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Improving Chemistry Learning Outcomes for Grade X Hydrocarbon Material Using the Method Student Teams Achievement Division (STAD)

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ABSTRACT

The learning achievement level of class XD students at SMAN 1 Kurau in chemistry is still relatively low, as indicated by the low number of students who successfully achieved the completion criteria, which was only 25.93%. Active student participation during the learning process is also still minimal. The purpose of this study was to determine the effectiveness of the application of the method. Student Teams Achievement Division (STAD) in improving student learning outcomes to achieve the classical mastery target of 85%. This study uses a classroom action research approach conducted in class XD SMAN 1 Kurau, and is divided into two cycles. Each cycle includes the stages of planning, action implementation, observation, and reflection. Data collection techniques include tests, observations, and documentation, while data analysis is carried out quantitatively. From the results of the study, it can be concluded that the implementation of the STAD method has been proven to be able to improve students' chemistry learning outcomes in the class to reach the classical mastery standard of 85%.

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INTRODUCTION

Chemistry instruction at the secondary level plays a crucial role in equipping students to understand basic chemical concepts, including hydrocarbons. Hydrocarbons are a challenging topic for students, involving many abstract concepts and complex molecular structures. Many students struggle to grasp this subject, resulting in suboptimal learning outcomes. Chemistry material consists of simple to complex ideas. One such complex material is hydrocarbons, which includes the naming of compounds, isomers, properties, and reactions that occur in hydrocarbon compounds. Based on the results of the daily hydrocarbon material test in the odd semester of 2023/2024, 60% of students' scores were still below the learning success standard of 73. The teacher stated that this occurred because students' interes rningterests resulted in them being less active during the lesson (Novalentia, D., et al. 2025).

To improve students' understanding of hydrocarbons, a more interactive and innovative learning approach is needed. Research reveals that students' conceptual understanding of chemistry shows varying skill levels. Students achieved a relatively good percentage in determining the molecular formula and structure of hydrocarbon compounds. Meanwhile, regarding the differentiation of reaction types and physical regularities, the results obtained were still in the adequate category. The ability to determine the isomers of hydrocarbon compounds still needs improvement because it is in the poor category. The use of engaging learning media and discussion or experimental methods can help increase student interest in learning (Malajai, M.M., et al. 2025).

Current learning methods are often conventional, such as lectures and individual practice exercises, which are less effective in motivating and engaging students in the learning process. As a result, student learning outcomes remain below the established success indicator standards. According to Fernando et al. (2024), learning motivation is crucial for improving student learning outcomes. The higher a student's motivation, the greater their effort, which in turn improves their learning achievement. Teachers need to strive to foster student motivation, as it is key to achieving learning objectives.

Furthermore, creating a conducive learning environment plays a crucial role in increasing student motivation. Using a variety of learning methods, such as project-based learning or group discussions, can encourage active student engagement. With the right approach, teachers can help students find meaning in each lesson, thereby increasing their motivation to achieve optimal results. Most students, approximately 80%, correctly understood how to name alkane compounds based on IUPAC regulations. However, they still struggled to organize the naming process systematically. Meanwhile, 20% of students still faced challenges in determining the lowest-numbered end of the parent alkane chain, leading to errors in naming the compounds (Purwanto, K.K. 2021).

The learning process becomes more effective with the use of learning media, which not only increases student motivation but also helps them remember the material they have learned and encourages active involvement in providing feedback (Saptiani, H., et al. 2022). Over time, innovative and enjoyable learning approaches have been developed, including the Student Teams Achievement Divisions (STAD) method. The STAD method is a form of cooperative learning that can increase interaction between students, deepen conceptual understanding, and increase student learning motivation.

According to Syahru Ramadhani, E. N. (2023), the STAD cooperative learning method has been proven to increase student participation in learning. The STAD method also helps students develop social skills and foster a sense of responsibility for their learning. The use of the STAD cooperative method in social studies learning has been shown to significantly improve student learning outcomes, achieving a completion rate of 93.93% in the second cycle, which exceeds the target of 85%. This demonstrates that the STAD method is effective in increasing student activity and learning outcomes (Junistira, D.D. 2022).

This research was motivated by the desire to improve student learning outcomes in hydrocarbons by applying the STAD method. The application of this method is expected to increase student engagement, conceptual understanding, and learning outcomes in grade 10 students at SMAN 1 KURAU. This research is likely to contribute to developing learning methods that enhance the quality of chemistry education, particularly in hydrocarbons.

METHODS

This study employs a collaborative and evaluative quantitative approach, which is the research construct within the paradigm aimed at determining the impact of STAD implementation on student learning outcomes. The quantitative approach was chosen because the main focus of this study is to measure changes in numerical learning outcomes due to the implementation of STAD on hydrocarbons in Class X of SMAN 1 Kurau, according to Ummah, A. M., dkk. (2023), The STAD learning model is known as a cooperative learning strategy that is implemented by dividing students into small groups that have different levels of learning ability, so that they can achieve common learning goals.

This collaborative approach facilitates effective interactions between students and teachers, ensuring that teaching and learning align with the needs and characteristics of learners. Furthermore, this study is evaluative in nature because it aims to evaluate the effectiveness of STAD implementation on student learning outcomes, enabling students to continuously improve. Research shows that implementing the STAD cooperative learning model can improve student learning outcomes, as evidenced by data indicating an increase in achievement (Rahmawati, et al. 2023).

The study was conducted at SMA Negeri 1 Kurau in April-May, with 27 students in class XD, semester II, 2024/2025, in one class. The focus of the study was the object of study or the focus of attention (Arikunto, 2002:99). In this study, data were collected using various techniques and instruments designed to provide a comprehensive picture of improvements in student learning outcomes and the ongoing learning process. The main technique used was a learning outcome test. To measure the success of the learning process, a learning outcome test was used, including descriptive questions. This test was administered before the learning process (pretest) and after the action cycle (posttest) as the main reference for determining improvements in student learning outcomes related to hydrocarbon material. This test instrument was compiled based on predetermined success indicators and tested for validity and reliability to ensure its accuracy in measuring student competency.

In the research, learning tools were developed, including lesson plans transformed into action research (PTK), teaching materials, learning media preparation, assignment materials, question outlines, and evaluation tools. All of these steps were designed to support an effective teaching and learning process. The cycle in this research includes a number of stages, namely:

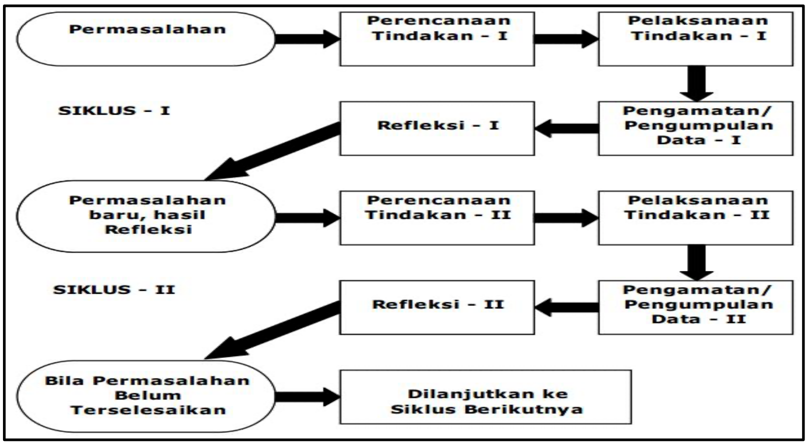

Figure 1. Main stages of classroom action research program

Figure 1 shows that the classroom action research program includes four main stages: planning, implementation, observation, and reflection. In the planning stage, problems are identified, and actions are designed. These actions are then implemented in the field. Following this, observations are conducted to collect data on the results of the actions. Finally, reflection is undertaken to assess success and determine next steps. This cycle is repeated until the problem is resolved and the objectives are achieved. The learning model is a form of learning activity that is systematically designed from beginning to end and delivered with its own characteristics by the teacher in the classroom (Aseany, L.K.A. 2021).

This classroom action research was implemented in two cycles. The number of cycles is based on the criteria outlined by Suyitno (2005: 3), who states that CAR should ideally be conducted in at least two cycles. Each cycle includes the stages of planning, action implementation, observation, and reflection. The learning plan in the first cycle was developed based on identifying emerging problems, both those originating from the teacher's teaching methods and the students' learning conditions. Meanwhile, the action plan for the second cycle was developed based on reflections on student learning outcomes from cycle I.

Data from observations of student activities were analyzed using a qualitative descriptive approach, presented in narrative form. This description aims to provide a detailed explanation of the observations of teacher and student activities during the learning process in each cycle. Meanwhile, the analysis of student learning outcomes was conducted quantitatively, covering the first cycle to the second cycle. The analysis methods used included calculating average scores and achievement percentages.

Table 1. Criteria for assessing student learning outcomes

Score Range	Completion Criteria
≥70	Achieved
<70	Not Achieved

Table 1 shows the assessment criteria based on the score range. If someone gets a score of 70 or more, they are categorized as Completed. On the other hand, if the score is less than 70, it is considered Not Completed. The scores obtained by students from the written learning outcome test are then analyzed using the formula:

1. Classical Learning Completion

$$\boxed{a = \frac{b}{c}\ x\ 100\%} \tag{1}$$

Information:
a = Completion
b = Total Students Completed
c = Total number of students

2. Average value

$$\boxed{X = \frac{\sum Y}{n}} \tag{2}$$

Information :
X = Average Value
∑Y= Total Score of All Students
n = Total of All Students

The benchmark for the success of this research is if a minimum of 85% of students in one class achieve a score of ≥ 70, which indicates the achievement of learning completion in the hydrocarbon material (alkanes and alkenes), and the level of student involvement during the learning process reaches a minimum of 80%.

RESULT AND DISCUSSION

Before conducting classroom action research, the researcher first collected baseline data to compare conditions before and after the action. This baseline data was obtained from the results of students' formative assessments. Details of the formative assessments at the initial stage are shown in Table 2.

Table 2. Results of the initial formative test

Score	Number of Students	Total Score	Percentage (%)	Remarks
70	7	490	25.93	Achieved
60	5	300	18.52	Not Achieved
50	11	550	40.74	Not Achieved
40	4	160	14.81	Not Achieved

Table 2 shows participant score data. A total of 27 students participated in the evaluation with varying scores. Most students (40.74%) did not complete the assessment because their scores were below 70, while only a small number (25.93%) completed the assessment and achieved a score of 70 or above. The average score for participants was 55.56, with the highest score being 70 and the lowest being 40.

According to Hopkins in Zuriah (2003:88), classroom action research (PTK) is defined as an activity conducted by teachers to improve the quality of their teaching or that of their colleagues. From the table, the data obtained is that there are seven students or 25.93% of students who are considered to have completed (scored 70) with an average score of 55.56, the highest score is 70 and the lowest score is 40 and there are 20 students or 74.07% of students who have not completed.

Before conducting classroom action research, a researcher first observes the class to identify or understand the problems teachers face related to student learning outcomes and the teaching and learning process. After identifying the issues that arise, the researcher can plan an action to be taken in the research. This includes compiling learning tools in the form of a lesson plan set up as a CAR, providing teaching materials, preparing learning media, assigning materials for students, creating question grids for evaluation, and compiling evaluation tools.

The details of the implementation of this classroom action research are as follows:

Cycle I

Planning: The activities carried out by the researcher at this planning stage include documenting student conditions, such as the number of students in the class and the daily chemistry test scores of class XD students in semester 2. Identification of problems that arise based on the results of the researcher's initial observations of the conditions of students and teachers. Action planning involves collaboration between teachers and researchers, specifically in developing learning models by integrating the STAD learning model. Researchers prepare a research activity schedule. Researchers divide students into several groups with different achievement levels, assisted by teachers. Researchers prepare student activity sheets, observation sheets, questionnaires, learning plans and end-of-cycle evaluation tools.

Action Implementation: Learning implementation actions are done in 1 meeting**.** Implementing learning by explaining the alkane material and continuing with providing practice questions to be discussed in groups. The researcher circulated to each group to check and assist students if they encountered difficulties in completing the practice questions. The researcher randomly appointed one group to present their group's answers in front of the class. The researcher, along with other groups, evaluated the answers to the practice questions they worked on. During this activity, the researcher provided opportunities for students or other groups to play an active role in the learning process, such as asking questions, providing responses, or expressing their opinions. At the end of the learning session, the researcher assigned homework, which will be discussed at the next meeting. At the end of cycle I, a 45-minute test was conducted on April 28, 2025, followed by filling out the cycle I learning reflection questionnaire.

Reflection: The data obtained in cycle I was collected for further analysis, and a reflection was conducted on the study results to determine whether there was an increase in learning outcomes after the action.

Cycle II

Planning: The action planning stage in cycle II is carried out based on the results of the reflection on actions in cycle I. Action planning in cycle II results from improvements made by implementing actions from cycle I. The planning activities carried out in cycle II are the preparation of learning plans (RP) and student worksheets.

Implementation of Actions: The learning activities in cycle II were almost the same as those in cycle I. In cycle II, the researcher provided an explanation of the material on alkenes, which are unsaturated hydrocarbon compounds. The researcher gave students exercises and homework to discuss in the next meeting. At the end of cycle II, a final test was conducted with a time limit of 45 minutes.

Reflection: The activities carried out at this stage are exactly the same as the activities in cycle I. The data obtained in the observation stage of cycle II are collected for later analysis.

Based on initial observations that revealed several problems, it was decided to implement the STAD method in teaching Alkanes. The actions in Cycle I were carried out in a single meeting session starting on April 28, 2025, with the implementation of teaching and learning activities referring to the previously designed lesson plan (RPP). During the learning process, students were given various practice questions to be completed independently or in groups. During the activity, the researcher and students were monitored by the collaborating teacher and fellow researchers who acted as observers. At the end of Cycle I, an evaluation test was conducted to assess student learning achievement. Details of the test results in Cycle I can be found in Table 3.

Table 3 shows data on student achievement. The lowest score was 40, and the highest was 80. The average class score was 60.37. Eleven students had not yet achieved mastery, while 16 had. The learning completion percentage in this class was 40.74%.

Table 3. Student learning outcome data for cycle I

No	Information	Revenue
1	Lowest value	40
2	Highest value	80
3	Class average grade	60,37
4	Total number of students who have not completed	11
5	Total students who completed	16
6	Learning completion percentage	40,74 %

In cycle II, the researcher reapplied the learning model used in cycle I, incorporating several adjustments based on previous reflections, with a focus on the Alkenes material. Learning activities were conducted once on May 8, 2025, following the previously prepared lesson plan. In general, the implementation method was similar to cycle I, but the researcher placed greater emphasis on the intensity of practice questions. During the learning activities, the activities of students and researchers were continuously observed by collaborating teachers and observers. At the end of cycle II, an evaluation test was again conducted to determine improvements in student learning outcomes. A complete summary of the test results can be seen in Appendix 13 and summarized in Table 12.

Table 4. Student learning outcome data for cycle II

No.	Information	Revenue
1	Lowest value	60
2	Highest value	80
3	Class average grade	72,22
4	Total number of students who have not achieved	3
5	Total students who completed	24
6	Learning completion percentage	88,89 %

Table 4 showed that the highest student score was 80 and the lowest was 60. The average class score was 72.22. Three students had not yet completed the course, while 24 students had completed it. The learning completion percentage in this class was 88.89%, indicating a fairly good level of success. From the table data, it can be seen that the average value of students in cycle II is 72.22 with a completion percentage of 88.89%.

Based on the data obtained in Cycle II, the quality of the learning process has improved compared to the previous cycle. This indicates that the right approach can have a positive impact not only on learning outcomes but also on overall classroom interactions and dynamics. This achievement is expected to serve as a foundation for learning in the next cycle or in other classes. The improvement in student learning outcomes at this stage is detailed in Table 5.

Table 5. Data on the increase in learning outcomes

No.	Cycle	Average value	Learning completion
1	Pre-cycle	55,56	25,93%
2	I	60,37	40,74%
3	II	72,22	88,89%

Table 5 shows the development of the average score and learning completion rate for each cycle. In the pre-cycle, the average score was 55.56, with learning completion only 25.93%. After the first cycle, the score increased to 60.37, with a completion rate of 40.74%. In the second cycle, the average score increased again to 72.22, with completion rate reaching 88.89%.

This classroom action research was conducted on hydrocarbons, specifically alkanes and alkenes, and was divided into two learning cycles. Cycle I had one meeting (45 minutes). In the implementation of Cycle I, the researcher attempted to create interactive learning experiences, both among students and between students and the teacher, to ensure the learning process was not one-way. To support this, students were given practice questions that had to be completed individually or in groups. According to Suparsawan (2021), the success of this learning is closely linked to the implementation of the STAD type of cooperative learning model, where students are directed to learn in small groups of four people.

Group discussions are intended to encourage collaboration among members in solving the assigned problems. If there are difficulties in understanding the problem, students are encouraged to help each other in the group. However, if all group members cannot find a solution, they can ask the teacher questions directly. Based on the final evaluation in cycle I, it was recorded that 40.74% of students had completed their learning. This figure indicates progress compared to the initial condition before the implementation of the action, which was 25.93%. This progress indicates an increase in student understanding of the learning material. One factor contributing to this improvement is active student involvement during the activity. With group learning, students can interact and be directly involved with each other, making the information received easier to understand and remember.

This cycle saw an increase in the number of students completing the course by 11, and the average student score rose from 55.56 (the midterm exam result for the even semester) to 60.37 after the cycle test. The teacher's (researcher's) active participation in the learning process also influenced student learning outcomes. However, this achievement fell short of the research target of 85% of students achieving the minimum completion threshold. These suboptimal results were caused by challenges in effective classroom management, as evidenced by students still lacking focus and showing signs of boredom during the learning process.

Another obstacle encountered during the learning process was that the researcher delivered the material too quickly, making it difficult for many students to understand the content. Therefore, adjustments and improvements to the learning strategy were necessary in the next cycle. It was hoped that with the improvements to the teaching and learning process in Cycle II, the classroom atmosphere would become more engaging and enjoyable, allowing students to be more active and optimally engaged during the learning process.

Cycle II was conducted in one 45-minute meeting on May 8, 2025, with discussion materials covering general formulas, the naming of alkene compounds, isomers, and their chemical properties. The learning process in this cycle was generally similar to the previous cycle but had undergone improvements based on the evaluation results from cycle I. In the implementation of cycle II, the average student score showed a significant increase, rising from the initial mid-semester score of 55.56 to 60.37 in cycle I, and then to 72.22 in cycle II, as depicted in Figure 2.

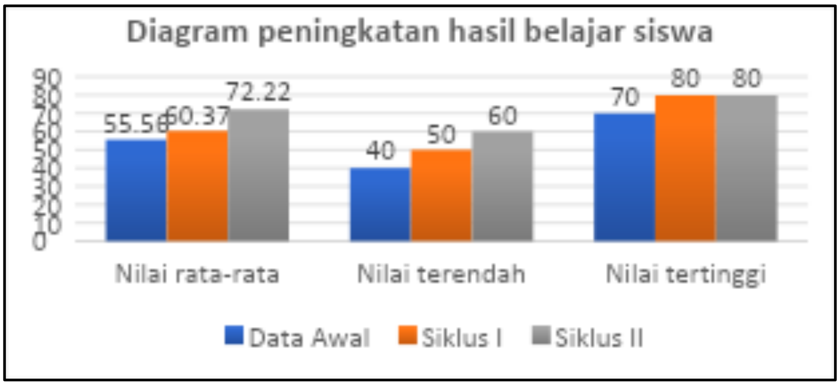

Figure 2. Diagram of increase in student learning outcomes

Figure 2 shows an increase in student learning outcomes from the beginning, after cycle I, and cycle II. In the average value, there was an increase from 55.56 to 60.37, then to 72.22. At the lowest value, it increased from 40 to 50, then to 60. For the highest value, it remained at 80. The increase was also evident in the number of students completing the learning, rising from 25.93% in cycle I to 88.89% in cycle II. This indicates that a more structured approach and involving active student participation provides more optimal results. The increase not only reflects a quantitative growth but also enhances the quality of the learning process in the classroom. and can be seen in figure 3.

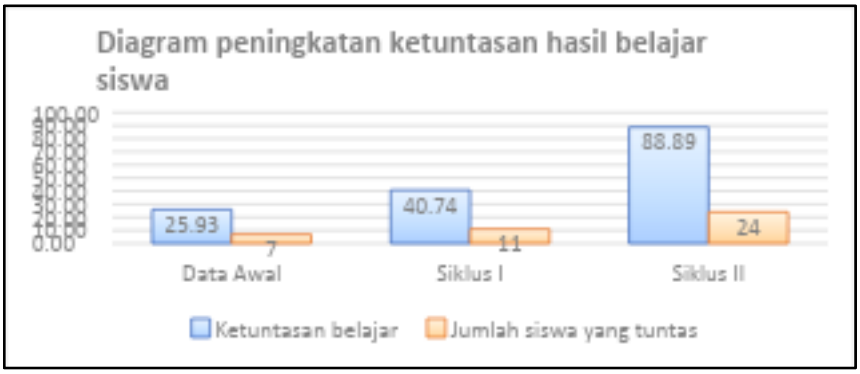

Figure 3. Diagram of improvement in student learning outcomes

Figure 3 shows an increase in the level of student learning completion from the beginning, after cycle I, and after cycle II. Learning completion increased from 25.93% in the initial data to 40.74% after cycle I and reached 88.89% after cycle II. Meanwhile, the number of students who completed the study increased from 7 to 11, and finally to 24. The STAD learning method is similar to the group work approach. However, the main difference lies in its focus: encouraging students to interact more actively and practice solving problems frequently. Through this method, students are not only involved in group discussions but also assigned tasks to work on problems both individually and collaboratively, thus prioritizing their active involvement throughout the learning process.

This is in line with the opinion of Sekarini, N. N. (2022), There was an increase in student learning outcomes between cycles I and II. The average student absorption capacity increased by 6%, while learning completeness increased by 25%. Therefore, the researcher concluded that applying the cooperative learning model, specifically the *Student Teams Achievement Division* (STAD), can positively contribute to improving students' Civics (PKn) learning outcomes. These findings suggest that learning strategies involving collaboration among students have the potential to strengthen their understanding and engagement in the learning process.

From the analysis and discussion, it can be concluded that implementing the STAD method successfully increased students' active participation in the learning process. According to research conducted by Suardiana, I.M. (2021), the implementation of the cooperative learning model, *Student Teams Achievement Division* (STAD), positively impacted the mathematics learning outcomes of fourth-grade students at SD Negeri 2 Telaga in the second semester of the 2018/2019 academic year. Researchers stated that using this model contributed to improving students' understanding of the subject through more structured and collaborative learning. This increased engagement had a positive impact on students' knowledge of the material and learning outcomes. This occurred because students were directly involved in every learning activity and were accustomed to working on the provided practice questions. When facing difficulties, they did not hesitate to discuss with their group mates or ask for help from the teacher.

CONCLUSION

Based on the results of the research analysis that have been described previously, it is concluded that the application of the method *Student Teams Achievement Division* (STAD) can improve the learning achievement of class XD students at SMA Negeri 1 Kurau. Researchers reported that the classical learning achievement of students reached 88.89% with a class average score of 72.22. In addition, it was also stated that the STAD method encourages students to participate more actively in the learning process through teamwork, thus creating a more enjoyable and interactive learning atmosphere. This indicates that a cooperative approach such as STAD, can have a positive impact on students' overall academic achievement.

Based on the research findings obtained, the researcher provides several suggestions for researchers or educational practitioners who wish to apply the method. In the *Student Teams Achievement Division* (STAD), it is recommended that students possess good time management skills to prevent classroom settings from disrupting the expected learning duration. During the teaching and learning process, teachers are also encouraged to use a variety of engaging learning methods to create a dynamic classroom atmosphere and maintain student concentration. Furthermore, regular practice exercises are recommended to encourage students to think actively and avoid wasting time on discussions that do not focus on the subject matter.

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