



## The Effectiveness of the Contextual Teaching and Learning (CTL) Learning Model on Environmental Pollution on Students' Learning Outcomes at State Senior High School 1 Darul Imarah

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### ARTICLE INFO

#### Article history:

Received: July, 2026

Received in revised from: August, 2026

Accepted: September, 2026

Available online: September, 28, 2026

**Keywords:** Contextual Teaching, Learning (CTL) Model, Learning outcomes.

### ABSTRACT

The Effectiveness of CTL Model in SMA Negeri 1 Darul Imarah Contextual Teaching and Learning (CTL) is a learning strategy that emphasizes the full involvement of students to connect the material with real-life situations. This study aims to determine whether the application of the CTL model to the material of Environmental Pollution can achieve student learning completeness in SMA Negeri 1 Darul Imarah. This study uses a quantitative approach of experimental type with a one group pretest-post-test design. The population in this study were all students of class X of SMA Negeri 1 Darul Imarah. The sample in this study was 34 students of X-E6. Data were collected through a test instrument of 20 questions and analysed using a normality test and a one sample t-test. The results showed a significant increase in students' average scores. Based on the hypothesis test, the value (t-count) = 46.093 > t-table = 1.69 with a significance value (0.001 < 0.05), so  $H_a$  was accepted. The advantages of the CTL model have been proven to increase activeness, problem-solving skills, collaboration, and in-depth conceptual understanding. It can be concluded that the application of the CTL model to the Environmental Pollution material is effective in achieving student learning outcomes.

### 1. Introduction

Education is a directed process involving interaction between educators and students in learning activities. This process aims to improve students' knowledge, understanding, and skills. Furthermore, education plays a role in developing thinking skills and attitudes in facing the learning process. In its application, education emphasizes the development of individual potential as a whole. Therefore, education is a crucial tool in shaping students' readiness to face the changing times (Akmal et al., 2025). Education is a serious effort to prepare students, through guidance, teaching, and/or training programs, for their future careers. Education is a conscious, planned effort to create a learning atmosphere and learning process so that students actively develop their potential to possess spiritual and religious strength, self-control, personality, intelligence, noble

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<https://doi.org/10.56806/jh.v7i3.489>

character, and the skills needed by themselves, society, the nation, and the state (Alpiani, et al., 2019). Education serves to empower human potential and pass it on. Education is considered a lifelong process that develops an individual's full potential, enabling them to live and live fully, thus becoming educated individuals, both cognitively, affectively, and psychometrically (Aprima & Sari, 2022).

Education is a conscious effort to facilitate the development and enhancement of students' potential. The core of education is learning activities. Therefore, educational services provide the resources needed to support a positive or quality learning process (Hambali, 2022). Education can develop and build future culture and civilization. On the one hand, education serves to preserve positive cultural values, and on the other, it serves to create change towards a more innovative lifestyle. Indonesian education experiences developments or curriculum changes every era to adapt to advances and student needs. The curriculum implemented in elementary schools should not only focus on academic aspects but also reflect the local identity and cultural richness of the local community (Zahrika & Semarang, 2023).

Education is a strategic process in developing the quality of human resources, thus requiring effective and sustainable management. One key factor in the success of education is the leadership of the principal. Leadership in education focuses not only on administrative aspects but also encompasses the leader's ability to influence, guide, and motivate the entire school community to optimally achieve educational goals. This aligns with the opinion of Nisa et al. (2023) who stated that the principal's leadership plays a role in "influencing, encouraging, guiding, directing, and empowering all school components in order to achieve predetermined educational goals" (Mayasena & Fadilah, 2026). Education is a conscious process carried out to develop human values within individuals. Through education, the quality of human resources can be significantly improved, allowing each individual's potential to grow to its maximum potential. However, this improvement in quality cannot be achieved without the support and collaboration of various parties (Prastika & Iman, 2026).

Contextual Teaching and Learning is a learning concept in which teachers bring the real world into the classroom and encourage students to make connections between the knowledge they have and its application in their daily lives, while students acquire knowledge and skills from limited contexts little by little, and from the process of constructing themselves, as provisions for solving problems in their lives as members of society (Rahman et al., 2023). Contextual Teaching and Learning (CTL) is a learning strategy that emphasizes the process of full student involvement in discovering the material they are learning and connecting it to real-life situations, so that students are encouraged to apply it in their lives (Nababan et al., 2023). Contextual Teaching and Learning (CTL) is an educational methodology that emphasizes active student participation in discovering subject matter and connecting it to real-world situations. Johnson (2007) emphasized that the Contextual Teaching and Learning (CTL) model Learning (CTL) is a system that stimulates cognition to form patterns that provide meaning (Nurhanipah et al., 2025).

Contextual Teaching and Learning (CTL) is a model offered in learning to increase motivation and make learning activities more meaningful. Contextual Teaching and Learning (CTL) is a system that stimulates the brain to construct patterns that create meaning by connecting academic content with the context of students' daily lives. Furthermore, Contextual Teaching and Learning (CTL) also enables students to apply and experience what is being taught with real-world problems, thereby making learning more meaningful and enjoyable (Simanullang et al., 2025). In contextual learning, constructivism emphasizes the importance of linking new knowledge to students' prior experiences and knowledge, thus enabling more meaningful and relevant learning (Baruno et al., 2025).

This study aims to examine the effectiveness of the contextual learning model (CTL) in improving student learning outcomes on environmental pollution. Contextual learning was chosen because a purely theoretical approach often makes it difficult for students to understand environmental concepts. By linking subject matter to students' real-life contexts, CTL is expected to increase learning motivation, student engagement, and deeper conceptual understanding. Therefore, this study will examine the extent to which CTL can improve student learning outcomes and provide a more meaningful learning experience.

Based on the results of initial observations conducted by researchers regarding environmental pollution learning, it was discovered that environmental pollution is a crucial issue that students need to understand because it is directly related to their daily lives. In this study, environmental pollution is classified into four main types: water, air, land, and noise pollution (Leko et al., 2024).

Teaching modules are one form of teaching materials in the form of printed media in the implementation of the independent curriculum. This teaching material in the form of modules is highly expected to be an alternative in complementing teaching materials in independent curriculum learning, especially in biology learning. This learning module contains learning objectives, learning steps (which include the learning media to be used), assessments, as well as other learning information and references that can help teachers in implementing learning (Tane et al., 2025).

During the observation phase, researchers integrated learning with real-world environmental conditions to facilitate students' concrete understanding of the concept. In the water pollution lesson, students were taken to the area around the school to directly observe environmental conditions. Through this activity, students were able to see concrete forms of pollution, identify its causes, and understand the impacts, particularly those resulting from littering. This activity is expected to raise students' awareness of the importance of maintaining a clean school environment.

Furthermore, in the noise pollution lesson, students were also taken to the area in front of the school, which is near the main road. There, students were able to experience firsthand the level of noise produced by motor vehicles. This experience helped students understand the concept of noise pollution, including its sources and its impact on comfort and health.

In the air pollution lesson, researchers again utilized the school's surroundings, particularly areas frequently traveled by vehicles. Through direct observation activities, students can recognize air pollution caused by vehicle exhaust and the factors that cause it. Furthermore, they are trained to analyze the impact of air pollution on human health and the environment, making the learning process more meaningful.

Finally, in the soil pollution topic, students are taken to the back of the classroom where there is a garbage dump. There, they can directly observe the condition of the soil that has been contaminated by the accumulation of waste. This activity helps students understand the concept of soil pollution, including its causes and the negative impacts on the environment and human health if waste is not managed properly.

Soil pollution occurs when foreign matter is added to a land area, causing a decline in soil quality and disrupting its natural functions as a provider of water, nutrients, and air. Contaminated soil can reduce agricultural quality, resulting in less fresh and nutritious crops. Causes of soil pollution include domestic waste, solid waste, liquid waste, industrial waste, and agricultural waste. Domestic waste originates from household activities, commerce, and similar facilities. Solid waste is removable, such as vegetable scraps and wood chips (Sri, 2021).

A learning model is a teaching procedure implemented in the classroom to achieve learning objectives. The learning models contained in this Pancasila Education teaching module are

determined based on several considerations, one of which is their alignment with the material being studied and the objectives to be achieved (Habibah & Fathurrahman, 2025).

Based on these four activities, it can be concluded that learning that connects material to real-world conditions in the surrounding environment can provide a more contextual and meaningful learning experience for students. Therefore, an effective learning approach is needed so that students not only understand the concept of environmental pollution theoretically but also develop environmental awareness and care in their daily lives.

## 2. Methodology

The approach used in this research is quantitative because the data processing is in the form of numbers presented in statistics. Quantitative research is empirical research whose data is in the form of numbers (Syahrizal & Jailani, 2023), where quantitative data is data in the form of numbers that can be processed using statistical techniques. The type of research used is a one-group pretest-posttest design, or a pre-experimental quantitative research design.

The data collection technique in this study used quantitative data, namely learning outcome data obtained from pretest and posttest scores on environmental pollution material. Then, the difference between the pretest and posttest scores (N-gain score) was calculated. The pretest score was taken at the beginning of the meeting, while the posttest score was taken at the end of the learning process at the last meeting, both control and experimental, with the same format and number of questions (Bawotong et al., 2024). The population in this study were all 10th grade students of SMA Negeri 1 Darul Ijarah. The sample in this study were 34 10th grade students of SMA Negeri 1 Darul Ijarah. The data collection technique used a 20-question coes test consisting of a pre-test and a post-test. The data analysis technique used a normality test and a one-sample t-test.

## 3. Results

Based on the data obtained, there was an increase in scores between the pre-test and post-test results. This indicates that the learning model had a positive impact on students' understanding of environmental pollution material. In addition, students also experienced an increase in their ability to understand and explain the concepts learned. Thus, the application of the CTL model can be declared effective in improving student learning outcomes. The results of the initial test (pre-test) of the application of the CTL model on environmental pollution material for students of SMA Negeri 1 Darul Ijarah and the final test (post-test) of the application of the contextual teaching and learning (CTL) model on environmental pollution material for students of SMA Negeri 1 Darul Ijarah are presented in Table 1.

**Table 1** Results of the Pre-Test Data Normality Test

|                | Test of Normality               |    |      |              |    |      |
|----------------|---------------------------------|----|------|--------------|----|------|
|                | Kolmogorov-Smirnov <sup>a</sup> |    |      | Shapiro-Wilk |    |      |
|                | Statistic                       | df | Sig. | Statistic    | df | Sig. |
| <i>Pretest</i> | .147                            | 31 | .088 | .950         | 31 | .160 |

Based on Table 1, the results of the Shapiro-Wilk test can be seen that the pre-test obtained a significance value (2-tailed) of 0.376, which is greater than  $\alpha = 0.05$ . Therefore,  $0.160 > 0.05$  was obtained. This indicates that the results of the pre-test data research are normally distributed. Meanwhile, the results of the post-test data normality test of student learning outcomes after the

application of the contextual teaching and learning (CTL) model on environmental pollution material are presented in Table 2.

**Table 2.** Post-Test Data Normality Test Results

| Test of Normality |                                 |    |      |              |    |      |
|-------------------|---------------------------------|----|------|--------------|----|------|
|                   | Kolmogorov-Smirnov <sup>a</sup> |    |      | Shapiro-Wilk |    |      |
|                   | Statistic                       | df | Sig. | Statistic    | df | Sig. |
| <i>Prosttest</i>  | .172                            | 31 | .020 | .933         | 31 | .053 |

Based on Table 2, the results of the Shapiro-Wilk test show that the post-test obtained a significance value (2-tailed) of 0.053, which is greater than  $\alpha = 0.05$ . Therefore,  $0.053 > 0.05$  is obtained. This indicates that the results of the post-test data research are normally distributed.

**Table 3** Distribution of N-Gain Scores

| <b>N-Gain Value</b>   | <b>Category</b> |
|-----------------------|-----------------|
| $g > 0,7$             | High            |
| $0,3 \leq g \leq 0,7$ | Medium          |
| $g < 0,3$             | Low             |

Based on the N-gain calculation, the average value was 0.41, which is considered moderate. The minimum score achieved by students was 0.04, while the maximum score was 0.83. These data indicate differences in learning outcomes among students, with some experiencing significant improvement, while others experienced moderate to low levels. Overall, these results indicate that the learning implemented was able to improve student learning outcomes with a moderate level of effectiveness.

**Table.4.** Results of One Sample T-test

| One-Sample Test |               |    |                 |                 |                                           |       |
|-----------------|---------------|----|-----------------|-----------------|-------------------------------------------|-------|
|                 | Test Value =0 |    |                 |                 |                                           |       |
|                 | t             | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference |       |
|                 |               |    |                 |                 | Lower                                     | Upper |
| <i>Posttest</i> | 46.093        | 30 | .001            | 76.613          | 73.22                                     | 80.01 |

Based on Table 4.3, the results of the one sample t-test obtained a significance value (2-tailed) = 0.001. Based on the criteria for making decisions by comparing the significance value (2-tailed). If the significance value (2-tailed)  $< 0.05$  then the t is accepted. Then obtained  $0.001 < 0.05$  so that it can be decided that the t is accepted, meaning that the application of the contextual teaching and learning (CTL) model on environmental pollution material at SMA Negeri 1 Darul Imarah can achieve learning completeness (average value  $\geq 70$ ).

If Based on the criteria for making decisions by comparing the values of t and t. To find the *ttabel*, the researcher used the t distribution table with a significance level of  $\alpha = 0.05$  and degrees of freedom (dk) =  $(n - 1) = 31 - 1 = 30$ , then obtained *ttabel* = 1.69. After obtaining *thitung* = 46.0 and *ttabel* = 1.69. Then obtained *thitung*  $>$  *ttabel* or  $46.0 > 1.69$ . So it can be decided that *Ha* is accepted, meaning that the application of the contextual teaching and learning model on

environmental pollution material at SMA Negeri 1 Darul Imarah can achieve learning completeness (average value  $\geq 70$ ).

#### 4. Conclusions

Student learning outcomes after implementing the Contextual Teaching and Learning (CTL) model significantly improved compared to pre-implementation. The average student score on the posttest was 76.61, compared to the average pretest score of 45.48. This improvement not only affected cognitive aspects but was also evident in increased student engagement during the learning process. Students became more active in asking questions, discussing topics, and connecting environmental pollution material to real-life situations. Based on data analysis, there was a significant difference between student learning outcomes before and after implementing the Contextual Teaching and Learning (CTL) model. Prior to implementing CTL, the learning process tended to use conventional methods such as lectures, reading textbooks, and working on exercises. This resulted in students being less active and less able to understand the relevance of the material to real-life situations. This resulted in low student learning outcomes.

From several opinions related to the Contextual Teaching and Learning (CTL) learning model above, it can be concluded that the Contextual Teaching and Learning (CTL) learning model is a learning model that can be used by teachers with the aim of encouraging students to make connections between the knowledge they have and the application of that knowledge in everyday life and referring to real-world problems, so that the learning obtained becomes more meaningful for students (Ester et al., 2023).

Comparisons with other learning models show that contextual learning has specific advantages in increasing learning motivation. Compared with problem-based learning, project-based learning, and cooperative learning, contextual learning demonstrates a greater effect in increasing learning motivation. This advantage lies in the ability of contextual learning to integrate various learning strategies into a coherent and meaningful framework for students (Putriani et al., 2025).

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