Revolutionizing Hydrocarbon Education: How Concept Maps Improve Chemistry Outcomes

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ABSTRACT

Purpose of the study: The purpose of this study is to determine whether there is an improvement in student learning outcomes in chemistry, specifically on the topic of hydrocarbons, through the use of concept map strategies.

Methodology: The subjects in this study were 22 students of class X at Asy-Syafiiyah Islamic High School Air Tiris. The types of data collected in this study include qualitative and quantitative data, consisting of learning data results and data on teacher and student activities. Data collection techniques used in this study were documentation, observation, and interviews.

Main Findings: Based on the results of the study, the use of concept maps can improve student learning outcomes in discussing hydrocarbon topics in class X Asy-Syafiiyah Islamic High School Air Tiris, Kampar District, Kampar Regency. The application of concept maps makes students more active and improves their performance. Data collection was carried out using a post-test, which was repeated each cycle, as well as documentation. As a result, the average score before the action was 59.00%, in Cycle I it increased to 67.50%, and in Cycle II it reached 81.50%. Based on data analysis, it can be concluded that the use of concept maps is effective in improving chemistry learning outcomes in class X Asy-Syafiiyah Islamic High School Air Tiris, Kampar District, Kampar Regency, with very good results.

Novelty/Originality of this study: Concept map-based learning methods revolutionize the way chemistry is taught, making hydrocarbon material easier to understand and apply.

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1. INTRODUCTION

The duties and roles of teachers as professional educators are indeed very complex, not limited to ongoing interactions during educational activities in the classroom, commonly referred to as the teaching and learning process. Teachers' responsibilities in this process encompass pedagogical, professional, personal, and social tasks [1]–[3] . Thus, a teacher's role in education is not confined to merely delivering information to students [4], [5].

In line with the progress and demands of the times, teachers must possess the ability to understand students with their unique characteristics to assist them in overcoming learning difficulties effectively. Moreover, teachers are required to master various effective learning models to guide students optimally, especially in Natural

Sciences subjects like chemistry [6]-[8]. Studying chemistry provides numerous benefits, one of which is fostering problem-solving skills [9]-[11]. By encountering and systematically addressing complex problems in chemistry, students develop habits of logical and structured thinking [12], [13]. Although chemistry is often perceived as a challenging subject due to its complexity, this very complexity can become an advantage when approached correctly, helping students build resilience and adaptability in solving daily life problems [14]-[16].

Chemistry also reveals to us the orderliness of nature, both at the macro and micro levels, ultimately deepening our admiration for the Creator. Furthermore, chemistry helps address various social issues, such as economic, legal, artistic, and environmental problems [17]-[19]. Thanks to advancements in chemical analysis, the composition of a product can now be determined with precision [20], [21]. At Asy-Syafiiyah Air Tiris High School, chemistry is one of the core subjects. Therefore, during the learning process, students are expected to actively participate, show a positive attitude toward learning, listen attentively to the teacher's explanations, ask questions proactively, and engage actively in the learning process.

Learning activities are an integral part of the educational process, yet for many adults, the enthusiasm for learning tends to decline [22], [23]. Learning is often viewed as a boring and meaningless activity, which hinders its development. In schools, a similar situation can be observed, where students generally lack creativity and active participation, especially in chemistry lessons, which negatively affects their academic performance [24]-[26]. Teachers often teach using the same materials year after year, rely heavily on rote memorization, and employ outdated teaching methods without incorporating engaging teaching media [27]-[29]. This standardized and formal approach diminishes students' interest and limits their ability to explore and innovate in their learning.

Based on observations conducted by the researcher, who also serves as a chemistry teacher at Asy-Syafiiyah Air Tiris Islamic Senior High School, the current learning conditions in the field still fall far short of expectations. Preliminary studies conducted at the school revealed several challenges in the chemistry learning process. First, students' learning outcomes are suboptimal, as evidenced by more than 60% of students failing to achieve the minimum completeness criteria of 65 in chemistry tests. Second, students find it difficult to comprehend the material presented by the teacher, with over 65% rarely able to answer questions posed during class. Third, 60% of students are not actively engaged during chemistry lessons, as seen in their passive behavior, where they tend to remain silent and only listen to the teacher's explanations without providing any responses or feedback.

Based on the symptoms mentioned above, it can be concluded that students' learning outcomes in the chemistry learning process tend to be low. This condition is likely influenced by teaching methods that fail to capture students' attention effectively. The quality of the teaching and learning process, as well as the level of achievement in instructional outcomes, generally depends on several factors, including student characteristics, teacher characteristics, teacher-student interactions, teaching methods, group dynamics, physical facilities, the subject matter, and the surrounding natural environment [30]-[32].

As an effort to improve students' learning outcomes and engagement, teachers need to implement effective learning strategies, one of which is the use of concept maps [33], [34]. Concept maps are a method of visually representing the concepts within a subject area. By creating concept maps, students can better see the relationships within a field of study, making the material clearer and more meaningful [35], [36]. Meaningful learning itself refers to a process where new information is connected to relevant concepts already existing in students' cognitive structures. This strategy is expected to help students understand key concepts and the relationships between them, thereby enhancing their mastery of the material and improving their chemistry learning outcomes.

Previous research conducted by Astriani et al., [37] emphasized the use of mind mapping to improve students' metacognitive skills in general learning, without a specific focus on certain materials or contexts. This study highlights how mind mapping helps students in planning, monitoring, and evaluating their learning process. Meanwhile, the current study more specifically discusses the use of concept maps as a tool to improve students' learning outcomes in chemistry learning, especially in hydrocarbon material. This study not only focuses on improving metacognitive skills, but also evaluates the effectiveness of concept maps in helping students understand complex chemical concepts and improve their academic outcomes. Thus, this study offers a more contextual and relevant approach to chemistry learning.

The novelty of this study lies in the application of concept maps as an innovative tool to improve students' understanding of hydrocarbon material in chemistry education. Concept maps provide a visual way that helps students organize information more systematically, facilitates understanding of relationships between concepts, and strengthens their memory of the material being taught. The urgency of this study arises because hydrocarbon material is often considered difficult by students, and many conventional approaches are not optimal in facilitating the understanding of complex basic concepts. By integrating concept maps in learning, this study aims to overcome these challenges and contribute to improving chemistry learning outcomes, especially in understanding the topic of hydrocarbons which is important in the chemistry curriculum.

2. RESEARCH METHOD

This research was conducted in two cycles and each cycle was conducted in two meetings. The subjects in this study were students of Grade X of Asy-Syafiiyah Islamic High School Air Tiris, with a total of 22 students. While the object of this study is the improvement of chemistry learning outcomes on the subject of Hydrocarbons.

To collect data on students' learning interests in the subject of chemical bonds in chemistry subjects in learning is carried out using 2 techniques, namely Documentation, data techniques using documentation, namely by collecting data on student learning activities, both learning data before using concept maps, and data after learning the use of concept maps, and collecting a list of names and cognitive results of students (task or exercise scores) namely cognitive results before and after action. Observation, observing the increase in chemistry learning outcomes in the subject of hydrocarbons.

Data analysis used in this study is a descriptive technique aimed at describing student learning outcomes. Data calculation activities start from collecting data, compiling or measuring data, processing data, presenting and analyzing, in order to provide a picture of a symptom, event or condition. It is also used to see the completion of students' chemistry learning individually and classically.

The results of this study were obtained through the initial test and final test of cycle I and cycle II. Data obtained from cycle I, II were then analyzed by calculating the number of evaluation/test results for each cycle in one class, then the number was calculated in percentage. The data obtained through observation activities and the learning process will provide an overview of the level of student learning outcomes in the subject of hydrocarbons in chemistry subjects.

3. RESULTS AND DISCUSSION

3.1. Implementation No Action

At the meeting without using the concept map, based on the writer's observation, the teacher's activities during the lesson implementation were categorized as adequate because the teacher faced difficulties in explaining the lesson to students. Additionally, the teacher found it challenging to encourage students to study effectively and seriously. The teacher also struggled to motivate students, stimulate critical and creative thinking, and create a clear connection between concepts. Therefore, it is advised that teachers develop more engaging teaching methods that are easier for students to understand, and motivate students to study actively.

Based on the writer's observations of student activities, it was noted that many students still did not pay attention to the teacher's explanation during the lesson implementation. As a result, these students faced difficulties in following the planned learning process. This was evident in the students' passive learning methods, their reluctance to ask questions, and the teacher's difficulty in motivating them. During the implementation test, students were unable to answer the questions provided by the teacher. The lecture method in teaching was found to be ineffective in improving student learning outcomes, particularly on the topic of identifying the elements C, H, and O in carbon compounds. The shortcomings identified will serve as motivation to improve future actions. The author will now move to Cycle I and apply the concept map learning strategy.

Cycle I

Based on the reflection of the pre-action, the writer observed several shortcomings in the teacher's activities, student engagement, and student learning outcomes on the topic of chemical bonds. The author consulted with the chemistry teacher to plan a better learning cycle, with the goal of improving upon the previous cycle. During the first cycle using the concept map, the teacher's activities were categorized as "excellent" because the teacher was able to explain the lesson calmly and clearly to the students. However, some students were still not serious in listening to the teacher's explanation. The teacher was also able to encourage students to study diligently, although there were still a few students who continued talking with their friends during the lesson. Additionally, the teacher succeeded in motivating students and encouraging them to think critically and creatively, though many students still struggled with critical and creative thinking.

Regarding student activities, there were noticeable changes. More students began paying attention to the teacher's explanation, although some still found it difficult to follow the planned learning process. During the implementation test, there was an improvement in students' ability to answer the questions provided by the teacher, though some students still could not answer the questions correctly. Based on the weaknesses observed in Cycle I, teachers and researchers will work together to improve the learning outcomes in Cycle II, as planned.

Cycle II

Based on the reflection of Cycle I, the author observed several shortcomings in the teacher's activities, student engagement, and student learning outcomes on the topics of hydrocarbon classification and the nomenclature of alkanes, alkenes, and alkynes. The author consulted with the chemistry teacher to plan a better learning strategy for the second cycle, with the goal of improving upon the previous cycle.

In the second cycle, where the concept map strategy was used, the teacher's activities were categorized as "excellent" because the teacher was able to explain the lesson to the students in a calm and controlled manner. The teacher successfully encouraged students to study seriously and was able to motivate students to think critically and creatively, as well as to construct maps depicting the relationships between concepts, which made it easier for students to understand the ongoing lessons.

Regarding student activities, there was noticeable improvement. More students began paying attention to the teacher's explanation, and the planned learning process was followed more effectively. During the implementation test, students showed improvement in answering the questions provided by the teacher and were able to complete the tasks within the given time. Teachers and researchers collaborated well, leading to better learning outcomes in Cycle II as planned.

Based on observations in Cycle II, the author concluded that, overall, student activities showed significant improvement and could be categorized as "good." Thus, the conclusion is that using the concept map strategy can improve students' learning outcomes on the topic of hydrocarbons in class X at Madrasah Aliyah Asy-Syafiiyah, Kampar District.

In the learning process before the action was taken, the interaction between teachers and students was less than optimal, with only a few students willing to ask questions or respond to the material provided by the teacher. In Cycle I, the interaction between teachers and students improved compared to the initial cycle. However, students were still shy and hesitant to ask questions. In Cycle II, the interaction between teachers and students significantly increased, with many more students eager to ask questions. The average student scores before the action were 59.00, while in Cycle I, they rose to 67.50, and in Cycle II, the average score increased to 81.50. The results show that, after applying the concept map learning model, students' performance improved with each cycle.

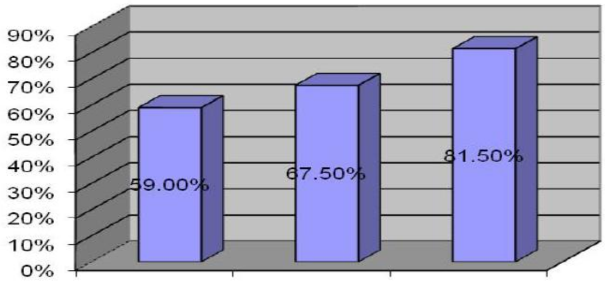

Figure 1. Average Learning Outcome Graph Student

The classical student learning completeness before the action was 59.00%. In Cycle I, it increased to 67.50%, and in Cycle II, it further rose to 81.50%. From these results, it can be concluded that after the application of the concept map learning model, student performance improved by 25% across the cycles.

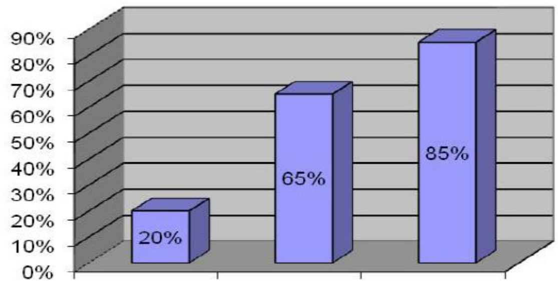

Figure 2. Graph Completeness Study Student Classically

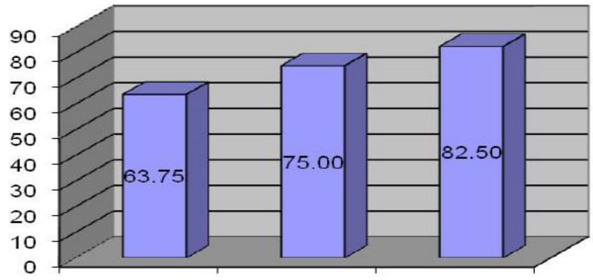

Figure 3. Graph Teacher Activities In Every Action

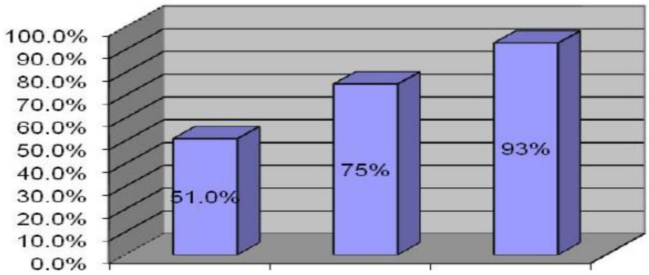

Figure 4. Graph Activity Students In Every Action

The comparison of results across all cycles shows positive changes overall. From various aspects of evaluation, the learning outcomes demonstrate significant improvement throughout the learning process.

The impact of this study can be seen in the increase in students' understanding of hydrocarbon material, because the use of concept maps helps them to see the relationship between various chemical concepts and facilitates the process of organizing information. With this approach, it is expected that students can more easily remember and apply these concepts in solving more complex chemical problems. However, this study also has several limitations, such as the possibility of difficulty in adapting the use of concept maps in classes with a large or diverse number of students, which can affect the effectiveness of its implementation. In addition, the success of this strategy is highly dependent on the teacher's ability to facilitate learning and encourage students to be actively involved in the use of concept maps.

4. CONCLUSION

Based on the results of the research and discussion, it can be concluded that there was an improvement in student learning outcomes with the implementation of the concept map learning method, particularly on the topic of hydrocarbons, at Asy-Syafiiyah Islamic High School in Air Tiris, Kampar District. The average student grades increased from 59.00 before the action, to 67.50 in Cycle I, and then to 81.50 in Cycle II. This represents an average increase of 8.50 from pre-action to Cycle I, and a further increase of 14.00 from Cycle I to Cycle II. Meanwhile, the classical completeness rate increased from 20% before the action, to 65% in Cycle I, and 85% in Cycle II. This shows an increase of 45% from pre-action to Cycle I, and a further increase of 20% from Cycle I to Cycle II, indicating very good study results. Further research is recommended to explore the application of concept maps to other chemistry materials and compare their effectiveness with other visual learning methods in improving students' understanding of more complex chemistry concepts.

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