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# Application of Learning Cycle 7e on Environmental Pollution Material Toward Students' Interest and Learning Outcomes in Class X

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**ABSTRACT**

This study aims to describe the learning interest and cognitive learning outcomes of students with the Learning Cycle 7E learning model on environmental pollution material. This research uses a quantitative approach with the type of Pre-Experimental Design and One Group Pretest-Posttest design. The research sample was all students of class X SMA Negeri 1 Antang Kalang. The research instruments included learning interest questionnaire, cognitive learning outcomes test, and learning applicability observation sheet. Questionnaires and tests were given before and after the implementation of the Learning Cycle 7E model, while observations were made during the learning process. Data analysis shows that interest in learning based on the calculation of N-gain testing using excel shows there is an increase but still low. While the cognitive learning outcomes between pretest and postest experienced changes but classically said to be incomplete. This model also shows a high level of applicability, indicating its suitability for the context of biology learning at the high school level.

KEYWORDS

Learning Cycle 7E,
Learning interest,
Learning outcomes



## 1. Introduction

Education is the main pillar in the development of quality human resources and global competitiveness. As stated by Trianto (2010), education is a form of creating a vibrant and directed human culture. In this context, an effective learning process is the main key in achieving national education goals (Hamalik, 2014). The quality of education, especially in science and technology, is an important indicator in measuring the progress of a nation in the era of the industrial revolution 4.0 (Ghufron, 2018). Biology learning, as an integral part of science education, has a strategic role in developing critical, analytical, and systematic thinking skills in students (Campbell et al., 2018). However, the reality in the field shows that there is still a gap between expectations and reality in the biology learning process. Research conducted by Çimer (2012) revealed that many students consider biology as a difficult and abstract subject, especially when dealing with complex concepts such as environmental pollution.

The Learning Cycle 7E model offers a more comprehensive approach and involves learners actively in the knowledge construction process. This model is a development of the 5E model introduced by Bybee et al. (2006), with the addition of two phases namely Elicit and Extend. The seven phases in this model-elicit, engage, explore, explain, elaborate, evaluate, and extend-are designed to facilitate student-centered learning and develop deep conceptual understanding (Eisenkraft, 2003). The Elicit phase focuses on eliciting students' prior knowledge, while the Extend phase encourages students to apply their understanding in new contexts. The integration of these two phases strengthens the learning process by building a bridge between existing knowledge and its practical application (Duran & Duran, 2004). This approach is in line with constructivism theory which emphasizes the importance of experience and reflection in the formation of understanding (Piaget, 1977).

Research conducted by Balta & Sarac (2016) showed that the application of the Learning Cycle 7E model can significantly improve students' conceptual understanding and higher order thinking skills.

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This finding is supported by other studies that demonstrate the effectiveness of this model in various science learning contexts. For example, Polyiem et al. (2011) found significant improvements in concept understanding and science process skills of secondary school students after the implementation of Learning Cycle 7E in biology learning. Furthermore, Mecit (2006) reported that this model not only improved academic achievement, but also had a positive impact on students' attitudes towards science. This shows the potential of Learning Cycle 7E in creating a more engaging and motivating learning environment. The effectiveness of this model can be attributed to the structure that allows students to explore, explain and apply scientific concepts in a meaningful context.

The results of observations and interviews with class X biology teachers revealed that the learning outcomes of students in biology subjects were still relatively low, with many students who had not reached the Minimum Completion Criteria (KKM) of 67. This phenomenon is in line with the findings of Fauzi & Fariantika (2018) which show that there are still many students who have difficulty in understanding biological concepts, especially those related to complex natural phenomena such as environmental pollution. Learners' lack of interest in learning is also a significant problem, as seen from their low activity and participation during the learning process. Hidi & Renninger (2006) assert that interest has a crucial role in encouraging learners' cognitive and emotional engagement in the learning process. Furthermore, research conducted by Rotgans & Schmidt (2017) showed a positive correlation between learning interest and students' academic achievement.

Teacher-centered learning patterns with the dominance of lecture and limited discussion methods have long been criticized as ineffective in developing students' critical thinking and problem-solving skills (Hmelo-Silver, 2004). This approach tends to create passive and less meaningful learning, especially in the context of biology learning that requires contextual and applicative understanding (Çimer, 2012). In the context of learning about environmental pollution, a more contextualized and experiential approach is needed. This material has high relevance to current global issues and has the potential to increase learners' environmental awareness (Stevenson et al., 2013). Therefore, the application of learning models that can facilitate learners to explore, analyze, and find solutions to environmental problems is very important.

The 7E Learning Cycle model, with seven systematic phases (Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend), offers a comprehensive learning framework to improve learners' conceptual understanding and higher-order thinking skills (Eisenkraft, 2003). Research conducted by (Uyanik, 2016) showed that the application of the Learning Cycle 7E model can significantly improve students' academic achievement and positive attitude towards science learning.

Based on this background, this study aims to examine the application of the Learning Cycle 7E learning model on environmental pollution material and its effect on the interest and learning outcomes of students in class X. The results of this study are expected to contribute significantly to the improvement of students' academic performance. The results of this study are expected to make a significant contribution in the development of biology learning strategies that are more effective, meaningful, and relevant to the demands of the 21st century.

## 2. Method

This research applies a quantitative approach, where research data is in the form of numbers, data collection uses research instruments, and data analysis is statistical (Sugiyono, 2008). The quantitative approach was chosen because it allows objective measurement of research variables and facilitates statistical analysis to test hypotheses (Creswell & Creswell, 2018). The research design used was Pre-Experimental with the form of One Group Pretest-Posttest Design. The choice of this design is based on the consideration that there is no random grouping of subjects and no control group (Sugiyono, 2017). This is in line with the conditions in the field, where there is only one class X in the school, making it impossible to form a control group.

One Group Pretest-Posttest Design involves measurements on research subjects before and after treatment. This design allows researchers to evaluate changes that occur as a result of the intervention provided (Fraenkel et al., 2012). In the context of this study, the design is useful to determine changes in students' interest and learning outcomes after the application of the Learning Cycle 7E learning model on environmental pollution material. Schematically, the research design can be described as follows:

O1 --- X --- O2

Description: O1 : Pretest (measurement of interest and learning outcomes before treatment) X: Treatment (application of Learning Cycle 7E learning model) O2: Posttest (measurement of interest and learning outcomes after treatment)

The population in this study were all grade X students at the school. Given that there is only one class X, then all students in the class are used as research samples (saturated sampling). The saturated sampling technique is used when all members of the population are used as samples (Etikan et al., 2016).

The variables in this study consist of 1) independent variable: application of learning cycle 7e learning model, 2) The dependent variable: Learning interest and student learning outcomes. The research instruments used include 1) learning interest questionnaire: to measure students' interest in learning before and after treatment, 2) learning outcomes test: to measure students' learning outcomes before (pretest) and after (posttest) treatment. The validity and reliability of the instrument were tested using content validity techniques through expert judgment and reliability testing using Cronbach's Alpha (Taherdoost, 2016).

The research procedure included three main stages 1) preparation stage: instrument preparation, instrument validation, and learning preparation, 2) implementation stage: giving pretest, implementing learning with Learning Cycle 7E model, and giving posttest, 3) final stage: data analysis and conclusion drawing. The improvement of argumentation and problem solving skills was tested using the normalized gain test. The formula for measuring the N-gain score is

$$\text{N-gain} = \frac{score\ postest - pretest\ score}{ideal\ score - pretest\ score}$$

N-gain results were interpreted using Table 1 (Hake, 1998).

**Table 1**. Interpretation of N-Gain Score

| *N-Gain* | *Criteria* |
|---|---|
| 0.0 ≤N-Gain < 0.3 | Low |
| 0.3 ≤ N-Gain < 0.7 | Medium |
| N-Gain > 0.7 | High |

## 3. Results and Discussion

The experimental results cover data on learning interest and cognitive learning outcomes observing the contents of the initial and final learning interest assessments with Learning Cycle 7E for 24 students by looking at table 2.

**Table 2.** Mean Value of Initial Interest, Final Interest, and N-gain of Learning Interest

| N | *Score* | | | |
|---|---|---|---|---|
| | *Pretest* | *Postest* | *N-gain* | Categori |
| 24 | 60,67 | 62,71 | 0,02 | Low |

The results of the research on students' interest in learning show interesting developments to be studied. Based on the data presented in Table 2, there is a change in the level of students' interest in learning before and after the learning intervention. At the initial stage (pretest), the average score of students' interest in learning was recorded at 60.67. After the implementation of the specially designed learning program, the results of the final learning interest questionnaire (posttest) showed an increase, with the average score reaching 62.71. To measure the effectiveness of the learning intervention, an N-

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gain calculation was used, which yielded a value of 0.02. According to the standard classification, this N-gain value belongs to the low category. This indicates that although there was an increase in students' interest in learning, the magnitude was still relatively small.

This interpretation of the data is reinforced by the visualization presented in Figure 1, where the percentage comparison of pretest and posttest scores can be observed more clearly. The graph shows a positive trend, but with a less steep gradient, confirming that the increase in interest in learning is in the lower category of the spectrum of improvement.

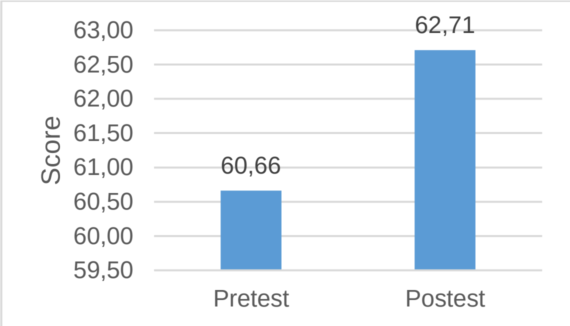

**Figure 1.** Percentage value of learning interest

For the indicator value of overall learning interest by looking at table 3.

**Table 3.** Learning Interest Indicator Item Score

| *No* | *Indicator* | *Average* | *Description* |
|---|---|---|---|
| 1. | The existence of a feeling of pleasure following the lesson | 82 | Very high |
| 3. | The existence of future hopes and aspirations | 80,75 | Very high |
| 4. | The existence of an interesting desire to learn | 80,3 | Very high |
| 5. | The existence of appreciation in learning | 56 | Medium |
| 6. | Conducive learning environment | 75,3 | High |

Table 3 presents interesting and informative findings regarding the indicators of students' interest in learning, providing valuable insights into the dynamics of learning motivation. Analysis of this data reveals that the “future hopes and aspirations” indicator recorded the highest score among all indicators measured. This finding is highly significant as it indicates that students find joy in their learning process, a key element in building intrinsic motivation. This feeling of enjoyment tends to encourage students' active engagement, increase the potential for material absorption and retention, and reflects success in creating an engaging and conducive learning environment.

At the other end of the spectrum, “appreciation in learning” emerged as the lowest-scoring indicator, opening up some important points to ponder. This indicates that students may feel underappreciated for their efforts and achievements in the learning process, a condition that has the potential to demoralize long-term learning. This gap between high feelings of enjoyment and low appreciation highlights an area where educational institutions and educators can improve their strategies to better recognize and reward students.

Based on these findings, several recommendations can be proposed to improve students' overall interest in learning. First, it is important to continue and improve practices that make learning enjoyable, such as interactive methods, project-based learning or the integration of relevant technologies. Second, more effective mechanisms need to be developed to recognize and reward, both formal and informal, student effort and achievement. Personalization of learning experiences that take into account students' individual preferences can also help integrate elements of fun with meaningful reward systems.

For data analysis of cognitive learning outcomes, namely pretest and posttest data by looking at table 4.

**Table 4.** Mean Values of Pretest, Postest, and N-gain of Cognitive Learning Outcomes

| *N* | *Score* | | | | |
|---|---|---|---|---|---|
| | ***Pretest*** | ***Postest*** | ***Gain*** | ***N-gain*** | ***Category*** |
| 24 | 45,55 | 61,33 | 15,83 | 0,27 | Low |

Table 4 presents significant data on the development of students' learning outcomes, providing a clear picture of the effectiveness of the learning process that has been implemented. Based on the data, there was an improvement in students' academic performance, although the improvement was not as great as might have been expected.

At the initial stage of the evaluation (pretest), the average score obtained by students was 45.55. This figure reflects the students' initial level of knowledge and understanding of the material to be learned. After going through a series of learning processes, the final evaluation (posttest) showed an increase with an average score of 61.33. This increase of 15.78 points indicates the positive impact of the applied learning method. Although the improvement is low, it is important to view these results as a positive step in the learning process. Any improvement, no matter how small, indicates progress in students' understanding and ability. However, these results are also a catalyst for reflection and improvement in teaching and learning strategies. Percentage value comparison by looking at Figure 2.

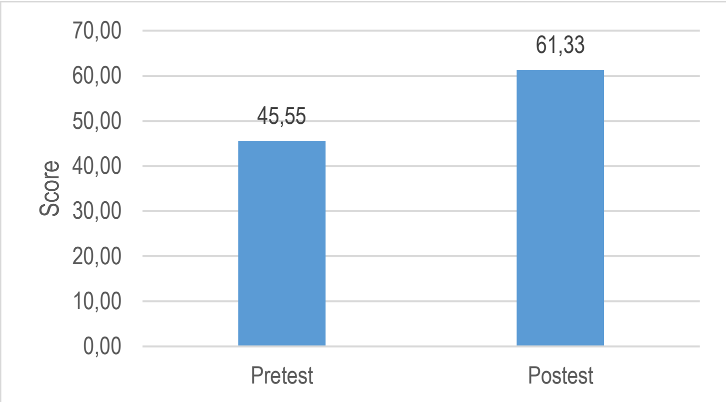


**Figure 2.** Percentage Value of Cognitive Learning Outcomes

For individual completeness, it can be declared complete if the learning outcomes at least reach the KKM, which is ≥ 67, if the value of students ≤ 67, it can be stated that the learning outcomes are declared incomplete. To find out the percentage of completeness by looking at Figure 3.

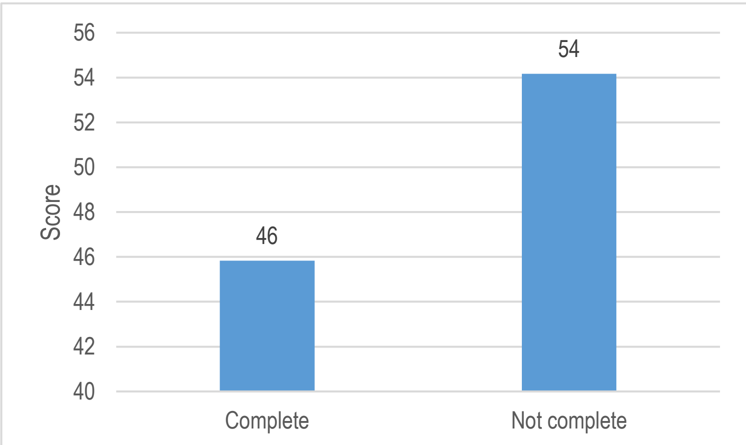


**Figure 3.** Percentage of Completeness of Learning Outcomes

The data shows that 46% of learners managed to reach the predetermined Minimum Completion Criteria (KKM), while 54% of learners were unable to reach the standard. These results indicate that the application of the Learning Cycle 7E model has a positive impact on some learners' understanding of environmental pollution material. However, there is still room for improvement considering that more than half of the learners have not reached the KKM.

The measurement of learning interest showed an increase in the average score of students' learning interest from pretest to posttest. This increase indicates that the applied learning intervention, namely learning cycle 7E, has a positive impact on students' interest in learning, although the change is relatively small. This low N-gain value indicates that the effectiveness of the learning intervention in increasing students' interest in learning is still limited. Some factors that may have influenced this outcome include a) duration of the intervention: If a special learning program is implemented over a short period of time, the effects may not be significant (Keller, 2010), b) appropriateness of the intervention: It is necessary to evaluate whether the designed learning program is appropriate for the needs and characteristics of the students (Renninger & Hidi, 2016), c) external factors: Various factors outside the intervention, such as the condition of the learning environment or students' intrinsic motivation, may also affect the outcome (Schunk et al., 2014).

Although the increase in interest in learning was low, the positive change still shows the potential of the intervention. Some recommendations for future research a) extend the duration of the intervention to see long-term effects (Hidi & Renninger, 2006), b) valuate and modify the learning program to be more effective in increasing interest in learning (Keller, 2010), c) integrate more diverse motivational strategies in the intervention (Schunk et al., 2014), d) onduct qualitative analysis to understand students' perceptions of the intervention (Renninger & Hidi, 2016).

These pretest scores are not just a row of digits, but rather a snapshot of students' prior knowledge. As Hattie (2009) explains in her meta-analysis, the pretest serves as a map showing students' starting points in their learning journey. This score becomes an important foundation, providing an overview of what students already know and which areas require further development. This 15.78-point increase in pretest and posttest scores may seem modest, but behind it lies a story of struggle and growth. As Hattie and Timperley (2007) point out, effective feedback - including that obtained through assessments such as posttests - can be a powerful catalyst for student learning and performance improvement. Although the increase in scores is low, it is still a positive indicator in the learning process with the learning cycle 7e model. Any improvement, no matter how small, reflects progress in students' understanding and ability. As stated by Ericsson in his research on expertise (Ericsson et al., 1993), expert performance is built through continuous practice and gradual improvement.

The achievement of KKM indicates that the application of the Learning Cycle 7E model has a positive impact on the understanding of some students regarding environmental pollution material, but there is still room for improvement considering that more than half of the students have not reached KKM. The achievement of 46% of students who meet the KKM shows that the Learning Cycle 7E model has the potential to improve student understanding. This is in line with the findings of Bybee et al. (2006) who stated that this model can improve students' conceptual understanding through structured stages. However, the fact that 54% of learners did not achieve the KKM indicates the challenges in implementing this model. Some factors that may have contributed to this include a) the complexity of the environmental pollution material which may take longer to understand thoroughly (Çepni & Şahin, 2012), b) differences in students' individual learning styles that may not be fully accommodated in this model, as discussed by Tuna & Kaçar (2013) in their study, c) possible lack of students' readiness or familiarity with a more active and student-centered learning approach (Mecit, 2006).

Overall, the Learning Cycle 7E model encourages active involvement of learners in the learning process. The Elicit and Engage stages help arouse students' curiosity and initial interest in environmental pollution material. This is in line with the findings of Polyiem et al. (2011) which showed that this model can increase students' motivation and interest in learning. The Explore and Explain stages in this model allow learners to connect the concept of environmental pollution with their daily experiences. Contextualizing material can increase the relevance of learning in the eyes of students, thus increasing their interest. The Elaborate and Extend stages encourage learners to apply their understanding in new contexts, developing critical thinking skills. Qarareh (2012) found that developing these skills can increase learners' confidence and interest in the material being studied. The Learning Cycle 7E model facilitates a deeper conceptual understanding of environmental pollution. Adesoji & Idika (2015) research showed that this model can improve students' conceptual understanding in science subjects. However, in its implementation, the learning cycle model has a low impact on student interest and learning outcomes. The implementation of the Learning Cycle 7E model requires more time than the traditional method. Çepni & Şahin (2012) noted that this can be a challenge in a crowded curriculum. Not all learners may be suited to this approach. Mecit (2006) emphasizes the importance of considering individual learning styles in the application of this model. Although there are challenges in its implementation, with the right adjustments and adequate support, this model can be an effective tool in improving the quality of science learning, especially on the topic of environmental pollution.

## 3. Conclusion

Based on the calculation of n-gain testing, it shows that there is an increase in learning interest scores but it is still low. Meanwhile, cognitive learning outcomes between pretest and posttest experienced changes but were classically said to be incomplete. The application of the Learning Cycle 7E model to environmental pollution material can increase the interest of grade X students in the topic although it is low. This model may succeed in making learning more interesting and involving students actively, thus increasing their interest in environmental issues. The learning cycle 7e model also had an impact on the learning outcomes of grade X students in the low category.

Although this study showed improved results, there are some limitations to consider such as the sample size of the study which may be limited to a relatively small sample size (grade X in one school), which may limit the generalizability of the results to a wider population. The study may have been conducted over a relatively short period of time, which may limit the observation of the long-term effects of applying the Learning Cycle 7E model. In addition, external factors such as learners' socio-economic background, teachers' teaching style, or school facilities may not be fully controlled, which could affect the results of the study. This study focuses on environmental pollution materials, so the effectiveness of the model on other materials or subjects may differ.

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