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Implementation of the Team Assisted Individualization (TAI) Cooperative Learning Model to Improve Student Learning Outcomes on Hydrocarbon Topics in Grade XI at State Senior High School

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ABSTRACT

This study aims to examine the effectiveness of the Team-Assisted Individualization (TAI) cooperative learning model in improving the learning outcomes of Grade XI students on hydrocarbon material at State Senior High School 2 Dumai. The research employed a randomized control group pretest-posttest design, involving two groups selected randomly, an experimental group that applied the TAI model and a control group that used discussion-based learning. A test on hydrocarbon concepts was administered to both groups before and after the treatment to measure student performance. The data were analyzed using a t-test at a 0,05-significance level. The results showed that the calculated t-value of 5,24023 exceeded the t-table value of 1,6664, indicating a significant difference in learning outcomes between the two groups. These findings suggest that the cooperative learning type of the Team Assisted Individualization is more effective in enhancing the learning outcomes of students compared to the discussion method previously used in the class.

Keyword: Cooperative model, hydrocarbons, learning outcomes, team assisted individualization.

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INTRODUCTION

Learning is a complex process in which teachers are required not only to deliver material but also to create an efficient, integrated, and enjoyable learning environment. Teachers play a key role in developing students' potential and improving learning quality and outcomes. In the field of chemistry, teachers face specific challenges. Chemistry, as a science subject, is often perceived as difficult due to its abstract, complex nature and interconnected concepts. This perception leads many students to feel less interested and struggle with understanding the material, which in turn results in low cognitive learning outcomes (Arpina, 2020).

Hydrocarbons are closely related to everyday life and serve as a basis for learning more advanced chemical concepts

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(Romadhona, 2020). When studying hydrocarbons, students are expected to understand chemical concepts related to molecular structure, chemical properties, and reactions (Asni, 2020). This understanding is part of cognitive learning outcomes, encompassing knowledge, comprehension, and critical and analytical thinking skills in chemistry. To achieve optimal cognitive learning outcomes and foster a learning environment that emphasizes concept formation, an interactive, inspirational, and engaging model is required (Fatma, 2020).

Interviews with chemistry teachers at State Senior High School 2 Dumai revealed that student achievement in the hydrocarbon topic remains below the Minimum Competency Threshold set by the school, which is 75. Data show that approximately 65% of students scored below this threshold. This situation is affected by multiple factors, such as the abstract and complicated characteristics of the subject matter, along with the students' limited active participation during the learning activities. In practice, the instruction is carried out using a group discussion method commonly applied in schools. While this method provides opportunities for students to exchange opinions, it has not been fully effective in reaching all students equally. Those who grasp the material more quickly tend to dominate the discussions, while those struggling to understand the content often lack sufficient opportunities to develop their understanding optimally.

The varying levels of comprehension among students necessitate a more flexible and responsive learning model. Teachers need to adopt models that not only promote collaboration but also provide each student with the opportunity to develop their understanding independently. One model considered suitable for this purpose is the team assisted individualization (TAI) cooperative learning model. This model integrates individual learning with structured group work. Students begin by studying the material independently, followed by group discussions in heterogeneous teams to help and collaborate on tasks. Afterward, students complete individual assessments, which are then used for group evaluation. These characteristics make the team assisted individualization model one that emphasizes peer tutoring, active participation, and concept reinforcement.

The advantage of the team assisted individualization model lies in its ability to accommodate differences in student ability, foster cooperation, and enhance understanding through direct interaction. Compared to other cooperative learning models that generally focus on group work, this model is specifically designed to support students with learning difficulties (Siwi, 2019). The group-based assessment system also motivates students to support one another. In practice, students with stronger comprehension actively explain the material to peers who are struggling, which in turn deepens their own conceptual understanding. Meanwhile, students in need of assistance gain the opportunity to ask questions and gradually build their understanding.

Previous studies have shown that the team assisted individualization model positively impacts learning outcomes. Asfarina (2021) found that this model improved students' performance in mathematics learning. Research by Laluas (2021) also demonstrated similar effectiveness in chemistry learning. However, the specific application of this model to hydrocarbon material has rarely been explored, warranting further investigation into its effectiveness in this context.

Based on these issues, this study is considered relevant and important. The

hydrocarbon topic requires a learning process that actively involves students, accommodates diverse learning abilities, and supports comprehensive concept reinforcement. The TAI cooperative learning model has the potential to address these challenges. If teachers continue to apply unstructured discussion methods that overlook individual student differences, learning outcomes are likely to remain low and below target expectations. This situation highlights the need for a more systematic and responsive instructional model tailored to individual student needs. Therefore, this study aims to evaluate the effectiveness of the team assisted individualization cooperative learning model in facilitating the improvement of student learning outcomes on the hydrocarbon topic in Grade XI at State Senior High School 2 Dumai.

METHODS

This study employed a quantitative experimental method using a randomized control group pretest-posttest design involving two classes with homogeneous characteristics. The experimental class implemented the team assisted individualization cooperative learning model, while the control class utilized the commonly used classroom discussion approach, which had previously been applied in teaching, had not yet demonstrated success in enhancing students' academic achievement. To evaluate the effectiveness of different instructional strategies, both the experimental and control groups were given identical pretests and posttests to assess their academic performance following the intervention. This research took place at SMA Negeri 2 Dumai, commencing in September 2024. The target population included Grade XI students enrolled in chemistry courses, divided into two groups: one experimental and one control.

Data collection involved administering a pretest prior to the intervention and a posttest afterward. The tools utilized in the study comprised (1) pretest and posttest items to assess students' baseline and final abilities, (2) teaching modules as learning guides, and (3) Student Worksheets (LKPD), which were used throughout the instructional activities.

The analysis of student performance data was performed through several statistical procedures, including tests for data distribution normality, group variance homogeneity, and N-gain analysis to assess the extent of students' academic progress. The N-gain score, derived from the difference between pretest and posttest results, served as the primary data for hypothesis testing. The aim was to determine whether a significant difference existed in student achievement between the experimental group—taught using the cooperative learning model known as Team Assisted Individualization—and the control group, which received instruction through a less effective discussion-based method.

Table 1. Research design

Group	Pretest	Treatment	Postest
Experimental	T_0	X	T_1
Control	T_0		T_1

Description:

$T_{0:}$ Pretest scores of students in the experimental and control classes

$T_{1:}$ Posttest scores of students in the experimental and control classes

X: Learning using the cooperative learning model of the Team Assisted Individualization type

RESULTS AND DISCUSSION

Results

The study was conducted at SMAN 2 Dumai from September 2024 until completion of the hydrocarbon topic in the 11th-grade chemistry class. Two groups were involved in the study: one served as the experimental group and the other as the control group. Both groups were composed of students with comparable academic capabilities, as determined by the mean scores of the preceding subject test. The experimental group was instructed using the cooperative learning strategy known as Team Assisted Individualization (TAI), while the control group used the commonly applied discussion method, which was not yet optimal.

Before the treatment, both classes were administered a pretest to measure their initial ability. After the treatment, a posttest was given to assess the improvement in learning outcomes. The pretest and posttest scores were then used to calculate the N-gain, which served as the basis for analyzing the improvement in students' learning outcomes.

Table 2. Distribution of students' pretest scores

Score range	Number of students (experimental)	Number of students (control)
0 – 20	8	10
21 – 40	15	10
41 – 60	13	11
61 – 80	1	5
Total	**37**	**36**

Table 2 shows the distribution of students' pretest scores before the treatment. Most students in both classes scored within the range of 21–60, with a fairly balanced distribution. This indicates that the initial abilities of both groups were relatively homogeneous.

Table 3. Distribution of students' posttest scores

Score range	Number of students (experimental)	Number of students (control)
60 – 70	0	12
71 – 80	13	17
81 – 90	11	6
91 – 100	13	1
Total	**37**	**36**

Table 3 shows the distribution of students' posttest after the treatment. The majority of students in the experimental group achieved scores in the 91–100 range, while a significant portion of the control group remained in the 60–80 range. This reflects a higher level of improvement in the experimental group.

Table 4. Students' n-gain categories

Score range	Category	Number of students (experimental)	Number of students (control)
0,20 – 0,29	Low	0	3
0,30 – 0,69	Medium	12	26
0,70 – 1,00	High	25	7
Total		**37**	**36**

Table 4 presents the distribution of each student's N-gain scores. The table indicates that the majority of students in the experimental group reached the high category, while the majority of students in the control group were only in the medium category. This suggests that the team assisted individualization learning approach successfully enhances student learning outcomes.

Students' learning outcomes were then analyzed using prerequisite tests, including normality and homogeneity tests, followed by a two-tailed t-test on the N-gain data as the hypothesis test. A summary of the results is as follows:

Table 5. Hypothesis test results

Group	N	$\sum X$	$\bar{X}$	$\sum X^2$	S_g	t_{value}	t_{table}	Conclusion
Experimental	37	0,796	29,48	24,47	0,164	5,24023	1,6664	Hypothesis accepted
Control	36	0,594	21,40	13,66				

From the distribution table above, it suggests that students in the experimental class experienced a greater increase in learning outcomes compared to the control class. This finding is reinforced by the hypothesis test results, in which the obtained t-value (t_{value} = 5,24023) exceeds the critical value (t_{table} = 1,6664), indicating a statistically significant difference in the learning outcome gains between both groups. The cooperative learning model of team assisted individualization has proven to be more effective in enhancing students' learning outcomes on the topic of hydrocarbons.

Discussion

This research was conducted to evaluate how the application of the Team Assisted Individualization cooperative learning model affects student performance in learning hydrocarbons. The improvement in learning outcomes was identified based on the analysis of N-gain scores calculated from the pretest and posttest results of each student. The hypothesis test results using the t-test revealed that the calculated t-value of 5,24023 exceeded the critical t-value of 1,6664 at a 0,05-significance level, indicating that the null hypothesis (H_0) was rejected and the alternative hypothesis (H_a) was accepted. This indicates a notable distinction in learning outcomes between students taught using the TAI model and those engaged in discussion-based learning. Therefore, implementing the cooperative learning model through team assisted individualization has been proven effective in enhancing students' achievement on the hydrocarbon topic in Grade XI at SMA Negeri 2 Dumai.

This progress can be attributed to the features of the TAI model, which focuses on a well-organized blend of independent learning and collaborative group work. In this model, students are placed into heterogeneous groups where they support each other in understanding the material. This collaboration provides students with

the opportunity to actively engage in discussions, correct misunderstandings, and reinforce concepts through peer dialogue. Mustofa (2018) supports these findings, stating that the team assisted individualization model is effectively enhances learning outcomes by utilizing structured group collaboration. Additionally, the model aligns with the principles of the Merdeka Curriculum, which encourages differentiated instruction and allows students to learn based on their individual abilities and readiness. Its implementation also supports the development of the Pancasila Student Profile, particularly in the aspects of mutual cooperation through group collaboration, as well as independence and critical thinking through the completion of individual tasks.

The improvement in learning outcomes is inseparable from the role of each stage within this learning model. The initial stage, known as the Placement Test, plays an important role in forming heterogeneous learning groups based on students' prior knowledge. The teacher used previous test scores to map students' understanding so that each group consisted of members with varying abilities. Students who had difficulties were given the opportunity to learn from peers with a stronger grasp of the material. For instance, when studying hydrocarbon nomenclature and physical properties, students with lower understanding were more active in asking questions and participating in discussions. On the other hand, students with a higher level of understanding were able to deepen their knowledge by explaining the material to their peers, such as the relationship between hydrocarbon structure and reactivity. These discussions within the group helped correct misconceptions and reinforced conceptual understanding. This is in line with Slavin (2008), who argued that heterogeneous group work enables effective reciprocal learning interactions.

The next stage, Teaching Group, also plays a role in enhancing students' learning outcomes. In this stage, the teacher facilitated the initial activity by presenting a learning video as an introduction to the material, which aimed to build students' initial understanding before group discussion began. After watching the video, students were given the opportunity to ask questions and clarify parts of the material they had not yet understood. This activity helped students become better equipped to engage in the following learning activities. They appeared more active during discussions, were able to restate the information they had learned, and demonstrated a higher level of engagement in group activities. Arends (2012) states that systematic delivery of material at the beginning of a lesson helps students complete their assigned tasks and supports the overall improvement of learning outcomes.

The core stage of this model is the Team Study phase. In this phase, students worked on Student Worksheets (LKPD) within their previously assigned heterogeneous groups. Students with a better understanding of the material assisted their group members in solving problems. The reciprocal interaction among group members allowed students not only to receive information but also to process and convey the material in a manner that was easier for their peers to understand. According to Nasution (2024), this type of small group learning helps students deepen their understanding because they are required to explain the material to others. Research by Tinungki (2022) also found that heterogeneous group discussion-based learning encourages active participation, which has a positive impact on students' learning outcomes.

The TAI model differs from conventional group learning practices. In traditional group work, groups are often

formed randomly without considering students' individual abilities, leading to imbalanced learning experiences. In contrast, this model forms groups based on Placement Test results, and the teacher remains actively involved in providing individual guidance throughout the learning process. This ensures that all students are monitored and none are left behind. Taguinod (2023) shows that students who actively engage in group interactions tend to achieve higher academic performance due to the repeated learning process supported by peer guidance.

The effectiveness of this model is reflected in the learning evaluation results. The average LKPD score in the experimental class was 87,705, while the control class achieved an average score of 78,36. On the unit test, the experimental class had an average score of 88,65, compared to 78,1925 in the control class. This difference indicates that students who were taught using the team assisted individualization model achieved higher learning outcomes than those who were taught using conventional group discussion methods. These findings are supported by Asmiwati (2022), who stated that this model is effective in encouraging students to study independently and actively within their groups, making the learning process more effective and positively influencing students' academic achievement.

CONCLUSION

Following the analysis and discussion, it can be inferred that applying the cooperative learning model team assisted individualization type had a positive impact on enhancing students' academic performance in the hydrocarbon topic for Grade XI students at SMA Negeri 2 Dumai. The statistical test results indicated that the computed t-value of 5.24023 surpassed the critical t-value of 1.6664, with (df) = 71 and a significance level of $\alpha = 0,05$, demonstrating a statistically significant improvement. This improvement shows that the team assisted individualization cooperative learning model is effective, as students' learning gains in the experimental class were classified as high.

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