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The Effect of the RICOSRE Learning Model on Students' Problem-Solving Abilities and Collaboration Skills in Biology Learning for Grade XI at SMA Negeri 2 Toraja Utara

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Abstract

The 21st century demands individuals to apply the 4C skills, especially in biology learning. There are problem-solving abilities and collaboration skills that need to be improved in education using the RICOSRE learning model. Therefore, using this model can improve students' problem-solving abilities and collaboration skills. The study population was all 11th grade science students consisting of 8 study groups with a total of 286 students. The research subjects were class XI A1 as the experimental class and XI A3 as the control class. The research sample was 72 students. Biology learning outcome data were measured using a test instrument consisting of 8 essay questions and a 42-item collaboration ability questionnaire. Data were analyzed using SPSS version 31. The RICOSRE learning model was significantly more capable of solving problems and collaborating optimally in students compared to the direct instruction model. This can be seen from the discussion process that was able to divide tasks evenly, help each other with friends, be active in discussion activities and respect each other in achieving a common goal of problem solving. Although the stages of the indicators were not sequentially continuous, this does not blame the research results. This is certainly influenced by many factors. Therefore, it can be concluded that the RICOSRE learning model is more significant compared to the direct instruction learning model which is less preferred by students.

INTRODUCTION

The 21st century is marked by numerous changes resulting from the rapid development of information technology, particularly in education. This requires every individual to apply the 4C skills, which include critical thinking, creativity, collaboration, and communication (Rahayu et al., 2023). Rosanaeni (2021) also outlined the characteristics of the 21st century, including problem-solving, communication and collaboration, literacy skills, information use and management, and media analysis. The 21st century, associated with the Industrial Revolution 4.0, has impacted every field, including education. Educational elements such as teachers and students are required to master the 4C skills to face the challenges of the 21st century. Therefore, students must be facilitated using learning designed to develop their problem-solving and collaboration skills (Hether, 2023).

21st-century characteristics are important to apply in science learning related to living organisms, particularly biology. Biology learning tends to be based on rote learning. This makes it difficult for students to understand biology lessons because learning biology involves not memorizing all the material, but rather understanding the concepts contained within it (Wiesje et al, 2025; Illene et al, 2023). Furthermore, biology learning is not just about concepts or theories; students also learn to observe various natural phenomena in life so they can formulate problems, provide solutions, and resolve them (Anugrah et al., 2022). Students are also required to solve problems, thus requiring problem-solving skills with appropriate strategies in teaching biology material, for example, by collaborating so that students can exchange views with peers and teachers (Azizah and Heffi, 2021). Therefore, biology learning requires problem-solving skills and collaboration skills in students to achieve learning objectives according to 21st-century demands.

Problem-solving skills are an important character trait to develop in the 21st century. According to Zakaria et al., (2025), problem-solving is the ability to identify problems and find solutions to effectively resolve conflicts using existing skills. Developing problem-solving skills is important because through this process, students can deeply understand problems, apply sound reasoning, analyze them carefully, choose appropriate strategies, and evaluate the solutions they have achieved (Feng, 2025). However, students' problem-solving skills have not met expectations because they are still classified as low. This low category is generally caused by a lack of ability to solve high-level problems (Siswanto, 2024). This opinion is in line with research conducted by Fidia et al in 2025 at SMP Negeri 4 Kota Sungai Penuh, which found that students' problem-solving skills were classified as low because the learning model used was not appropriate to the students' circumstances.

Students' low problem-solving skills are also linked to each individual's ability to collaborate with others. According to Poysa et al., (2025), collaborative problem-solving is recognized as one of the key competencies needed by students today and in the future. Collaborative skills play a crucial role in positively impacting problem-solving skills by encouraging discussion, sharing concepts, and collaborative problem-solving (Mandailina et al., 2025). According to Waruwu (2023), collaborative skills are the ability to participate in any activity to make the work or problem at hand easier to solve. Collaboration is carried out together to balance differences in perspectives and knowledge, provide advice, listen, and support one another. Working in groups also supports communication skills with other students and the exchange of opinions to find solutions to problems from discussions (Khotimah et al., 2025).

Collaboration skills emphasize the process of planning and working together, providing optimal contributions by providing constructive perspectives for each idea, accepting other opinions and daring to provide support for opinions that are in line with common goals (Noor Nasran and Zakaria, 2025). Collaboration skills as a partnership for 21st Century Skills show activities in demonstrating the ability to work politely and effectively to find solutions to problems even through quite long stages such as discussing with different ideas and concepts and having a sense

of responsibility for collaborative work and conducting self-evaluation of each member so that work in the group provides an optimal contribution to solving problems (Pujiati et al, 2022).

Collaboration skills are crucial in education, yet they remain low. This is evidenced by research conducted by Khotimah et al. (2023) at SMA Muhammadiyah 3 Surakarta, which found that students' collaboration skills were still low due to the implementation of a teacher-centered learning model. Issues regarding students' problem-solving and collaboration skills must be addressed immediately to achieve learning objectives.

Students at SMA Negeri 2 North Toraja also experienced similar problems. Based on initial observations conducted through interviews with several students and educators, the dominant learning model used in biology lessons was teacher-centered. This is evidenced by the relatively low average scores obtained by students over two semesters. Furthermore, teachers also lack a variety of learning models that foster collaboration and problem-solving skills. Teachers often use textbooks as a resource for students to summarize biology, making learning seem monotonous and boring.

Given the challenges of low problem-solving and collaboration skills, learning needs to be renewed by selecting appropriate learning models. One learning model that can facilitate the practice of problem-solving skills is the RICOSRE learning model. The RICOSRE learning model has a syntax consisting of: Reading, Identifying a problem, Constructing the solution, Solving the problem, Reviewing the solution, and Extending the solution The RICOSRE model is a learning model that can facilitate students to practice problem-solving and collaboration skills (Mahanal et al, 2022). RICOSRE is a development of a problem-solving-based learning model that requires active participation from students. In solving problems, students gather information through literacy activities which are then discussed to gain new knowledge (Friedel, 2023). Thus, the application of the RICOSRE model is expected to have a positive influence on improving the character of 21st-era students. The RICOSRE model was chosen because it involves stages that are able to overcome problems (Rahma et al, 2025). The purpose of this study is to determine the effect of the RICOSRE learning model on the problem-solving abilities and collaboration skills of grade XI students of SMA Negeri 2 Toraja Utara, especially in biology learning.

METHODS

The design used in this study is the Pretest-Posttest Nonequivalent Control Group design. In its implementation, this design consists of a control group and an experimental group, each of which will be given a pretest to see the initial conditions and given a posttest to see the final conditions after being given treatment. The test to measure problem solving ability consists of 8 numbers, while collaboration skills are measured using a questionnaire containing 42 statements. More clearly, this research design is presented in Table 1.1.

Tabel 1. Research design

Group	Pretest	Treatment	Posttest
Experimental	O1	X	O2
Control	O3	-	O4

This research method uses a quantitative method with a quasi-experimental design. This study presents two groups, namely the experimental group and the control group. The experimental group received treatment using the RICOSRE learning model while the control group received treatment using the Direct Instruction (DI) learning model. The Direct Instruction model was applied to the control class because it conforms to the model used at SMA Negeri 2 Toraja Utara. A pretest was given to both groups before being given treatment and a posttest was given

after the treatment. The purpose of this study was to determine whether the use of the RICOSRE learning model affects students' problem-solving abilities and collaboration skills in biology learning.

The population in this study was all study groups in class XI of SMA Negeri 2 Toraja Utara with a total of 8 study groups. The sampling technique in this study used a simple random sampling technique by drawing lots to select 2 classes from 8 available classes. The sample of this study consisted of two classes taught with the RICOSRE learning model in the experimental class and the direct instruction learning model in the control class. The results obtained from the sampling technique were class XI A1 as the experimental class and class XI A3 as the control class, each class consisting of 36 students.

Data collection techniques were carried out using test and non-test approaches. There were 8 questions related to the digestive system material in the form of essay questions. These questions were arranged according to problem-solving indicators according to (Fidia et al, 2024), namely: understanding the problem, making a problem-solving plan, carrying out the problem-solving plan, and re-examining the results. The non-test tool in the form of a student respondent questionnaire in the form of a Likert scale to determine the collaboration skills of students learned with the RICOSRE learning model which consists of 5 indicators: participating actively, working productively, being responsible, being flexible, and respecting each other between groups. The instrument has been tested for validity with the consideration of 2 experts. Data analysis in this study used SPSS Version 31 software. Descriptive analysis and inferential analysis are the two stages of data analysis carried out in this study.

RESULT AND DISCUSSION

Data collection was conducted to determine students' problem-solving and collaboration skills. Scores for students' problem-solving skills criteria obtained in classes taught using the RICOSRE learning model and classes taught using the PBL model can be seen in Table 2.

Table 2. Average Student Scores for Each Problem-Solving Ability Indicator in the Control Class and Experimental Class

No	Indicator	Average indicator (%)			
		Control Group		Experimental Group	
		Pretetst	Postest	Pretest	Postest
1	Understanding the problem	48,26	67,36	50	80,9
2	Create a problem-solving plan	33,33	55,56	45,8	72,57
3	Carry out a problem solving plan	32,64	50,69	35,76	68,06
4	Check back	49,65	68,75	48,96	80,56

Table 2 shows the average student scores for each problem-solving indicator. In the pretest for the control class, the reexamining indicator received the highest score, while the lowest average score for the implementing problem-solving plan indicator was the same as the posttest score for the control class. These data indicate that students in the control class were better able to solve problems and draw logical conclusions based on biological concepts. This could be because students did not use structured problem-solving steps. Similarly, in the experimental class, the highest pretest score was for the reexamining indicator, while the lowest score was for the implementing problem-solving plan indicator. This contrasts sharply with the average posttest scores, where the highest score was for understanding the problem, and the lowest was for implementing a problem-solving plan. Therefore, many students did not create a problem-solving plan but still drew conclusions to solve the problem at hand. The difference in the increase in the

problem-solving ability scores of students in the control and experimental classes can be seen in the image below.

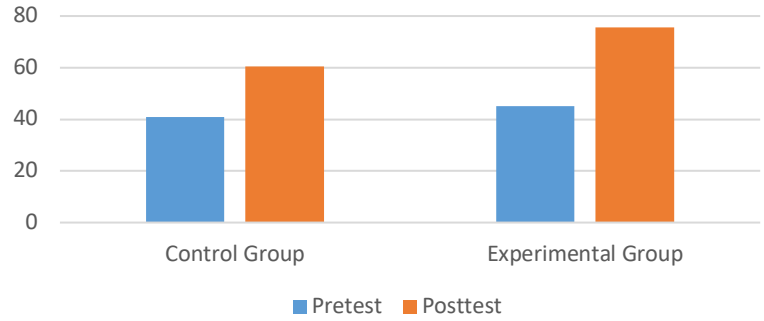

Figure 1. Increase in students' problem-solving ability scores

The figure above shows the increase in student problem-solving skills in the control and experimental classes. The increase in problem-solving skills in the experimental class reached 30.38%, while the increase in the control class was only 19.62%. Collaboration skills were also one of the factors measured in this study. The table below shows the average student scores for each collaboration skill indicator in the experimental class and the Direct Instruction model in the control class. Table 3 shows the average student scores for each collaboration skill indicator in the experimental class and the Direct Instruction model in the control class.

Table 3. Average Student Scores for Each Collaboration Skills Indicator in the Control Class and Experimental Class

No	Indicator	Average indicator (%)			
		Control Group		Experimental Group	
		Pretetst	Postest	Pretest	Postest
1	Active participation	71,96	77,78	72,83	81,94
2	Work productively	72,99	79,65	71,11	83,13
3	Responsible	76,62	84,24	75,39	86,57
4	Flexibility	74,77	81,13	73,15	86,81
5	Mutual respect between groups	78,94	88,43	79,17	89,27

Table 3 shows the average student scores for each collaboration skill indicator. In the pretest for the control class, the indicator with the highest score was mutual respect between groups, followed by responsibility, and the lowest was active participation. This is directly proportional to the students' posttest results. In the experimental class, the mutual respect between groups indicator also received the highest score in the pretest, while the responsibility indicator received the lowest score. Similarly, the posttest results showed the lowest score was for active participation. This is because students are less active in expressing ideas, often absent from group discussions, and lack the initiative to find solutions when the group encounters difficulties. Therefore, it is important for teachers to encourage students to actively express ideas and foster initiative in discussions to foster effective student collaboration.

The difference in the increase in the value of students' collaboration skills in the control and experimental classes can be seen in the image below.

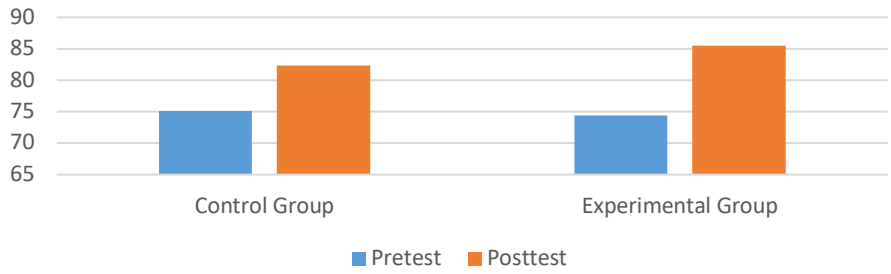

Figure 2. Increase in students' collaborative skills scores

The figure above shows the increase in collaborative skills scores of students in the control and experimental classes. The increase in problem-solving skills in the experimental class reached 11.11%, while the increase in scores in the control class was only 7.27%. The results of the study, which went through a data analysis process, showed that the RICOSRE model had a more significant influence on improving students' problem-solving and collaboration skills. The significant difference between the scores of the experimental and control classes is evidence that the RICOSRE learning model syntax, when consistently applied, is able to encourage the development of both behaviors. Problems relevant to students' lives make them more motivated to think critically and find appropriate solutions to solve problems. Collaboration skills are also developed when students work together in groups to understand problems, exchange opinions with each other, share tasks, and make joint decisions in an effort to achieve common interests. Activities such as group discussions, information searches, and joint presentations train communication skills, coordination, and mutual respect for the opinions of group members.

These data are supported by the results of SPSS version 31 tests, which show significant differences between the two models. The results of the hypothesis test on students' problem-solving abilities are shown in the following table.

Table 4. Results of the Problem-Solving Ability Hypothesis Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6324.610[a]	2	3162.305	35.198	0.000
Intercept	5043.467	1	5043.467	56.136	0.000
Pretest	2312.023	1	2312.023	25.734	0.000
Model Pembelajaran	2586.838	1	2586.838	28.792	0.000
Error	6199.261	69	89.844		
Total	345996.094	72			
Corrected Total	12523.872	71			

Based on Table 4.14 above, the data obtained shows that the significance value is 0.000 < 0.05, meaning that there is a difference in problem-solving abilities between students who are taught using the RICOSRE model and the direct instruction learning model. The RICOSRE learning model, specifically for improving problem-solving skills, presents students with problems that must be solved through a series of critical thinking processes, starting from understanding the problem, developing a problem-solving plan, implementing the problem-solving plan, and then reviewing it (Badriah et al., 2024). Through these stages, students are trained to systematically analyze information and test the effectiveness of their solutions. Problem-based learning can develop critical and systematic thinking skills, which are at the core of problem-solving skills (Waruwu et al, 2023; Hou et al, 2025).

Research shows that problem-solving stages are not always sequential due to the complexity of cognitive processes and learning habits. Students often focus directly on the end result rather than the process, resulting in hastily formulating plans without understanding the important information in the problem (understanding the problem). Furthermore, students may excel in procedural aspects (making plans) but lack interest in literacy (understanding the problem). Furthermore, students often immediately try to plan solutions, leaving them with two options: if the plan is successful, they skip the in-depth understanding stage. Conversely, if the plan fails, they return to understanding the problem. This causes fluctuations in scores between indicators (Castrol, 2023). The relationship between collaboration skills and problem-solving abilities is synergistic. The following table shows the hypothesis test for students' collaboration skills.

Table 5. Hypothesis Test for Students' Collaboration Skills

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3304.098[a]	2	16.52.049	53.599	0.000
Intercept	661.038	1	661.038	21.447	0.000
Pretest	3130.172	1	3130.172	101.555	0.000
Model Pembelajaran	241.620	1	241.620	7.839	0.000
Error	2126.741	69	30.822		
Total	512599.206	72			
Corrected Total	5430.839	71			

The table above shows that the collaboration skills of students taught using the RICOSRE learning model and the direct instruction learning model are very significant. The relationship between collaboration skills and problem-solving abilities is synergistic. Collaboration facilitates the exchange of ideas, the division of tasks, and joint decision-making, making the problem-solving process more effective. Conversely, complex problem-solving requires solid cooperation among group members, thus fostering collaboration skills (Maquil et al., 2021). Collaboration is crucial today because it is needed by everyone. Students are required to collaborate with one another in a broad global society with shared characteristics (Nurhoman et al, 2025). In a collaborative classroom, students work to share goals, learn together, engage in meaningful tasks, and build on prior knowledge to generate ideas and a variety of products (Wibowo et al., 2024).

Based on this, if collaborative skills are trained and applied optimally by students, they will be able to improve their problem-solving abilities in real life. Thus, the success of improving these two skills lies not only in providing relevant problems, but also in the active involvement of students in the entire RICOSRE learning process. Structured syntax, support for group interactions, and real-world problem-based investigations are key factors that make RICOSRE effective in significantly developing problem-solving and collaboration skills. The context of collaborative problem-solving is perhaps the most effective pedagogical model for developing literacy (Law et al., 2025)

CONCLUSION

Based on the observations and analysis of research data that I have conducted, by using the RICOSRE learning model, students are better able to solve problems and collaborate optimally with other students. This can be seen from the discussion process that is able to divide tasks evenly, help each other with friends, actively participate in discussion activities and respect each other in achieving a common goal of problem solving. Although the stages of the indicators are not sequentially continuous, it does not blame the results of the study. This is certainly influenced by

many factors. Therefore, it can be concluded that the RICOSRE learning model is more significant than the direct instruction learning model, which is less preferred by students because it does not inspire student enthusiasm. Suggestions for further research include examining the factors that influence the non-gradualness of the research results and comparing them with other learning models to prove the effectiveness of the RICOSRE learning model.

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