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IMPLEMENTATION OF PROBLEM-SOLVING LEARNING MODEL ASSISTED BY STUDENT WORKSHEETS TO IMPROVE CRITICAL THINKING SKILLS IN THE CONTEXT OF REACTION RATE

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Abstract: This research aims to describe the implementation of the problem-solving learning model, students' activities, critical thinking skills, learning outcomes, and students' responses toward learning model implementation. Methods of the research used are pre-experimental with one group pretest-posttest design. The research subjects were 36 students of class 11^{th} grade MIPA 1 at Senior High School 19 Surabaya, Indonesia. It is found that the problem-solving learning model was implemented during two meetings obtained an average percentage of 96.57% and 98.68%. Secondly, students' relevant activities for enhancing critical thinking skills during two meetings received 96.24% and 97.61%. Thirdly, critical thinking skills on the four indicators have increased in the high criteria as the N-gain score represents for the interpretation indicator is 0.86, analysis is 0.75, evaluation is 0.86, and inference is 0.89. Fourth, student learning outcomes classically get a percentage of 97.22%. Fifth, students give positive responses to implementing the problem-solving learning model assisted by student worksheets with a responses percentage of 94.61%. The result represented that the problem-solving learning model assisted by student worksheets can train students' critical thinking skills on reaction rate material.

Keywords: *Problem Solving Learning Model, Critical Thinking Skills, Reaction Rate*

INTRODUCTION

Education is one component related to a person's level of quality. Along with the development of the times, a person must continue to learn and prioritize education to achieve a better standard of living. Education is an effort for students to develop their abilities; this is done through a learning process [1]. Currently, the education system in Indonesia is guided by the 2013 curriculum, which requires learning to be student-centered and able to develop three aspects, including knowledge, attitudes, and skills [2,3]. The skill aspect in learning is emphasized on 21st-century skills. The National Education Association (n.d) identifies 21st-century skills as "The 4Cs," which include critical thinking and problem-solving, creativity, communication, and collaboration [4]. One of the skills students must possess as a provision for a competitive future is critical thinking [5].

Critical thinking is a skill in analytical thinking which includes understanding and identifying problems, synthesizing and connecting previously obtained knowledge or information, analyzing problem-solving strategies, and evaluating strategies that have been carried out [6,7]. Critical thinking skills make students view a problem from a different perspective and think correctly to solve it [8]. Students also learn to formulate their opinions, draw conclusions in systematic analysis, and are reflective of decision making [9,10]. Thus, critical thinking skills are extremely crucial and must be trained for students through to learning at school, particularly in chemistry.

Chemistry is a chapter of natural science in which the study of matter in terms of composition, structure, properties, changes, and the energy involved. Chemistry also discusses concepts, theories, and laws based on natural phenomena [11]. The material of reaction rate is one of the chemistry materials covered in senior high school. This material has characteristics that include abstract concepts, mathematical calculations, graphic presentations, and multiple representations (macroscopic, sub-microscopic, and symbolic), so students must learn to think critically in understanding the material [12]. Learning chemistry on the reaction rate material can be done by connecting the concept with the phenomenon being studied. The subject matter is connected with real-life phenomena, such as iron rusting, food spoilage, photosynthesis in plants, and many other reactions.

The researcher conducted a pre-research at senior high school 19 Surabaya and found that many students still had difficulty understanding chemistry. Most students still can not achieve the Minimum Completeness Criteria (MCC) in chemistry subjects. Students get low average scores in the context of reaction rate. They do not associate the concepts studied with actual phenomena or problems in everyday life, so they are less trained in developing critical thinking skills to solve the problems that arise during learning activities. In addition, the chemistry learning activities are still carried out teacher-centered. It makes students passive and rarely ask questions or express opinions. Students only listen, take notes, and memorize the material, so their critical thinking skills cannot develop optimally.

Based on these situations and problems, one alternative that is expected to be used to train critical thinking skills is a problem-solving learning model. Problem-solving was defined as an effort for students to participate actively in dealing with confusing situations and challenging their thinking to find acceptable solutions supported by facts, and providing the opportunity for students to learn new concepts from their prior experience [13]. Through the problem-solving learning model, students will interact in their discussion groups to clarify and elaborate ideas on solving the problems at hand to stimulate students to think critically [14]. Problem-solving will enhance the learning activities and support students to transfer knowledge for understanding real-life problems [15]. Implementation of problem-solving learning models is expected to make learning more meaningful exciting and stimulate creativity for students [2].

George Polya, in his book entitled "How to solve it," suggests that there are four steps that must be taken to solve problems, namely: 1) Understood the problem, 2) Device a plan, 3) Carry out the plan, and 4) Look back [16]. According to Gagne, learning by problem-solving is the most complex type of learning because it is related to other kinds of knowledge, especially the use of existing rules accompanied by analysis and inference. Therefore, training students to solve problems can increase their critical thinking skills [17].

In the learning process, problem-solving models will be maximized to practice critical thinking skills if assisted with student worksheets. Lestari in Sari et al. [18] explains that student worksheets are one learning media to help students understand the material easily, construct knowledge obtained independently, and make students active during learning activities. It is corroborated by Prianto & Harnoko in Sari et al. [18], student worksheets can help students obtain notes or information about concepts from material that has been taught systematically so that they can develop these concepts. Student worksheets used in learning can be designed according to the steps of the problem-solving learning models and are expected to upgrade and support students' critical thinking skills [18].

Applying the problem-solving model with student worksheets can improve learning achievement and critical thinking skills [17]. Furthermore, research supported Intani et al. [19] that enhancing students' critical thinking skills and learning achievement can be conducted by implementing problem-solving learning models equipped with student worksheets. Then research by Pratiwi & Azizah [20] shows that students' critical thinking skills are successfully trained by problem-solving learning models implementation.

Based on the description above, the researcher is interested in researching the implementation of a problem-solving learning model assisted by student worksheets that aim to train critical thinking skills on reaction rate material.

RESEARCH METHOD

The research methods used are Pre-Experimental with a “one group pretest-posttest design.” This research had no other comparison groups because it was only conducted on one sample group. The research design pattern is as follows:

$$\boxed{\mathbf{O_1\ X\ O_2}}$$

Information:
O_1: Pretest was given before treatment
; X: Given the treatment
; O_2: Posttest was given after treatment
[21]

The research was carried out at Senior High School 19 Surabaya in the odd semester on November 2021 during two meetings. The research subjects were 36 students of class 11^{th} grade MIPA 1 at Senior High School 19 Surabaya. The syllabus, lesson plans, and student worksheets as learning tools are used in this research. The research instruments included learning model implementation observation sheets, student activity observation sheets, pretest-posttest sheets of critical thinking skills and learning outcomes, and student response questionnaire sheets.

The procedure of this research was divided into the following three steps: planning, performance, and analysis of the data research. The planning steps begin with a literature study on critical thinking skills, student worksheets, problem-solving learning models, and material analysis of reaction rates. Followed by the planning of learning tools and research instruments, then a validation process is conducted by the validators to determine feasibility from research instruments and learning tools used. The performance steps include giving a pretest, applying a learning model with student worksheets, and giving a posttest and student response questionnaires. The last is an analysis of the data research. Data during the performance steps are analyzed according to the correct analytical technique.

Methods of data collection using tests, observation, and questionnaires. Data pretest-posttest of critical thinking skills and learning

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outcomes on the sub-material about reaction rate factors were collected using the test method. Data on the learning model implementation and student activities during learning were collected using the observation method. Last, student responses about implementing the problem-solving models assisted by student worksheets were collected using the questionnaire method. Data obtained from the research are quantitative and qualitative data. The following is a description of the data analysis technique was used in this research:

1. Analysis of the Implementation of the Problem Solving Learning Model

The implementation of the learning model was analyzed based on data obtained from the learning model implementation observation sheets using qualitative descriptive analysis. Assessment of the implementation of the learning model uses a scoring guideline, and then score ware analyzed by the following formula:

$$\%\, implementation = \frac{\sum The\ obtained\ score}{\sum Maximum\ score}\ x\ 100\%$$

Furthermore, the percentage of implementation scores is interpreted according to Table 1.

Table 1. Interpretation of Learning Implementation

Percentage (%)	Criteria
0-20	Very poor
21-40	Poor
41-60	Enough
61-80	Good
81-100	Very good

[22]

The application of the learning model is said to be implemented well if it gets a percentage of ≥61%.

2. Analysis of Students' Activities

Students' activities during learning activities were analyzed based on data obtained from student activity sheets using qualitative descriptive analysis. Observations of students' activities were done by three observers every 2 minutes for 60 minutes. The data obtained from the three observers were then averaged. Then the activity data were analyzed using the following formula:

$$\%\, activity = \frac{\sum activity\ that\ appears}{\sum Overall\ activity}\ x\ 100\%$$

[22]

Students' activities are good during learning if the percentage of students' relevant activities is higher than irrelevant activities.

3. Analysis of Critical Thinking Skills

Assessment of critical thinking skills uses pretest and posttest sheets with questions essay and covering four critical thinking indicators (interpretation, analysis, evaluation, and inference). The pretest-posttest data was analyzed by statistics using SPSS 23.0 and descriptive qualitative using N-gain score.

A normality test was carried out to determine the normality of the pretest-posttest data, in which this test was a prerequisite test. If the significance value (Sig.) > 0.05, the data is normally distributed. After that, the hypothesis was tested using the Paired Sample t-test with a significance level (α) = 0.05. The t-test was used to determine the significant difference between the pretest and posttest scores. According to the basis of decision making, the value of Sig. (2-tailed) < 0.05 means Ha is accepted. It can be said that there is a significant difference between pretest and posttest scores of critical thinking skills [23].

The next step is to calculate the N-gain score from the pretest and posttest data to assess the improvement of students' critical thinking skills using the following formula:

$$< g > = \frac{Posttest\ \ score -\ Pretest\ score}{maximum\ score -\ Pretest\ score}$$

Then the N-gain score is converted into criteria, as shown in Table 2.

Table 2. N-gain Criteria

N-gain score	Criteria
g ≥ 0.7	High
0.7 > g ≥ 0.3	Medium
g < 0.3	Low

[24]

If students get an N-gain score in the medium or high criteria, critical thinking skills can be trained well.

4. Analysis of Learning Outcomes

The learning outcomes assessment aims to determine whether or not a student's learning is complete after a problem-solving learning model was applied using a cognitive test. Individual learning mastery has been achieved if the value of ≥75 was obtained, which is the MCC value of Senior High School 19 Surabaya. Classical completeness is obtained if ≥75% of students have completed individual learning. The following formula can be used to calculate the percentage of classical completeness:

$$\%\, completenes = \frac{\sum students\ who\ complete}{\sum\ all\ students}\ 100\%$$

[22]

5. Analysis of Students' Responses

Students' responses data was obtained from response questionnaires to problem-solving learning models assisted by student worksheets distributed after learning activities. Response questionnaire data analysis was carried out using qualitative descriptive according to the Guttman scale that is shown in Table 3.

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Table 3. Guttman Scale

Answer	Score
Yes	1
No	0

The following formula is used to calculate the results of the response questionnaire:

$$\%\,Response = \frac{\sum students\ choose\ "Yes"}{\sum \text{all}\ students}\ x\ 100\%$$

The percentage of questionnaire responses is interpreted according to Table 4.

Table 4. Interpretation of Questionnaire Responses

Percentage (%)	Criteria
0-20	Very less
21-40	Less
41-60	Enough
61-80	Good
81-100	Very good

[22]

If the percentage is ≥ 61%, it means students respond positively to the application of the learning model.

RESULT AND DISCUSSION

Implementation of the Learning Model

The implementation of the problem-solving learning model was observed by three observers during two online meetings using learning model implementation observation sheets that have been adapted to the problem-solving model syntax in the lesson plan. The purpose of observing the learning model's implementation is to assess the quality and conformity between the teachers' learning stages in learning activities and the learning stages in a lesson plan.

The problem-solving learning model syntax consists of four phases, namely (1) understanding the problem, (2) device a plan, (3) carrying out the plan, and (4) looking back [16]. Observation data of problem-solving learning model implementation for two meetings is shown in Figure 1.

Based on Figure 1. Each stage of the learning model shows a percentage ≥ 61% so that the average percentage of implementation of the problem-solving learning model at meeting-1 is 96.57% and meeting-2 is 98.68%, with very good criteria.

The learning stages start from the introduction. In this introduction stage, the teacher starts the lesson by greeting, praying together, asking how things are, and checking students' attendance. Furthermore, the teacher relates the material that has been obtained previously with the material to be studied, motivates the presentation of pictures, and conveys the learning objectives. The average percentage in the introduction stage for two meetings was obtained at 100%. Both get very good criteria.

The core activities in learning include four phases from the problem-solving learning model syntax. Phase 1 is understanding the problem. In phase 1, the teacher distributes student worksheets containing phenomena that lead to problems so that students must understand and solve in groups by identifying the main problems. The average percentage obtained in phase 1 for two meetings is 98.61% and 100%, with very good criteria. It shows that percentage has increased.

Phase 2 is the device a plan. In phase 2, the teacher guides the students to design a problem-solving plan by formulating a problem formulation, submitting a hypothesis, and determining the experiment's variables that will carry out according to the instructions on the student worksheet. Learning activities in phase 2 for two meetings have increased with an average percentage of 95.83% and 100%, with very good criteria.

Phase 3 is carrying out the plan. In this phase, the teacher guides students in carrying out problem-solving plans prepared by presenting experimental videos, collecting and organizing experimental data, analyzing experimental data, and the evaluation process. Learning activities in phase 3 for two meetings have increased with an average percentage of 93.33% and 98.33%, with very good criteria.

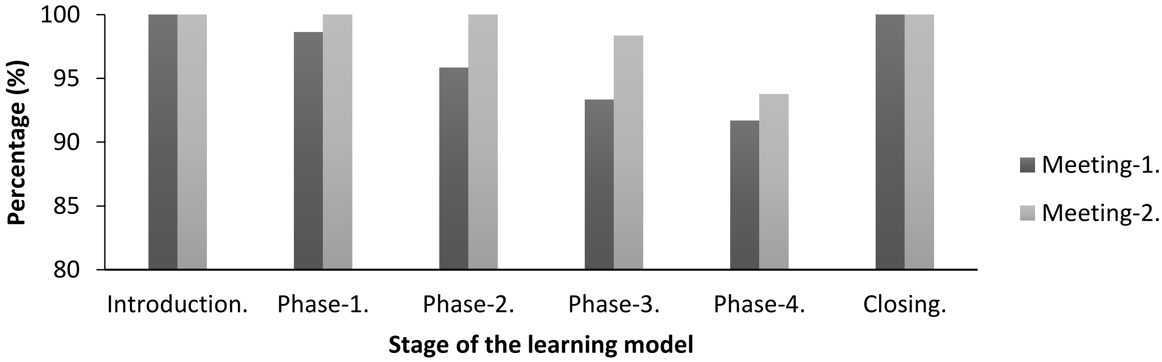

Figure 1. Percentage of Problem-Solving Learning Model Implementation

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Phase 4 is looking back. In phase 4, the teacher asks students to re-examine their problem-solving process and asks students to convey and conclude solutions according to the problem-solving result. In addition, the teacher also provides reinforcement or straightens things that are not appropriate to the problem-solving process carried out by students. The average percentage obtained in phase 4 for two meetings has increased by 91.67% and 93.75%, with very good criteria.

The last learning stage is closing. Closing activities include the teacher concluding the material that has been studied with the students, the teacher providing information regarding the next material, and praying together to end the lesson. The average percentage in the closing stage for two meetings was obtained at 100%. Both get very good criteria.

The teacher's role in applying the problem-solving learning model is a motivator, facilitator, and learning dynamist for students, either individually or in groups [25]. The teacher in this study applies a problem-solving learning model assisted by student worksheets containing material, practical instructions, and practice questions to be solved by discussion. In this way, effective interactions can be formed between teacher and students and give students an opportunity to think critically to solve a problem [26,19].

The results conclude that the problem-solving learning model had been implemented very well, which was indicated by an increase in the average percentage for two meetings. The teacher has carried out a series of learning activities following the steps of the problem-solving learning model assisted by student worksheets. Students' critical thinking skills in solving problems can be trained. The previous research supported these statements, which explained that critical thinking skills were successfully trained to students by the implementing syntax of the problem-solving learning model, with the percentage of implementation in good and excellent criteria [20].

Students’ Activities

Students’ activities during the online learning process were observed by three observers using the student activity observation sheet. Each observer can do observed three groups of four students. The students' activities were observed as the dominant activity that appeared every 2 minutes with an allotted 60 minutes in the online learning process. The aim of observing students' activities is to determine the suitability of relevant activities that students were doing with problem-solving learning models and determine whether students have practiced developing critical thinking skills in the learning process. The data from observing students' activities during two meetings are presented in Table 5 below:

Based on Table 5. Students' activities consist of relevant activities shown in numbers 1-14 and irrelevant activities in number 15. Students’ relevant activities were assisted by student worksheets that included critical thinking indicators, namely interpretation, analysis, evaluation, and inference [27].

Students formulate a problem formulation, determine experimental variables, and collect experimental data in the interpretation indicators. In the analysis indicator, the students analyze the experimental data by answering questions on the student worksheets. In the evaluation indicators, students answer evaluation questions, and the last is inference indicators; students submit hypotheses to answer the problem formulation and draw conclusions.

Teaching and learning activities assisted by student worksheets adapted to step of problem-solving models and critical thinking indicators can support student learning activities. This statement agrees with the research conducted by Hadi [28] and Choirudin et al. [26] that student worksheets will encourage students to participate more actively in learning, growing the learning potential and increasing the learning achievement.

Based on the study results, the percentage of relevant activities for two meetings was 91.69% and 93.79%, respectively, while the irrelevant activities were 8.31% and 6.21%. The results indicate that the students have carried out activities to practice critical thinking skills very well, with a higher percentage of relevant activities than irrelevant activities. Thus, it can support problem-solving learning models implementation to practicing a critical thinking skill.

Critical Thinking Skills

Critical thinking is an organized process that involves mental activity [29]. Facione [27] says six indicators of critical thinking skills, including interpretation, analysis, evaluation, inference, explanation, and self-regulation. However, only four indicators were trained in this research, namely interpretation, analysis, evaluation, and inference, because they were adapted to the material.

Assessment of critical thinking skills that have been trained using pretest and posttest sheets with essay or description questions. The pretest is carried out before learning, and the posttest is carried out after learning. The results of pretest-posttest scores were tested for prerequisites using the normality test with SPSS version 23.0 to determine the normality of data distribution. The normality test was carried out using Kolmogorov-Smirnov test. The following results of the normality test are obtained in Table 6.

Based on Table 6. The normality test resulted in a significant value for the pretest is

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0.155, and the posttest is 0.200. These results indicate that both Sig. values > 0.05, which means that the pretest and posttest data are normally distributed [23]. Furthermore, tested the hypothesis using the Paired Sample T-test with a significance level (α) = 0.05 to determine the significant difference between the pretest and posttest scores. The results of the test are presented in Table 7.

Table 5. Students' Activities Observation Data

Students' Activities	Percentage (%)	
	Meeting 1	Meeting 2
1. Answering greetings through google meet	9.97	9.63
2. Paying attention to the apperception and motivation given by the teacher through google meet	8.31	8.39
3. Respond to questions related to apperception and motivation given by the teacher through google meet	5.65	5.90
4. Reading phenomena on student worksheets	7.64	7.76
5. Determine the main problems contained in the phenomenon and convey it through google classroom or google meet	5.98	6.52
6. Making a problem formulation and conveying it through google classroom or google meet **(Interpretation)**	4.65	4.97
7. Making hypotheses and presenting them through google classroom or google meet **(Inference)**	5.32	5.59
8. Determining experimental variables and conveying them through google classroom or google meet **(Interpretation)**	6.98	6.83
9. Observing experimental videos displayed through google meet	9.30	9.01
10. Collecting and organizing data based on experimental videos and presenting them through google classroom or google meet **(Interpretation)**	6.64	6.52
11. Analyzing data based on experimental videos by answering questions on the student worksheet **(Analysis)**	5.32	5.90
12. Answering evaluation questions and presenting them through google classroom or google meet **(Evaluation)**	5.65	6.21
13. Drawing conclusions and conveying them through google classroom or google meet **(Inference)**	6.98	6.83
14. Presenting experimental video observations through google meet	3.32	3.73
Percentage of Relevant Activities	**91.69**	**93.79**
15. Irrelevant activities outside of learning activities	8.31	6.21
Total	**100**	**100**

Table 6. Normality Test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	,127	36	,155	,950	36	,107
Posttest	,120	36	,200*	,930	36	,024

Table 7. Paired Sample T-test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std.Error Mean	95% Confidence Interval of the Difference: Lower	Upper			
Pretest - Posttest	-69,14639	8,05038	1,34173	-71,87024	-66,42253	-51,535	35	,000

Based on Table 7. The result of the t-test was obtained Sig. (2-tailed) = 0.000. It follows the basis of decision-making that if the significance value < 0.05, H_o is rejected, and H_a is accepted [23]. Thus, it can be concluded that there is a significant difference between pretest and posttest

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scores of critical thinking skills before and after learning.

In addition, the N-gain test was performed on the pretest-posttest scores for each indicator of critical thinking skills. The N-gain test is used to measure the enhancement of students' critical thinking skills between before and after learning. The following results of the N-gain test are shown in Table 8.

From the data in Table 8. each score on the indicator of critical thinking skills were being trained for two meetings has increased; as evidenced by the average of pretest score is higher than posttest score and have an N-gain score in high criteria. This increase indicates that the implementation of problem-solving learning models can train critical thinking skills so that the students' thinking abilities become more critical for identifying problems, solving problems, analyzing, and making conclusions.

Interpretation is defined as the ability to express and comprehend the intent of a situation, experience, data, assessment, procedure, rule, or various criteria [27]. Interpretation indicators are trained to students through activities to formulate the problems from a phenomenon presented on student worksheets, identify experimental variables, and collect and organize experimental data. Measurement of interpretation indicators using pretest and posttest sheets. The average result of the pretest score of the interpretation indicator is 19.56, which means it is very low because students write the problem formulation that is not correct, does not match the phenomenon, and is not in the form of questions that contain variables. In addition, students also cannot determine the experimental variables correctly and cannot interpret the experimental data into tables. While the average posttest score of the interpretation indicator was 88.54, this result was higher than the pretest score. It means that students correctly answer the questions so that the interpretation indicators are successfully trained, and the N-gain score is 0.86 in high criteria.

Analysis indicators require students to connect information and concepts with the questions contained in the problem [27]. Analysis indicators are trained in phase 3 on the problem-solving learning model syntax, namely by doing analysis questions on student worksheets. The analysis indicators were tested using a pretest-posttest sheet. Pretest and posttest scores of analysis indicators have an average of 18.75 and 79.17; this result has increased. In this case, students can analyze the relationship between the concept of the reaction rate factors and the phenomenon's problems. Thus, the analysis indicators were successfully trained, and the N-gain score of analysis indicators is 0.75 in high criteria.

Evaluation is defined as the ability to appraise the credibility of representations or statements and to be able to logically evaluate the relation between ideas, explanations, concepts, and questions [27]. Evaluation indicators are trained during learning activities with problem-solving models through working on evaluation questions in student worksheets. To measure the evaluation indicators can use the pretest and posttest sheets. Pretest and posttest scores of evaluation indicators have an average of 17.01 and 88.54. Based on these results, the posttest score is better because students can assess the quality of the relationship between concepts and questions using inductive or deductive reasoning. The N-gain score of the evaluation indicator is 0.86, with high criteria.

Inference indicators invite students to identify the elements needed in making conclusions by considering information relevant to a problem [27]. Inference indicators are trained through phases 2 and 4 on the problem-solving learning model syntax, namely by proposing hypotheses and drawing conclusions from the problem-solving process. Assessment of inference indicators was carried out using pretest and posttest sheets. The test results have increased with the N-gain score of inference indicator is 0.89 in high criteria. It means the inference indicator has been successfully trained.

The results of improving students' critical thinking skills cannot be separated from the assistance of student worksheets during learning activities. Student worksheets have a quite important role, namely as a medium to facilitate the achievement of learning objectives. Student worksheets also serve as a guide during the learning process to stimulate the students to think critically through problem-solving and analytical questions.

Based on the results using the t-test and N-gain test, it is known that there are significant differences in the pretest-posttest scores of critical thinking skills between before and after learning, as well as the N-gain scores was obtained in high criteria. Thus, it can be concluded that the implementation of the problem-solving learning models assisted by student worksheets can train students' critical thinking skills.

The result is reinforced by the study of Pratiwi & Azizah [20] that critical thinking skills are successfully trained by applying the problem-solving learning model. In addition, it also follows the study results by Hidjrawan et al. [30], who argue that the application of the problem-solving learning model is effective in improving critical thinking skills. Thus, learning by presenting problems to be solved is very influential on students' critical thinking skills [31].

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Table 8. N-gain Test

Indicator	Pretest	Posttest	N-gain	Criteria
Interpretation	19.56	88.54	0.86	High
Analysis	18.75	79.17	0.75	High
Evaluation	17.01	88.54	0.86	High
Inference	18.23	90.97	0.89	High

Learning Outcomes

Learning outcomes are the success achieved by students and can be regarded as an indicator of the achievement of learning objectives. Learning outcomes were measured using a cognitive test sheet containing ten multiple-choice questions about reaction rate factors material. Learning outcomes assessment aims to measure students' knowledge and completeness learning after implementing the problem-solving learning model assisted by student worksheets. Students have completed their learning outcomes if they score above the MCC, which is ≥ 75.

From the total students in class 11th grade MIPA 1, there are 35 students complete and one student incomplete, so classical completeness learning outcomes are obtained with 97.22%.

It indicates that the final ability of students is very good and can be said to have mastered the cognitive aspects of reaction rate factors. Learning outcomes are influenced by the quality of the teacher when explaining the subject matter, which results in students' interest and motivation to learn [32]. In addition, learning outcomes are also influenced by strategies, methods, and models that are used appropriately in learning activities [33]. In this case, the use of problem-solving models assisted by student worksheets is appropriate and able to make students practice to enhance their thinking abilities, achieve completeness and improve learning outcomes.

The previous research states that applying the problem-solving learning model in science learning can increase students' learning outcomes [2]. Furthermore, research by Ernida et al. [34] also suggested that students will more easily understand the material when their thinking skills are successfully trained, evidenced by improved students' cognitive learning outcomes after the problem-solving learning model was applied.

It can strengthen the results of this research.

Students' Responses

After completing the learning activities, students' responses were obtained from response questionnaires distributed via the google form link at the last meeting. The response questionnaire aims to determine how students responded to learning activities using the problem-solving learning models assisted by student worksheets on the reaction rate material. In addition, it is also a material for teacher introspection on the weaknesses and strengths during teaching and learning activities. Here is the data from questionnaire responses of learning implementation in Table 9.

Table 9. Result of Students' Questionnaire Responses

Questions	Percentage (%)	Criteria
1	91.7	Very good
2	86.1	Very good
3	83.3	Very good
4	94.4	Very good
5	94.4	Very good
6	97.2	Very good
7	94.4	Very good
8	97.2	Very good
9	100	Very good
10	100	Very good
11	97.2	Very good
12	97.2	Very good
13	94.4	Very good
14	97.2	Very good
15	94.4	Very good
Average	94.61	Very good

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Based on Table 9. The response questionnaire contains 15 questions regarding the problem-solving learning process and student worksheets. Each question has received a positive response because the percentage is ≥ 61% [22]. The results showed that the average percentage obtained from all questions in the response questionnaire was 94.61%, with very good criteria.

It indicates that implementing the problem-solving learning model assisted by student worksheets to practice critical thinking skills has been successful because the students gave a positive response.

According to the proposed by Hidjrawan et al. [30], students gave a positive response to the implementation of the problem-solving learning model that can improve critical thinking skills. In addition, students' positive response to learning chemistry with applying the problem-solving model can make students happy and motivated to participate in learning [34].

CONCLUSION

Based on the results of research and discussion, it can be concluded that the implementation of the problem-solving learning models assisted by student worksheets can train students' critical thinking skills on the reaction rate material. It is supported by implementing the learning model in very good criteria. The student's relevant activities were increased from the 1st meeting to the 2nd meeting. The cognitive learning outcomes obtained are very good. The students get completeness of learning. Students' critical thinking skills have improved after applying the problem-solving learning model with N-gain in high criteria, and students give a positive response to the applied learning. Furthermore, it's recommended to conduct research using a problem-solving learning model with various strategies, approaches, and learning media on the other chemistry materials to train critical thinking skills.

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