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Empowering scientific literacy skills through an integrated SSCS learning model with RQA strategies

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ABSTRACT

Understanding science is needed in the context of scientific literacy. Scientific literacy cannot be separated from the role of reading literacy. Literacy is a prerequisite component so that students can have four life competencies namely Creativity, Critical Thinking, Collaboration, and Communication (4C). This research is quasi-experimental research with a pretest and post-test non-equivalent control group design. The population is students from SMP Negeri 9 and 17 with a class VIII sample of 105 students. The instrument for assessing students' scientific literacy skills is in the form of multiple-choice tests and essays prepared to represent indicators of scientific literacy, namely: 1) identifying scientific problems/phenomena, 2) interpreting data and drawing conclusions, 3) understanding science concepts, and 4) applying science concepts to life. Data on students' scientific literacy abilities analyzed using the t-test. using the SPSS ver. 20. The research results obtained show that there is a difference in scientific literacy between the SSCS model treatment group integrated with RQA learning strategies and the conventional model. The SSCS+RQA class experienced an increase of 52.48%. The significant increase changed the scientific literacy category from low to very high. Meanwhile, the RQA control class experienced an increase of 33.89%. This increase was also able to change the scientific literacy category from low to high.

Introduction

Science learning emphasizes providing direct experience to develop student competencies. Through a scientific thinking framework, learning is directed at realizing scientific methods, values and attitudes. Therefore, science learning must be based on the essence of science, namely products, processes, applications and attitudes. Learning can be based on the nature of science when classroom learning is designed to emphasize: 1) student-centered, 2) diversity of learning sources, 3) competency-based learning approach, and 4) comprehensive assessment. Learning science at a higher level is a scientific thinking activity which is essentially high order thinking skills. Leonard & Penick (1993, in Sesrita, 2020) added that science lessons should place more emphasis on student activities, meaning there are more student-centered activities and science process skills to obtain concepts.

Literacy skills support the emergence of higher-level thinking abilities. Literacy has a broad meaning. According to Suyono (2009), literacy can be interpreted as literacy, namely legal literacy, technological literacy, information literacy, critical thinking, sensitivity to the environment, and even sensitivity to politics. The core of literacy is reading-thinking-writing activities. Literacy is a prerequisite component so that students can have the four life competencies (4C) which encourage the growth of good character following the Pancasila Student Profile. Unfortunately, the results of a survey conducted by PISA and TIMSS stated that Indonesian students were ranked low (Ni'mah, 2019).

The Ministry of Education and Culture has been encouraging literacy since 2016 by organizing various School Literacy Movement activities as part of the implementation of Minister of Education and Culture Regulation Number 23 of 2015 concerning the Development of Character. In science learning, literacy skills are needed to achieve certain achievements. This literacy ability is better known as scientific literacy. Reports related to government efforts related to developing student literacy have been revealed in the writings of Rahmadinata (2022), Irfansyah and Surya (2021), Benaziria (2018).

Understanding science is needed in the context of scientific literacy. Therefore, scientific literacy cannot be separated from the role of students' reading literacy. However, after evaluation, the average figure for the National Alireading Index in 2019 was included in the low literacy activity category (Kemendikbud et al., 2019). Ministry of Research and Technology (2021) and Arlis et al., (2020) state that scientific literacy is scientific knowledge and skills that are able to identify questions, obtain new knowledge, explain scientific phenomena, and also draw conclusions based on facts, understand the characteristics of science, how scientific awareness is. and technology shape the natural, intellectual, and cultural environment, as well as the willingness to engage and care about science-related issues. According to Kurnia et al (2014), scientific literacy is a student's ability to master knowledge and science in a learning process. The definition of scientific literacy has been revealed by Chiappeta et al. (2014) and Gormally et al. (2012).

Scientific literacy is important because it can foster critical thinking and skills in solving problems creatively (Banila et al., 2021). Apart from that, scientific literacy also makes people able to choose the right information, understand pictures, charts and tables of scientific information. Furthermore, Gormally (2012) revealed that indicators of scientific literacy include identifying valid scientific opinions, conducting effective literature searches, understanding the elements of research design and how they impact findings or conclusions, making accurate graphs from data, solving problems using quantitative skills. , including basic statistics, understanding and interpreting basic statistics, and making inferences, predictions, and conclusions based on quantitative data. By being literate, someone can apply scientific knowledge through the ability to identify questions, make conclusions based on evidence, and make decisions. At the same time, it can construct scientific knowledge in solving everyday life problems (Baihaqi et al., 2015; Toharudin, et al. 2011).

The problem of low scientific literacy is also found in several schools in Kupang City. The results of observations at SMP Negeri 9 and SMP Negeri 17, Kupang City when testing literacy tests were carried out in Teaching Campus activities, information was obtained that in general students were not able to solve the literacy questions given, especially those related to scientific literacy. This can happen because students are not used to working on literacy questions, their interest in reading is low during learning, and their ability to identify and solve problems in everyday life related to the learning process is also still low. On the other hand, it can also be seen that during the learning process, student activity and interaction with learning resources is still low. Meanwhile, literacy skills, especially scientific literacy, are one of the demands that students need to improve. Therefore, so that

students' literacy skills can be developed, teachers need to create a supportive learning environment, one of which is by implementing learning models. According to Fitriyani et al (2020), students' scientific literacy abilities and understanding can be developed and improved with the right learning model. One of the models offered is the Search Solve Create and Share (SSCS) model integrated with Reading, Questioning and Answering (RQA) learning strategies.

SSCS is a cooperative learning model based on problem-solving that involves students' learning experiences through developing asking, thinking and sharing skills (Pizzini & Separdson, 1992; Pizzini et al, 1989). The SSCS learning model emphasizes students to think critically and creatively (Yusnaeni et al, 2017; Yusnaeni & Corebima, 2017) so that students can solve a problem and provide solutions so that they can build problem-solving abilities (Milama et al, 2017). It is hoped that the involvement of real experiences in learning will stimulate students' thinking abilities. On the other hand, students' creative ideas will easily emerge when the interaction between students and reading material is more focused through learning strategies. There are various learning strategies offered to increase student activity, one of which is using RQA (Reading, Questioning and Answer) in learning.

RQA is a learning strategy that guides students to read certain subject matter, for example summarized in one chapter or several sub-chapters. RQA allows students to study the material, look for important points packaged in the form of questions and look for answers to important things from various sources. The reading, asking and answering activities in RQA are expected to improve literacy skills. Bahri (2016) revealed that through reading habits, a person can be trained to sort authentic information, train critical thinking skills, and develop analytical skills.

The Reading and Questioning stage in this research was integrated into the Search phase of SSCS. Integration in this stage aims to help students find a lot of information and ideas to explore as a form of Answering in the Solve and Create phases so that they will produce an original product to share in class. With the RQA strategy, students will not only read, but more than that, students will better understand what they read so that they will automatically develop literacy habits.

Based on the advantages in the SSCS learning model and the advantages in using the RQA strategy, it is hoped that it can overcome the problem of low literacy skills of students in Kupang City, which in turn can also overcome the problem of low student learning outcomes. Several research results regarding the SSCS learning model in relation to student literacy have been reported by Sanaky and Magfirah (2023) and Martinah (2019). The results of their research found that the SSCS learning model could improve students' scientific literacy skills. Meanwhile, the results of research on the RQA strategy in relation to increasing literacy have also been reported by Hasanuddin (2012), Hidayahtika, et al (2020), and Salsabila (2022). These two studies also indicate that research related to creating a learning environment through the use of learning models as an effort to develop scientific literacy is very necessary.

Literacy is a prerequisite component so that students can have four life competencies (4 Cs) which encourage the growth of good character in accordance with the Pancasila Student Profile. Literacy skills also really support the emergence of critical thinking skills. These two abilities are demands that need to be developed in classroom learning. Therefore, learning needs to be packaged in an appropriate model and strategy, namely through the application of the SSCS Integrated Learning Strategy RQA learning model.

METHODS

Research Design

This research is quasi-experimental research with a pretest-post-test non-equivalent control group design. The procedure for implementing the treatment based on the research design is shown in Table 1.

Table 1
Treatment Classes Based on Variables

Prettest	Treatment	Posttest
O1	S1	O2
O3	S2	O4

(Adapted from Borg & Gall, 1983)

information:

O1, O3	=	pretest score
O2, O4	=	posttest score
S1	=	SSCS + RQA group
S2	=	Control group

Population and Sample

This research used a population of students at SMP Negeri 9 and 17 in class VIII Kupang. Determination of schools was carried out using purposive sampling. The class samples used were classes VIII A and VIII B. The sampling technique in this research used random sampling, namely random sampling. Determining the experimental class (SSCS+RQA) and control class (Conventional) was carried out randomly because the characteristics of the students were generally homogeneous. The total sample of students was 105 people.

Research Instrument

The instruments used in this research include learning instruments in the form of teaching modules, media and student worksheet, as well as instruments for assessing students' scientific literacy abilities in the form of multiple-choice tests and essays. The multiple-choice test has 20 numbers while the essay test has 5 numbers. The score for multiple choice, if correct, is worth 1 if incorrect, 0, while the essay score ranges from 1-4 based on a predetermined rubric. The indicators used to measure literacy skills refer to Gormally (2012), namely 1). identifying scientific problems/phenomena, 2). Interpreting data and concluding 3). Understand science concepts, 4). Applying science concepts to life. This test was given at the beginning (pretest) and end of learning (post-test) in the control class and experimental class. This test has been validated first by instrument experts and has been tested, where the test was declared valid and reliable with a reliability value of 0.730.

Data Collection Procedures

Before learning is carried out, a pretest of a predetermined sample class is carried out to determine students' initial scientific literacy abilities. The results of this test are also used as a placement test to determine the control class and experimental class. The control class was given learning using the conventional model (learning uses a scientific approach) and the experimental class was given learning using the SSCS model guided by RQA. The learning material taught is the circulatory system and respiratory system. Learning is carried out for 6 weeks. After the learning was carried out, it was continued with a post-test in both classes to see the effect of the SSCS learning model assisted by RQA in improving scientific literacy skills. Scientific literacy ability is determined based on criteria adapted from Arikunto (Dinata, et al (2024), namely very high (80-100), high (66-79), medium (56-65), low (40-55) and very low (0-39).

Data Analysis Technique

The prerequisite test before the t-test was carried out using the Kolmogorov-Smirnov normality test and the Levene homogeneity test. If the Sig value. (2-tailed) > 0.05 then the data is said to be normal and homogeneous. Next, hypothesis testing is carried out using the t-test. The criterion for hypothesis testing is if the sig value. (2 - tiled) < 0.05, then H_0 is rejected, and Ha is accepted. On the other hand, if sig. (2-tiled) > 0.05, then H_0 is accepted and Ha is rejected (Sugiono, 2017). The hypothesis H_0 proposed is that there is no difference in scientific literacy between the group of students taught using the SSCS with RQA learning model and the conventional group. All forms of data analysis were carried out using the SPSS ver. 20.

RESULTS AND DISCUSSION

The data of scientific literacy is measured through students' answers to tests given in each treatment group. The scientific literacy indicators used are: 1). identifying scientific problems/phenomena, 2). Interpreting data and concluding 3). Understand science concepts, 4). Applying science concepts to life. The results of measuring scientific literacy in both groups can be seen in Table 2.

Table 2
Description of Pre and Post Test Science Literacy Scores in the RQA Integrated Control and SSCS Classes

Scientific Literacy Indicators	Test	Treatment Group	
		SSCS + RQA	Control
Identify scientific problems/phenomena	Pre	7.92	6.81
	Post	18.91	16.28
Data interpretation and draw conclusions	Pre	8.55	8.43
	Post	17.70	12.55
Understand science concepts	Pre	3.43	8.62
	Post	18.58	14.17
Applying science concepts to life	Pre	9.40	10.34
	Post	26.59	25.09
Total Science Literacy Score	Pre	29.30	34.20
	Post	8178	68.09
Science Literacy Category	Pre	Very low	Very low
	Post	Very High	High

Table 1 shows that there was an increase in scientific literacy skills in both treatment groups. The SSCS+RQA class experienced an increase of 52.48%. The significant increase changed the scientific literacy category from very low to very high. Meanwhile, the RQA control class experienced an increase of 33.89%. This increase was also able to change the scientific literacy category from low to high. Of the two treatment classes, the largest increase occurred in the SSCS+RQA class. Table 1 also shows that the highest score for the scientific literacy indicator in the post-test results in the SSCS+RQA class was applying science concepts to life, while the lowest score was obtained for the indicator of interpreting data and drawing conclusions. The same thing also applies to the control class. Where in the control class, even though it uses a scientific approach, the pattern of implementation still emphasizes teacher dominance in teaching and in student activities they tend to answer questions that are already on the students' worksheets, without involving students' mental activism in it. Students still have difficulty when faced with cases of interpreting reading or interpreting data because this activity requires high analytical thinking skills. Students can provide analysis when they have a lot of related knowledge about the concepts being studied. This is indeed a common weakness of students in Indonesia which is illustrated in the results of the analysis carried out by Yanti et al (2020) that children in Indonesia have difficulty interpreting reading and providing critical evaluations of the reading they are given Interpreting data and drawing conclusions are very important stages in learning (Yuni & Fisa, 2020; Yuni, 2015).

Interpreting data and concluding is related to higher-order thinking skills. When students can do this, it means they can use their deductive and inductive thinking processes. On the other hand, higher-level thinking can be trained by reading a lot and new information will be discovered. On the other hand, reading habits can train someone to sort authentic information, develop critical thinking skills, and develop analytical skills (Bahri, 2016). This is in line with Lewis in Yuriza et al (2018) that higher-level thinking skills can emerge when someone receives new information. Therefore, to train scientific literacy indicators related to data interpretation and drawing conclusions, students' learning environment needs to be created systematically and measurably through reading activities. The data in Table 1, when calculating the percentage increase in scientific literacy abilities based on each indicator and visualized in graphical form, can be seen in Figure 1

Figure 1 shows that the use of the SSCS learning model integrated with RQA strategies can improve the overall indicators of students' scientific literacy. This is possible because at each stage the SSCS model has trained students to provide meaningful experiences for students so that students are motivated to study harder. Providing RQA in the SSCS stage triggers the emergence of literacy indicators determined in learning. The increase in literacy indicators varies depending on the demands of the level of thinking required.

The Search stage, when combined with Reading and Questioning activities, stimulates activities related to identifying phenomena and understanding the concepts being taught. Yanti et al (2020) revealed that reading habits can increase students' scientific literacy skills by 3.6%.

The Solve stage combined with Answering stimulates students to understand concepts and interpret data that they have previously identified. In the create stage, at this stage students design

creative products or the results of their work, whether in the form of reports, images or ppt. This creativity product is certainly associated with the application of the concepts they have received during the learning process. This is in line with Sawyer (2012) that creative activities in education can increase student involvement, allowing them to understand concepts more deeply and apply knowledge in different contexts.

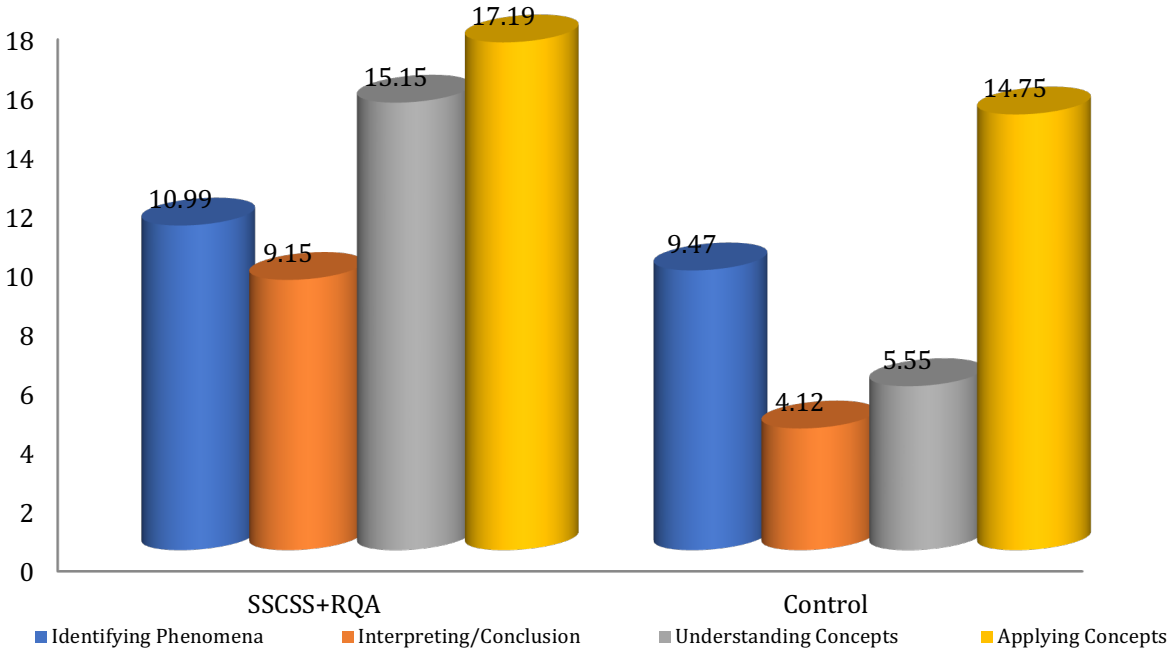

Figure 1. Graph of Percentage Increase in Score Based on Scientific Literacy Indicators.

The last stage of SSCS is share, at this stage students present or communicate the results of their discussion in front of the class. This stage involves students' ability to make reasons why they make the chosen conclusions, and this stage is related to indicators of data interpretation and concluding. In this stage, according to Chin (1997), students communicate their findings, solutions and conclusions to their teachers and friends. This stage triggers the growth of students' evaluation and analysis skills which can raise new questions as feedback for discussion.

Before carrying out the t-test analysis, a prerequisite test is first carried out in the form of a normality test using the Kolmogorov-Smirnov test. The results of the normality test on literacy data obtained a sig value of 0.068, while the results of the homogeneity test using the Levene test obtained a sig value of 0.821. Both values are greater than 0.05 so they are categorized as normal and homogeneous. The complete results of the t-test on scientific literacy data are presented in Table 3.

Table 3
The Result of Student Science Literacy t-Test

		Levent test for equality variances		t-test for Equality of Means		
		F	**Sig.**	**t**	**df**	**Sig. (2 Tailed)**
Scientific Literacy	Equal variances assumed	0.052	.821	5.834	103.00	.000
	Equal variances not assumed			5.856	102.97	.000

The t-test results in Table 3 show that the significance value (sig.2 tailed) of 0.000 is smaller than 0.05. These results indicate that the hypothesis which states there is no difference in scientific literacy between the SSCS+RQA group and the control group is rejected. In the sense that the scientific literacy of the SSCS+RQA class is different from the control class, where from the average calculation results it can be seen that the SSCS+RQA class is higher than the control class which is taught using the

conventional model. This difference is possible because in the SSCS learning model students have been trained to be literate from the start at the search stage. Student activities at this stage are intended to search for various information to resolve and solve problems. When combined with the RQA strategy, it further encourages students to become literate and find solutions to the problems they encounter. Where the incorporation of the RQA strategy in it makes students' activities more focused and systematic regarding what they will do. This is certainly in line with Pizzini (1991) in Yusnaeni et al, 2017) who explains that the SSCS learning model when applied in classroom learning requires students to be directly involved in solving problems, strengthening scientific concepts, processing information, and developing scientific methods. Furthermore, it was also confirmed by Nurbaeti (2023) that RQA in learning can increase students' scientific literacy, where the activities of reading, asking questions, and looking for answers are carried out continuously. Pakpahan (2016) also revealed that the more often a student reads, the more it will affect the student's literacy skills.

The RQA integrated SSCS learning model in this research is designed in such a way that in the student worksheet, at the search stage, include reading and questioning activities with more systematic directions, while at the solve stage it is combined with answering activities. For activities in the create and share stages, students follow activities from the SSCS model in general. In the search stage combined with reading and questioning, students are required to read from all sources so that they can easily find new information related to the material being taught and write down several related problems regarding the information they have read. This activity certainly creates an environment for practicing students' literacy activities. This is in line with Erlistiani, et al (2020) that in SSCS students are trained to explore more information. This was further strengthened by Liu & Li (2020), namely that effective questioning techniques can increase students' understanding and involvement in the learning process. By asking questions, students can develop critical thinking skills and better information literacy.

The second stage is solving guided answering, where students' activities at this stage are solving problems and finding solutions to the problem formulation they got from the first stage. According to Kahfi, et al (2017), RQA can trigger students to create and answer questions from the text they read. Brown (2019) shows that students who actively answer questions show improvements in text comprehension and literacy skills.

The results of this research indicate that the RQA-integrated SSCS learning model can be used as an alternative to improve students' scientific literacy skills. Scientific literacy is the ability to use scientific knowledge and abilities, identify questions and draw conclusions based on existing data evidence to understand and help students make decisions about the natural world and human interactions with nature (Fitrianingsih, et al. 2022). These results are also supported by Syam (2023) and Hidayahtika et al (2020) who essentially argue that SSCS and RQA can improve students' literacy skills.

CONCLUSION

Based on the findings, it can be concluded that there is a difference in scientific literacy between the SSCS model treatment group integrated with RQA learning strategies and the conventional model. The SSCS+RQA class experienced an increase of 52.48%. The significant increase changed the scientific literacy category from low to very high. Meanwhile, the RQA control class experienced an increase of 33.89%. This increase was also able to change the scientific literacy category from low to high. Of the two treatment classes, the largest increase occurred in the SSCS+RQA class.

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