Integrating Culturally Responsive Teaching into Discovery Learning to Enhance Problem-Solving Skills and Learning Outcomes in Chemistry

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ABSTRACT

This research aimed to increase problem solving ability (KPM) and student's learning achievment in chemistry trough the implementation of the Culturally Responsive Teaching (CRT) approach integrated with the Discovery Learning (DL) model. The research was counducted in grade XF of SMA Negeri 2 Palu withs in 36 students during the 2024/2025 academic year, using the Kemmis and McTaggart model for two cycles, where each cycle consists of the planning, implementation & observation, and reflection stages. The data were collected using problem solving (KPM) test, learning achievement tests and observation will be analyzed quantitatively and qualitatively. The results showed that problem-solving ability, which were initially in the very low to moderate category, improved to the moderate to very good category at the end of cycle II. The average learning outcome showed an increase from 56% to 86%. The application of the CRT approach indicates the integration of local culture, such as the use of examples of making utakelo and kaledo foods, as well as the burning of lalampa in explaining Lavoisier, Proust, and Dalton's laws, making it easier for students to understand the concepts and be more active in the learning process. Thus, the application of CRT has been proven to improve problem-solving skills and learning outcomes in chemistry learning.

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INTRODUCTION

Problem-solving skills (KPM) have been agreed to be the goal of Indonesian education and one of the key skills to face life in the 21st century. The importance of KPM is contained in the independent curriculum in the chemistry subject objectives section where students can develop the ability to innovate to produce a product that is able to solve problems. Problem-solving is the process of formulating a problem, exploring solutions, and implementing the best solution to a new situation (Yu et al., 2015). KPM is the ability to analyze solutions to the problems presented. Students who have good KPM mean they are able to think in accordance with scientific principles. This is in line with research that states that studying chemistry can begin with contextual and practical problem-solving. The level of problem-solving ability can be measured, one of which is through (Wicaksono & Korom, 2022) (Ojeda et al., 2021) (Bilican Demir, 2018) Sulistiyanti et al., (2021) *the IDEAL problem solving* test with phases starting from I:*Identify problem*, D:*Define goal*, E:*Explore possible strategies*, A:*anticipate outcomes and act*, and finally L:*look back and learn* (Rokhim et al., 2022) .

The implementation of learning to train KPM students can be categorized into two, namely *problem solving as a "problem of assessment"* and *problem solving as a "problem of learning"*. *Problem solving as a "problem of assessment"* begins with students learning traditional scientific skills and concepts and then working on problem-solving problems, while *problem solving as a "problem of learning"* involves students in scientific research to find solutions to new problems that have never been experienced. One of the effective approaches used in practicing problem solving is (Al Assaf, 2019) *the Culturally Responsive Teaching* (CRT) approach. The CRT approach is a learning approach that makes local culture or wisdom as a real example of learning material packaged into learning content. The CRT approach creates an inclusive and contextual learning environment. (Antika Sri et al., 2023)

KPM students can also be optimally trained with the right learning model. Some of the learning models that can be used to practice problem solving are (Gunawan et al., 2020) *Problem Based Learning* (PBL), *Creative Problem Solving* (CPS), *Contextual Teaching and Learning* (CTL), and inquiry. Inquiry-based learning facilitates learners to acquire scientific knowledge in the same way that science includes content knowledge (concepts and ideas), procedural knowledge (procedures and strategies used in all forms of scientific inquiry) and epistemic knowledge (the way in which ideas are justified and guaranteed in science). inquiry-based learning model, one example is the (Harefa & Surya, 2021) *Discovery Learning model* (Ojeda et al., 2021) .

Based on the results of the diagnostic assessment (*pretest*), it is known that the KPM of class XF students in chemistry subjects at SMA Negeri 2 Palu is still low. Based on the observation data, learning is often carried out with lectures so that it is centered on the teacher. This is also coupled with the low interaction between teachers and students. In addition, only a few students are active in the classroom. Based on this background, the researcher is interested in conducting classroom action research related to improving students' problem-solving abilities and learning outcomes by using the *Culturally Responsive Teaching* (CRT) approach integrated with *the Discovery Learning* (DL) model in chemistry learning in class XF SMA Negeri 2 Palu.

RESEARCH METHODS

The design of this research is a Classroom Action Research (PTK) conducted at SMA Negeri 2 Palu for the 2024/2025 school year with 36 students in class XF. This research was carried out in two learning cycles. The research design used is adapted from the design of Kemmis & Mc. Taggart with three stages, namely *planning*, implementation (*Action*) & observation (*Observing*), and *reflection (Reflecting*). The research design used can be seen in Figure 1 below.

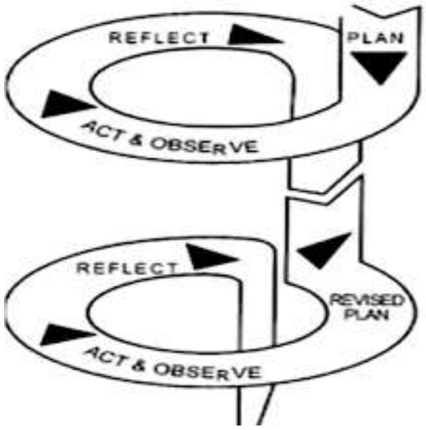

Figure 1. Kemmis & Taggart's Model Class Action Research Cycle (Kemmis, S., McTaggart, R., & Nixon, R., 2014)

This study uses data collection techniques in the form of observation and KPM tests and learning outcomes. Observation is used to determine how teachers plan and implement learning actions in the classroom, as well as to find out the affective and psychomotor aspects of students. Observation data will be analyzed qualitatively. The test is used to measure students' problem-solving skills and learning outcomes. Test data will be analyzed quantitatively (percentage). Learning is effective if students have postest scores above KKM (Value 75) and have a minimum moderate KPM category. ≥

RESULTS AND DISCUSSION

This research aims to improve Problem Solving Skills (KPM) and student learning outcomes. Students' low problem-solving ability can be caused by various things. Based on observation data, learning tends to be carried out by conventional methods (lectures). Students have difficulty understanding chemistry concepts because learning has not been presented contextually, so their understanding tends to be abstract. This is supported by the statement that chemistry as an abstract science requires contextual-based learning strategies to make it easier for students to understand. This condition has an impact on the low activity of students in learning activities. This is also supported by Wardani et al., (2023) the low results of the initial KPM test for class XF students of chemistry subjects at SMAN 2 Palu. The percentage of diagnostic assessment results can be seen in Table 1 and Table 2 below.

Table 1
Diagnostic Assessment Results (*Pretest*) KPM Class XF

Category	Range	*Pretest*	
		Frequency	Present (%)
Very High	81 – 100	2	6%
Tall	61 – 80	5	14%
Keep	41 – 60	13	36%
Low	21 – 40	6	17%
Very Low	0 – 20	10	28%
Sum		36	100%

Table 2
Diagnostic Assessment Results (*Pretest*) of Class XF Learning Outcomes

Category	Range	*Pretest*	
		Frequency	Present (%)
Conclusion	75 – 100	11	31%
Incomplete	0 – 74	25	69%
Sum		36	100%

The results of the diagnostic assessment showed that most students had low KPM supported by learning outcomes of 69% which showed that more than half of the students did not understand the basic concepts that became the foundation of learning, so a more contextual learning strategy was needed so that their understanding could gradually improve. The results of diagnostic assessments are important to be used as a basis for mapping students' initial abilities as the basis for determining the right learning strategy. (Rahaman et al., 2024)

In cycle I, teachers began to apply the CRT approach by associating Lavoisier's legal material to contextual examples in the form of utakelo food, kaledo, and lalampa burning and then directed to the reaction of the formation of one of the compounds in the example. This helps students understand that typical foods can be related to the reaction of the formation of compounds which are then related to the total mass of the fixed so that it is in accordance with the concepts of Lavoisier's Law and Proust's Law. This is supported by the fact that the integration of local cultures can help learners relate concepts to everyday experiences. The results of the observation also show that some students are starting to be more active in asking questions and discussing, although some are still passive. Research indicates that the implementation of CRT is able to maximize student involvement. The data on the comparison of Snoop Dogg et al., (2024) Rahmawati et al., (2020) *the results of the pretest* (diagnostic assessment) and *posttest* of the first cycle of KPM is shown in Table 3, while the comparison data *of the pretest* and *posttest of* the learning outcomes of cycle II is shown in Table 4 below.

Table 3
Comparison of KPM Cycle I Students

Grade Categories	Value Interval	*Pretest*		*Postest*	
		Frequency	Present (%)	Frequency	Present (%)
Very High	81 – 100	2	6%	4	11%
Tall	61 – 80	5	14%	13	36%
Keep	41 – 60	13	36%	12	33%
Low	21 – 40	6	17%	6	17%
Very Low	0 – 20	10	28%	1	3%
Sum		36	100%	36	100%

Table 4
Comparison of Learning Outcomes of Cycle I Students

Grade Categories	Value Interval	*Pretest*		*Postest*	
		Frequency	Present (%)	Frequency	Present (%)
Conclusion	75 – 100	11	31%	20	56%
Incomplete	0 – 74	25	69%	16	44%
Sum		36	100%	36	100%

Based on Tables 3 and 4, in the first cycle the average score of students' problem-solving ability and learning outcomes showed an increase, but this achievement did not meet the target because there were still 16 people (44%) students who had not obtained the Minimum Completeness Criteria (KKM) score. As in the study, the application of CRT at the initial cycle stage can improve learning outcomes, although it has not reached the optimal level. Septiani et al., (2024)

After reflecting, in the second cycle learning was improved by strengthening collaborative activities, varying learning media, and encouraging the participation of all students in discussions. The application of CRT to *Discovery Learning* learning is carried out through more structured syntax stages. At the stimulation stage, the teacher shows a video of the burning of Sulawesi lalampa to stimulate students' curiosity. The video leads to both perfect (CO_2) and imperfect (CO Gas) combustion reactions. Furthermore, at the *Problem Statement stage*, students were directed to discuss the relationship between the mass ratio of C and O in the compounds CO and CO_2. At the Data *Collection stage*, students observe the mass of elements C and O, and make simple calculations about the comparison of the masses C and O. Then at the data processing stage, students analyze that the comparison of the masses C and O in CO and CO 2 gases is in accordance with the concept of Dalton's Law. The verification stage is carried out with a group presentation, where students present the results of their analysis and relate it to chemical concepts. In the final stage of drawing conclusions (*Generalization*), the teacher and the students concluded that if two elements form more than one compound, then the ratio of the mass of the first element reacting with the mass of the second element that is constant will always be in the form of an integer and simple according to the concept of Dalton's Law.

With the above steps, learners are not only more active, but also feel that learning has a meaning that is close to their lives and culture. The data on the comparison of *the pretest* and *postest* results of the second cycle of KPM is shown in Table 5, while the comparison data *of the pretest* and *postest* of the second cycle learning outcomes is shown in Table 6 as follows.

Table 5
Comparison of KPM Cycle II Students

Grade Categories	Value Interval	Pretest		Postest	
		Frequency	Present (%)	Frequency	Present (%)
Very High	81 – 100	2	6%	6	17%
Tall	61 – 80	10	28%	20	56%
Keep	41 – 60	15	42%	9	25%
Low	21 – 40	3	8%	1	3%
Very Low	0 – 20	6	17%	0	0%
Sum		36	100%	36	100%

Table 6
Comparison of Learning Outcomes of Cycle II Students

Grade Categories	Value Interval	Pretest		Postest	
		Frequency	Present (%)	Frequency	Present (%)
Conclusion	75 – 100	17	47%	31	86%
Incomplete	0 – 74	19	53%	5	14%
Sum		36	100%	36	100%

The application of the CRT approach in cycle II, the results showed the development of student learning outcomes from 47% to 86%. The results of the study also showed that there was an increase in KPM and learning outcomes from postest results in cycle II compared to cycle I with comparative data on problem-solving skills in table 7 and learning outcomes in table 8 as follows.

Table 7
Comparison of KPM *Postest* Results for Students

Grade Categories	Cycle I		Cycle II	
	Frequency	Present (%)	Frequency	Present (%)
Very High	4	11%	6	17%
Tall	13	36%	20	56%
Keep	12	33%	9	25%
Low	6	17%	1	3%
Very Low	1	3%	0	0%

Table 8
Postest Comparison of Student Learning Outcomes

Grade Categories	Value Interval	Cycle I		Cycle II	
		Frequency	Present (%)	Frequency	Present (%)
Conclusion	75 – 100	20	56%	31	86%
Incomplete	0 – 74	16	44%	5	14%

This is in line with research that shows that collaborating ethnochemistry into CRT learning can maximize students' cognitive learning outcomes. In addition, classroom action research by reinforces the idea that the integration of CRT based on local culture adds to the appeal of learners as does the use of videos that help learners understand the learning material visually. The results of this study's observation show a significant increase in affective and psychomoral aspects that support the improvement of KPM and student learning outcomes. Thus, the concept of the basic laws of chemistry can be better understood through the Wardani et al., (2023) Snoop Dogg et al., (2024) *Culturally Responsive Teaching* approach that utilizes local culture as a learning context.

CONCLUSION

This class action research shows that the application of *the Culturally Responsive Teaching* (CRT) approach integrated with *the Discovery Learning* (DL) model is effective in improving the problem-solving skills (KPM) and outcomes of class XF students of SMA Negeri 2 Palu on the basic laws of chemistry. The application of CRT through the integration of local cultures, such as the making of utakelo and kaledo, as well as the burning of lalampa in the concepts of Lavoisier's Law, Proust, and Dalton helps students understand the concept of chemistry in a more contextual and meaningful way. The learning outcome data showed an increase from 56% to 86%, as well as an increase in KPM which was originally in the very low to medium category to the medium to very good category at the end of cycle II.

Teachers are advised to be able to integrate local culture in chemistry learning to strengthen students' understanding, and to be able to combine the CRT approach with other learning models. Schools are expected to support the implementation of CRT by providing contextual learning resources based on local culture. Further research can develop the implementation of CRT on other chemical materials and add other evaluation instruments such as interviews or reflections of students, as well as use statistical tests to determine the relationship between KPM and learning outcomes.

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