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Boosting Creative Thinking with the 8E Learning Cycle: An Experimental Study on Virus Concepts in Senior High School

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Abstract

Creative thinking skills are a crucial foundation for developing students' potential to become knowledgeable, competent, critical, and innovative individuals. This study aims to examine the effect of a project-based learning model using the 8E Learning Cycle *on students' creative thinking skills in the topic of viruses at the senior high school (SMA) Phase E level. The research employed a true experimental design with a posttest-only control group. The study involved Grade X students of SMAN 1 Lareh Sago Halaban for the 2024/2025 academic year. Data were analyzed using an independent samples t-test with a significance level of α = 0.05. The results showed a significance value of 0.000 < 0.05, indicating a significant difference between the experimental and control groups. The average creative thinking test score in the experimental class was 58.38% (categorized as fair), while the control class scored 36.15% (categorized as low). These findings demonstrate that the application of the* 8E Learning Cycle*-based project model significantly enhances students' creative thinking skills. Therefore, this model is effective in fostering creative thinking through contextual and project-oriented learning approaches.*

Keywords: *Project-Based Learning,* 8E Learning Cycle, *Creative Thinking Skill*

Abstrak

Keterampilan berpikir kreatif merupakan dasar penting dalam mengembangkan potensi peserta didik agar menjadi individu yang cakap, kritis, dan inovatif. Penelitian ini bertujuan untuk mengetahui pengaruh model pembelajaran proyek berbasis Learning Cycle 8E terhadap keterampilan berpikir kreatif peserta didik pada materi virus di jenjang SMA Fase E. Metode yang digunakan adalah true experimental design dengan desain posttest-only control group. Subjek penelitian adalah peserta didik kelas X SMAN 1 Kecamatan Lareh Sago Halaban Tahun Ajaran 2024/2025. Analisis data dilakukan menggunakan independent samples t-test dengan taraf signifikansi α = 0,05. Hasil uji menunjukkan nilai signifikansi sebesar 0,000 < 0,05, yang berarti terdapat perbedaan signifikan antara kelas eksperimen dan kelas kontrol. Rata-rata hasil tes berpikir kreatif peserta didik pada kelas eksperimen mencapai 58,38% (kategori cukup), sedangkan kelas kontrol hanya 36,15% (kategori kurang). Temuan ini menunjukkan bahwa penerapan model proyek berbasis Learning Cycle 8E secara signifikan meningkatkan keterampilan berpikir kreatif. Dengan demikian, model ini efektif dalam mengembangkan kemampuan berpikir kreatif peserta didik melalui pendekatan kontekstual dan berorientasi proyek.

Kata Kunci: Pembelajaran Proyek, Learning Cycle 8E, Keterampilan Berpikir Kreatif

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INTRODUCTION

In the field of education, a well-formulated concept plays a crucial role as a foundation for expressing ideas that can be implemented to drive a more fundamental transformation namely, an education system capable of producing innovative changes that are systematic, targeted, and measurable (Hasanuddin et al., 2018, p. 1). Law Number 20 of 2003 on the National Education System serves as both the legal and philosophical foundation for the implementation of educational policies, including the promotion of autonomy and freedom of thought in the learning process. At present, various efforts have been made by the Indonesian government to improve the quality of education, one of which is the reform and development of the national curriculum (Aji, 2020; Andri, 2017; Iskandar et al., 2025; Putri et al., 2024).

The curriculum serves as a guideline for the implementation of education at all levels and functions as a tool to achieve educational objectives (Pratiwi et al., 2023, p. 81). In line with the rapid development of education in the 21st century, there has been a growing emphasis on essential skills such as communication and teamwork, critical thinking and problem-solving, as well as creativity and innovation (Iskandar et al., 2025; Sari & Manurung, 2021). As a response to these evolving demands, several adjustments have been made to the curriculum in Indonesia. One of the most significant reforms is the introduction of the *Merdeka Curriculum*, a new concept proposed by Nadiem Makarim, which promotes independent and flexible learning tailored to students' needs (Cahya et al., 2025; Ridwanulloh et al., 2024; Warmansyah et al., 2023).

The *Merdeka Curriculum* represents an instructional innovation designed to enhance the quality of the teaching and learning process. It is structured to address the challenges of 21st-century education by simplifying content and emphasizing essential competencies. Key features of this curriculum include a focus on core subject matter to promote deeper learning, increased time allocation for character and competency development through collaborative learning within real-world contexts, clearly defined learning objectives for each educational phase, and the implementation of a flexible learning schedule (Arsyad & Fahira, 2020; Kemendikbud, 2022; Patria & Zulkarnaen, 2023). These components are intended to create a more engaging, relevant, and student-centered learning experience (Pratiwi et al., 2023).

The implementation of the teaching and learning process, a structured yet flexible learning framework is essential to ensure effective delivery. Various instructional models can be applied to support this process. One of the recommended models for the implementation of the *Merdeka Curriculum* is project-based learning. This model employs projects as the initial step to acquire, construct, and integrate new knowledge through real-life experiences (Arsyad & Fahira, 2020, p. 8).

The stages of project-based learning typically involve several essential steps: formulating a driving or essential question, designing a project plan, creating a timeline, monitoring students' progress throughout the project, and assessing the final outcomes as well as evaluating the overall learning experience (Purnomo & Ilyas, 2019, p. 7).

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This approach encourages students to engage in contextual learning and supports the development of 21st-century skills such as collaboration, critical thinking, and creativity.

Sitorus et al., (2020) states that in project-based learning, students engage in an extended process of inquiry to address complex questions, problems, or challenges, while simultaneously developing key 21st-century skills such as collaboration, communication, and critical thinking. To effectively implement the stages of project-based learning, the 8E Learning Cycle offers a well-structured framework. This model provides a sequence of phases that promote active student participation throughout the learning process, thereby offering a more systematic guide for students during project implementation and supporting the development of essential competencies.

The *Learning Cycle 8E* is a constructivist-based instructional model designed to support students in developing critical and creative thinking skills, as well as connecting scientific concepts to real-life contexts (Esaputri & Okmarisa, 2023, p. 26). This model consists of eight phases: *engage*, *explore*, *e-search*, *elaborate*, *exchange*, *extend*, *evaluate*, and *explain*. It is grounded in constructivist learning theory, wherein students build their understanding based on prior knowledge. The implementation of the *Learning Cycle 8E* aims to develop students' cognitive structures, enhance conceptual understanding, and address common misconceptions (Andina et al., 2019, p. 999).

According to the study conducted by Sitorus et al., (2020), the *Learning Cycle* model was explored as an effort to develop an interactive and creative instructional approach aimed at enhancing students' creativity and learning abilities. This research was grounded in *connectivist learning theory*, which emphasizes the significance of linking concepts and learning experiences within real-world contexts. In contrast, from the perspective of *Project-Based Learning*, the focus was on students' ability to solve problems through project implementation. This approach aligns with *constructivist learning theory*, which posits that knowledge is actively constructed by learners through direct experience and engagement in the learning process. With the rapid advancement of education in the modern era, there has been a growing emphasis on 21st-century skills, which include communication, teamwork, critical thinking, problem-solving, as well as creativity and innovation. According to the Career Maine Department of Labor (USA), creative thinking is a vital skill as it is considered one of the essential abilities required in daily life (Sari & Manurung, 2021, p. 1015).

Despite this growing emphasis, data from the Organisation for Economic Co-operation and Development (OECD) indicates that Indonesia's performance in the *Programme for International Student Assessment* (PISA) 2018 remains low. In the science domain, Indonesia ranked 70th out of 78 participating countries, scoring 396—the lowest score recorded in comparison to the country's performance in the previous three cycles. Furthermore, the 2016 *Trends in International Mathematics and Science Study* (TIMSS) showed that Indonesia ranked 36th out of 46 countries in terms of students' confidence in science (Priyambodo et al., 2021, p. 232).

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Creativity from an early age can be realized and nurtured through support and inspiration, both from within oneself and from others, as every individual possesses different levels and forms of creativity. However, in actual classroom settings, the instructional methods implemented often fail to support the development of creative thinking skills as part of the learning outcomes. This is concerning, as creative thinking is a crucial component in the learning process; students' ways of thinking can significantly influence both their learning abilities and the overall effectiveness of instruction (Rahmaniati & Umami, 2021, p. 50).

Creative thinking ability refers to students' capacity to generate ideas, solutions, or thoughts through mental exercises that reflect cognitive performance (Zaiyar & Rusmar, 2020, p. 113). According Sari & Manurung, (2021), the indicators of creative thinking skills include: (1) *Fluency*, the ability to express concepts or ideas clearly and accurately; (2) *Flexibility*, the ability to generate multiple alternative solutions to a problem; (3) *Originality*, the ability to produce unique or unconventional responses; and (4) *Elaboration*, the ability to develop ideas in a detailed and relevant manner when responding to questions or issues.

Based on preliminary observational findings obtained through an interview with the Biology teacher of Grade X at SMAN 1, Lareh Sago Halaban Subdistrict, Lima Puluh Kota Regency Ms. YN. it was found that project-based learning had been implemented in the classroom, where students were assigned a final project. However, despite utilizing a project-based learning model, its implementation was considered ineffective, leading the teacher to revert to direct or conventional instructional methods. During the learning process, the teacher presented the material, and students engaged in discussions related to the topic with the intention of encouraging them to discover their own skills and creative ideas for the assigned project. Nevertheless, the outcomes indicated that several students had not yet demonstrated adequate creative thinking skills, and some were still unable to complete the project tasks effectively. Furthermore, the project-based learning model integrated with the 8E Learning Cycle has never been applied in Biology learning at the school.

According to a study by Lestari & Ilhami, (2022), one of the efforts to realize learning aimed at fostering students' creative thinking skills is through the implementation of project-based learning models. This finding is supported by Esaputri & Okmarisa, (2023), who argue that the 8E Learning Cycle is an instructional model designed to help students overcome misconceptions and develop a coherent cognitive structure and understanding. Rooted in the constructivist approach, the 8E Learning Cycle emphasizes the importance of students' active involvement in expanding their prior knowledge through structured learning experiences.

In the field of education, understanding viruses is a crucial concept that should be developed from an early stage. Virus-related topics are commonly taught in high school biology courses, aiming to provide students with foundational knowledge about viral structure, replication, and infection mechanisms. This material emphasizes a

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process skills approach, in which teachers are expected to encourage students to develop problem-solving abilities through scientific methods and to emulate how scientists work in discovering new facts. Therefore, teaching virus-related content requires the implementation of an appropriate instructional model to ensure that the learning process is meaningful and that its outcomes are beneficial to students.

Based on the explanation above, the purpose of this study is to investigate the effect of implementing a project-based learning model integrated with the *Learning Cycle 8E* on high school Phase E students' creative thinking skills in the context of virus-related biology material.

METHODS

Research Design

This study employed a quantitative approach with a true experimental design using a posttest-only control group model. The research was designed to assess the effect of a specific treatment in this case, the project-based learning model incorporating the 8E Learning Cycle on students' creative thinking skills. Two groups were involved: an experimental group that received the intervention and a control group that followed conventional learning methods. Data were collected and processed numerically to evaluate learning outcomes.

Population and Sampling

The population consisted of all Grade X students at SMAN 1 Lareh Sago Halaban in the 2024/2025 academic year. The sampling technique used was random sampling, facilitated through the SPSS 25 application. Based on the results, class X.E.2 was assigned as the experimental group, while class X.E.4 served as the control group. Both groups were considered to have relatively similar academic characteristics prior to the intervention.

Instruments

The research instrument consisted of a posttest designed to measure students' creative thinking skills. The test comprised 15 open-ended essay questions that allowed students to freely express their ideas. This format was chosen to assess creative thinking indicators such as fluency, flexibility, elaboration, and originality. By allowing diverse responses, the instrument aimed to capture the depth and creativity of student thinking.

Treatment Procedures

In the experimental group, the learning process was conducted over five meetings. The first four meetings implemented the 8E Learning Cycle stages integrated into a project-based learning model. Activities began with the engage stage, where students connected new material with their prior knowledge. During the explore phase, students watched a contextual video and formulated questions about the virus topic. In

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the e-search stage, they independently sought answers using books and digital references. The process continued with the elaborate stage, in which students deepened their understanding through group discussions, and the exchange stage, where ideas were shared, and project planning began. Students were then guided through the extend phase to develop their projects further, while the evaluate stage allowed them to present their work and reflect on their learning. The final explain stage helped students articulate what they had learned compared to their initial understanding.

In contrast, the control class followed conventional instruction over the same duration. Each session included teacher-led presentations using PowerPoint, direct instruction via lectures, and guided question-and-answer sessions. Students worked in groups to complete worksheets (LKPD) and presented their answers before the teacher concluded each session. This method followed standard classroom practices without integration of the 8E model or project-based elements.

Data Collection and Analysis

At the fifth meeting, both groups were given the same posttest to assess their creative thinking skills. Students were allotted 105 minutes to complete the 15 essay questions. The collected data were analyzed quantitatively. The process included scoring student responses based on a rubric aligned with the creative thinking indicators. Statistical analysis began with normality and homogeneity tests to ensure the data met assumptions for inferential testing. Subsequently, an independent samples t-test was conducted to determine whether there was a statistically significant difference between the two groups' posttest scores, with a significance threshold set at $\alpha = 0.05$.. To find the test score, the formula is used:

$$score = \frac{number\ of\ scores\ obtained}{moximum\ score} x\ 100$$

(Maimufi et al., 2021)

To determine the interpretation of creative thinking scores used:

Table 2. creativity thinking score interpretation

Score	Score interpretation
81 – 100	Very good
61 – 80	Good
41 – 60	Sufficient
21 – 40	Less
0 – 20	Very Less

(Mulyadi, 2024, p. 376)

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RESULTS AND DISCUTION

Data on Creative Thinking Skills Test Results in Samples Classes

Table 3. Creative thinking presentation

No	KBK indicator	Experiment Class		Control Class	
		Percentage	Category	Percentage	Category
1.	*Fluency*	56.77%	Sufficient	33.51%	Less
2.	*Flexibility*	45.49%	Sufficient	27.60%	Less
3.	*Originality*	52.78%	Sufficient	43.06%	Sufficient
4.	*Elaboration*	78.47%	Good	40.45%	Less
average		58.38%	Sufficient	36.15%	Less

Based on table 3, it shows that there is a significant difference in the average score on the posttest results of students' creative thinking skills between the experimental and control classes. The difference can be seen from the value of each indicator of creative thinking skills. In the experimental class, the lowest indicator is flexibility with an achievement of 45.49% (sufficient). While the highest indicator is elaboration with an achievement of 78.47% (good). In the control class, the lowest indicator for posttest results was flexibility with an achievement of 27.60% (less) while the highest indicator was originality with an achievement of 43.06% (sufficient).

Prerequisite Test Analysis

Table 4. Sample class normality test results

No	Class	Kolomogorov-Smirnov		
		Statistic	Mean	Sig
1.	Eksperimen	0.101	58.59	0.200
2.	Kontrol	0.075	35.94	0.200

Based on the output from SPSS, the normality test using the One-Sample Kolmogrov Smirnov Test method shows that the significance value is> 0.05, so it can be concluded that the control and experimental class data are normally distributed.

Table 5. Homogeneity test results of sample class

Kriteria	Levene statistic	df1	df2	Sig.
Based on mean	1.325	1	70	0.254
Based on median	1.322	1	70	0.254
Based on median and with adjusted df	1.322	1	56.546	0.255
Based in trimmed mean	1.325	1	70	0.254

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Based on the homogeneity test table, the significance value is 0.254 (0.524>0.050), it can be concluded that the data of the two sample classes are homogeneous.

Table 6. Hypothesis test of sample class

Kriteria	T	df	Sig.(2-tailed)
Equal variances assumed	6.924	70	0.000
Equal varriances not assumed	6.924	63.082	0.000

The hypotheses in this study are:

$H_0 : \mu_1 \neq \mu_2$: The application of project learning based on learning cycle 8e on virus material has no effect on students' creativity thinking skills.

$H_1 : \mu_1 > \mu_2$: The application of learning cycle 8e-based project learning on virus material affects students' creativity thinking skills.

Based on hypothesis testing using the independent samples t test method, the sig-(2 tailed) value is 0.000 <0, 05 with a real level $\alpha = 0.05$, so H_0 is rejected and H_1 is accepted. it can be concluded that the application of the learning cycle 8e-based project learning model has an effect on creativity thinking skills.

According to Susanto et al., (2020, p. 126), humans are able to think and understand something, and knowledge is defined as something that is known. The capacity to assess problems and look for answers when faced with problems is an important component in creativity thinking skills. One way to measure creative thinking skills is by using open-ended problems, which are problems that have a variety of solutions or solution strategies. These methods are used to measure aspects of students' creative thinking skills, namely fluency, flexibility, novelty and detail (Umar & Abdullah, 2020, p 43).

The research that has been conducted aims to determine the effect of applying a project learning model based on learning cycle 8e on students' creativity thinking skills on virus material. In this study using posttest as the final result to determine the creative thinking skills of students. The average results of the creative thinking skills of students in the experimental class were 58.38% (sufficient) while the average results in the control class were 36.15% (less).

Based on table 3, the percentage value of each creative thinking indicator from the posttest results shows that the experimental class obtained a higher percentage of each indicator compared to the control class. This is in accordance with research (Purnomo & Ilyas, 2019, p. 74) that project learning is an innovative learning approach, which emphasizes contextual through complex activities. Nate K. Hixson (2012) added that in project-based learning, students will go through a long process of investigation, responding to questions from complex problems, or challenges, practicing the skills demanded in the 21st century (collaboration, communication and critical thinking). With the help of learning cycle 8e stages that help students to connect students' initial

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scientific concepts with students' final scientific concepts after applying learning. In accordance with research (Esaputri & Okmarisa, 2023, p. 26) that Learning cycle 8e is learning conducted with a constructivist approach that aims to help students in critical and creative thinking that connects scientific concepts with everyday life.

Puluhulawa et al., (2020, p. 36) mentioned the advantages of the learning cycle learning model, namely the learning atmosphere is set in a pleasant atmosphere (jouful learning). Conditions that cause the learning atmosphere to be dynamic and students are free to move and not burdened with physical and mental pressure. In terms of learning, the learning cycle learning model with the main vision of student-centered changes the paradigm into fun learning by providing opportunities for students to do learning activities so that they are challenged to solve a problem. Meanwhile, the direct learning model is more oriented towards completing the subject matter according to the time limit set in the curriculum or in the program that has been designed previously. Direct learning tends to present concepts abstractly so that it is difficult for students to understand.

This study measures four indicators of creative thinking using tests in the form of essays. The explanation of creative thinking skill indicators is as follows:

Fluency

The purpose of this indicator is the ability to generate many ideas or produce original ideas (Harisuddin, 2019, p. 17). The percentage of the posttest results of the achievement of fluency indicators in the experimental class was 56.77% (sufficient category), while the percentage of the control class posttest results was 33.51% (insufficient category). Based on these percentages, the experimental class has better answers and percentages than the control class. This is in line with Lestari & Ilhami's, (2022, p. 136) which states that project learning helps students in their learning process. Thus, the experimental method designed makes students look for answers or problems faced individually through the experiments given and it can be concluded that project learning is very influential on students' creative thinking skills.

Flexibility

The next indicator of flexibility is the ability to suggest various ways or several creations differently for solving problems (Harisuddin, 2019, p. 17). Based on the percentage of posttest results, the achievement of flexibility indicators in the experimental class was 45.49% (sufficient category), while the percentage of control class posttest results was 27.60% (insufficient category). Based on these percentages, the experimental class has better answers and percentages than the control class. This is in line with research Rizal et al., (2022, 246) showing that learning cycle learning can increase students' creativity and understanding of the cognitive structure illustrated in the worksheet.

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Originality

The next indicator is originality, which is the ability to come up with ideas in an original way, not cliché (Harisuddin, 2019, p. 18). Based on the percentage of posttest results, the achievement of originality indicators in the experimental class was 52.78% (sufficient category), while the percentage of posttest results of the control class was 43.06% (sufficient category). Based on these percentages, the experimental class has better answers and percentages than the control class. This is in accordance with research (Rahmawati et al., 2019, p. 2) which states that learning cycle 8e learning is informed by constructivist theory where students build their own knowledge rather than obtaining data from others. This learning model can also improve students' skills by stimulating communication and empathy skills at the exchange stage during group discussions.

Elaboration

The next indicator is elaboration, which is the ability to describe something in detail, shown by a number of additions and details to each idea so that a simple stimulus becomes more complex (Harisuddin, 2019, p. 18). Based on the percentage of posttest results, the achievement of elaboration indicators in the experimental class was 78.47% (good category), while the percentage of posttest results of the control class was 40.45% (sufficient category). Based on these percentages, the experimental class has better answers and percentages than the control class.

CONCLUSION

The findings of this study indicate that the implementation of the project-based learning model using the 8E Learning Cycle positively influences students' creative thinking skills in learning the virus topic at the senior high school (SMA) Phase E level. Students in the experimental group demonstrated better performance across all indicators of creative thinking—such as fluency, flexibility, elaboration, and originality—compared to those in the control group. These results suggest that the 8E Learning Cycle supports the development of creativity through contextual, student-centered, and project-oriented learning. The statistical analysis confirms that the improvement in students' creative thinking was significant, thereby validating the effectiveness of this model. In line with current educational goals that emphasize higher-order thinking skills, this study highlights the importance of adopting innovative learning models like the 8E Learning Cycle to foster creativity in science education. Future research may explore the long-term impact of this approach and its application across different subjects and educational levels.

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