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The RICOSRE-FC potential in improving high school students' critical thinking skills

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ABSTRACT

Critical thinking skills are essential 21st-century skills to improve using innovative learning. This study aimed to determine the influence of the RICOSRE-FC model in improving the critical thinking skills of high school students in biology learning. The type of research used is a quasy experiment. The population in this study was all students of class XI MIPA SMAN in Soppeng, South Sulawesi, Indonesia. The classes used for the research sample were 6 classes, 2 classes were taught with the RICOSRE-FC model as an experimental group, 2 classes were taught with the RICOSRE model as a positive control group, and conventional learning as a negative control group. The sample was determined using random sampling techniques. The instrument used is an integrated critical thinking skills test essay test with a scoring rubric of 0-5. Data analysis with the one-way ANCOVA test continued with the LSD test. The results of the one-way ANCOVA test show that a p-level score of 0.00<0.05 means that the learning model affects students' critical thinking skills. RICOSRE-FC has the highest corrected average of 77,349, which shows that the RICOSRE-FC model can potentially to empower students' critical thinking skills.

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INTRODUCTION

Students need 21st-century skills to face the era of society 5.0. In general, 21st century skills of a complex nature are very challenging for students to learn, but students develop them less if they are not taught in the learning process (Zubaidah, 2016). The 21st-century skills that students need to receive information from various technological media are critical thinking skills (Partnership for 21st Century Learning, 2019).

Critical thinking skills are the skill to understand a concept, apply a concept, synthesize, and evaluate information received (Zubaidah, 2010). Critical thinking is in the form of the construction of thinking as a logical process to the phenomena that occur (Behar-Horenstein & Niu, 2011; Mulnix, 2012). Critical thinking students have the following characteristics: (1) prioritizing rational reasoning, (2) evaluating various points of view and perspectives, (3) having an open mind for alternative interpretations, (4) accepting new evidence, explanations, and findings, (5) reassessing the information obtained, (6) considering all reasonable possibilities, (7) setting aside personal prejudices and biases, and (8) avoiding hasty judgment (Goodwin & Sommervold, 2012).

The results of the research on students' critical thinking skills in the world show that about 80% of students are in a low category, which means that students need to be more empowering their critical thinking skills (Bouygues, 2018). Students' low critical thinking skills are caused by being unable to use information to solve problems, lacking confidence in providing arguments, and evaluating evidence of problems (Firdaus, Kailani, Bakar, & Bakry, 2015). In addition, students are accustomed to learning by memorizing material, as well as students quickly completing tests without analyzing a question (Seventika, Sukestiyarno, & Mariani, 2018). Another reason, students still have difficulty in understanding the basic concepts of a material and do not have a skeptical attitude (Basri, Purwanto, As'ari, & Sisworo, 2019).

The fact that it happens that the empowerment of students' critical thinking skills is still very lacking (Oktavia & Hardinata, 2020). The lack of empowerment of critical thinking skills causes students to be passive in studying biology (Sudarisman, 2015). According to Elisanti, Sajidan, & Prayitno (2018) that students' low thinking skills are due to students' difficulty in understanding the meaning of an event, experience, and information obtained from literature review.

Based on preliminary studies at SMAN 1 and SMAN 2 Soppeng, it shows that students' critical thinking are still categorized as low. Seen in the results of the preliminary study of critical thinking skills, students have an average score of 38.17 in the low category. The low critical thinking skills based on the results of observations made by researchers show that learning is still teacher-centered. The learning process is supposed to actively involve students, so that students think critically about the information received (Ku *et al.*, 2019) and utilizing technology in the learning process. According to Valtonen *et al* (2017) and utilizing technology in that teachers are important to use technology in supporting the learning process in the classroom, so as to train students' thinking skills.

Preliminary studies show that innovative problem-based, technology-integrated learning models are needed to empower critical thinking skills. Empowerment of critical thinking skills should be by utilizing innovative learning models (Jatmiko et al., 2018; Patmanthara & Hidayat, 2018; Setyaningsih & Utama, 2021; Zain & Jumadi, 2018). Innovative learning model that can be developed to empower critical thinking skills, namely the RICOSRE model (Sari, Mahanal, & Zubaidah, 2018; Setiawan, Mahanal, & Zubaidah, 2021). The RICOSRE model is problem-based learning, facilitating students actively in the learning process, involving the application of knowledge in the problem-solving process in students' daily lives (Mahanal & Zubaidah, 2017).

The RICOSRE model is integrated with flipped classrooms to address the weaknesses of the RICOSRE model in empowering critical thinking skills. Flipped classrooms are used in the reading stage so that students already understand the concept of the material before the process of identifying problems in the classroom. Flipped classrooms have an important role in empowering critical thinking skills. Flipped classrooms encourage students to increase interaction in the classroom to discuss with their peers. In addition, teachers use online platforms to hone students' critical thinking in processing information obtained outside of class time for discussion in the

classroom (Kong et al., 2013). Digital classroom design such as flipped classroom can develop students' critical thinking (Lase, 2019). Flipped classrooms are still very rarely applied in the classroom, due to the lack of knowledge of teachers and students regarding technology (Arnold-Garza, 2014; Kong, 2014). The application of flipped classroom in biology learning can divide the stages of RICOSRE which tend to be very dense, so that the stages of problem solving and extending the problem solution can be maximized in the classroom so that it can empower critical thinking skills.

Biology is a complex material, relating to students' daily lives in the context of science, environment, technology, and society (Darmawan, Yusnaeni, Ismirawati, & Ristanto, 2021). The biological material used in this study is the digestive system and respiratory system. The digestive system and respiratory system have abstract material characteristics, because they are related to the processes that occur in the body, so that if they only use conventional models, students do not understand the concept of the material (Darmawan et al., 2021). Digestive system and respiration system materials visualized in the form of learning videos in google classroom. The material of the digestive system and the respiration system is also related to the complex life of students on a daily basis, when the problems present in the student's daily life related to the material of the digestive system and the respiration system are processed and analyzed by the student this can train the student's thinking process so that students can empower critical thinking skills. The purpose of this study is to determine the influence of the RICOSRE-FC model in improving the critical thinking skills of high school students on biology learning.

RESEARCH METHODS

Research Design

This research is a quasy experiment. The free variables in this study are learning models consisting of 3 types, namely the RICOSRE-FC, RICOSRE and conventional learning models. The bound variable of critical thinking skills. The control variables in this study are, the ability of the teacher, the same number of hours and learning materials. The treatment was carried out using learning tools in the form of a syllabus, lesson plan, worksheet, and evaluation tools. The design used is a pretest-posttest non-equivalent control group design as shown in Table 1.

Table 1. Research design

Pre-test	Treatment	Post-test
O	X1	O
O	X2	O
O	X3	O

Note:

X1 = RICOSRE-FC
X2 = RICOSRE
X3 = Conventional learning
O1 dan O3 = pre-test
O2 dan O4 = post-test

Population and Samples

The population in this study was all students of class XI MIPA SMAN in Soppeng, South Sulawesi, Indonesia. The classes used for the research sample were 6 classes, 2 classes were taught with the RICOSRE-FC model as an experimental group, 2 classes were taught with the RICOSRE model as a positive control group, and conventional learning as a negative control group. The sampling technique used is a random sampling technique. Classes are randomly selected from 10

classes. The randomly selected class is an equivalent class based on the results of the class equivalence test with one-way ANOVA which can be seen in Table 2.

Table 2. Class equivalence test results with one-way ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	196.33	10.00	19.63	1.36	0.20	1.86
Within Groups	5045.20	349.00	14.46			

The score used in the class equivalence test is a score of student biology learning outcomes. A p-value of >0.05 means that there is no difference in the biology learning outcomes of high school students, this means that 10 classes are equivalent.

Instruments

The critical thinking indicators measured in this study consist of 6 indicators abbreviated as FRISCO (focus, reason, inference, situation, clarity, and overview). Critical thinking skills instrument in the form of an essay test totaling 10 questions. Validation of essay tests includes validation of contents and constructs validated by expert validation as well as empirical validation obtained from the results of test instrument trials to students who have passed the biological material used in the study. In addition, the test was also tested for reliability using Alpha Cronbach. The critical thinking skills test instrument developed is classified as valid (Table 3) and reliable (Table 4) so that it can be used in data collection in the field. The critical thinking skills rubric is used to determine the score of critical thinking skills integrated with the essay test. The rubric used is the critical thinking skills rubric of (Zubaidah, Corebima, & Mistianah, 2011) adapted from Finken and Ennis with a score or points of 0-5.

Table 3. Validity Test Results

Question Items	Pearson Correlation	p	Information
1a	0.739	0.00	Valid
1b	0.660	0.00	Valid
2a	0.661	0.00	Valid
2b	0.846	0.00	Valid
2c	0.704	0.00	Valid
3a	0.410	0.02	Valid
3b	0.412	0.02	Valid
3c	0.581	0.01	Valid
4a	0.679	0.00	Valid
4b	0.755	0.00	Valid
5a	0.847	0.00	Valid
5b	0.723	0.00	Valid
6	0.805	0.00	Valid
7	0.507	0.00	Valid
8	0.783	0.00	Valid
9a	0.445	0.01	Valid
9b	0.373	0.04	Valid
9c	0.457	0.01	Valid
10a	0.412	0.02	Valid
10b	0.844	0.00	Valid
10c	0.884	0.00	Valid

Table 4. Reliability test results

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items	Information
0.778	0.886	21	Reliable

Procedures

The research procedure is adjusted to the stages of RICOSRE-FC. An initial test of critical thinking skills is given at the beginning of the meeting. Students are given worksheets relating to the material of the digestive system and the respiration system. The first stage is literature review, students read various literature relevant to the material and watch learning videos contained in google classroom. In the second stage of the question and answer session, students conduct a question and answer related to the learning video that is shown in Google Classroom. The third stage Identifying the problem, students identify the problem contained in the student's worksheet. The fourth stage of Constructing the Solution, students design several solutions to solve the problem. The fifth stage of solving the problem, students choose the right solution from various solutions to solve the problem. In the sixth stage of reviewing the problem solving, students re-examine the accuracy of the solution by presenting in front of the class. The last stage is extending the problem solution, students is applying solutions that have been used with similar problems. The final test of critical thinking skills is given at the end of the learning meeting. The research flow chart is shown in Figure 1.

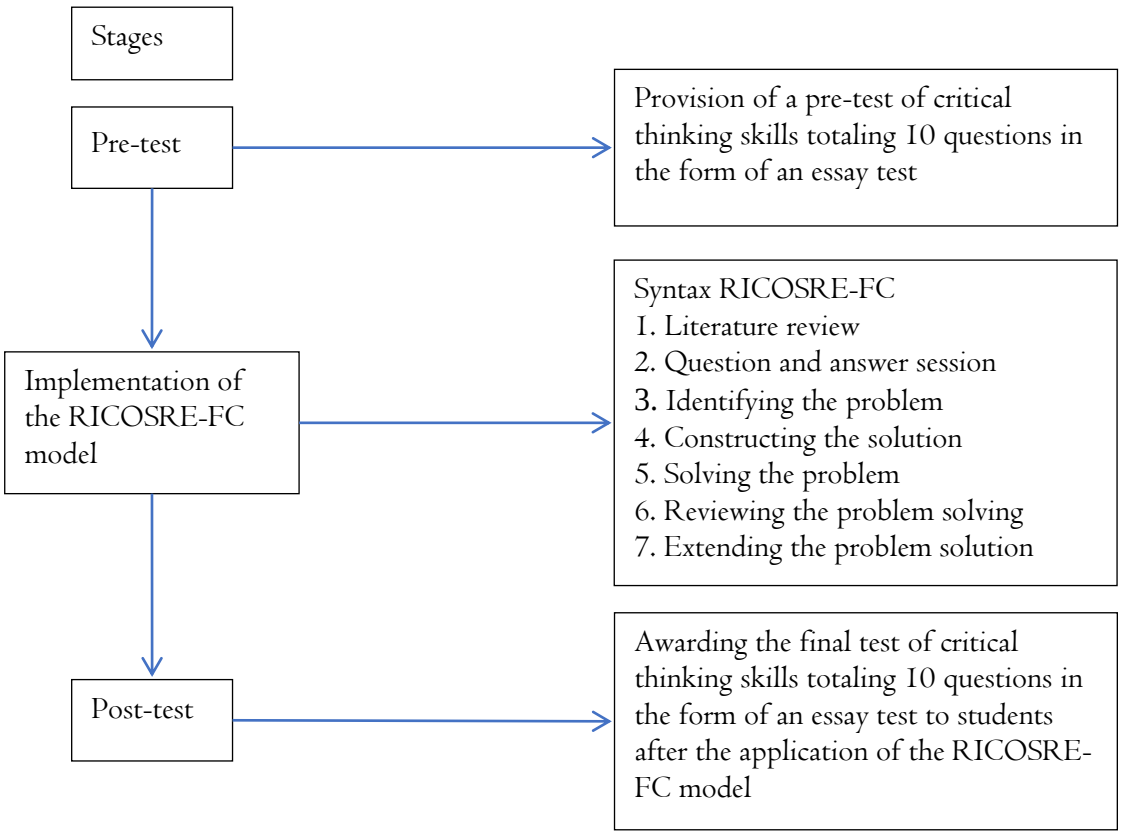

Figure 1. Research flowchart.

Data Analysis

Research data were analyzed using descriptive statistics and inferential statistics. Descriptive statistics to show descriptions of critical thinking. Descriptive statistical values include average,

highest average, lowest average, and difference between pre-test and post-test changes. Inferential analysis using one way ANCOVA test with a significance level of 5% was used to test the hypothesis, before the data was analyzed with the one way ANCOVA test, prerequisite tests were first carried out, namely the normality test and homogeneity test. Normality test using Kolmogorov-Smirnov One-Sample test. Homogeneity test using Levene's Test of Equality Of Error Variance (Mertler & Reinhart, 2017). Data that has been tested with one way ANCOVA followed by LSD test.

RESULTS

The results of a descriptive analysis of students' critical thinking skills taught with the RICOSRE-FC, RICOSRE and conventional models are shown in Table 5.

Table 5. Results of descriptive analysis

Model	Critical Thinking Skill		Enhancement
	Pre-test	Post-test	
RICOSRE-FC	32.1	80.25	48.15
RICOSRE	26.45	70.85	44.4
Conventional	23.3	63.75	40.45

Based on Table 5, it can be seen that there is an improvement in each learning model. The highest increase was seen in the RICOSRE-FC model with a difference of 48.15. After descriptive analysis, inferential analysis is then carried out. The prerequisite test results seen in Table 6 show a p-level value of > 0.05 which means that the data is normally distributed and homogeneous. Normal and homogeneous data can be continued with the one-way ANCOVA test. One-way ANCOVA test results shown in Table 7.

Table 6. Prerequisite test results

Variable	Test Type		N	p	α	Information
Critical Thinking Skill	Normality	Pre-test	120	0.080	0.05	Normal
	Normality	Post-test	120	0.283	0.05	Normal
	Homogeneity	Post-test	120	0.164	0.05	Homogen

Table 7. One-way ANCOVA test results

Source	SS	df	MS	F	p
Corrected Model	6475.717[a]	3	2158.572	61.512	.000
Intercept	10890.578	1	10890.578	310.345	.000
Xkbk	995.451	1	995.451	28.367	.000
Model	1604.341	2	802.171	22.859	.000
Error	4070.649	116	35.092		
Total	626020.000	120			
Corrected Total	10546.367	119			

The results of the ANCOVA one-way test in Table 7 show that a p-level value of < 0.05 means that the learning model affects the critical thinking skills of high school students in biology

learning. The difference between the three learning models can be seen after the LSD test. LSD test results are shown in Table 8.

Table 8. LSD test results

Learning model	Corrected Average	Notation
RICOSRE-FC	77.349	a
RICOSRE	71.352	b
Conventional	66.149	c

The LSD test results in Table 8 showed the highest corrected average obtained by the RICOSRE-FC model with a score of 77.349. RICOSRE-FC, RICOSRE, and conventional learning have the potential to develop critical thinking skills. The RICOSRE-FC model differs markedly from the RICOSRE model and the conventional model. The RICOSRE model is significantly different from the conventional model. The results of the LSD test can be concluded that the RICOSRE-FC model has the potential to improve the critical thinking skills of high school students in biology learning.

DISCUSSION

The effectiveness of the RICOSRE-FC model is seen by comparing with other models. The results of the analysis show that the learning model applied in this study affects students' critical thinking skills. This suggests that there is a significant difference in students' critical thinking skills when taught with the RICOSRE-FC model and students taught with the conventional model. The RICOSRE-FC class has the highest average compared to the conventional class.

RICOSRE-FC is focused on actively engaging students in thinking and contributing ideas. Therefore, the RICOSRE-FC syntax can facilitate the development of students' critical thinking skills. These findings are reinforced by the findings of previous studies which also stated that RICOSRE syntax can support the improvement of students' critical thinking skills (Azizah, Mahanal, Zubaidah, & Setiawan, 2020; Mahanal, Zubaidah, Sumiati, Sari, & Ismirawati, 2019). The RICOSRE-FC syntax can facilitate the empowerment of students' critical thinking skills. RICOSRE-FC in this study was originally developed from the RICOSRE and flipped classroom models. Thus, both learning models encourage students to use their knowledge operationally to solve contextual problems in everyday life as well as critically face information that exists in cyberspace (Al-Zoubi & Suleiman, 2021; Mahanal, Zubaidah, Setiawan, Maghfiroh, & Muhaimin, 2022). The RICOSRE-FC model is not like the conventional model. The RICOSRE-FC model exposes students to reading and watching learning videos in google classroom at the beginning and expands the process of solving problems at the end of the classroom.

The first stage performed on the RICOSRE-FC model is literature review. Students read materials and watch learning videos through google classroom at home. RICOSRE-FC helps students develop critical thinking skills through reading. Reading can also enlarge students' thinking capacity (Finissha, 2021). Through reading, students build an integration between their initial knowledge and the knowledge they gain from reading (Mancheva et al., 2015) . In addition, reading expands the experience, and enriches knowledge supports the development of students' critical thinking. Text analysis facilitates the transformation of passive students into active students (Nurfatimah, Hamdian Affandi, & Syahrul Jiwandono, 2020). Students also watch existing learning videos in google classroom, with learning videos critical thinking skills students can be empowered (Sudarmin, Mursiti, & Asih, 2018).

The second stage is Q&A session, this stage students do a question and answer in google classroom related to the learning video that is shown. Q&A discussions make students and teachers interact with each other so that students' critical thinking skills become better. It's different if students tend to just listen, take notes, and rarely ask questions can't empower students' critical thinking skills because there is no interaction (Bustami & Corebima, 2017). The first and second stages of students do it at home. The student becomes an independent learner at home, when the availability of an adequate learning environment and attracts his attention so that his thought processes can develop. A good student's learning independence can improve his critical thinking skills (Rachamatika et al., 2021).

The first and second stages of students do it at home. The student becomes an independent learner at home, when the availability of an adequate learning environment and attracts his attention so that his thought processes can develop. A good student's learning independence can improve his critical thinking skills. According to Ennis (1996) Students with critical thinking will be able to articulate the problem. Students also learn to identify information and data based on assumptions and expected results. The fourth stage is construction the solution. Students explore their knowledge to find solutions to problems that have been formulated in the previous stage. Through exploration, students are encouraged to design investigations and create cause-and-effect relationships between problems and solutions (Mahanal & Zubaidah, 2017).

The fifth stage is solving the problem. Students are motivated to share and discuss alternative solutions with their group members. Students need to choose the most effective solution among several solutions offered by collecting relevant data and information to support the arguments that have been chosen (Newton et al., 2012). Implementing solutions, students must also be able to organize information. Organizing general and specialized information plays an important role in critical thinking (Leen, Hong, Kwan, & Ying, 2014). Critical thinking is necessary in problem solving because it helps a person understand new information based on concepts he has already.

The sixth stage is reviewing the problem solving, which is reviewing and expanding the problem-solving process, each group takes turns communicating the results of its group discussions in front of other group members. Other students can make any suggestions during class discussions. Therefore, presenters should be selective in accepting suggestions. Students' ability to sort out information is part of developing critical thinking skills (Facione, 2011). The seventh stage is extending the problem solution, in addition to analyzing the effectiveness of the solution, students need to rethink alternative solutions to solve similar problems in the future. This alternative solution should be more effective than the previous solution (Mahanal & Zubaidah, 2017).

CONCLUSION

The RICOSRE-FC, RICOSRE, and conventional learning models affect students' critical thinking skills with a p-value of 0.00<0.05 based on the results of the one way ANCOVA test. The RICOSRE-FC model has the potential to improve the critical thinking skills of high school students in biology learning with a corrected average score of the RICOSRE-FC model of 77,349 higher than the RICOSRE and conventional models.

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