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# The Effect of Contextual Teaching and Learning (CTL) Model on Reaction Rate Material on Critical Thinking Ability and Character of Student

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**Abstract**

This research investigates the impact of the Contextual Teaching and Learning (CTL) model on critical thinking abilities and student character in the reaction rate topic at SMA Negeri 3 Gorontalo Utara. This research employs a quantitative methodology with a near-experimental design, specifically employing a one-group pre-test and post-test design. Data were gathered through questionnaires and tests. The study's population consisted of grade XI students at SMA Negeri 3 Gorontalo Utara throughout the opening term of the academic cycle for 2024-2025. A total sampling method was used, selecting 50 students from two classes who enrolled in chemistry specialization. The findings indicate that the application of the CTL model led to an improvement in critical thinking skills, with the experimental class showing a mean pre-test result of 37.56% and a post-test result of 84.22%, whereas the replication group recorded pre-test and post-test averages of 37.33% and 83.89%, respectively. As for character growth, the experimental group displayed an average score of 80.13%, while the replication group showed 79.90%. Both classes demonstrated significant progress, as shown by the consistency of the results in both groups. The outcomes of the paired sample t-test reveal a noteworthy value of 0.000 < 0.05, prompting the dismissal of H0 and the endorsement of Ha, confirming that the CTL model positively affects critical thinking skills and student character in reaction rate material.

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## 1. INTRODUCTION

Chemistry, as a field within the Natural Sciences (IPA), presents numerous fascinating phenomena that have the potential to shape moral behavior. Teaching moral values requires providing examples and models that demonstrate how these values are applied. The concepts in chemistry offer a framework that students can replicate, provided the teacher guides them in understanding the underlying meaning. Internalization occurs when students connect specific phenomena, facts, or concepts to the moral principles outlined in the Quran (Gonibala et al., 2019).

Chemistry instruction should be approached through different methods or models, considering its unique characteristics. To prevent students from losing interest, it is essential to vary the teaching strategies according to the topic being covered. The success of student learning achievements is influenced by how well instructional strategies harmonize with the essence of the subject matte (Munandar & Rumape, 2021). Chemistry education in senior high schools (SMA) frequently encounters several obstacles that can hinder students' comprehension and engagement with the subject. A significant issue is the insufficient availability of proper laboratory facilities. Numerous schools lack fully equipped chemistry labs, which restricts the ability to conduct practical experiments, a crucial component of chemistry education. Practical sessions are vital as they enable learners to directly engage with the practical implementation of theoretical knowledge in real-world

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situations, thereby enhancing their grasp of chemical concepts (Hasanah et al., 2022).

Activities that stimulate advanced cognitive abilities in learners are those that involve them in dynamically building and linking ideas. The CTL model l is a comprehensive approach designed to help students grasp the significance of learning materials and connect them to their real-life contexts, including personal, social, and cultural aspects. This enables students to develop dynamic and adaptable knowledge and skills, allowing them to independently build their understanding. (Hamidah & Citra, 2021).

One of the key topics in chemistry, the rate of reaction, involves a blend of abstract concepts and mathematical theory, such as collision theory, along with the calculation of reaction order and rate constants. The abstract nature of these chemical concepts can hinder students from developing their critical thinking skills. (Rokhani, 2022). Based on the nature of reaction rates, CTL is an effective model for enhancing Analytical reasoning abilities and shaping student character, as it encourages learners to connect the knowledge they acquire with real-life situations, making the learning process more meaningful and applicable. Kismatun highlighted that CTL is characterized by six key features, one of which is the application of knowledge in a real-world context, a crucial aspect for fostering students' critical thinking abilities. (Kismatun, 2021).

Critical reasoning abilities entail an ongoing effort of intentional and proactive thought, directed at forming logical conclusions, not merely to uncover solutions but also to address challenges effectively through the process of understanding concepts, applying, synthesizing, and evaluating the information obtained and produced. It is considered a higher-level cognitive skill that plays a crucial role in student development and is essential for thriving in society, particularly within the scope of 21st-century competencies (Dai et al., 2022). This skill is vital for addressing the various challenges encountered in both social and personal contexts. When analyzing phenomena in chemical reactions, having strong critical thinking abilities is necessary (Munandar et al., 2022). Analytical reasoning abilities can be nurtured, honed, and enhanced through educational practices and evaluation methods (Ijirana et al., 2022)

Based on discussions held with a chemistry educator in class X at SMA Negeri 3 North Gorontalo, it was found that the school follows an independent curriculum. However, the learning process has not yet fully adopted contextual learning as it is still in the adaptation phase. SMA Negeri 3 North Gorontalo is located in a remote area, where access to adequate educational facilities, including chemistry labs and supporting technology, is limited. From the observation, it is known that the average value of student learning outcomes in chemistry, especially in concepts that require analytical understanding such as reaction rates, is still below the Minimum Completion Criteria (KKM) set by the school, which is 75. In addition, students' critical thinking skills are also still less than optimal, marked by their low ability to analyze chemical problems, provide logical arguments, and draw appropriate conclusions based on the data obtained. This condition also affects students' character development, especially in terms of discipline, responsibility, creativity, curiosity and communicative ability. Consequently, this study It is crucial to investigate the practicality of the CTL approach in such remote areas and its effect on learners' analytical reasoning skills and character development. The choice of this school is also due to the fact that, despite The application of the Freedom Curriculum, the learning approaches used still primarily rely on lectures and discovery learning, which do not fully foster students' critical thinking skills.

Research has shown that the use of CTL learning models effectively enhances students' critical thinking abilities and character development. For instance, a study by Nurhadi (2021) revealed thatse applying CTL in chemistry instruction can boost student engagement and comprehension of complex chemical concepts. Similarly, Siregar (2020) found that CTL fosters student traits like independence and teamwork, as learners actively engage in contextual and practical learning experiences. However, this study has a novelty value that lies in the application of the CTL model in a specific context on reaction rate material that has not been explored much before. This study is also unique in that it uses a replication class as the experimental repetition class to test the consistency of the application of the CTL learning model. Thus, the results obtained can provide a more comprehensive picture of the effectiveness and consistency of the application of CTL in chemistry learning. In addition, this study was conducted in a school located in a remote area that provides its own challenges in the learning process. This context is

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important because the application of CTL in an environment with limited resources can provide a new perspective in the adaptation of contextual-based learning methods. Therefore, implementing the CTL model at SMA Negeri 3 Gorontalo Utara, particularly for reaction rate material, is anticipated to address current challenges while positively impacting students' critical thinking and character development. Given the issues raised by educational experts, the goals of the independent curriculum, and the various findings on enhancing critical thinking and moral values, it is crucial to undertake an investigation into "The Effect of CTL Model on Reaction Rate Material on Critical Thinking Ability and Student Character."

## 2. METHOD

The study was carried out at State Senior High School 3 of Northern Gorontalo, located in class XI, on Jalan Bintara No. 72, in the Pinontoyonga village, Atinggola Subdistrict, located in the North Gorontalo Regency of Gorontalo Province, throughout the opening term of the academic cycle for 2024-2025.

This research employs a quantitative methodology with a near-experimental design, specifically employing a one-group pre-test and post-test design (Sriyanti et al., 2020). The research involves both an experimental group and a replication group, where one group acts as the experimental cohort, while the other functions as the replication set. Replication refers to repeating the experiment to achieve more accurate estimates and Evaluate the coherence of the outcomes. The design of the research is presented in Table 1.

Table 1. Research design

| Sampel | Pre-test | Treatment | Post-test |
|---|---|---|---|
| I | $Y_1$ | T | $Y_2$ |
| II | $Y_3$ | T | $Y_4$ |

Source: (Sriyanti et al., 2020)

Prior to implementing the treatment in the two sample classes, both were given a Pre-test for the experimental class (Y1) and Pre-test for the replication class (Y3), then the two sample classes were given the CTL model learning treatment (T), Afterward, the two samples were given a Post-test for the experimental class (Y2) and Post-test for the replication class (Y4) in order to see the learning outcomes before and after treatment. The existence of a replication class with the same treatment aims to obtain a more accurate estimate and test the consistency of the results obtained, so that it can ensure that the changes that occur in the experimental class are truly caused by the CTL learning model intervention. The replication class functions as a step to control external variables that can affect the results, so that it can verify whether the findings obtained in the experimental class can be maintained or obtained again under similar conditions. In this study, the sample was taken by total sampling, namely all grade XI students who chose chemistry as their interest subject in the odd semester of the 2024/2025 Academic Year, totaling 50 students, which were divided into 2 classes. The experimental class was XI C, and the replication class was XI E, both of which implemented the CTL learning model. The gathering of information incorporated the utilization of questionnaires and assessments, The questionnaire or survey used in this study is a type of closed questionnaire or survey, because respondents only need to give a mark on one of the answers that are considered correct, the questionnaire used in data collection consists of 25 statements with Likert Scale answers to assess how the character of students is then to measure students' critical thinking skills are carried out through essay test questions conducted before and after treatment for CTL learning. The instrument used in data collection on the question sheet as many as 12 questions with essay answers to assess the extent of students' critical thinking skills on the material that has been taught. Data analysis was conducted using both descriptive and inferential techniques with the SPSS Statistics 26 program, through test validity test, test reliability test, data normality test and homogeneity test to test hypotheses with independent sample t-test, paired sample t-test, and N-gain score test.

## 3. RESULT AND DISCUSSION

### 3.1. Result

**Validity Test**

The objective of this verification procedure is to evaluate whether the question instrument is valid. The results of the validity test can be seen in the correlation value column in the SPSS Statistics 26 program. The instrument is said to be valid if the Pearson Correlation value is greater than the r-table value at the 5% (0.05) significance level. The calculation results show the Pearson Correlation value for the critical thinking ability instrument and character instrument is greater than 0.05.

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then according to the assumptions of the validity test both instruments are valid.

**Reliability Test**

The aim of this reliability examination is to evaluate the consistency or steadiness of the item instrument. The calculations revealed a Cronbach Alpha value of 0.705 for the critical thinking ability instrument and 0.919 for the character instrument. According to the category guidelines, values of 0.705 and 0.919 fall within the high and very high categories, respectively, indicating that the instruments used in this study meet the reliability criteria.

**Pre-test and Post-test Results of Experimental Classes and Replication Classes**

The initial evaluation was conducted to measure the learners' capabilities. baseline knowledge and their confidence in answering questions on material that had not been covered yet, Subsequent to the implementation of the CTL model, a follow-up assessment was carried out to gauge the enhancement of the students' critical thinking skills. The data collected shows the average scores from both The initial and final assessments for both the experimental and replication groups, depicted in Figure 1

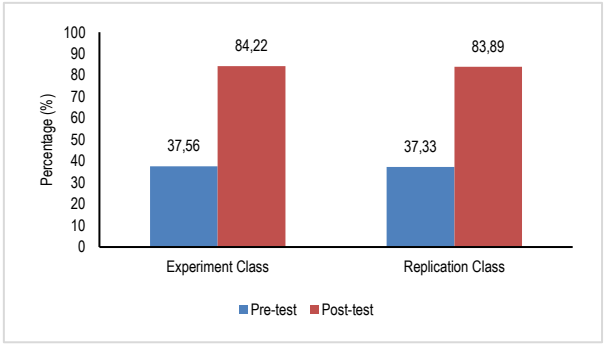


Figure 1. Data on pre-test and post-test results based on indicators of critical thinking ability in experimental classes and replication classes

**Data on Pre-test and Post-test Results Based on Indicators of Critical Thinking Ability in Experimental Classes and Replication Classes**

The initial test was administered to assess students' critical thinking abilities for each question indicator before the intervention, and the final test was used to evaluate their critical thinking skills for each indicator after the intervention. The data concerning Pre-test and Post-test Results, reflecting Indicators of Critical Thinking Ability in both Experimental and Replication Classes among students at North Gorontalo 3 State High School, is shown in Figures 2 and 3.

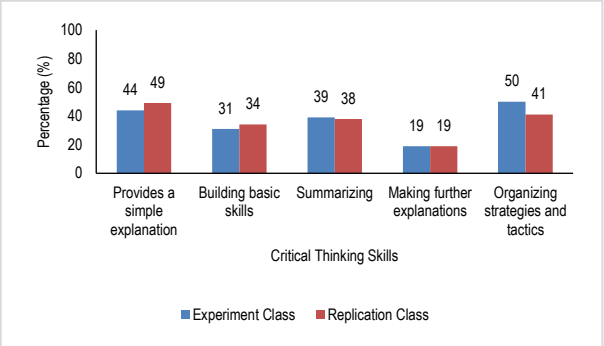


Figure 2. The results of the pre-test assessment of critical thinking skills for each indicator in the experimental and replication classes

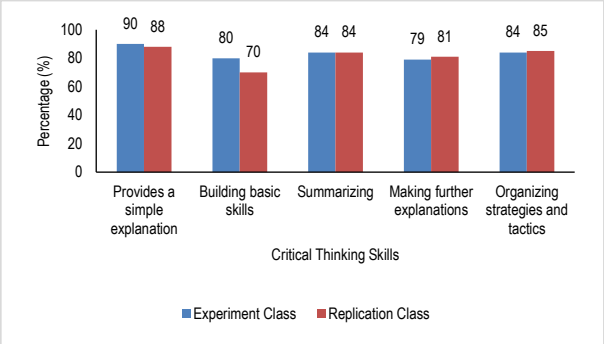


Figure 3. The results of the post-test assessment of critical thinking skills for each indicator in the experimental and replication classes

**Data on Student Character Results Based on Character Aspects in Experimental Classes and Replication Classes**

The results of student character measured in this study are divided into five aspects, namely aspects of responsibility, discipline, creativity, curiosity, friendliness/communicativeness. the results of character measurements in each aspect of SMA Negeri 3 North Gorontalo students are presented in Figure 4.

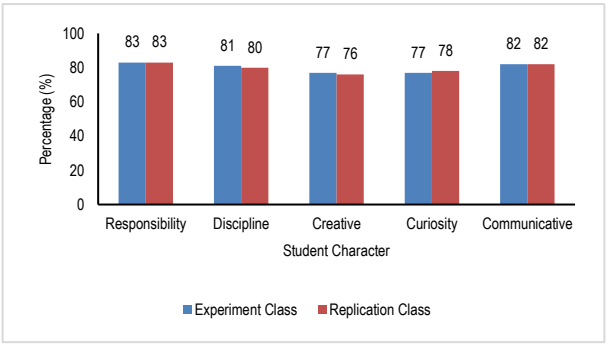


Figure 4. Student character results of each indicator in experimental and replication classes

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**Normality Test**

The aim of the normality assessment is to determine if the sample data derives from a population exhibiting a normal distribution. For this investigation, data deemed suitable must adhere to a normal distribution. In this study, the Shapiro-Wilk test was employed to evaluate normality. The findings from the Kolmogorov-Smirnov test are Displayed within Tables 2 and 3.

Table 2. Normality test results of critical thinking ability data

| Class | Shapiro-Wilk | | |
|---|---|---|---|
| | Statistic | df | Sig. |
| Experiment.Pre-Test | .152 | 25 | .139 |
| Experiment Post-Test | .151 | 25 | .121 |
| Replication Pre-Test | .127 | 25 | .155 |
| Replication Post-Test | .137 | 25 | .188 |

Table 3. Character data normality test results

| Class | Shapiro-Wilk | | |
|---|---|---|---|
| | Statistic | df | Sig. |
| Experiment | .128 | 25 | .244 |
| Replication | .082 | 25 | .763 |

**Data Homogeneity Test**

A homogeneity analysis is performed to assess if the variations within the data are consistent across groups. The decision criterion for this analysis relies on the p-value: a value below 0.05 implies a significant difference in the variances between two or more groups, while a value above 0.05 suggests that the group variances are equivalent. The findings of this consistency assessment are displayed in Tables 4, 5, and 6.

Table 4. Results of the homogeneity assessment for pre-test data on critical thinking skills.

| | Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|---|
| Based on Mean | 1,322 | 1 | 48 | .256 |
| Based on Median | .592 | 1 | 48 | .445 |
| Based on Median and with adjusted df | .592 | 1 | 37,390 | .446 |
| Based on trimmed Mean | 1,172 | 1 | 48 | .284 |

Table 5. Homogeneity test results of critical thinking ability post-test data

| | Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|---|
| Based on Mean | .987 | 1 | 48 | .326 |
| Based on Median | .940 | 1 | 48 | .337 |
| Based on Median and with adjusted df | .940 | 1 | 47,710 | .337 |
| Based on trimmed Mean | .967 | 1 | 48 | .330 |

Table 6. Results of character data homogeneity test

| | Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|---|
| Based on Mean | 2,214 | 1 | 48 | .141 |
| Based on Median | 2,170 | 1 | 48 | .147 |
| Based on Median and with adjusted df | 2,170 | 1 | 42,221 | .148 |
| Based on trimmed Mean | 2,167 | 1 | 48 | .148 |

**Hypothesis Testing**

The statistical tests applied in this study include independen sample t-test dan paired sample t test. both evaluated using SPSS Statistics 26, were employed with a significance threshold of (2-tailed) >0.05. The outcomes of these analyses are displayed in Tables 7 and 8, illustrating the results derived from the Independent Samples T-test.

**a. Independent Samples T-test**

Table 7. Independent samples t-test of critical thinking ability

| | Levene's Test for Equality of Variances | | t-test for Equality of Means | | |
|---|---|---|---|---|---|
| | F | Sig. | t | df | Sig. (2-tailed) |
| Equal variances Assumed | .987 | .326 | .157 | 48 | .876 |
| Equal variances not assumed | | | .157 | 47,058 | .876 |

Table 8. Independent samples t-test character

| | Levene's Test for Equality of Variances | | t-test for Equality of Means | | |
|---|---|---|---|---|---|
| | F | Sig. | t | df | Sig.(2-tailed) |
| Equal variances Assumed | 2,214 | .143 | .116 | 48 | .908 |
| Equal variances -not-assumed | | | .116 | 43,886 | .908 |

**b. Paired Samples T-test**

A paired-sample t-test was conducted utilizing SPSS Statistics 26 to examine the average differences between two related samples, employing a two-tailed significance level of <0.05. When Sig. (2-tailed) < 0.05, the null hypothesis (H0) is dismissed, while the alternative hypothesis (H1) is upheld, indicating that the Contextual Teaching and Learning (CTL) Model consistently impacts

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both the experimental and replication classes. The findings of this analysis are summarized in Table 9, showcasing the outcomes derived from the paired-sample t-test.

Table 9. Paired samples t-test

| Class | 95% Confidence Interval of the Difference | | | |
|---|---|---|---|---|
| | mean | N | df | Sig. (2-tailed) |
| Experiment | -46,720 | 11,025 | 24 | .000 |
| Replication | -46,600 | 13.185 | 24 | .000 |

### Gain Normality Test (N-Gain)

The N-gain value, also referred to as the normalized improvement, serves as a tool for evaluating the success of a particular approach or intervention in a study. The outcomes of the N-gain assessment are displayed in Table 10.

Table 10. N-gain score

| No | N-Gain Score (%) | |
|---|---|---|
| | Eksperiment Class | Replication Class |
| 1 | 72.13 | 76.54 |
| 2 | 79.49 | 69.88 |
| 3 | 69.44 | 58.21 |
| 4 | 63.77 | 75.00 |
| 5 | 79.25 | 70.93 |
| 6 | 78.21 | 66.00 |
| 7 | 60.94 | 80.95 |
| 8 | 73.81 | 91.67 |
| 9 | 59.57 | 85.33 |
| 10 | 62.69 | 62.07 |
| 11 | 62.67 | 85.33 |
| 12 | 68.12 | 87.23 |
| 13 | 88.06 | 79.49 |
| 14 | 86.36 | 63.93 |
| 15 | 95.83 | 72.46 |
| 16 | 73.61 | 64.10 |
| 17 | 71.79 | 73.44 |
| 18 | 60.94 | 66.07 |
| 19 | 91.67 | 72.84 |
| 20 | 72.84 | 76.39 |
| 21 | 88.00 | 83.33 |
| 22 | 75.00 | 78.13 |
| 23 | 82.72 | 67.95 |
| 24 | 86.21 | 64.15 |
| 25 | 79.10 | 85.33 |
| **Average** | **75,2882** | **74,2707** |
| **Min. Value** | **59,57** | **58,21** |
| **Maxx Value** | **95.83** | **91,67** |

### 3.2. Discussion

This research aims to investigate the impact of the CTL approach on learners' outcomes cognitive development and critical thinking abilities approach on students' critical thinking abilities and character at SMA Negeri 3 Gorontalo Utara, specifically in relation to the topic of reaction rates. To achieve this, the experimental class was taught using the CTL model. A replicated class, mirroring the experimental class, was also created to assess the consistency and effectiveness of the CTL model in enhancing students' critical thinking skills and character development.

The research commenced by gathering data through school observations, which revealed that the two classes involved in the study shared similar abilities, utilized identical teaching materials, and underwent the same learning processes (homogeneous). Throughout the research, both the experimental group and the replication group participated in three teaching and learning sessions. Prior to studying the reaction rate topic in these classes, an initial evaluation was conducted to gauge the students' proficiency initial abilities and gauge their critical thinking skills regarding the reaction rate material. Examination of the pre-test The findings suggested that the average scores for the experimental class (37.56) and the replication class (37.33) were nearly identical. These findings suggest that students' critical thinking skills were still significantly underdeveloped. Additionally, both classes demonstrated a normal and homogeneous distribution, supported by the normality test results (Shapiro-Wilk method) showing significance values > 0.05 and the homogeneity test results (Levene Statistical method) also yielding significance values > 0.05. This indicates acceptance of the null hypothesis (H0), confirming that the two classes were homogeneous and exhibited no significant differences.

Following the administration of the pre-test, the next step involved delivering instruction (providing material) to both the experimental and replication classes, both utilizing the CTL model. Once the learning process concluded, the final session included post-tests and character questionnaires for both classes. The post-tests were conducted to evaluate the mastery of the material taught and to measure the impact of the applied learning media. Statistical data analysis revealed that the students' critical thinking scores were 84.22 for the experimental group, the mean score was 83.89, closely mirroring the replication group's average of 83.56. With a marginal gap of just 0.33, it can be inferred that the outcomes of the experimental group are highly consistent with those of the replication group.

The findings indicate that the application of the CTL model has a significant impact in improving students' critical thinking skills and provides consistent results between the experimental and replication classes. The use of CTL that integrates real-life contexts with learning allows students to engage more deeply in the learning process, encouraging them to think critically and develop positive character traits.

According to the hypothesis assessment conducted through a paired sample t-test within a 95% confidence interval for the difference, the analysis revealed a significant level of 0.000 is less than 0.05, signifying the rejection of the null hypothesis (Ho) and the acceptance of the alternative hypothesis (Ha). The effectiveness and consistency of the CTL model were further demonstrated in replication classes (experimental class repetitions) employing the unpaired t-test alongside the N-gain score assessment. For critical thinking skills and character values, The analysis using the unpaired sample t-test revealed a noteworthy difference values of 0.876 > 0.05 and 0.908 > 0.05, respectively. Meanwhile, The test for the N-gain index in evaluating the experimental and replication classes produced average percentages of 75.29% and 74.27%, respectively, categorized as moderate or fairly effective.

These findings confirm that the CTL model significantly impacts students' critical thinking skills and character development in the reaction rate material. This effectiveness stems from the ability of the CTL approach to integrate learning activities with real-life contexts, enhancing students' engagement and understanding. The CTL model encourages students to actively participate in learning through steps such as inquiry, questioning, and reflecting. The inquiry step invites students to search for answers and solve problems independently, which develops their critical thinking skills. The questioning stage involves students in asking questions and providing creative responses, thus improving their analytical and critical thinking skills. In addition, through reflection, students can evaluate and analyze their learning process, which strengthens critical thinking skills. At the same time, CTL pays attention to character development through collaborative activities and group problem solving, which fosters responsibility, discipline, creativity, and good communication among students. These results align with previous research, such as Nurnadia, (2021) which investigated the influence of CTL on Students' analytical reasoning abilities and comprehension mastery. The study reported average post-test scores of 81.03 for critical thinking and 79.83 for concept mastery. The N-gain analysis yielded scores of 0.64 for critical thinking and 0.50 for concept mastery. The t-test outcomes revealed a p-value of 0.000, which is lower than the 0.05 threshold, indicating statistical significance, supporting the conclusion that the CTL model positively impacts students' critical thinking and concept mastery in MTs Laboratorium Jambi City.

**Students' Critical Thinking Ability**

According to the data evaluation, the mean critical thinking skills of both the experimental and control groups yielded strikingly similar outcomes, as reflected in the 12 questions across the 5 analyzed indicators, namely: (1) Providing simple explanations; (2) Developing basic skills; (3) Drawing conclusions; (4) Offering further explanations; and (5) Creating strategies and tactics.

For the "providing simple explanations" indicator (questions 1, 2, and 3), the experimental class showed a mean score of 44% in the moderate range and 90% in the exceptionally high range for the and post-test, respectively. The replication class, on the other hand, recorded 49% in the medium range, with 88% categorized as very high on average. This indicates that students are capable of answering questions effectively, analyzing arguments, and understanding the reasoning behind specific problems.

These findings align with (Facione, 2015) research, which emphasizes that the ability to provide clear explanations is a vital aspect of critical thinking, as it requires students to present their ideas in a logical and organized manner. Active participation in CTL-based learning enables students to practice explaining concepts in a comprehensible way. The comparison of average pre-test and post-test scores for this indicator highlights a notable improvement in students' critical thinking skills in both classes, particularly in providing simple explanations.

The indicators for enhancing fundamental skills in points 4 and 5, evaluated through the pre-test and post-test in the experimental class, Unveil an overall proportion of 31% in the lower range and 80% in the higher range. In the replication class, the average percentages are 34% in the low range and 79% in the high range. Regarding this skill development indicator, students show the ability

to provide responses and explain their reasoning for questions or statements related to a specific issue by citing credible sources. This aligns with (Ennis, 1995) research, which emphasizes that critical thinking skills involve assessing information and distinguishing between valid and invalid arguments. Contextual learning facilitates students' understanding of how to connect information with credible sources, thereby enhancing their argumentation skills. Based on the average pre-test and post-test percentages for this indicator, Clearly the post-test results surpass the pre-test scores in both classes, signaling a notable enhancement in students' critical thinking abilities inbuilding basic skills.

The average percentages for indicators 6, 7, and 8 in both the pre-test and post-test of the experimental class were 39% in the low range and 84% in the very high range, in the replicated clas, the average The proportions stood at 38% for the lower range and 84% for the exceedingly high range. These indicators involve solving problems to enable students to make generalizations. This aligns with the findings of (Paul & Elder, 2019) who emphasize that the ability to draw conclusions is a critical component of critical thinking, requiring students to derive logical conclusions from available evidence. The interactive learning approach in CTL facilitates students in improving their concluding skills. The comparison of pre-test and post-test averages for this indicator reveals that the post-test scores surpass the pre-test scores in both classes, indicating an improvement in students' critical thinking abilities related to concluding.

The indicators provide additional clarification for points 9 and 10. In the experimental group, the mean percentages for the pre-test and post-test are 19% in the low range and 79% in the high range. On the other hand, the replication group displays averages of 19% in the low range and 81% in the exceptionally high range. This indicator, which involves providing further explanations, indicates that students can identify assumptions and build arguments necessary to support a statement on the given problem. This aligns with (Lipmam, 2018) perspective, which stresses the importance of considering assumptions in critical thinking, as unexamined assumptions can undermine the quality of the arguments formed. Context-based learning offers students the chance to practice creating further explanations in a structured manner. The post-test results for this indicator are higher than the pre-test scores in both classes, suggesting An enhancement in students' analytical reasoning abilities related to providing further explanations.

The indicators for managing strategy and tactics in the experimental group, according to the initial and final assessments for numbers 11 and 12, Show a mean proportion of 50% within the moderate range and 84% in the exceptionally high bracket. In the replication class, the respective averages are 41% in the medium category and 85% in the very high category. For managing strategies and tactics, students are able to choose a course of action and determine solutions to the questions posed. This aligns with (Halpern, 2019) view that the ability to organize strategies is a key aspect of critical thinking, where individuals must be able to plan based on situational analysis. The CTL model promotes strategic thinking in students when faced with challenges, thereby improving these skills. Given the average percentage improvement from pre-test to post-test for this indicator, it is evident that post-test scores surpassed pre-test scores in both classes, indicating an increase in students' critical thinking skills in managing strategies and tactics.

**Student Character**

The analysis of student character was based on five aspects: responsibility, discipline, creativity, curiosity, and friendliness/communication. These were assessed through 25 statements, reflecting the average character values for each aspect in both the experimental and replication classes. The CTL (Contextual Teaching and Learning) learning model has steps that can effectively improve student character. The constructivism step provides opportunities for students to build their own understanding, thus increasing their sense of responsibility in completing learning tasks. The inquiry stage encourages students to discover concepts independently, which fosters a disciplined attitude in the exploration process. In the questioning step, students are trained to ask questions and provide creative responses, improving critical thinking skills and curiosity. Through the formation of learning communities, students are accustomed to working together and communicating with peers, which strengthens the character of friendliness/communicative. The modeling step provides concrete examples in the learning process, while reflection helps students evaluate their learning process independently, fostering an attitude of responsibility and

discipline. Authentic assessment provides a fairer process-based evaluation and encourages students to show positive character in every stage of learning. In terms of responsibility, both classes achieved a score of 83%, which is classified as very good. Regarding discipline, the experimental class scored 81% and the replication class 80%, both falling into the very good category. For creativity, the experimental class earned 77% while the replication class scored 76%, both placed in the good category. As for curiosity, the experimental class scored 77%, and the replication class scored 78%, both within the good category. Lastly, for friendliness/communication, both classes scored 82%, categorized as very good. Overall, the average character scores in both classes were nearly identical, indicating that the CTL learning model produced consistent results, demonstrating its effectiveness in positively influencing student character in the reaction rate material. These results are in line with research by (Siagian et al., 2024) which found that the application of CTL learning models can significantly improve students' responsibility and discipline characters. In addition, (Meilinda & Utaminingsih, 2024) research showed that the CTL method had a positive effect in shaping students' friendly and creative characters.

## 4. CONCLUSION

The findings of the study demonstrated that the Contextual Teaching and Learning (CTL) model significantly enhanced students' critical thinking abilities in reaction rate topics. Analysis revealed a steady improvement within both the experimental and replication groups, with mean critical thinking scores of 84.22 and 83.89, respectively. Furthermore, the adoption of the CTL approach positively impacted the development of student character, as reflected in the closely aligned average scores of 80.13 for the experimental group and 79.90 for the replication group.

However, this study has some limitations. this investigation has certain constraints. It was exclusively carried out among 11th-grade students at SMA Negeri 3 Gorontalo Utara and focused solely on the Reaction Rate topic. In addition, the character aspects measured are still general so that they do not describe the specific characters that can be improved through the CTL model.

For future research, It is suggested that the CTL approach be implemented in various other chemistry materials to test the generalization of its effectiveness in different subjects. In addition, the measurement of student character should be done more specifically to understand the impact of CTL models on the development of certain values, such as cooperation, responsibility, or independence.

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