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Elevating Problem-Solving Prowess: The Impact of ICT-Assisted ReCODE Learning Model on Class VIII Students' Problem-Solving Skills at SMPN 18 Makassar

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Abstract: Problem-solving skills are one of the 21st-century skills that are important to improve, especially in the field of science. However, some studies show that students' problem-solving skills are still low. This study aims to determine the effect of the ICT-assisted Reading, Connecting, Observing, Discussing, Evaluating (ReCODE) learning model on students' problem-solving skills. This research is a quasi-experimental research with Pretest-Posttest Nonequivalent Control Group Design research design. The study population was all students of class VIII SMPN 18 Makassar. Sampling using a purposive sampling technique which consisted of experimental class and control class. The instrument used was an essay test instrument with data collection methods using pre-test and post-test results. Data were analyzed using descriptive and inferential statistical analysis. The results of the analysis were obtained t_{count} = 2.4 > t_{table} = 1.67 which means H_0 is rejected and H_1 is accepted. Based on these results, it can be concluded that the ReCODE Learning model assisted by ICT affects the problem-solving skills of class VIII students of SMPN 18 Makassar.

Keywords: Problem-solving skills; ReCODE; STAD

Introduction

Knowledge is not enough for students to succeed in the world. The 21st century has made it even more important for education to provide multi-skilled and technologically proficient students (Zubaidah, 2020). Students need to acquire 21st-century skills such as problem-solving, creativity, innovation, metacognition, communication, and critical thinking (Hamzah, 2023). Problem-solving is a process involving systematic observation and critical thinking to find the right solution or approach to achieve a goal (Rahman, 2019).

Problem-solving is an activity of students using the scientific method to solve problems by the theory they have learned. The importance of problem-solving skills is the ability of students to deal with problems by connecting them to their scientific concepts, thus enabling their skills to be used scientifically (Susiati et al., 2020). Problem-solving skills help students to be creative, logical, critical and more confident in a variety of problem situations. This process prioritizes the strategic steps that students take to solve problems (Diansyah et al., 2018; Putri et al., 2022). These strategies are organized in an indicator formulated by Greeinstein (Greeinstein, 2012), namely understanding the problem, extracting information and developing a solution plan, implementing the solution plan, and evaluating the results.

Students' ICTs become urgency when it is found that these skills are still low, especially in science learning. Diansyah et al. (2018), mentioned that during the science learning process, students' problem solving skills are still low. Accordingly, the results research of Nova et al. (2021), also show that 79% of students still

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have low problem solving skills. This percentage is included in the high category so it is necessary to improve students' problem solving skills.

One of the problems that causes low problem solving skills is that there are still many students who are not realizing the knowledge and skills in solving the problems they face. The learning process is still teacher-centered so students are less interested in finding and building their concepts of learning materials. Learners are less given space to express their thinking creations so students are passive in learning (Nova et al., 2021; Zakiyah et al., 2018). This causes students to be less practiced in developing problem-solving skills and applying the concepts learned at school in everyday life. Therefore, it is necessary to improve students' problem solving skills.

Improving problem solving skills in learning activities can be achieved by integrating them into learning which aims to improve the quality of learning. (Saenab, 2019; Sinta et al., 2019). It can also be achieved by helping learners develop participation, encouraging cooperation and communication, increasing learner engagement and motivation, emphasizing student-centred learning, and designing learning activities that are relevant to the real world (Zubaidah, 2019). Students' preference for a learning model that actively engages them will make the learning process more meaningful (Yuberti et al., 2019).

The Reading, Connecting, Observing, Discussing, and Evaluating (ReCODE) learning model is one of the constructivist learning models that can improve students' problem solving skills. This learning model is student-centered which can guide students to improve critical thinking skills and be able to bring up ideas or ideas of students in learning (Saenab, 2022). It will help students to develop problem-solving skills because it facilitates two key skills in the problem-solving framework, namely observation and critical thinking skills (Rahman, 2019).

The syntax in the ReCODE learning model is Reading phase, Connecting phase, Observing phase, Discussing phase, and Evaluating phase (Saenab, 2019). The results of research by Sockalingam et al. (2011) and Veli (2014), show that students have difficulty in developing problem solving skills because they do not understand the basic concepts. Through the Reading phase, students will have prior knowledge so that it is easier to construct new information obtained to help students in problem-solving. The Connecting phase provides opportunities for students to connect the results of reading activities with class topics so that they can make connections (meaningful learning). The Observing phase provides opportunities for students to build knowledge based on real experiences interacting with the environment through investigation. These learning activities will help students to construct science concepts so that it can support students to develop problem-solving skills (Nasriyanti et al., 2021). The Discussing phase is the phase where students express arguments for solving the problems that happen. Students will discuss, debate and critically analyze alternatives to overcome each problem that occurs (Astuti, 2019). The Evaluating phase facilitates students to train problem-solving skills indicators, namely Evaluation and reflection (Kurniawati et al., 2012).

The syntax of the ReCODE learning model described above, of course, will be more efficient if assisted by Technology, Information and Communication (ICT). Some research results show that ICT is an important part of learning activities where ICT can be a source of information in the form of online materials or videos and applications, become a medium for delivering information to facilitate the learning process (Effendi et al., 2019; Hartami, 2020; Supiandi et al., 2018). Therefore, the ReCODE learning model will adapt to this condition.

This study aims to determine the level of students' problem-solving skills before and after the implementation of the Reading, Connecting, Observing, Discussing, Evaluating (ReCODE) learning model supported by ICT, the level of students' problem-solving skills before and after the implementation of the STAD Cooperative learning model, the improvement of students' problem-solving skills after the implementation of the ICT-supported Reading, Connecting, Observing, Discussing, Evaluating (ReCODE) learning model and the STAD cooperative learning model, as well as the effect of the ICT-supported Reading, Connecting, Observing, Discussing, Evaluating (ReCODE) learning model on students' problem-solving skills.

Method

This research is quasi-experimental research using Pretest-Posttest Nonequivalent Control Group Design. The research was conducted at SMPN 18 Makassar. The study population was all students in class VIII of SMP Negeri 18 Makassar in the 2022/2023 school year consisting of ten classes with a total of 300 students. The sample selection was conducted using purposive sampling technique, which is a sampling technique with certain considerations (Sugiyono, 2019), So that two sample classes were obtained, namely class VIII.8 as an experimental class with the treatment of the ReCODE learning model assisted by ICT and class VIII.6 as a control class using the STAD type cooperative learning model, each of which had 25 students. This research design is presented in Table 1.

Table 1. Research Design

Class	Pretest	Treatment	Postest
Experiment	O_1	X	O_2
Control	O_3	-	O_4

This research uses problem-solving skills test instruments in the form of essay questions consisting of 10 items that have been made based on 4 indicators of problem-solving skills. Data collection was carried out after students were given treatment, namely the application of the ReCODE learning model assisted by ICT. The data obtained were then analyzed using descriptive statistical analysis and inferential statistical analysis. Descriptive statistical analysis is statistics used to analyze data by describing without making general conclusions, while inferential statistical analysis is statistics used to analyze data that can be generalized to the entire population (Sugiyono, 2019).

Result and Discussion

Problem-solving is a fundamental process used to identify a problem by considering options and making choices based on information. Problem-solving is used when routine solutions do not exist (Greeinstein, 2012). Problem-solving skills are a human's ability to find a problem, find a solution and implement the solution. Problem-solving is a thought process that connects past experiences with existing problems and then looks for solutions. Furthermore, it is explained that the characteristics of problem-solving are the existence of a cognitive process that can be seen from changes in the behavior of students to produce behavior that leads to finding solutions and the latter is a process that involves the dimensions of knowledge to find solutions (Siswani et al., 2021).

Table 2. Results of Descriptive Statistical Analysis of Problem-Solving Skills of Students

Statistics	Experiment Class		Control Class	
	Pretest	Posttest	Pretest	Posttes
Total Sample	25	25	25	25
Highest Score	28	38	25	33
Lowest Score	3	21	10	18
Average Score	16.20	26.68	16.04	24.04
Std. Deviation	5.32	3.97	4.21	3.87
Variance	28.31	15.81	17.79	15.04

Table 2 shows the average score of students' problem solving skills in the experimental class is higher than the control class. The average score of the problem-solving skills test in the experimental class increased by 10.40 while the control class increased by 8.

Table 3. Category Description of Posttest Score of Students' Problem Solving Skills

Score Interval	Category	Experiment Class		Control Class	
		Total Students	Percentage	Total Students	Percentage
26-40	High	13	52%	9	36%
13-25	Medium	12	48%	16	64%
0-12	Low	0	0%	0	0%

Table 3 shows that the percentage of students who obtained the high category in the experimental class was higher than the percentage of students in the control class. Although there were no students in the low category in both groups, the percentage of students in the experimental class showed better results than the control class. Based on Table 2 and Table 3, it is found that the average score in the experimental class is higher than the control class. In addition, it was also obtained that in the categorization of students' problem-solving skills, the experimental class achieved a higher percentage in the high and medium categories. This proves that the experimental class that was taught by applying the ICT-assisted ReCODE learning model obtained better results than the control class that used the STAD Type Cooperative learning model. The ICT-assisted ReCODE learning model which is built on the constructivist learning paradigm puts students as the center of learning (Saenab, 2019).

Constructivist learning gives students the opportunity to work together and facilitates problem solving in learning. In addition, learners will tend to be problem-centered so as to train students to solve problems (Hamat et al., 2010). Although the STAD-type cooperative learning model also puts an emphasis on learner-centered learning (Cahyani et al., 2019). However, this model still makes Cahyani educators the main source of information through the distribution of material in the syntax of the learning model. Students are less given the opportunity to discover their own concepts and make connections (Meaning full learning). Instead, with the ReCODE learning model, students are emphasized to acquire prior knowledge before the learning process occurs, so that students can construct the information they obtain and make connections (Saenab et al., 2020).

Table 4. N-gain Analysis Results of Students' Problem Solving Skills

Score Interval	Experiment Class		Control Class		Criteria
	Frequency	Percentage	Frequency	Percentage	
$0.7 \leq g \leq 1.0$	1	4%	0	0%	High
$0.3 \leq g < 0.7$	20	80%	13	52%	Medium
$0 \leq g < 0.3$	4	16%	12	48%	Low

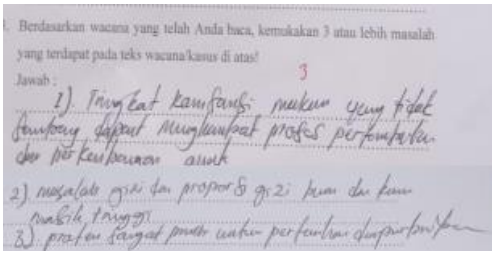
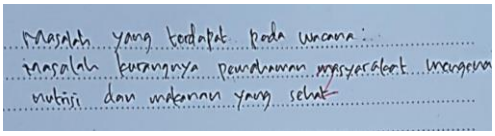
Table 4 shows the difference in the improvement of problem-solving skills in the experimental and control classes. The analysis results show that the improvement of problem-solving skills in the experimental class has a higher percentage in the high and medium categories compared to the control class, thus it can be assumed that the experimental class obtained better results. The percentage of students in the control class still reached 48% in the low category. This means that almost 50% of students experience low improvement with the application of the STAD Type Cooperative learning model. This indicates that the STAD Type Cooperative learning model is still less able to improve problem solving skills, even though the model has facilitated students to be actively involved in learning. This is in line with the results of research conducted by (Sinaga et al. (2018) which states that the STAD-type cooperative learning model has weaknesses in terms of improving students' problem solving skills.

Table 5. N-gain Analysis of Achievement of Students' Problem-Solving Skills Indicators

Problem-Solving Skill Indicators	Experiment Class		Control Class	
	N-gain	Category	N-gain	Category
Understanding the Problem	0.42	Medium	0.38	Medium
Developing a Solution Plan	0.40	Medium	0.33	Medium
Implementing the Solution Plan	0.29	Low	0.26	Low
Evaluating Results	0.52	Medium	0.33	Medium

Table 5 shows that both groups in each indicator are in the same category. However, based on the N-gain score, it was found that the N-gain score in the experimental class was higher than the control class even though it was in the same category. The first indicator is understanding the problem. Based on the results obtained, it can be seen that in the indicator of understanding the problem, the experimental class reached a value of 0.42 while the control class obtained a value of 0.38. Jonassen (2000), revealed that prior knowledge broadens the scope of thinking and helps in seeing problems from different perspectives. The Reading phase of the ReCODE learning model facilitates students to have prior knowledge through reading materials obtained by students before entering the learning process (Saenab, 2019) so that students already have the basic knowledge that enables students to understand the context, facts and important information related to the topic of the problem. Accordingly, Sockalingam et al. (2011) and Veli (2014), also stated that students have difficulty in developing problem-solving skills because they do not have a good understanding of the basic concepts. Therefore, the Reading phase will take part in overcoming this problem. It is this phase that differentiates the ReCODE learning model from the STAD-type co-operative learning model. The STAD cooperative model tends not to have a special stage to help students understand the problem. The difference is shown in the post-test results of problem-solving skills in the two groups presented in Table 6.

Table 6. Comparison of Student's Answers to the Post-test between Experimental and Control Classes

Experiment	Based on the discourse read, state 3 or more issues contained in the discourse! 
Control	Based on the discourse read, state 3 or more issues contained in the discourse! 

Based on Table 6, it can be seen a comparison of the answers of each student in the experimental class and control class when answering post-test questions. Students in the experimental class gave answers in accordance with questions that asked to write three or more problems. Meanwhile, students in the control class

only wrote down one problem contained in the discourse. In addition, the answers of students in the control class were not specific to the problems in the discourse, and wrote answers that were too general. In contrast, the answers in the experimental class specifically refer to the problem points contained in the discourse. Based on these results, it can be seen that the Reading phase in the ReCODE learning model has a better effect on students' problem understanding than the STAD type cooperative learning model.

The next indicator is to develop a solution plan. The Connecting phase of the ReCODE model helps students make connections between new information and prior knowledge or experience (Saenab et al., 2020). This enables students to formulate more effective problem-solving plans or strategies based on the understanding gained. This is in accordance with Nelwati et al. (2020) that with the new knowledge obtained, students are able to organize their ideas to solve problems. Meanwhile, while the STAD-type cooperative learning model has group activities that involve sharing ideas, students only focus on group discussions so individual strategy development is limited (Sumiantari et al., 2019).

The STAD-type Cooperative model does not give equal emphasis on individual strategy development. In addition, students' skills in understanding the problem are also an influencing factor in the preparation of the plan. Students in the experimental class understood the problem well enough so that it was easier to compile ideas in solving the problem.

The third problem-solving skill indicator is implementing the solution plan. The research results show that this indicator is the one with the lowest increase compared to other indicators, both in the experimental and control classes. This happened because students tended to be unable to distinguish between developing a solution plan and implementing a solution plan. However, when compared between the two groups, the experimental class still obtained a higher value and almost reached the moderate category, reaching 0.29. The ReCODE model in the experimental class involved the Observing and Discussing phases which provided opportunities for students to interact between group members and between groups in class discussions so that it could help students in implementing the solution plan. Although the STAD type of Cooperative learning mode also emphasizes group work and the opportunity to discuss and share ideas within the group, the role of individuals in implementing the solution plan is still not comparable to the Observing and Discussing phases in the ReCODE model.

The last indicator is evaluating the results. When seen in the data presented in Table 5, it is obtained that the indicator evaluating the results is the indicator with the largest N-gain value in the experimental class. The ReCODE learning model has an Evaluating stage that encourages students to evaluate results and make evaluations through reflection activities. At the end of each learning process, students will be instructed to reflect in a reflection journal. Students who are involved in reflecting, assessing, and evaluating themselves provide an opportunity to develop critical thinking skills, which is one of the frameworks of problem-solving (Erdogan, 2019; Norton et al., 2020; Rahman, 2019). Although the STAD-type co-operative learning model also has evaluation activities, the focus is not the same as the ReCODE learning model. The evaluation done in the STAD type of Cooperative learning model tends not to maximize the individual type and is done only by the representative of the students in the class. This is very different from the ReCODE learning model which emphasizes each individual.

In addition, the application of ICT-assisted ReCODE provides students with a new and interesting experience that motivates them to learn and seek information. The use of ICT in the learning process makes it easier for students to explore various kinds of knowledge and helps them in problem-solving. This is in accordance with the results of research by Wigati (2019), which states that the use of ICT in learning can help students to be skilled in solving problems or in determining concepts.

Strengthening the assumption that there is an effect of the ReCODE learning model assisted by ICT on students' problem solving skills, then inferential statistical analysis is carried out, namely hypothesis testing by going through the prerequisite test, namely the normality test and homogeneity test.

Table 7. Normality Test Calculation Results

Group	n	Pretest		Posttest		Conclusion
		χ^2_{count}	χ^2_{table}	χ^2_{count}	χ^2_{table}	
Experiment	25	1.69	11.07	3.23	11.07	Normally Distributed
Control	25	7.86	11.07	7.47	11.07	Normally Distributed

Table 7 shows the results of the calculation of data distribution in both groups. The test criteria carried out are, if $F_{count} < F_{table}$ at the 5% significance level and the degree of freedom (dk) = k-1 = 6-1 = 5 then the data is normal, so based on the data presented in Table 7, it is found that the data is normally distributed.

After both samples are considered to come from normally distributed data, the homogeneity test is then carried out. The homogeneity test aims to determine whether the data in this study have the same variance (homogeneous) or not (heterogeneous). The homogeneity test used is the F-test. The F_{table} is obtained k (research variable) while n (number of respondents) so that df (n1) k-1 = 2-1 = 1 is obtained, while df (n2) = n-k = 50-2 = 48 with a significance level of 5%, F_{table} is obtained at 4.04 which is seen from the F distribution table (table of F-statistics P = 0.05). While the Fcount value is obtained at 1.05. Based on the results of the analysis, it is obtained that the value of $F_{count} < F_{table}$, namely 1.05 < 4.04, thus it can be stated that the data variance of the two groups is homogeneous.

Based on data analysis, the experimental class and control class were considered normally distributed and homogeneous, so they continued to test the hypothesis with the t-test. The test criteria are if $t_{count} > t_{table}$ at a significant level (α) = 0.05 then H_0 is rejected and H_1 is accepted and so on. Based on hypothesis testing using the t-test, the value of t_{count} = 2.4 and ttable = 1.67 is obtained so that $t_{count} = 2.4 > t_{table} = 1.67$. This means that H_0 is rejected and H_1 is accepted. So it can be concluded that there is an effect of the Reading, Connecting, Observing, Discussing, Evaluating (ReCODE) learning model assisted by ICT on the Problem-Solving Skills of SMPN 18 Makassar students on the subject matter of the Human Digestive System.

Conclusion

Based on the results of the research that has been done, it can be concluded that the ReCODE learning model using ICT has an effect on problem-solving skills seen in the results of hypothesis testing which states the t_{count} value of 2.4. In addition, it was found that the level of problem solving skills of students taught with the ICT-assisted ReCODE learning model was in the high category, while students taught with the STAD-type Cooperative learning model were in the medium category. The improvement of problem solving skills of students taught with the ICT-assisted ReCODE learning model and the STAD-type Cooperative learning model is in the medium category.

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