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Application of Cooperative Learning Jigsaw Model to Improve Student's Learning Achievement in Chemistry Learning

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Abstract

This study aims to improve student achievement in learning chemistry in class X MIA4 at SMA Negeri 1 Palu by applying the Jigsaw Cooperative Learning Model. The classroom action research (CAR) problem can be formulated as follows: Is the Jigsaw Cooperative Learning Model application able to improve student achievement in learning chemistry in class X MIA4 SMAN 1 Palu? CAR is carried out with the following stages to answer the problem: 1. planning, 2. implementation. 3. observation, and 4. evaluation and reflection. The study results can be explained as follows several fundamental aspects of learning were successfully improved by applying the Jigsaw cooperative learning model. Such as student activity in collaboration and in completing worksheets independently, actively asking and answering questions, and making students feel happy and enthusiastic. Likewise, the average evaluation of each cycle showed that the percentage completeness increased. In cycle one, action one was 73.8%, action two 85.5%, and activity three 92.9% increased in cycle two, the average from three actions was 98.0%. It can be concluded that the application of the Jigsaw cooperative learning model can improve student achievement in class X MIA4 SMA Negeri 1.

Keywords: Cooperative learning, jigsaw, learning achievement, chemistry learning

Introduction

The quality of education in Indonesia has increased. It is due to the improvement of the curriculum. One of the subject matter taught in high school education units is chemistry. The burden carried by the school, in this case, the teacher, is weighty because it is the teacher who is at the forefront in shaping the students' personalities. Thus the education system in the future needs to be developed so that they are more responsive to the demands of society and the challenges the world of work will face.

The availability of learning tools is one of the factors that can support the learning process to run well and improve the quality of education. As previously stated, this is in agreement with Ayuningtyas et al. (2015) that learning tools provide convenience and can assist teachers in preparing and carrying out teaching and learning activities in the classroom. This toolkit offers several strategies to encourage students to use different learning styles. Thus, with careful planning, the needs of all students can be met in a Science class. The teaching pattern described above is one of the causes of the low academic achievement in chemistry subjects for graduates of SMAN 1 Palu. Data from the analysis of daily tests for class X shows that students who have not completed individually are 45.0%. The formative test results indicate that student achievement is still below the average class success, with a percentage of at least greater than 75%. It shows that student achievement in chemistry subjects still needs to be improved.

Efforts to improve student achievement in chemistry subjects need to be taken seriously by chemistry teachers because chemistry teachers are the spearhead of implementing learning in the classroom. Therefore, improving student learning achievement must be done by chemistry teachers by making changes, innovations, and new creativity in chemistry learning (Manurung, 2021). So far, it has been objectively acknowledged that chemistry learning is too dependent on the lecture method or various lectures. Sometimes the teacher also improves the question and answer practice and discussion. However, the results are still less effective. So chemistry teachers need to apply a method or learning model that can optimize all learning resources such as; teachers, students themselves, and fellow students. Teachers' pedagogical strategies will improve students' skills and four learning dimensions: knowledge, process, understanding, and product (Tabiolo & Rogayan,

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2019). One of the cooperative learning-based learning models considered to improve student achievement in chemistry subjects is the jigsaw model (Kartika et al., 2020). The jigsaw model provides students opportunities to find the knowledge that is their task and jointly, in groups, develop that understanding (Halimah & Sukmayadi, 2019).

The knowledge found by themselves through the jigsaw model will eventually be embedded in students' minds (students do not easily forget because they found it themselves). In addition, this jigsaw model allows students to do a kind of shearing between groups by forming expert groups (Halimah & Sukmayadi, 2019; Wang, 2007). So that through this jigsaw model, chemistry learning takes place dynamically and interestingly because of the variations in the origin group and the expert group. If in learning chemistry with various lecture and lecture methods, students gain knowledge only through the teacher, then through the cooperative learning jigsaw model, each student can gain knowledge from 4 (four) sources simultaneously, namely; 1. From the students themselves personally, 2. Other students in the group, 3. other groups through groups or expert teams, and 4. From the teacher as a learning facilitator

Research on the application of cooperative learning jigsaw models in learning has been carried out, including Applications of jigsaw collaborative learning in science learning and basic technology: changes in physics and chemistry. The results showed that jigsaw cooperative learning resulted in a significantly better mastery of scientific concepts related to physical and chemical changes than traditional learning. The students who took the lesson had a lower proportion of misconceptions. Jigsaw cooperative learning is an effective teaching technique that can increase students' motivation, learning achievement, self-confidence, and willingness in science and technology lessons (Tarhan et al., 2013). Another research is on the effect of the jigsaw cooperative learning model and confirmatory laboratory method on the achievement of prospective physics teachers in science teaching and learning practice courses.

Another research is about the effect of jigsaw cooperative learning and confirmatory laboratory methods on the achievement of prospective physics teachers. This paper aimed to describe the chemistry learning achievement of class X MIA4 students at SMA Negeri 1 Palu by applying the Jigsaw Cooperative Learning Model.

Methods

Research settings

This research was conducted at SMA Negeri I Palu, Central Sulawesi Province. The research subjects were students of class X MIA 4, with 42 students consisting of 18 males and 24females. The action was carried out during chemistry class hours (according to the lesson schedule at SMA Negeri I Palu) in a predetermined class, namely X MIA4. The duration of action is six weeks or six meetings divided into two cycles—one cycle of three steps, where each activity is allocated 2 hours of lessons. So the total number of lesson hours used in this classroom action research (CAR) was 12 hours of classes.

Factors studied

1. Student factors: Seeing student achievement results after following the action (jigsaw) in chemistry subjects. In addition, students' responses were also observed during KBM with jigsaw actions. Student responses that need to be followed such as perseverance, seriousness, cooperation in groups, a collaboration between groups (team of experts), the ability to ask and answer questions, and respect for other groups
2. Teacher factor: Seeing how the teacher designs learning with the jigsaw model includes identifying the materials and tools used, learning tools, observation and evaluation tools, and observing the implementation of actions carefully and in-depth.

Activity procedures

1. Planning

There are three stages in planning this CAR: The first stage is compiling learning tools in the form of learning scenarios and teaching plans, determining the nine sub-subjects (materials) that are the content of the action. The determination of this material is adjusted to the curriculum and learning tools, especially study material analysis, preparing learning materials and tools, and organizing relevant learning media.

The second stage is to make indicators for the design of group formation based on gender, religion, and of course, the level of achievement/academic ability of students. At this stage, a plan for changing the composition of group members has also been prepared nine times (actions) to avoid group saturation

The third stage is making various instruments of action in the form of devices for observing teacher activities and student activities in KBM with jigsaw actions, making evaluation instruments that are tailored to specific learning objectives as contained in learning tools, especially teaching plans

2. Implementation

The action was carried out nine times in three cycles. The target of the action is students, the teacher's giver of action, and the type of action is the cooperative learning jigsaw model. As an action giver, the teacher has activities to carry out these actions divided into three stages: the initial stage (opening/introduction), the core activity stage, and the final or closing stage. Similarly, student activities are divided into three phases (early, core, and final).

Teacher activities in the early stages include; Delivering greetings, attending attendance, conveying the title of the material and the importance of the material, stating the learning objectives, generating initial knowledge, forming groups, explaining student assignments in groups, and motivating students and sharing the required facilities. At the same time, student activities in the early stages include responding to greetings, responding to attendance, paying attention to goals, listening to material explanations, sitting in groups, taking notes and understanding group assignments, and receiving worksheets/materials given by the teacher.

At the core activity stage, the teacher carries out several activities or actions such as: asking students to understand the worksheet, asking students to do assignments according to the worksheet, helping and guiding students to work together in groups, forming expert groups/teams, asking the expert team to explain the results of their discussions to the group. The initial group set the percentage course and set the responders in turn. At the core activity stage, the student activities include understanding worksheets, doing assignments according to worksheets, conducting cooperatives, actively discussing in expert teams, socializing the results of expert team discussions, making presentations, and providing responses to other groups.

Furthermore, the teacher's activities at the final stage are stated, namely: responding to group work results and presentations, concluding, evaluating formative tests, and ending learning. At the same time, the student activities at the final stage are observing the teacher's conclusions, making independent summaries, completing formative test questions, and responding to closing greetings from the teacher.

3. Observation

Observations were made before and during the implementation of the action. Before, the practical action was in the form of completeness of teacher learning, including worksheets and media; when the action is carried out, what is observed is the teacher's activities in carrying out measures starting from the initial, core, and final stages. Students' responses were also monitored while receiving actions, especially collaboration between students and expert teams.

4. Reflection

Reflection is intended to identify the strengths and weaknesses of the actions that have been taken. The sources of information for reflection are the results of observations of teacher and student activities and the evaluation results of formative tests. A good assessment of the previous action is maintained in the following step. While specific weaknesses are discussed together, look for the best way to improve these weaknesses. Thus, the researcher makes this reflection stage a medium for revision of action. Reflection is getting more mature every time you finish one cycle

Data collection techniques

Source of data: Students and teachers

Types of data: Two types of data are the research target: Qualitative data, obtained from the observations of teacher and student activities in each action in the form of an observation sheet and presented in the form of a percentage. Quantitative data were obtained from the evaluation results given at the end of each action (formative test-post-test), and the instrument used was a learning outcome test.

Data analysis techniques

In classroom action research, the increase in student achievement due to the action is the most expected aspect. Therefore, the analysis used is closely related to the study of student achievements, such as analysis of absorption, learning completeness, and average scores. The formula used is as follows:

1. Individual absorption

$$\%\ individual\ absortion = \frac{score\ obtained\ by\ participant\ ts}{\max score\ question}\ x\ 100\%$$

2. Complete learning individually.

Individually participants are said to have completed learning if they get an absorption percentage of ≥ 60%

3. Classical absorption

$$\%\ individual\ absorution = \frac{total\ score\ of test\ takers}{ideal\ score\ for\ all\ students}\ x\ 100\%$$

4. Mastery of classical learning.

$$\%\ mastery\ of\ classical\ learning = \frac{number\ who\ student\ completed}{total\ number\ of\ students}\ x\ 100\%$$

Participants are said to have finished studying classically if they get the percentage of classical power ≥ 85 % (Saldi et al., 2017)

5. Average learning outcomes

$$avarage\ value = \frac{total\ score\ obtained\ by\ all\ students}{the\ number\ of\ students}$$

6. Performance Indicator

The performance indicators used in this study are individual absorption, classical completeness, and average scores. The constructivism approach is considered successful in increasing student learning achievement if each action produces a minimum of 60% individual absorption (individual mastery) and is said to have completed classical learning; if 85% or more students have completed learning

Results and Discussion

The data obtained are presented in two categories, namely the results of observations of teacher activities (**Table 1**) and student activities (**Table 2**). Based on **Table 1**, it can be seen that the development of teacher activities in each cycle through the application of the jigsaw cooperative learning model is increasing. It can not be separated from the improvement efforts made by the teacher based on the suggestions and reflections of each cycle. Of course, the teacher's activities in each process can affect student activities in participating in learning (Widayati, 2008). The results of observing student activities are presented based on **Table 2**.

Table 1. Results of observation of teacher activities cycle 1 and 2 actions 1, 2, 3

No	Activity	Action score per cycle					
		1			2		
1	Doing daily activities	5	4	5	5	5	5
2	Delivering the topic	4	4	4	5	4	5
3	Delivering goals	5	4	5	4	4	5
4	Explain the importance of the material and generate students' prior knowledge	4	3	4	4	5	4
5	Form a group	5	5	5	5	5	5
6	Explaining individual and group tasks and group responsibilities	2	2	3	4	4	5
7	Adjust the sitting position of each group effectively and efficiently	4	2	3	5	5	5
8	Provide the necessary facilities	5	4	4	5	4	5
9	Explain to students to understand and complete LKS	5	4	4	4	4	4
10	Help students complete assignments	2	3	3	4	4	4
11	Helping students teach each other the results that have been done	2	3	4	4	4	4
12	Forming an expert group	2	3	4	4	4	5
13	Provide opportunities for expert groups to socialize	3	4	3	4	4	4
14	Ask the group to prepare or formulate a final answer	2	3	4	4	5	5
15	Carry out presentations	2	3	4	4	4	4
16	Organize feedback and feedback	2	4	3	3	4	4
17	Help smooth presentation	2	3	3	4	4	5
18	Responding to learning	3	4	5	5	5	5
19	Carry out evaluation	5	5	5	5	5	5
20	Carry out daily activities	4	4	4	5	5	5
	Amount	66	71	80	87	88	93
	Predicate	Less	Enough	Enough	Good	Good	Special
	Average per cycle	72.3			89		
	Predicate	Enough			Good		

From **Table 2**, it can be seen that all aspects observed experienced an increase in student activity in participating in learning. After describing the data for cycles one and two accompanied by details of strengths and weaknesses, it can be seen that the results of the research both concerning teacher and student activities showed an excellent tendency to increase student achievement. In other words, student learning outcomes in chemistry subjects using the jigsaw cooperative learning model were successfully improved. Through the application of jigsaw, Eilks & Leerhoff (2001) also showed that the cognitive aspects of students produced were satisfactory.

Table 2. Observation results of student activities in learning cycle 1 and 2 models

No	Activity	Action score per cycle					
		1			2		
		1	2	3	1	2	3
1	Doing daily activities	3	3	4	4	5	4
2	Pay attention to the topic	3	4	3	4	4	5
3	Pay attention to goals	3	3	4	4	5	5
4	Pay attention to material descriptions and involvement in the generation of prior knowledge	3	3	3	3	4	4
5	Involvement in group formation	3	3	4	5	4	5
6	Understand group duties and responsibilities	2	3	3	4	4	4
7	sitting in groups	4	3	4	5	5	5
8	Receive learning facilities	4	4	5	5	5	5
9	Understanding LKS	4	4	4	5	5	5
10	Completing the task	2	3	3	3	2	4
11	Sharing in groups	3	3	3	4	3	4
12	Involvement in expert groups	3	3	3	4	4	4
13	Socialization	3	3	4	3	3	3
14	Prepare the final answer formulation/report	3	3	3	4	4	4
15	Follow the presentation	3	3	3	3	4	4
16	Give feedback and feedback	3	3	3	3	3	3
17	Involvement in Helping smooth presentations	3	4	3	3	3	3
18	Responding to learning	3	3	3	4	3	4
19	Following the evaluation	4	4	5	4	3	4
20	Carry out daily activities	4	5	5	5	5	5
	Amount	63	67	68	84	88	89
	Predicate	less	less	less	Good	Good	Good
	Average per cycle	66			83.6		
	Predicate	Enough			Good		

To find out and prove the success of implementing the jigsaw cooperative learning model in learning chemistry in improving student learning achievement, **Table 3** contains the evaluation results starting from the first act of cycle one to the third act of cycle two (6 actions). The data is made in one table to increase learning outcomes. Each cycle can be seen directly.

Table 3. Student evaluation results in cycle 1 and cycle 2

Nilai	Cycle 1 Action			1 cycle average	Cycle 2 Action			2 cycle average
	1	2	3		1	2	3	
Total	2671	2745	2916	2747.4	3132	3070	3062	3157.4
Absorption	63.6	67.0	69.4	65.4	74.5	74.9	76.6	75.2
Avarage	63.6	67.0	69.4	65.4	74.5	74.9	76.6	75.2
% Completeness	73.8	85.5	92.9	90.5	92.9	100	95.0	98.0

Based on these data, the CAR problems formulated in the introduction section can be answered and discussed. The problem is whether applying the jigsaw cooperative learning model can improve student achievement in class X MIA4 SMA Negeri 1 Palu, especially in chemistry lessons. Improved learning achievement can be seen from the evaluation results of each action (average, absorption, and classical completeness).

The study results, especially the evaluation results, showed that students' absorption increased when applying the jigsaw cooperative learning model in chemistry. In the first cycle for the first action, the absorption capacity of 63.6 was achieved, the second action increased to 67.0, and the third action became 69.4. Meanwhile, in the second cycle for the first action, the absorption capacity was 74.5, which increases the previous step in the first cycle. The dual action became 74.9, and in the third act, the absorption power was achieved at 76.6. The evaluation results show that students' absorption increases when applying the jigsaw cooperative learning model in chemistry learning.

The increase occurred because students contributed knowledge in each cycle that directly took part in learning (Karacop & Doymus, 2013; Karacop, 2017). The same thing happened to the application of the jigsaw cooperative learning model to improve student achievement in class X IPA3 SMA Negeri 1 Padang, which can be seen in the results of the evaluation of each action, absorption from 63.5 to 76.6 and classical completeness from 73.8 to 92.9% (Aswirna, 2012). Previous research found that cooperative learning leads students to research and construct their knowledge according to students' cognitive characteristics (O'Leary & Griggs, 2010). Therefore, an essential part of cooperative learning is how to learn in groups (Doymus, 2008).

These data indicate an increase in absorption in chemistry learning by applying the jigsaw cooperative learning model, likewise to classical completeness. The completeness of each individual is determined by a score of 65 (according to the KKM at SMAN 1 Palu with a maximum score of 100). The first cycle for the first action only reached 73.8%, which means it also met the classical completeness standard even though there were still 10 students who did not complete it individually. In the second act, it became 85.5% which means 6 students did not complete individually, and in the second cycle, it was 85.5%. The third action rose again to 92.9%, which means three students did not complete individually.

Furthermore, the increase in classical completeness is increasingly visible in the second cycle. Cycle two for the first act of classical completeness reached 92.9% (3 students did not complete individually, the second action became 100%, and the third action became 95.0% which means there were only 2 students who did not complete individually. It means that there is an increase in classical completeness; this is in line with Muhardini's research (2010) that applying the jigsaw type cooperative learning model in class X9 students of SMAN 2 Mataram can increase classical mastery to 85.7% with a class average of 75.4. From the results of this study, it can be said that the application of the jigsaw-type cooperative learning model can improve the chemistry learning achievement of class X9 students of SMA Negeri 2 Mataram. Applying the jigsaw-type cooperative learning model can increase chemistry students' motivation and learning outcomes of class XI MIPA3 SMA Negeri 1 Marga in two cycles, with classical learning mastery reaching 89.74% (Widarta, 2020).

Based on the description above, it has been successfully proven that applying the jigsaw cooperative learning model can increase absorption and classical mastery, which means that student learning achievement is proven to improve. It can also be seen and established based on increased student learning outcomes. Existing data show that in cycle one for the first action, the average score was 63.6, the second action rose to 67.0, and the third action rose again to 69.4. Furthermore, in the second cycle, the first action obtained an average value of 74.5, the second action was 74.9, and the third was 76.6. It means that overall all actions tend to increase student learning outcomes. Therefore, it is concluded that applying the jigsaw cooperative learning model in learning chemistry can improve student achievement.

Conclusions

Based on the results of classroom action research in class X MIA4 IPA SMA Negeri 1 Palu, it can be concluded that applying the jigsaw cooperative learning model can improve student achievement. The learning achievement of class X MIA4 students of SMA Negeri 1 Palu in chemistry can be improved if a jigsaw cooperative learning approach is used. It can be proven by two indicators: the cycle's average value and the cycle's classical completeness. For the average value, one cycle has an average value of 65.4 with classical completeness of 90.5%. In cycle two, the average value rose again to 75.2 with 98% classical completeness. Thus, it is proven that the cooperative learning jigsaw model approach can improve student achievement in learning chemistry in class X MIA4 SMA Negeri 1 Palu.

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