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Effectiveness of Teaching Materials to Support Merdeka Curriculum Learning on Basic Chemical Law Material on Learning Outcomes of Phase E SMA / MA

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A B S T R A C T

This study aims to determine the level of effectiveness of teaching materials to support merdeka curriculum learning on the material of the basic laws of chemistry on the learning outcomes of students. This research is a follow-up research from the Plomp model development research with a type of quasi-experimental research with a Nonequivalent control group design. This study consists of two samples, namely the experimental class and the control class with a total of 62 students selected by purposive sampling technique. Based on the results of the research conducted, the experimental class has an average N-gain value of 0.71 with a high category, and the control class with an average N-gain of 0.53 with a medium category. For hypothesis testing using the t-test, the t-count value is 5.323 and the t-table is 2.00. The results of data analysis show that learning by using teaching materials to support merdeka curriculum learning on basic laws of chemistry material effectively improves student learning outcomes.

1. Introduction

Curriculum is one approach that has the ability to improve the quality of education in Indonesia. The curriculum according to Law Number 20 of 2003, is "a set of learning plans related to objectives, content, and teaching materials used as guidelines in organizing learning activities to achieve national education goals." In education, the government has now issued a new policy regarding the use of curriculum in schools, namely by issuing a policy regarding the merdeka curriculum (Jojor & Sihotang, 2022). The merdeka curriculum is intended as a government effort to improve students' understanding, behavior, and character. Among the important changes in the merdeka curriculum include (1) project-based learning as skill building and in accordance with the nature of Pancasila

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learners, (2) focus on essential material so that students can learn basic competencies in depth, and (3) teacher flexibility to adjust learning based on students' abilities and adapt to digital media (Fianingrum et al., 2023).

The merdeka curriculum aims to provide freedom to teachers and students during the learning process. In its application, teachers are free to use learning tools provided by the government or develop their own learning tools tailored to the needs of students (Ananda Ismail & Mawardi, 2021). One of the learning tools made by teachers is teaching materials (Hidayatni & Fathani, 2023). Teaching materials are an important component in improving students' knowledge and learning experience (Fadila et al., 2023). Teaching materials consist of carefully compiled information that is tailored to learning objectives (Magdalena et al., 2020). The availability of teaching materials can improve the efficiency and effectiveness of learning.

ing process is an activity carried out by teachers and students to achieve learning objectives. The goal is to improve understanding of the concepts taught. During the learning process students must adapt actively by searching, finding, and using the information they have (Ningsih et al., 2019). Learning outcomes can be improved through learning activities. This is because students' involvement in learning activities can foster their creativity in critical thinking, so that they can understand the material effectively. In addition, it stimulates curiosity to improve their ability to remember and analyze information, and strengthens confidence in expressing opinions. Therefore, learning activities are very important in improving student learning outcomes (Nuraini et al., 2018).

The use of textbooks available at school is not sufficient in terms of variations in learner activities and increasing their understanding in solving problems (Piawi et al., 2018), and has not been equipped with a form of sample problems and practice questions that are able to measure the extent to which students are able to achieve goals in the learning process, especially in basic chemical law material. Teaching materials that are tailored to the needs of students will help the learning process to be active, effective, creative, interesting and fun (Mawardi & Fitriza, 2019). Teaching materials that are relevant to the teaching material will create more active and innovative learning to achieve learning objectives (Murod et al., 2021), so they have the ability to improve student learning outcomes.

Education is the most important factor in a person's life, because it can distinguish a person's ability to think (Bella, 2023).Learning outcomes show how much skill is obtained during the learning process which is carried out by assessing attitudes, skills, and is characterized by changes in behavior before and after following the learning process (Purwandari & Wahyuningtyas, 2017). Every learning process is expected to have changes obtained by students not only the ability to understand the concept of material but also the development of skills and attitudes of students (Aghni, 2018), especially in chemistry. Learning results obtained based on tests given to students show an increase in understanding of the concept of material (Lenggogeni & Mawardi, 2022).

Chemistry subjects cover things that are submicroscopic, macroscopic, and symbolic. Basic chemical law material is one of the chemical materials that support learning in the independent curriculum phase E, this material is systematic and abstract (Laliyo et al., 2020). Which students must learn before learning other chemical calculation materials such as stoichiometry. Basic chemical law material consists of facts, principles, procedures, and contains many concepts so that some students still have difficulty understanding it (Kurniawati et al., 2016) which causes students' learning outcomes to be low. Chemistry learning experiences several obstacles in the learning process. One of the obstacles faced is how lessons are conducted, as well as the availability of teaching materials that cover the chemistry material being taught. Most of the books owned by teachers are textbooks or books provided by the government. The book provided by the government or the Ministry of Education and Culture book has not discussed topics that can cover all chemistry materials, especially the basic laws of chemistry.

During the implementation of the merdeka curriculum, there are still few teachers who develop teaching materials independently. In 2023, research was conducted that focused on making teaching materials that support merdeka curriculum learning on basic chemical law material. The results showed that teaching materials that can support merdeka curriculum learning are needed by teachers and students, especially in basic chemical law material, because basic chemical law material is material that is difficult for students to understand because it contains various concepts. The development research has produced a prototype of teaching materials to support merdeka curriculum learning on the basic laws of chemistry phase E SMA (Fauzan et al., 2023). In Vocational High Schools in the field of tourism expertise, chemistry subjects are not studied directly as subjects, but are integrated into applied science subjects (Afinda, 2023).

Teaching materials with interesting content and illustrations can be used as learning resources in learning (Farras Aulia Sugria et al., 2023). Teaching materials that have been developed already contain attractive images, mind mapping, and colors. able to support learning are teaching materials that have mind mapping, images, and colors that can attract students' attention so as to increase students' enthusiasm for learning (Sinaga & Rakhmawati, 2022). The teaching materials that have been developed also contain multi representations. Teaching materials that have been equipped with multiple representations can improve student learning outcomes (Setyandaru et al., 2017).

The presentation of teaching materials to support merdeka curriculum learning has been equipped with multi-representation of chemistry which is useful for explaining the concept of the material contained in the teaching materials (Novia et al., 2023). By using chemical representations, students' understanding of a subject matter will increase, and this understanding will be stored in students' memory (Fauzan et al., 2023) besides that the teaching materials that have been developed have also been equipped with examples along with discussions of questions and practice questions that can increase students' understanding of the concepts that have been obtained.

This study aims to determine how effective the teaching materials used to support merdeka curriculum learning on the subject (Mawardi & Fitriza, 2019) of basic laws of chemistry on the learning outcomes of phase E SMA/MA students.

2. Methodology

Effectiveness research is an advanced research from EDR (Educational Design Research) development research. effectiveness research is carried out at the assessment phase stage in the Plomp model. The type of research used is quasi experiment with Nonequivalent control group design. The research involved two sample classes, namely the experimental class and the control class or comparison class. The comparison class in question is a class that is not given treatment so that the learning is the same as the existing learning at school, while the experimental class is given treatment by applying learning using teaching materials supporting merdeka curriculum learning on basic chemical laws that have been tested for validity and practicality. This research design can be seen in Table 1.

Table 1. Research Design

Class	Pretest	Treatment	Posttest
Experiment	O_1	X	O_2
Control	O_3		O_4

Description:

X: Treatment.
O_1: experimental class pretest.
O_2: control class pretest.
O_3: experimental class posttest.
O_4: control class posttest

The research was conducted at SMA Negeri 1 VII Koto Sungai Sarik, Padang Pariaman Regency, West Sumatra. Starting in the even semester of the 2023/2024 school year. The population in this study were all X grade students of SMA Negeri 1 VII Koto Sungai Sarik even semester of the 2023/2024 school year. The samples in this study were students of class X.E1 as the experimental class and X.E4 as the control class. The sampling technique used was nonprobability sampling with purposive sampling. The class was chosen based on the teacher's provisions by considering the comparison of learning outcomes before learning on basic chemical law material, students in both classes had comparable average learning outcomes so that they were selected as samples.

This study consists of independent variables, dependent variables, and control variables. The independent variable here is the teaching material supporting merdeka curriculum learning on basic chemical laws. The dependent variable is student learning outcomes through pretest and posttest scores. The controlled variables are teachers, merdeka curriculum, learning materials, and time allocation.

The instrument in this study is a knowledge test instrument in the cognitive domain. The test consists of pretest and posttest. The instrument is in the form of multiple choice questions totaling 20 items, where each question consists of five answer choices that are adjusted to the competency achievement indicators of basic chemical law material.

Before the learning is carried out, the two samples will be given an initial test in the form of a pretest after which the learning process is carried out where the experimental class will apply learning using teaching materials supporting merdeka curriculum learning on basic chemical laws, while the control class applies learning using the Ministry of Education and Culture books available at school. At the final stage of the learning process, a posttest will be carried out on both samples to see the effectiveness and conclusions obtained.

Data analysis techniques to obtain research results include the N-gain test to determine how effective the teaching materials used are. Normality test was conducted to determine whether the sample distribution was normal, Lilliefors test was used to test normality. Homogeneity test is used to determine whether the data variance of the two samples is homogeneous, F test is used to evaluate homogeneity. Hypothesis testing aims to determine whether the research hypothesis can be accepted or rejected. Hypothesis testing is done with the t test.

3. Results and Discussion

Results

This study aims to determine the level of effectiveness of teaching materials to support independent curriculum learning on basic chemical laws material on student learning outcomes. The results of the study were obtained from the learning outcomes of students in the cognitive domain. After conducting research at SMA N 1 VII Koto Sungai Sarik, primary data in the form of learning outcomes were obtained. In the learning process, the experimental class used teaching materials to support independent curriculum learning, while the control class used printed books provided by the school. The learning outcomes consist of test scores. The test is in the form of multiple choice questions totaling 20 questions with each question given a score of 5 for the correct answer, for the wrong answer given a score of 0. The following are the average pretest and posttest results from the two samples in Figure 1.

From the figure it can be seen that the comparison of the learning outcomes of the experimental and control classes can be seen from the difference in pretest and posttest scores. The average pretest score of the control class was 18.55 and in the experimental class 18.71. For the average posttest score in the dick class 61.93 and the experimental class 77.1. Comparison of the improvement in learning outcomes of control and experimental classes can be seen from the results of the difference in pretest and posttest scores.

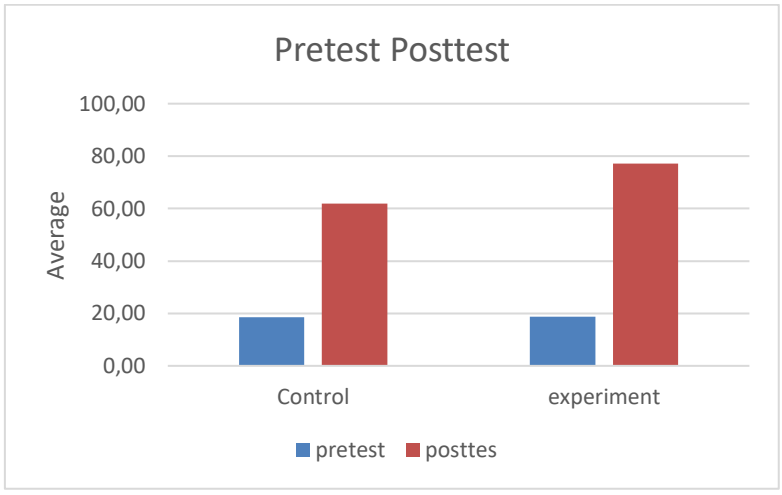

Figure 1. Graph of Pretest and Posttest Scores of Experimental and Control Classes

The N-Gain value aims to determine the level of effectiveness of the treatment given to the sample class as for the treatment given in the form of teaching materials to support independent curriculum learning on basic chemical laws. The average N-gain test results can be seen in Table 2.

Table 2. Average N-gain Test Results

Class	N	Average N-gain	Category
Control	31	0,52	Low
Experiment	31	0,71	Tall

Where the average N-gain value of the experimental class is 0.71 which falls into the high category. As for the control class, the average N-gain value is 0.52 which falls into the medium category. The N-gain value illustrates the comparison between the concepts obtained by students during the learning process. So learning using teaching materials supporting merdeka curriculum learning on basic chemical laws has a higher level of effectiveness than learning using the Ministry of Education and Culture book.

The normality test is carried out to determine whether the data obtained is normally distributed or not. The normality test was carried out using the Liliefors test. Data is normally distributed if the value of L0 < Lt, while the data is not normally distributed if L0 > Lt. for the real level (α) is 0.05. The results of the normality test on the sample class can be seen in Table 3.

Table 3. Liliefors Test Results for Normality

Test	Class	N	L_0	L_t	Distribution
Pretest	Experiment	31	0,133	0,159	Normal
	Control		0,145	0,159	Normal
Posttest	Experiment	31	0,105	0,159	Normal
	Control		0.100	0,159	Normal

From the results obtained, the pretest L-count value in the experimental class was 0.133 and the control class was 0.145, while the posttest Lcount in the experimental class was 1.05 and the control class was 0.100. Where Ltabel (n = 31, α = 0.05) is 0.159. This shows that L-count < L-table. So it shows that the four data are normally distributed.

The homogeneity test is carried out to find out whether what is obtained has a homogeneous variance or not. The homogeneity test was carried out with the F test. Data is said to be homogeneous if the value of F-count < F-tabe. The results of the data homogeneity test of the two samples can be seen in Table 4 below.

Table 4. F Test Results Homogeneity

Test	Class	Df	S^2	f_{count}	f_{table}	Information
Pretest	Eks	32	74,94	1,04	1,84	Homogen
	Ktr	32	71,98			
Posttest	Eks	32	121,12	1,31	1,84	Homogen
	Ktr	32	159,62			

Table 4 shows the results of the homogeneity test of learning outcomes data from both samples. The F-count obtained on the pretest data is 1.04 and on the pretest value is 1.31 with the F-table value (N = 31, α = 0.05) of 1.84. From the results obtained, it is stated that the value of F-count < F-tabel, so it is concluded that the pretest and posttest data from the two samples have the same data distribution.

After it is known that the data from both samples are normally distributed and homogeneous, the two data proceed to the hypothesis test. The hypothesis test carried out is the t test. The hypothesis is seen whether the research hypothesis is accepted or rejected. The data from the hypothesis test results can be seen in Table 5 below.

Table 5. T-test Results

Test	Class	Df	Average	S^2p	T_{count}	t_{table}	Information
Pretest	Eks	30	18,7	73,46	0,072	2	H_0 accepted
	Ktr		18,54				
posttest	Eks	30	77,9	139,6	5,232	2	H_0 rejected
	Ktr		62,09				

The null hypothesis of the t test is that the average scores of the experimental and control classes are the same and are accepted if t-count < t -table. For pretest value data, the tcount = 0.07 with a t-table of 2.00 where t-count < t-table so that H_0 is accepted and H_1 is rejected. In the t test of the posttest value, a t-count = 5.23 was obtained with a ttable of 2.00, meaning that the t-count> t-table so that H_0 was rejected and H_1 was accepted. From the results of the data obtained, it can be seen that the difference in the pretest and posttest scores of the experimental class is greater than the control class. Thus the learning outcomes of the experimental class using teaching materials supporting merdeka curriculum learning are greater than learning using the Ministry of Education and Culture book.

Discussion

This study aims to analyze the effectiveness of teaching materials supporting independent curriculum learning on basic chemical laws on the learning outcomes of class X students of SMA Negeri 1 VII Koto Sungai Sarik. In this study there were two samples used, namely the experimental class and the control class. In the experimental class, learning uses teaching materials to support merdeka curriculum learning on basic chemical laws, while in the control class learning uses the kemendikbud book provided at school.

The learning outcomes in the experimental group were different from the control group, according to this study. Before starting the learning process in both groups, students were given an initial assessment (Pretest). The pretest lasted for 90 minutes. This pretest was designed to measure students' initial knowledge of the basic laws of chemistry before they started the actual study program. Table 1 shows that there is a difference of 0.16 between the mean pretest scores of the two samples. This indicates that both sample groups started with the same level of knowledge about the basic laws of chemistry.The learning method in the experimental class, namely E1 teaching materials supporting merdeka curriculum learning on basic laws of chemistry. Each learner is given one teaching material and Ministry of Education book during the learning process. Learning activities begin with teacher introduction, followed by teacher guidance during the learning process. In the control class E.4, learning uses the Kemendikbud book. Each student was given one Kemendikbud book as the main learning material.

The basic laws of chemistry teaching materials used in the study have been written in language that is easy to understand, and there have been examples and forms of discussion that are easy for students to understand. The material presented in the teaching materials has been arranged systematically so that the concept of the basic laws of chemistry is easy to understand. Accordance to research conducted by (Sinaga & Rakhmawati, 2022) states that the enthusiasm of students in preparing information can be increased by teaching materials that are equipped with attractive colors, images, and illustrations. In addition, the teaching materials developed also contain chemical multi representations that can be used as a way to help students recognize and understand the concepts described (Hurrahman et al., 2022) Abstract chemical material can be more easily understood by students by using chemical multi representations (Rusiani et al., 2019). There are three levels of multi representation in chemistry learning: The macroscopic level describes chemical processes that can be observed with the five senses. The submicroscopic level explains the arrangement and movement of particles. Furthermore, the symbolic level explains that all chemical processes can be described using symbols, numbers, formulas, and reaction equations (Sukeimi, 2022). Understanding chemical concepts at three levels of chemical representation and the ability to connect them is known as a mental model. Mental models are formed and developed during the learning process (Katmiati & Rahmi, 2021). The following is the relationship between chemical multi representations in the formation of mental models in Figure 2.

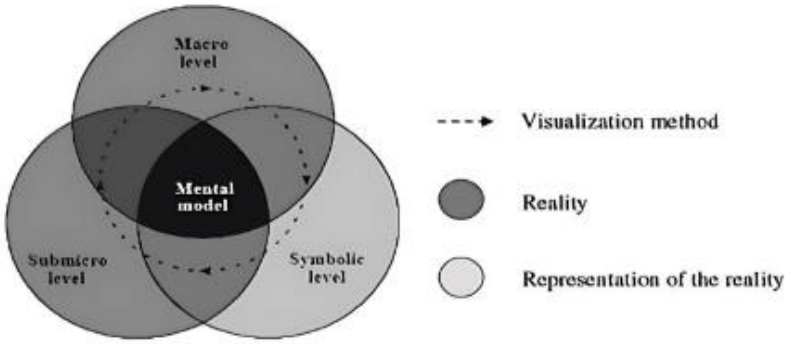

Figure 2. The Relationship between Mental Models and Representations

The following is an example of chemical representation contained in teaching materials supporting merdeka curriculum learning on basic chemical laws.

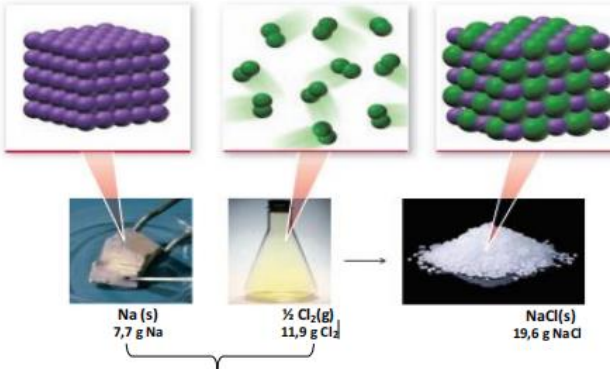

Figure 3. Examples of Chemical Multi representation

The mental model contained in the picture above has contained all three levels of chemical multi representation. the macroscopic level of the image is a salt compound that can be seen with the five senses. The submicroscopic level shows Na and Cl atoms which are described as the particle arrangement of Na and Cl reacting to form the NaCl compound. As for the symbolic level, there is an arrangement of the constituent elements of the NaCl compound.

Researchers used the GIL paradigm in both sample classes during the learning process. The GIL model is a learning strategy that prioritizes placing students as the focal point in the learning process. This approach requires facilitating student progress through a series of fundamental questions that encourage the development of a deep understanding of the concepts being instructed (Munzil & Rochmawati, 2021). The application of the guided inquiry method can improve student academic achievement. Guided inquiry prioritizes a learning approach centered on problem discovery by individual students. Guided inquiry learning quotes increases students' understanding of the interconnectedness of the concepts they acquire, increases their self-confidence, and fosters their motivation to acquire knowledge (Tuti et al., 2023). There are five stages of GIL activities, namely orientation, exploration, concept formation, application, and closing.

The learning stage with the guided inquiry model begins with orientation, at the orientation stage the teacher conveys learning objectives and provides examples of chemical phenomena that occur in everyday life related to the material being taught (Ananda Ismail & Mawardi, 2021). The teacher provides a picture of the material being taught, the picture aims to motivate students to have enthusiasm and foster curiosity about the material being studied by reviewing previous lessons related to the material to be studied. At the orientation stage, the teacher provides information about learning objectives and encourages students to connect the material with chemical phenomena that occur everyday. The second stage is the exploration and concept formation stage, at this stage students are asked to explore the model to answer key questions that encourage students to find concepts, so that learning objectives can be conveyed properly (Aumi & Rahadian, 2013).

The second stage is the exploration and concept formation stage, where students are asked to find information about the material being studied. At this stage learners are given a simple problem with a model equipped with multi representation. Learners are asked to find out about the model given by answering key questions that will directly encourage students to find concepts, so that learning objectives can be conveyed properly. The concept is discovered, introduced, and formed through key questions (Hartandi & Mawardi, 2022).

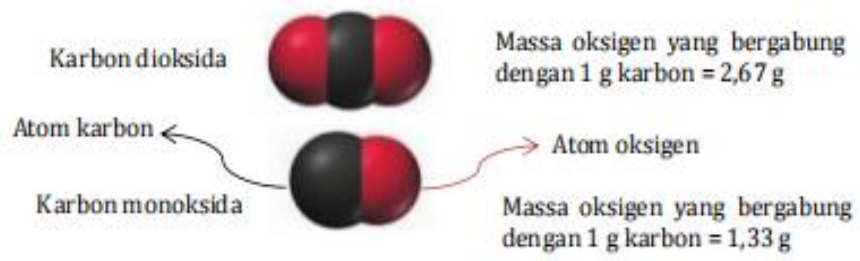

Figure 4. One Model of Exploration and Concept Formation

The model depicted Figure 4 above represents the exploration and concept formation stages of the law of multiple comparisons. Students can witness the process of comparing the constituent components of a compound. To show the cognitive process of students in understanding the model provided, a number of responses from many students were collected and then examined. This table displays examples of student responses during the exploration and idea building phase of the law of multiple comparisons sub-matter. The model allows students to develop an understanding of the mass changes before and after the reaction in the law of multiple comparisons. Observers can witness the formation of several compounds when two elements are in contact with each other. The mass composition of each compound is related in such a way that if the mass of an element is equal, then the mass of the second element in each compound is directly proportional and expressed as an.

In the answer of learner 1, the concept is appropriate, students are able to make a reaction equation but have not been able to mention how the relationship between

the mass of the oxygen element in carbon dioxide and carbon monoxide 2, learner two has been able to make a reaction equation and is able to mention the mass of the oxygen element in carbon dioxide and carbon monoxide compounds, but has not been able to write a simple comparison of the compounds formed. And in learner 3, the ability of students to connect all concepts to get the concept of the law of multiple comparisons has been seen, namely being able to make the reaction equation that occurs, being able to determine the mass number of elements in the compound, and being able to mention the ratio of elements in each compound in Table 6.

Table 6. Student Answer Analysis

Student	Answers
student 1	Reaction equation 1. $C_{(g)} + O_{(g)} \rightarrow CO_{(g)}$ Reaction equation 2. $C_{(g)} + O_{2(g)} \rightarrow CO_{2(g)}$
student 2	Reaction equation 1. $C_{(g)} + O_{(g)} \rightarrow CO_{(g)}$ Reaction equation 2. $C_{(g)} + O_{2(g)} \rightarrow CO_{2(g)}$ The number of O atoms in reaction 1 is 1 and the number of O atoms in reaction 2 is 2. While the number of C atoms in reactions 1 and 2 is the same as 1. so the mass of the element O in carbon monoxide is 1 x 1.33 = 1.33 grams. The atomic mass of O in carbon monoxide is 2 x 1.33 = 2.66 grams.
student 3	Reaction equation 1. $C_{(g)} + O_{(g)} \rightarrow CO_{(g)}$ Reaction equation 2. $C_{(g)} + O_{2(g)} \rightarrow CO_{2(g)}$ The number of O atoms in reaction 1 is 1 and the number of O atoms in reaction 2 is 2. While the number of C atoms in reactions 1 and 2 is the same as 1. so the mass of the element O in carbon monoxide is 1 x 1.33 = 1.33 grams. The atomic mass of O in carbon monoxide is 2 x 1.33 = 2.66 grams. So the mass ratio of the element O in both compounds is 1: 2 While the mass of element C in both compounds is 1: 1

After learners answer key questions in the exploration and concept formation stages. Furthermore, in the application stage, they have the opportunity to analyze more complicated situations, to transfer the knowledge gained with other knowledge (Mawardi & Fitriza, 2019). In this section, there are several exercises related to the topic. Problem solving is done in groups. The exercises provided are intended to enable students to build confidence in situations that are familiar with the concepts obtained (Yani et al., 2020).

The next stage is the closing stage. At this stage, one group representative reads the results of the discussion obtained and summarizes the learning. After that, the teacher informs the results of the discussion and provides reinforcement of concepts regarding the material learned (Sari & Mawardi, 2022).

After the learning process is carried out, students are given a final test posttest is given to measure the extent to which the ability of students to understand the concepts studied. In the experimental class, the average posttest score was 77.10 and in the control class the average posttest score was 61.93. The data on the results of the implementation of teaching materials to support independent curriculum learning is supported by the number of students in each class, namely 31 students in each sample class. The high posttest score obtained by students

illustrates the ability of students to understand the concept of material (Lenggogeni & Mawardi, 2022)

Based on the description above, it can be seen that the teaching materials are effective in improving students' academic achievement. This refers to the average N-gain value of the experimental class N-gain = 0.71 which is included in the high category, while the average N-gain of the control class is 0.532 which is included in the medium category, meaning that students are able to understand concepts more thoroughly when using teaching materials to support merdeka curriculum learning. The average N-gain value compares the value of students after learning with the maximum value. The progress of learning outcomes illustrates the achievement of learning concepts (Wijayanti & Lutfi, 2021).

Furthermore, the normality test was carried out. Based on the normality table, it is known that the value of L-count (experimental class and control class) L-tabel, this indicates that the data obtained in both samples have a normal data distribution at the 0.05 significance level. Then the homogeneity test was carried out, from the homogeneity test results it was found that F-count < F-table so it was concluded that the data of the two samples had a homogeneous variance at the 0.05 significance level. Based on the results of the normality test and homogeneity test, then proceed to the hypothesis test with the t test.

Based on the hypothesis table, it is found that the t-count> t-table value and it is found that H_0 is rejected and H_1 is accepted. This indicates that there is a significant difference in student learning outcomes where the ability of students to understand the concept of basic chemical law material in the experimental class is better than the control class. Where in the experimental class the learning process was carried out using teaching materials supporting merdeka curriculum learning on basic chemical law material. So that it shows that the teaching materials supporting merdeka curriculum learning on basic chemical laws are effective on student learning outcomes.

This is in accordance with research conducted by Sausan (2019) with the title "The effectiveness of the basic chemical law module based on guided inquiry integrated with experiments on the learning outcomes of class X students of SMA Pertiwi 1 Padang" with the results of the study it can be concluded that the average learning outcomes of students using guided inquiry-based modules produce good learning outcomes compared to conventional classes.

From the results of the analysis of posttest data given to the two samples, it can be concluded that the provision of treatment in the learning process using teaching materials to support independent curriculum learning on basic chemical laws is able to improve student learning outcomes. This can be seen from the difference in the average pretest and posttest and the achievement of TP. The posttest average is much higher than the pretest average. By using teaching materials to support independent curriculum learning on basic chemical law material, students are helped to analyze and understand concepts in basic chemical law material. So it can be concluded that the use of teaching materials to support independent

curriculum learning in basic chemical law material is effective in improving learning outcomes.

4. Conclusion

Based on the results of the study, it can be concluded that the experimentl class that applied learning using teaching materials to support merdeka curriculum learning on basic chemical laws obtained a higher average N-gain value than the control class. This proves that the teaching materials supporting merdeka curriculum learning are effective for improving students' cognitive learning outcomes on basic chemical laws, so the authors suggest: the use of teaching materials supporting independent curriculum learning on basic chemical laws can be applied in school learning to improve students' learning outcomes.

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