and virtual laboratory integration in science learning (Nurhajjah et al., 2018; Saputri et al., 2024). Overall, this study emphasizes the importance of integrating innovative learning models and instructional technology in science education. The combination of the 7E Learning Cycle model and virtual laboratory media successfully created active, contextual, and meaningful learning experiences, thereby supporting the comprehensive development of students' cognitive abilities. Therefore, this model is recommended as an alternative instructional strategy for science learning, particularly for abstract topics such as motion and force.

4. Concluison

This study concludes that the implementation of the 7E Learning Cycle model assisted by virtual laboratory media effectively improved students' cognitive learning outcomes on the topic of motion and force for seventh-grade junior high school students. The learning process, which involved the stages of elicit, engage, explore, explain, elaborate, evaluate, and extend, successfully encouraged students to participate actively in classroom activities and construct their understanding independently. The results of the descriptive analysis showed that the experimental class achieved higher average scores than the control class across all cognitive indicators, ranging from remembering to creating. Students who learned through the 7E Learning Cycle model supported by virtual laboratory media demonstrated better conceptual understanding and higher-order thinking skills compared to those who experienced conventional learning methods. In addition, the inferential analysis using the Mann–Whitney U test indicated a statistically significant difference between the two groups, confirming the effectiveness of the learning model. The integration of virtual laboratory media also played an important role in supporting students' understanding by providing interactive simulations and visualizations of abstract concepts. Therefore, the 7E Learning Cycle model assisted by virtual laboratory media can be recommended as an innovative and effective alternative approach for science learning, particularly in physics education.

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Reference

Abraham, I., & Supriyati, Y. (2022). Desain Kuasi Eksperimen dalam Pendidikan: Literatur Review. *Jurnal Ilmiah Mandala Education (JIME)*, *8*(3), 2442–9511.

Agustin, P., & Permatasari, R. I. (2020). Pengaruh Pendidikan dan Kompensasi Terhadap Kinerja Divisi New Product Development (NPD) pada PT. Mayora Indah Tbk. *Jurnal Ilmiah M-Progress*, *10*(2), 174–184.

Andini, A., Mas'ud, A., & Suhada, I. (2024). Model Learing Cycle 7E Berbantu Virtual Lab Terhadap Hasil Belajar Siswa Pada Materi Sistem Ekskresi. *Pena Masum Sujai Inspire Conference*, *1*(1), 310–319.

Hidayah, M. R., & Derlina. (2025). Pengaruh Model Learning Cycle 7E terhadap Hasil Belajar Siswa pada Materi Suhu dan Kalor Kelas XI SMAN 14 Medan. *Jurnal Luminous: Riset Ilmiah Pendidikan Fisika*, *6*(2), 188–195.

Ismail, Permanasari, A., & Setiawan, W. (2016). Efektivitas Virtual Lab Berbasis STEM dalam Meningkatkan Literasi Sains Siswa dengan Perbedaan Gender. *Jurnal Inovasi Pendidikan IPA*, *2*(2), 190–201.

Kusnandar, D. (2019). *Pengaruh Model Problem Based Learning Terhadap Hasil Belajar Kognitif dan Motivasi Belajar IPA*. *1*(1), 17–30.

Nabilla, N., Zahrotunisa, S. A., Mulhayatiah, D., & Herni, Y. S. (2021). Need Analysis of REACT-Based E-Module Development to Improve Critical Thinking Skills in Physics Learning. *JPPS (Jurnal Penelitian Pendidikan Sains)*, *11*(1), 90–98.

Ngatini. (2024). Upaya Meningkatkan Hasil Belajar IPA Materi Gerak Dan Gaya Melalui Metode Demonstrasi Pada Siswa Kelas VII G SMP Negeri 13 Kota Magelang Tahun Pelajaran 2022/2023. *Science and Education Journal*, *3*(1), 144–154.

Nuraisyah, Latifah, S., & Ningrum, A. R. (2025). Pengaruh Model Pembelajaran Learning Cycle 7E Menggunakan Media Spinning Wheels Terhadap Hasil Belajar Peserta Didik pada Mata Pelajaran IPAS di Kelas 5 MIS MMA 4 Sukabumi. *Indonesian Research Journal on Education*, *5*(2), 1401–1408.

Nurhajjah, A., Wijaya, A. K., & Kusumawati, I. (2018). Penerapan Model Learning Cycle (LC) 7E sebagai Upaya Peningkatan Hasil Belajar Siswa tentang Zat dan Wujudnya di Kelas VII. *Jurnal Ilmu Pendidikan Fisika*, *3*(2), 42–43.

Putri, F. I. (2021). Perbandingan Hasil Belajar Siswi Kelas VII C Dan VII D terhadap Mata Pelajaran IPA Fisika. *Jurnal Ilmu Kependidikan*, *10*(1), 38–47.

Rohani, S., Hatika, R. G., & Rita, S. (2020). Pengaruh Model Pembelajaran Learning Cycle 7E Terhadap Hasil Belajar Kognitif Fisika Siswa Kelas X SMAN 3 Rambah Hilir. *Jurnal Pendidik Indonesia*, *1*(2), 44–51.

Saputri, A., Sitompul, S. S., & Habellia, R. C. (2024). Pengaruh Model Learning Cycle 7E Berbantuan Media Virtual Lab dalam Meningkatkan Hasil Belajar Listrik Dinamis. *Jurnal Education and development*, *12*(1), 55–60.

Sholihah, A. M., & Astuti, D. S. (2025). Analisis Tingkat Kognitif Pada Soal Buku Teks IPA Kelas VII Berdasarkan Taksonomi Bloom (Revisi). *Bioscientist : Jurnal Ilmiah Biologi*, *13*(1), 126–137.

Subekti, Y., & Ariswan, A. (2016). Pembelajaran Fisika dengan Metode Eksperimen untuk Meningkatkan Hasil Belajar Kognitif dan Keterampilan Proses Sains. *Jurnal Inovasi Pendidikan IPA*, *2*(2), 252.

Sugiyono. (2019). *Metode Penelitian Pendidikan (Kuantitatif, Kualitatif, Kombinasi, R&D dan Penelitian Pendidikan)*. Alfabeta.

Taufiq, A. U., Kartina, & Djafar, H. (t.t.). Pengaruh Model Pembelajaran Awareness Training Terhadap Motivasi Belajar Fisika. *Jurnal Pendidikan Fisika*, *7*(1), 10–16.