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Research Article

Problem-solving ability: Implementation of RICOSRE learning models on environmental change topic

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ABSTRACT

The development of technology and science has progressed very rapidly. Students are required to master various kinds of abilities, one of which is problem-solving ability. Problem-solving ability need to be developed in the learning process. The learning model that can facilitate students in practicing problem-solving ability is the Reading, Identifying, Constructing, Solving, Reviewing and Extending (RICOSRE) learning model. The purpose of this study was to determine the effect of using the RICOSRE learning model to the problem-solving abilities of Senior high school students on environmental change topic. This research was conducted at Senior High School 3 of Tangerang in January-June 2022. This type of research is quantitative with a quasi-experimental research method. The research sample amounted to 62 students with each class totaling 31 students who were selected by random sampling. Based on the t-test calculation at α = 0.05, a significance of 0.028 was obtained, which means that there is an effect of the RICOSRE learning model on the problem-solving abilities of students on environmental change topic.

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INTRODUCTION

The development of technology and science is progressing very rapidly (Brown et al., 2018; Berawi, 2019; Asry, 2020). This progress is one of the characteristics of the 21st century to produce quality human resources (Singh, 2019; González & Ramírez, 2022; Puspitarini, 2022). The century that has been running for two decades is also called the age of knowledge (Thomas et al., 2019; Angga et al., 2022). This is reinforced by the opinion of Mintasih (2022) that the role of science has become very dominant in the 21st century. This century is a challenge for all areas of life including education (Kennicutt, 2019; Schoppe & Fagan, 2022).

Education is a tool to create generations who are skilled in their fields (Sujana, 2019; Miftahurrohmah et al., 2021). The 21st century education is a process to empower and develop all the potential that students have in order to form a better character (Rahayu et al., 2022). Education in this century requires a variety of abilities that must be mastered by students in order to become a successful person in life. One such ability is problem-solving (Siagan, 2019; Hulaikah, 2020).

Wagner categorizes problem-solving ability as one of the seven abilities that learners must have to face life and the world of work. Problem - solving ability are included in the way of thinking among the other three categories of the 21st century ability: ways of working, tools for working and ability for living in the world (Care, 2015; López, 2021). Problem-solving ability is a series of actions to solve problems by using steps in order to produce an expected solution (Lin, 2019; Huang et al., 2020). Problem-solving ability must be owned by students in finding problems and finding solutions to a problem (Retnawati, 2018; Hutajulu, 2019; Sigit et al., 2019; Triani et al., 2019; Yayuk & Husamah, 2019).

Problem-solving can be used as a cornerstone of Science Learning models in the classroom (Kirtikar, 2013; Maskur et al., 2020). The problem-solving-based learning model begins with the exposure of real-world problems that encourage students to solve problems by connecting their knowledge with application in everyday life (Tivani & Paidi, 2016; Ulger, 2018). One of the learning models that can facilitate students in training problem-solving ability is the Reading, Identifying, Constructing, Solving, Reviewing and Extending (RICOSRE) (Mahanal & Zubaidah, 2017). RICOSRE learning model has six syntax / stages, namely Reading, Identifying a problem, Constructing the Solution, Solving the problem, Reviewing the solution, and Extending the solution (Mahanal et al., 2019). Models that have a problem-solving syntax can be applied in schools, especially in Biology subjects (Fatmawati et al., 2021; Setiawan et al., 2021).

Biology is one of the cross-interest subjects for social science students. Most of the students in this subject tend to memorize the concept rather than be able to apply it if they find problems in real life related to related concepts (Utomo, 2020). Biology is one of the subjects of Science Education in Senior High School (Azrai et al., 2016). Biology learning is not only about concepts or theories, but students also learn to observe various natural symptoms in life so that they can formulate problems, provide solutions, and solve these problems (Saxe & Summerfield, 2021; Simatupang & Ionita, 2020).

Biology material that is suitable to be applied problem-solving based learning model is the topic of environmental change (Tivani & Paidi, 2016). Students who learn about environmental change topic can obtain information and problems contained in the surrounding environment (Markowitz et al., 2018; Suryanda et al., 2018). The environment is an important part for human life (Supriyatin et al., 2016; Berdimuratova & Mukhammadiyarova, 2020). Research conducted by Azrai et al. (2017) explained that Biology, especially on environmental change topic, develop less imagination in the process of solving problems. Students should have the ability to solve problems and understand the values that must be done to the environment by finding solutions to various problems related to environmental change (Ojala & Bengtsson, 2019).

This study was aimed to determine the effect of using the RICOSRE learning model to the problem-solving ability of senior high school students on environmental change topic. The benefits of this research to be input and consideration for learning biology in schools by applying the right learning model on environmental change material. Then, it is expected to be a source of information and additional references for teachers regarding the latest learning models based on problem solving.

METHOD

This study uses a quasi-experimental method with the independent variable is RICOSRE learning model and the dependent variable is the problem-solving ability of students on environmental change topic. This research design uses Pretest-Posttest Control Group Design (Table 1). The study was conducted at Senior High School 3 of Tangerang which was carried out in January-June 2022.

Table 1. The pretest-posttest control group design

Group (R)	Pretest	Treatment	Posttest
R1	O1	X	O2
R2	O3	C	O4

The description of the table is R1 = experimental group, R2 = control group, X = treatment (using RICOSRE model), C = control (using DI model), O1 = experimental group pretest, O2 = experimental group posttest, O3 = control group pretest, and O4 = control group posttest.

The target population in this study are students of X social studies class at Senior High School 3 of Tangerang. Senior High School 3 of Tangerang was selected by purposive sampling. The Affordable population is students of X IPS 3 for the application of Reading, Identifying, Constructing, Solving, Reviewing and Extending (RICOSRE) model and students of X IPS 1 for the application of Direct Instruction (DI) model. Sample selection was done by simple random sampling technique.

Research instruments developed based on the stages of problem-solving based on Bransford and Stein (1993), namely identify the problem, define the problem, explore the problem, act on the strategy, look back and evaluate the effect. The instrument of problem-solving ability used is a written test in the form of essay on

environmental change topic as many as 11 valid questions with a score of 1-4. Hypothesis testing using independent t-test with the help of Statistical Product and Service Solution (SPSS) version 26. Rubrics and indicators of problem-solving ability (Bransford & Stein, 1993) can be seen in Table 2.

Table 2. The rubric and indicator of problem-solving ability

Indicators	Scoring indicators	Score
Identify the problem	Write down three or more issues relevant to the article.	4
	Write down two issues relevant to the article.	3
	Write down an issue relevant to the article.	2
	Write down issues that are not relevant to the article.	1
	No answer.	0
Define the problem	Write three or more problem formulations in the form of standard question sentences and relevant to the article.	4
	Write two problem formulations in the form of standard question sentences and relevant to the article.	3
	Write a problem formulation in the form of standard question sentences and relevant to the article.	2
	Write down the formulation of the problem that is not relevant to the article.	1
	No answer.	0
Explore the problem	Write down three or more alternative solutions or ways of solving the problem to be solved.	4
	Write down two alternative solutions or ways of solving the problem to be solved.	3
	Write down an alternative solution or ways of solving the problem to be solved.	2
	Write down alternative solutions or ways of solving problems that are not relevant to the problem to be solved	1
	No answer.	0
Act on the strategy	Choose or determine the best alternative solution with rational reasons to the problem in the article.	4
	Choose or determine the best alternative solution for reasons that are less rational with the problems in the article.	3
	Choosing or determining the best alternative solution for reasons that are not rational with the problems in the article.	2
	Select or determine alternative solutions that do not fit in the article.	1
	No answer.	0
Look back and evaluate the effect	Respond with realistic ideas, concrete steps, write conclusions in accordance with the problem.	4
	Answer with realistic ideas, concrete steps, write conclusions that are less accordance with the problem.	3
	Answer with realistic ideas, concrete steps, write conclusions that are not in accordance with the problem.	2
	Answering unrealistic, not concrete steps, writing conclusions does not fit the problem.	1
	No answer.	0

RESULTS AND DISCUSSION

Based on the value of problem-solving ability, experimental class students obtain an average value of pretest 56.45 and posttest 84.46, then the gain score in the experimental class of 28.01. Meanwhile, control class students obtained an average value of pretest 57.70 and posttest 79.90, then the gain score in the experimental class of 22.20 (Figure 1).

The average pretest of the experimental and control class learners had almost the same score. However, after being given a model treatment in the experimental class using the RICOSRE model and the control class using the DI model, obtained posttest averages of 84.56 and 79.90. One of the factors that influence the difference is the syntax of the model to the measured variables. Syntax is an important aspect because it contains stages or standards that must be followed when wanting to implement a learning model (Saputri et al., 2019; Maknun & Kamila, 2022). The syntax of the RICOSRE model is divided into 6 stages, namely Reading, Identifying a problem, Constructing the Solution, Solving the problem, Reviewing the solution, and Extending the solution (Mahanal et al., 2019). The initial syntax of RICOSRE is Reading where students are directed to read reading materials such as power points and modules on environmental change topic that have been given before the learning process takes place. Power point can help learners in understanding information (Singh et al., 2018). This is because power point combines various types of media into an attractive package (Munasti & Suyadi, 2021). The modules provided also have attractive pictures or illustrations (Kumar et al., 2020). This is

reinforced by Khojanah et al. (2022) which states that students ' enthusiastic interest in Reading will be higher if accompanied by pictures.

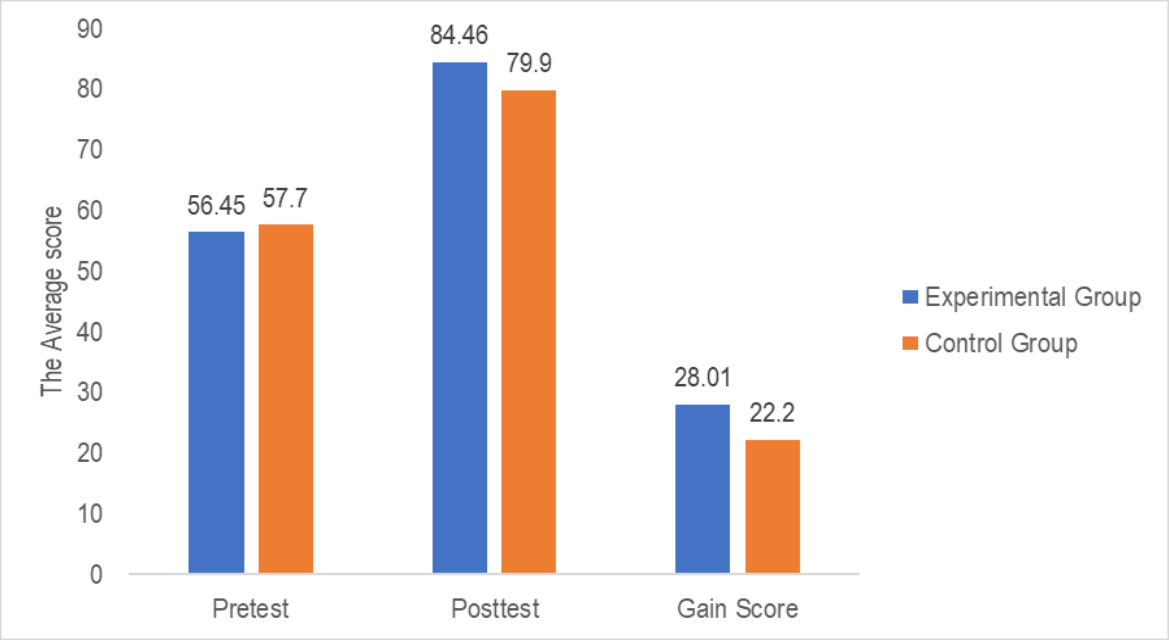

Figure 1. The average pretest, posttest and gain score

Reading should be able to understand the intent of the content, not just finish reading for completion (Suryanda et al., 2018; Falloon, 2020). Not only reading texts, watching videos about environmental change is also included in the Reading stage, because learning can be developed by adjusting and developing (Sigit et al., 2019). Questions contained in the worksheet students (*Lembar Kerja Peserta Didik*/LKPD) identified in advance by students at the stage of Identifying. Learners are directed to understand the intent of the questions in detail. This is reinforced by the opinion of the Organization for Economic Co-operation and Development (OECD) (2013) which states that identifying questions is included in literacy which aims to understand the intention and make a decision. The role of the teacher is influential at the Identifying stage in asking whether there are questions that are difficult to understand for students about LKPD. If students have understood the question on LKPD, then it can proceed to the next stage, which is Constructing.

Building a thought before answering a question or constructing is the third stage of RICOSRE. Learners at this stage can exchange information with peers or teachers regarding previous identified questions. For example, understanding the meaning of a diagram or histogram regarding the amount of waste from year to year in a place. Through building activities or exploration of ideas, it is expected that students can determine strategies to stimulate solutions (Mahanal & Zubaidah, 2017). Constructing is a bridge between identifying and Solving stages. The stage of Solving or solving a problem is the key so that students can and get used to use problem-solving ability. When searching for an answer, learners will develop analytical thinking ability to solve problems (Sartono et al., 2018; Khoiriyah & Husamah, 2018). The problem-solving ability of the experimental class students increased in the second meeting because the answers were arranged in a solution and systematically. This is reinforced by Walid (2019) that problem-solving can educate students to think systematically and be able to find a way out of the situation at hand.

The next stage is Reviewing or reviewing the results of the answers. Students share or present the results of the discussion to be able to add information. Presentations and discussions can act as strengthening students understanding on the topic discussed. Reinforcement in classroom teaching is also important because it can improve academic achievement and the ability of students (Park et al., 2019; Dewantara et al., 2020). In the Extending stage, students and teachers analyze each other whether the proposed solution is appropriate and can be used in the long term in people's lives. This is because learning about the environment aims to change human behavior in order to develop understanding, ability and awareness of the environment (Ramadhan et al., 2019; Ichsan et al., 2019).

Learning conducted in control classes using the Direct Instruction (DI) model according to Arends has 5 stages, namely establishing sets, explanations and/or demonstrations, guided exercises, feedback, and advanced exercises. Learners are most enthusiastic in the feedback phase because the teacher always provides understandable answers for learners who ask. Explanation phase according to Eggen and Kauchak is

an important phase for teachers because they have to provide an explanation so that students can understand the information provided. The Direct Instruction (DI) Model is often used by teachers of Senior High School 3 of Tangerang on environmental change topic. In the study by Sigit et al., (2019) some teachers argue that for environmental learning, it is enough to remember and memorize the topic in a package book or textbook. This is one of the reasons why teachers are reluctant to carry out further development.

The score of each indicator of problem-solving ability of students in experimental and control classes varies (Table 3). The highest pretest average of experimental class students is Define the problem of 74.60 and the highest posttest value is Identify the problem of 87.10. Meanwhile, the lowest average score on pretest and posttest experimental class students are Look back and evaluate which obtained a score of 33.87 and 78.63. Students in the control Class obtained the highest average pretest and posttest indicators Define the problem with a score of 70.16 and 84.27. Meanwhile, the lowest average score on pretest and posttest control class is Look back and evaluate with a score of 40.32 and 74.60.

Table 3. The average of each indicator tests the problem-solving ability

Indicators	Experimental group		Control group	
	Pretest	Posttest	Pretest	Posttest
Identify the problem	56.18	87.10	56.99	70.03
Define the problem	74.60	86.69	70.16	84.27
Explore the problem	60.08	85.08	61.69	82.66
Act on strategy	57.66	83.47	59.68	79.84
Look back and evaluate	33.87	78.63	40.32	74.60

The Define the problem indicator obtained the highest average pretest score in the experimental and control classes. The same applies to the average posttest of the control class. This proves that students are more mastered the ability to ask questions or formulate problems. Hasibuan and Moedjiono (2012) stated that asking questions based on curiosity will facilitate learners in the learning process. The indicator with the highest posttest average score in the experimental class is Identify the problem which means that the students have been able to identify a problem. The indicator with the lowest average pretest and posttest score in both classes is Look back and evaluate. This shows that students still have difficulty in analyzing the effectiveness of the solutions that have been proposed. Wahyuningsih et al. (2018) stated that students still have to sharpen the activities of analyzing, evaluating, and creating knowledge.

According to Riduwan (2010), in the experimental class there is a significant increase. A total of 13 students in the experimental class were categorized as good at pretest and 26 students were categorized as very good at posttest. In the control class, 10 students categorized well at pretest and 13 students categorized very well at posttest. None of the students were categorized very well for pretest grades in the experimental and control classes. This could be due to the fact that there has been no effect on the application of the model yet and even some students have not been able to set the time during the pretest so that many questions are not answered. Grouping students by category problem-solving ability can be seen in Table 4.

Table 4. Grouping learners by category problem-solving ability

Categories	Score	Total of learners			
		Experimental group		*Control group*	
		Pretest	*Posttest*	*Pretest*	*Posttest*
Very good	81.00 – 100.00	0	26	0	13
Good	61.00 – 80.00	13	5	10	18
Medium	41.00 – 60.00	15	0	20	0
Low	21.00 – 40.00	3	0	1	0
Very low	0 – 20.00	0	0	0	0

The lack of ability of students in implementing time management strategies indicates that they have not been fully able to make decisions about what to do and act on these decisions which are caused because they have not been able to fully escape from the dependence of others (Syartissaputri et al., 2014; Ahmad Uzir et al,, 2020). The posttest results addressed as many as 26 excellent students in the experimental class and 13 Control class students. Changes can occur due to practice and experience. This is reinforced by the statement of Rijal and Bachtiar (2015) that learning outcomes are affected by learners' experiences. The learning outcomes of students in both classes also vary. This diversity can be caused because each student has their own unique learning style (Azrai et al., 2017; Hassan et al., 2021). The application of RICOSRE model has a significant effect on the problem-solving ability of experimental class students. This is evidenced by the hypothesis test that the significance value of the problem-solving ability of less than 0.05 is 0.028 which means that H_0 is rejected at $\alpha = 0.05$ (Table 5).

Table 5. The result of unpaired sample t-test

		t-test for Equality of Means				
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
***Gain score* of problem-solving ability**	Equal variances assumed	2.257	60	.028	5.8000	2.5703
	Equal variances not assumed	2.256	59.090	.028	5.8000	2.5703

The use of learning resources also has an impact on students problem-solving ability. The learning resources for control class students are less, which are using only textbooks provided at school. Meanwhile, the RICOSRE model in learning emphasizes using many sources because this model has a Reading stage for reading or listening. Reading more will help to increase the knowledge of students (Hu et al., 2018; Pamungkas, 2019). This is also reinforced by Ichsan et al., (2019) and Van Laar et al. (2020) that learners in the technological age can easily search for a variety of information, but must filter and use good information. Before the Solving stage, students in the experimental class are required to undergo detailed and systematic stages of Identifying and Constructing first. This is because in the RICOSRE model, students are actively invited to be able to identify a problem, be able to solve the problem and be able to find a solution to the problem (Martela, 2019; Rahmawati et al., 2021). Meanwhile, in the control class, only the phase of guided and advanced exercises that can be used by learners to think about solving problems (Gayatri, 2009; Bradford, 2019; Risdianto et al., 2020).

CONCLUSION

Based on the results of the study it can be concluded that there is an effect of learning models Reading, Identifying, Constructing, Solving, Reviewing, and Extending (RICOSRE) to the problem-solving ability of students on environment change topic. The implementation of this learning models can be used as an alternative model on the problem-solving ability because the syntax of RICOSRE learning model is more emphasis on thinking solutions and systematic. Students are required to slowly solve a case or problem.

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